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SKILLS FOR A GREENER FUTURE: A GLOBAL VIEW

**Based on
32 country studies**

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32 country studies**

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Editors

Olga Strietska-Ilina and **Tahmina Mahmud**, Employment Policy Department, International Labour Office (ILO).

Authors

Chapter 1: Olga Strietska-Ilina, Employment Policy Department, ILO.

Chapter 2: Katie McCoshan, international consultant.

Chapter 3: Olga Strietska-Ilina (Employment Policy Department, ILO), **Marek Harsdorff** (Enterprises Department, ILO), **Andrew McCoshan** (international consultant), **Simon Broek** (international consultant), **Tahmina Mahmud** (Employment Policy Department, ILO).

Chapter 4: Andrew McCoshan, international consultant.

Chapter 5: Andrew McCoshan, international consultant.

Chapter 6 : Guillermo Montt (ILO DWT-CO Santiago, formerly Research Department, ILO), **Marek Harsdorff** (Enterprises Department, ILO), **Olga Strietska-Ilina** (Employment Policy Department, ILO), **Trang Luu** (Research Department, ILO), **Bolormaa Tumurchudur-Klok** (Employment Policy Department, ILO), **Ana Podjanin** (Employment Policy Department, ILO).

Chapter 7: Simon Broek, Marye Hudepohl, international consultants.

Chapter 8: Olga Strietska-Ilina (Employment Policy Department, ILO), **Andrew McCoshan** (international consultant), **Simon Broek** (international consultant), **Tahmina Mahmud** (Employment Policy Department, ILO).

FOREWORD

Climate change and environmental degradation are among the greatest challenges of our times. There is no other Earth. It is up to us to save this planet. And yet, for all the profound changes that are occurring in the world of work, and all the intense debates on their implications for workers and companies, the media spotlight continues to focus on the potential effects of automation and artificial intelligence, leaving the effects of climate change and environmental degradation on work largely in the shadows. The signatories of the 2015 Paris Agreement recognized the urgent need for action on climate change. But their commitment to environmental sustainability is not enough. The creation – and, even more, the implementation – of specific policies and regulations depend entirely on the capability, commitment and enthusiasm of women and men, young and old, workers and entrepreneurs in developed and developing countries.

Climate change and environmental degradation reduce productivity and destroy jobs, and their effects fall disproportionately on the most vulnerable. Action to combat these processes can potentially create millions of jobs – but this requires a bold effort steps to invest in people's capabilities to realize their full potential and contribute to the productivity of enterprises. The essential process of transition to the green economy may disrupt labour markets and will require reskilling and upskilling of workers to reduce the risk of rising unemployment, poverty and inequality.

At the 2018 Conference of the Parties to the United Nations Framework Convention on Climate Change Conference (COP24), a green transition that was also a just transition for the workforce and the creation of decent work were declared crucial to effective, inclusive and climate-resilient development. Skills development is a cornerstone of that just transition. The availability of the right skills paves the way to a productive green transformation and decent job creation. Skills development also serves as a buffer against the effects of transitory disruptions. The transition to a greener future is happening; but it requires a coordinated policy approach to make it just and inclusive.

The International Labour Organization has mobilized the efforts of three departments to produce the report *Skills for a greener future*, the Skills and Employability Branch of the Employment Policy Department working in close collaboration with the Green Jobs Programme of the Enterprises Department and the Research Department. The report draws on 32 national studies, whose findings also contributed to the ILO's 2018 *World Economic and Social Outlook: Greening with jobs*, and was produced in partnership with the European Centre for the Development of Vocational Training (Cedefop), which prepared national reports in six EU member States.

The report builds on its predecessor, *Skills for green jobs: A global view*, published by the ILO in 2011. This new edition presents an expanded qualitative analysis, with coverage of several additional countries and regions. It is a ground-breaking piece of empirical research and modelling, providing new insights into likely occupational skill effects in declining and growing industries by 2030 based on two global quantitative scenarios. Evidence of good practices collected in the surveyed countries demonstrates how skills development can underpin the green transition. We believe this report can contribute to the global endeavour to create a greener future for generations to come.



Sangheon Lee
Director,
Employment Policy Department



Vic Van Vuuren
Director,
Enterprises Department



Damian Grimshaw
Director,
Research Department

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LIST OF ABBREVIATIONS

ALMP	active labour market policy
BCG	Boston Consulting Group
BGT	Burning Glass Technologies
BREA	Barbados Renewable Energy Association
Cedefop	European Centre for the Development of Vocational Training
CFC	chlorofluorocarbon
CHP	combined heat and power
CITC	Climate Change International Technical and Training Centre (Thailand)
COP	Conference of the Parties to the UNFCCC
CSR	corporate social responsibility
CWA	community workforce agreement (US)
EMIS	education management information systems
EPI	Environmental Performance Index
EU	European Union
GBCI	Green Building Council Indonesia
GCI	Global Competitiveness Index
GDP	gross domestic product
GEP	Green Economy Progress (Index)
GGC	Green Growth Committee (Republic of Korea)
GHG	greenhouse gas
GNI	gross national income
HAKE	Himpunan Ahli Konservasi Energi (Association of Energy Conservation Experts, Indonesia)
HCFC	hydrochlorofluorocarbon
HDI	Human Development Index
HIC	high-income country/ies
IEA	International Energy Agency
ICT	information and communications technology/ies
ILO	International Labour Office/Organization
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISCO	International Standard Classification of Occupations (IL)
ISIC	International Standard Industrial Classification of All Economic Activities (UN)
IT	information technology/ies

LIC	low-income country/ies
LMIC	lower-middle-income country/ies
MDGs	Millennium Development Goals
MIC	middle-income country/ies
MITD	Mauritius Institute of Training and Development
MRIO	multi-regional input–output model
MW	megawatt
NDC	nationally determined contribution
NES	National Ecotourism Strategy (Philippines)
NGO	non-governmental organization
OECD	Organisation for Economic Co-operation and Development
Onemev	National Observatory for Jobs and Occupations of the Green Economy (France)
O*NET	Occupational Information Network (US)
OSH	occupational safety and health
PES	public employment services
PGBI	Philippine Green Building Initiative
PGJA	Philippines Green Jobs Act
PRONATEC	National Programme of Access to Technical Education and Employment (Brazil)
PV	photovoltaic(s)
PVET	primary vocational education and training
R&D	research and development
RC	regional council
RMG	ready-made garments
RPL	recognition of prior learning
SCGJ	Skill Council for Green Jobs (India)
SDGs	Sustainable Development Goals
SIDS	small island developing states
SME	small and medium-enterprises
STEM	science, technology, engineering and mathematics
SVET	secondary vocational education and training
TESDA	Technical Education and Skills Development Authority (Philippines)
TGO	Thailand Greenhouse Gas Management Organization
TVET	technical and vocational education and training
UK	United Kingdom
UMIC	upper-middle-income country/ies
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
UV	ultraviolet (light/radiation)
WEF	World Economic Forum

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EXECUTIVE SUMMARY

It is time to take stock

The right skills¹ for jobs are an essential prerequisite for the transition to environmentally sustainable and socially inclusive economies. In 2010–11 the International Labour Office (ILO) conducted research in a sample of 21 countries, in collaboration with the European Centre for the Development of Vocational Training (Cedefop). The research resulted in the ILO report *Skills for green jobs: A global view* (Strietska-Ilina et al., 2011) and in Cedefop's synthesis report for selected EU countries (Cedefop, 2010). The report identified major gaps in and shortages of skills for green jobs,² looked into the alignment between skills, environmental policies and institutional arrangements, and suggested policy response strategies and good practices.

Almost a decade has passed since that research was undertaken, and it is now time to revisit the country analyses and see what progress, if any, has been achieved. This new round of research, conducted in 2018, updated information from countries covered in the previous study and included an additional number of countries where the review was done for the first time. This expanded sample has made it possible to achieve a better and more balanced regional coverage and to come up with truly global findings and recommendations. Altogether in this round, 32 countries were covered, 26 by the ILO³ and six European Union (EU) countries by Cedefop⁴ (see figure ES 1). Together, these 32 countries account for 63 per cent of world employment, 65 per cent of global GDP and 63 per cent of CO₂ emissions (see the list of country reports in Annex 1).

In addition, the report uses a multi-regional input–output model (EXIOBASE v3) to analyse transactions between 163 industries across 44 countries in order to quantify the occupational skills needs of the transition to energy sustainability and circular

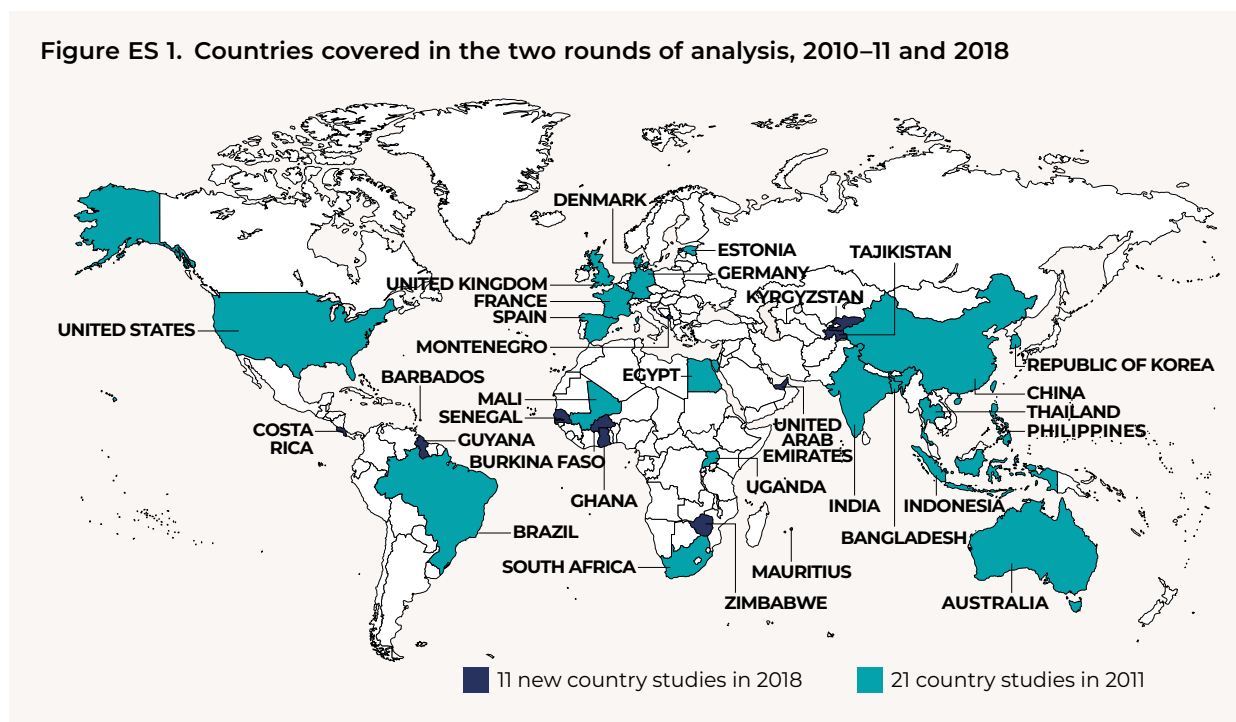
1. The term “skills” is used throughout this document to refer to the knowledge, competence and experience needed to perform a specific task or job. A “skill” is an ability to carry out a manual or mental activity, acquired through learning and practice (Strietska-Ilina et al., 2011).

2. The ILO defines “green jobs” as decent jobs that contribute to preserving or restoring the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency. Green jobs help to improve efficiency in the use of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems, and support adaptation to the effects of climate change (ILO, 2016a).

3. Australia, Bangladesh, Barbados, Brazil, Burkina Faso, China, Costa Rica, Egypt, India, Indonesia, Ghana, Guyana, Republic of Korea, Kyrgyzstan, Mali, Mauritius, Montenegro, Philippines, Senegal, South Africa, Tajikistan, Thailand, United Arab Emirates, Uganda, United States, Zimbabwe (preliminary findings in 2018; ILO, forthcoming 2020).

4. Denmark, Estonia, France, Germany, Spain, United Kingdom.

Figure ES 1. Countries covered in the two rounds of analysis, 2010–11 and 2018



economy. By weighting the results to reflect employment composition in other countries, global scenarios are produced. Expanding on the ILO's exploration of the likely job impacts by 2030 of keeping the rise in global temperature below the 2°C ceiling set by the Paris Agreement on Climate Change (ILO, 2018a), this is the first global study to analyse the implications of the transition to low-carbon and resource-efficient economies for skills, gender and occupations.

The main objectives of this global qualitative and quantitative analysis are to identify:

- the scale of the need for reskilling and upskilling to realize the employment potential of the transition to environmental sustainability (the “green transition”);
- changes in occupations, skills gaps and skills shortages in meeting the skills demand of the green transition;
- progress made since 2011 in the countries surveyed then in coordinating skills and environmental policy matters across ministries and between public and private sectors;
- the specific needs of vulnerable and disadvantaged groups in adjusting to change, and effective skills policy measures to increase productivity and support a just transition.

Climates are changing

Anthropogenic greenhouse gas emissions and pollution have been on the rise, caused by economic growth patterns based on overexploitation of natural resources and fossil-fuel energy generation. Global carbon dioxide emissions grew by 1.7 per cent in 2018 to a record-high level (IEA, 2019). Environmental degradation, loss of biodiversity, desertification, rising sea levels and changing climate patterns all affect the ways we live, work and earn.

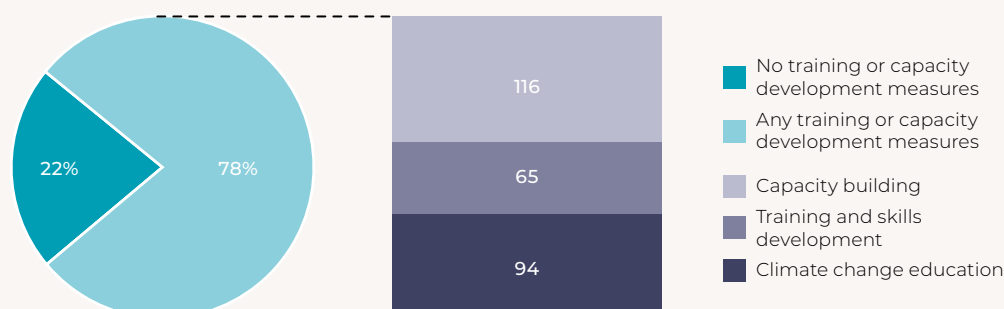
While the climate situation itself has been deteriorating, the climate of international talks about it has improved. A sense of urgency and heightened anxiety about the consequences of climate change and environmental degradation for economies and societies have resulted in major accords on climate change and sustainable development. In particular, 2015 was marked by two main developments: the adoption of the United Nations 2030 Agenda and its 17 Sustainable Development Goals (SDGs), and the Paris Agreement on Climate Change.

However, the climate of national politics has not mirrored everywhere the “global warming” of international talks and agreements. In many countries, there has been significant delay in linking public policy to action; some have even moved backwards in policy and regulation. The mere acceptance of global deals is not enough: their success depends entirely on national commitments and implementation. Progress in national policies and implementation has been uneven and is lagging behind the ambition needed.

Ambitious national commitments and sectoral priorities to implement the Paris Agreement underestimate the role of skills development measures

The green transition is conditional on countries' implementation of their commitments to the Paris Agreement. Since that agreement was reached, the Intergovernmental Panel on Climate Change (IPCC) has called for the acceleration of measures to limit global warming further, to 1.5°C above pre-industrial levels, in order to minimize the severe consequences of climate change for people, livelihoods, ecosystems and economies (IPCC, 2018). Countries have committed themselves to the implementation of the Paris Agreement through nationally determined contributions (NDCs), so far submitted by 183 UN Member States, which stipulate the adaptation and mitigation measures they will take in targeted economic sectors. Two-thirds of these countries recognize in their NDCs the importance of capacity development and climate change literacy, but less than 40 per cent of NDCs globally include any plans for skills training to support their implementation, and over

Figure ES 2. Share of countries that mention capacity development and skills training in their NDCs, and types of measure specified



Note: the sample consisted of 169 NDCs.

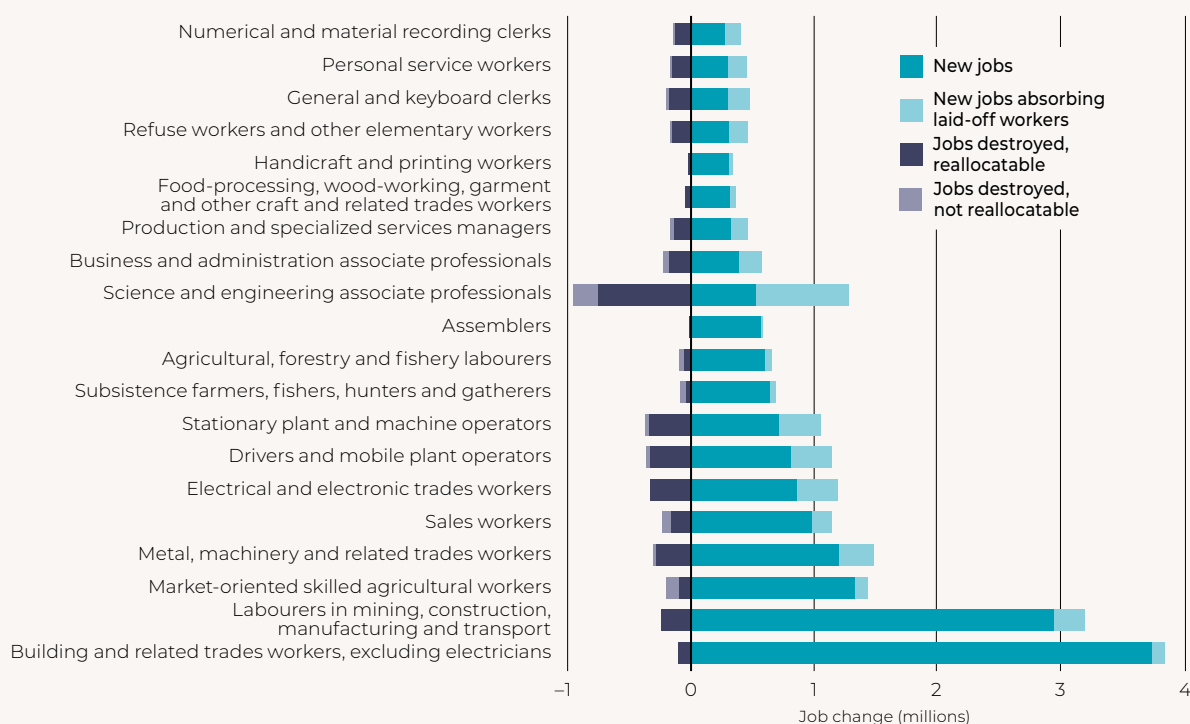
Source: Data computed from NDC Explorer, Jan. 2019. Available at: <https://klimalog.die-gdi.de/ndc>.

20 per cent do not plan any human capital related activities at all (figure ES 2). This should set alarm bells ringing, for commitments in the energy, agriculture, waste, manufacturing, transport and tourism sectors set out in NDCs are all subject to the availability of relevant skills in these industries. Who other than women and men, workers and managers, will take investment decisions, change production processes, and install and maintain clean technology?

The green transition could create millions of jobs, but would require major investments in reskilling

The ILO has produced estimates of the impact that the transition to energy sustainability by 2030 will have on employment (ILO, 2018a). The extension of this analysis shows that almost 25 million jobs will be created and nearly 7 million lost globally. Of the latter, 5 million can be reclaimed through labour reallocation – that is, 5 million workers who lose their jobs because of contraction in specific industries will be able to find jobs in the same occupation in another industry within the same country. This means that between 1 and 2 million workers are likely to be in occupations where jobs will be lost without equivalent vacancies arising in other industries, and will require re-skilling into other occupations. It also means that massive investment will be needed to train workers in the skills required for close to 20 million new jobs (see figure ES 3).

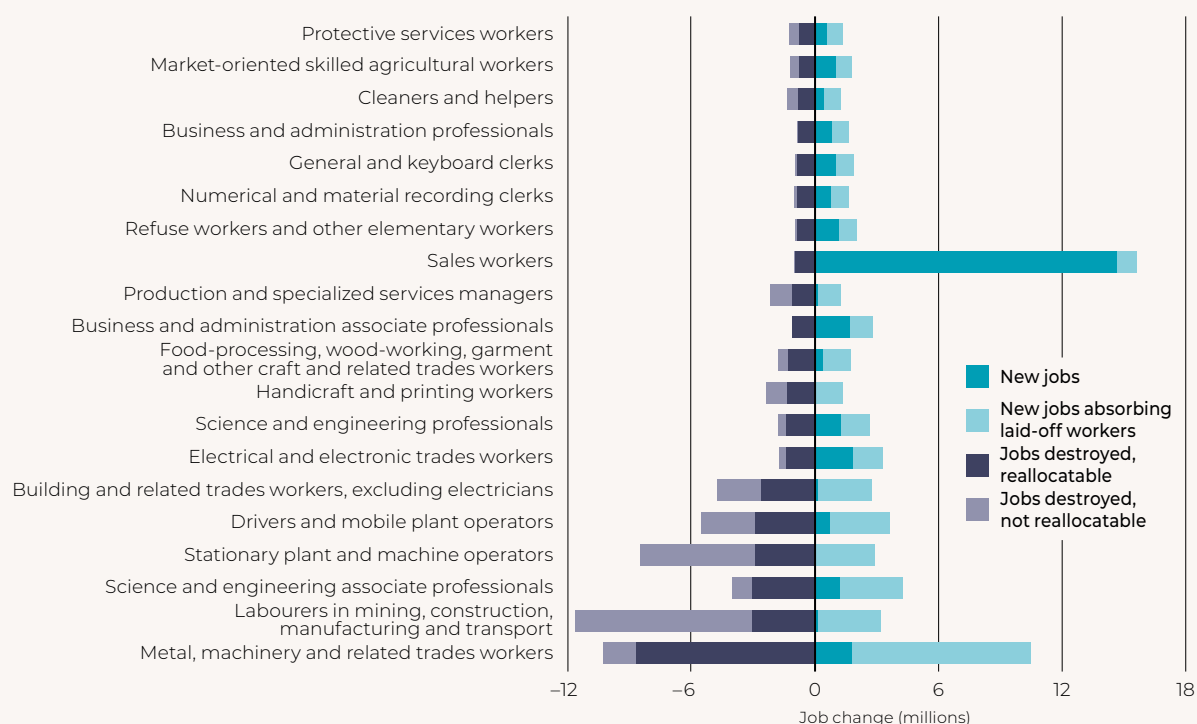
Figure ES 3. Occupations most in demand across industries in a global energy sustainability scenario, 2030



Note: Difference in employment between the sustainable energy scenario (the 2°C scenario) and the business-as-usual scenario (the 6°C scenario) of the International Energy Agency (IEA) by 2030 (ILO, 2018a). Detailed information on the methodology is described in ILO, 2018a, pp. 39, 172–170).

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

Figure ES 4. Occupations most susceptible to job destruction and reallocation across industries in a global circular economy scenario, 2030



Note: The figure shows difference in employment between the scenario of a sustained 5 per cent annual increase in recycling rates for plastics, glass, pulp, metals and minerals across countries and related services, and a business-as-usual scenario (the 6°C scenario) (ILO, 2018a). For detailed information on the methodology see ILO, 2018a, pp. 39, 162–170.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

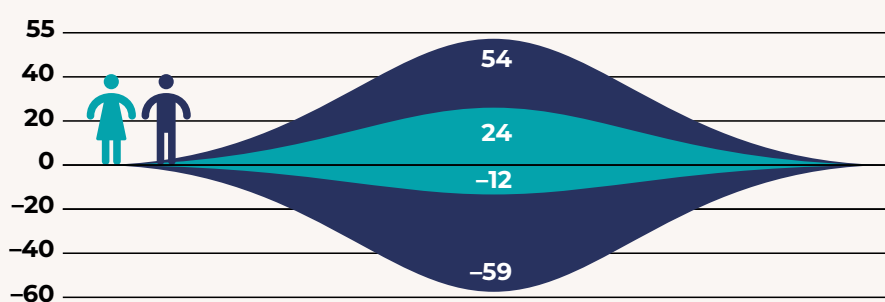
The ILO also estimates that in working towards a circular economy, a net total of between 7 and 8 million new jobs will be created by 2030, as compared to a business-as-usual scenario (ibid.). The extension of these estimates shows that in the circular economy scenario, nearly 78 million jobs will be created and almost 71 million destroyed. Of those workers whose jobs are destroyed, a large proportion – amounting to nearly 49 million – will find vacancies in the same occupation in other industries within the same country, that is, through reallocation. As for the remainder, close to 29 million jobs will be created without reallocation, and a little under 22 million will be destroyed without vacancies in the same occupation opening up in other industries. Figure ES 4 shows the 20 occupations that will figure most prominently in job destruction and reallocation in the circular economy scenario.

Gender disparities will persist, and the “creative destruction” of jobs will have greatest effect on male workers in mid-skill occupations

In both the energy sustainability and the circular economy scenario, most job creation and reallocation is concentrated among mid-skill occupations. The greatest impact will therefore be on male-dominated occupations (figure ES 5). These results suggest that the growth in mid-skill jobs in the green transition can partly offset the global trend in which skill-biased technological change is hollowing out mid-skill occupations. Men in mid-skill occupations will have the greatest need of reskilling and upskilling to enable them to tap into new job opportunities. This also suggests that current occupational gender stereotypes are likely to persist: women will get only a fraction of the jobs created, unless measures are taken to train women in relevant skills, so that they can benefit from potentially created jobs.

Figure ES 5. Jobs created and destroyed in a global circular economy scenario, by gender, 2030 (millions)

Job change by gender



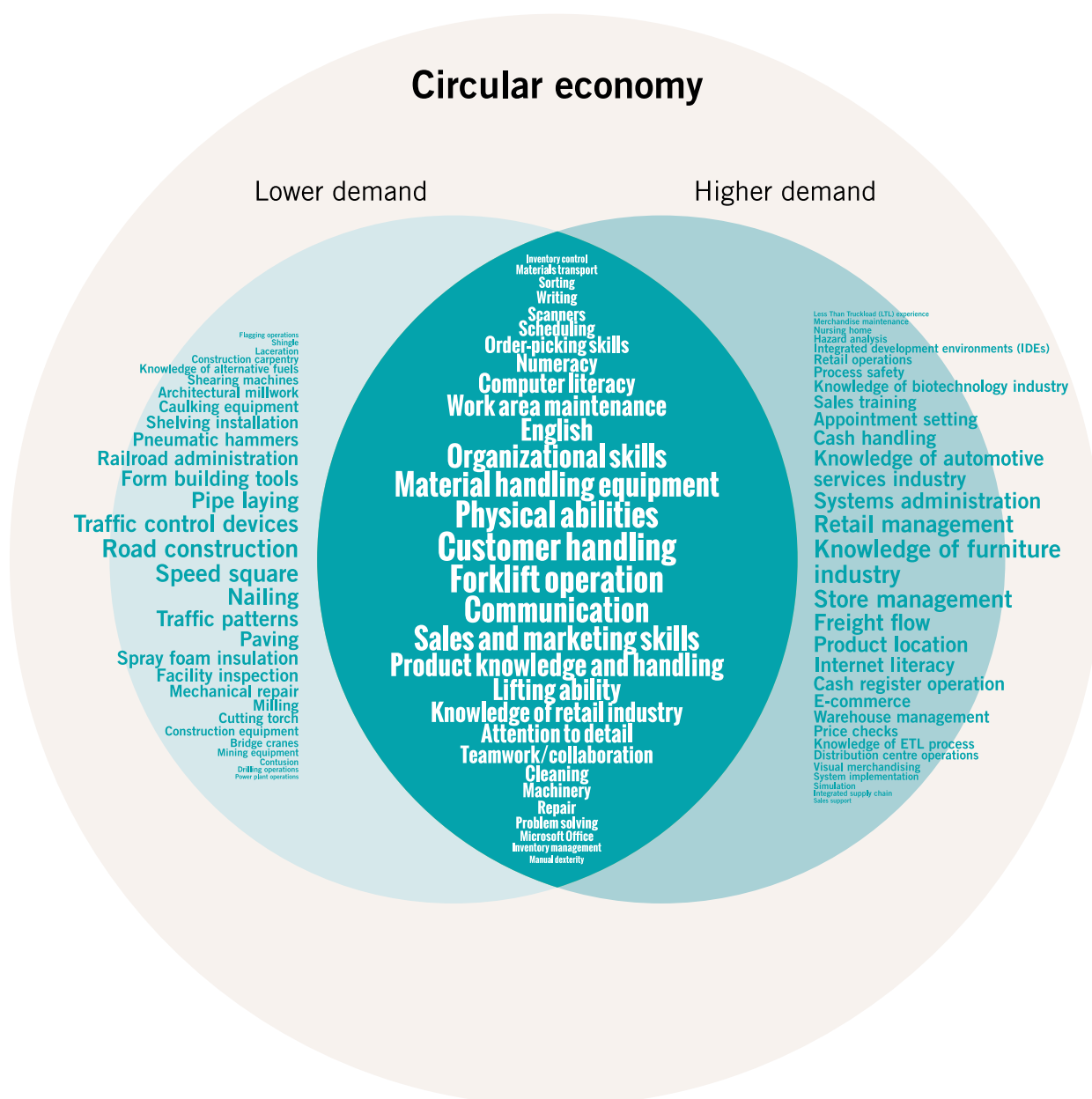
Note: For detailed information on the methodology see ILO, 2018a, pp. 39, 162–170.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

Only 2 per cent of global jobs are at risk of disruption, but the creation of over 100 million jobs is conditional on training

In both the energy sustainability and the circular economy scenario, it is estimated that only around 2 per cent of the global labour force will be affected. This represents a much lower share than estimates of the jobs potentially lost to automation and the digital economy (e.g. McKinsey Global Institute, 2017; Frey and Osborne, 2013). Moreover, for most of those 2 per cent of workers, jobs will not disappear, but will require reallocation and reskilling. Even workers in the jobs that are expected to disappear with no equivalent vacancies in other industries – possibly over 1 per cent of the global workforce – may well be able to use their skills in growing industries with some additional training. There is a set of core and technical skills that are potentially transferable, within occupations, from declining to growing industries; but retraining will be needed to enable workers to acquire new skills for use in the latter (see figures ES 6 and ES 7). Of particular importance will be core (or soft) skills, which can confer a comparative advantage as they can be transferred across occupations.

Figure ES 6. Overlap of core and technical skills for workers in mining, construction, manufacturing and transport, in declining and in growing industries (circular economy scenario)

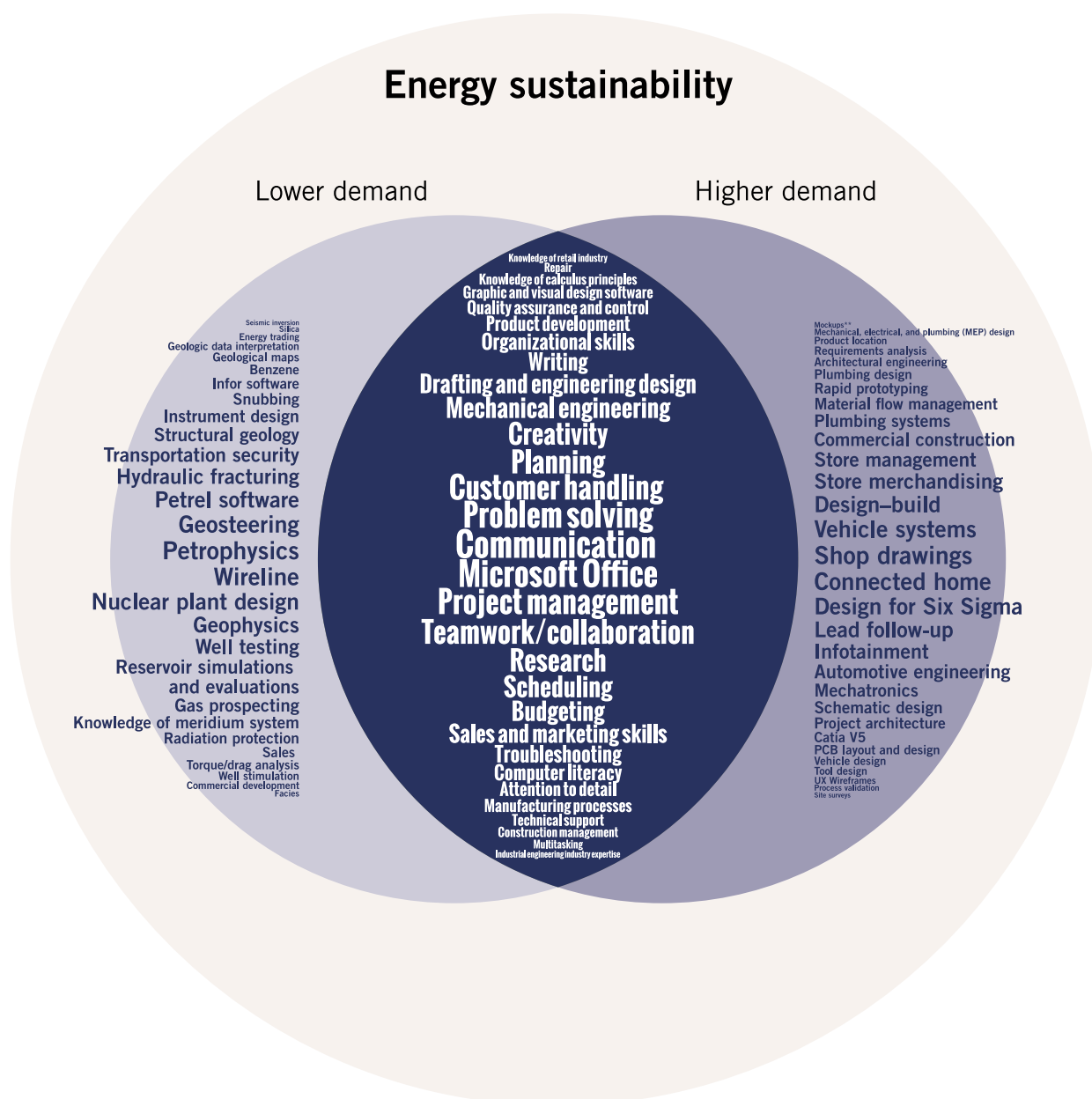


Note: The green area shows a large overlap of core and technical skills within the same occupation in both declining and growing industries.

Source: Calculations based on real-time data on vacancies, Burning Glass Technologies. US data (2017) are used as a proxy.

However, the transition to environmentally sustainable and inclusive economies and societies cannot take place if the skills demanded by new jobs are not available in the labour market. The transition is therefore conditional on investment in training to develop skills to meet new requirements and avoid skills mismatches. Forward-looking skills strategies are necessary to train young people and reskill the current workforce to meet the skills needs of the new jobs generated in the transition process in expanding sectors (see figures ES 8a and ES 8b).

Figure ES 7. Overlap of core and technical skills for science and engineering professionals, in declining and in growing industries (energy sustainability scenario)



Note: The blue area shows a large overlap of core and technical skills within the same occupation in both declining and growing industries.

Source: Calculations based on real-time data on vacancies, Burning Glass Technologies. US data (2017) are used as a proxy.

**Figure ES 8. Top skills needed in high-, medium- and low-skill occupations
(energy sustainability and circular economy scenarios)**

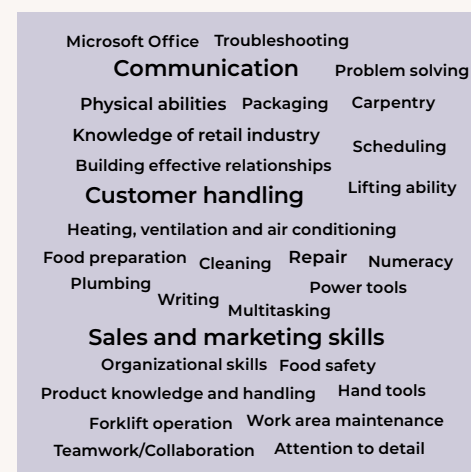
8(a). Circular economy scenario



8(b). Energy sustainability scenario



Medium-skill occupations



Low-skill occupations



Source: Calculations based on real-time data on vacancies, Burning Glass Technologies. US data (2017) are used as a proxy.

In spite of positive forecasts of net job creation, some countries currently face constraints

Although growth in jobs in the transition to more environmentally sustainable economies is widely forecast, not only in the global scenarios but in national projections as well, actual progress in job creation since 2011 has been erratic. In some countries green jobs, in particular, have increased their share of total employment, but in others the share of green jobs in total employment has flatlined. This may be partially explained by the sluggish recovery from the world economic crisis of 2008–09 and the productivity slump of the decade since then. Such patterns may also reflect a natural development curve in jobs related to energy and manufacturing, whereby an initial phase in which employment rises steeply as new products are designed, manufactured and installed is followed by a phase in which maintenance and replacement become more important, requiring relatively fewer jobs. In addition, job creation and job destruction have different dynamics: job losses may result immediately from certain policy decisions (e.g. banning plastics, closing down mines), while job creation may be more gradual, involving efforts to attract investors, the creation of a favourable investment climate and the stimulation of a green type of investment. Newly created jobs may not be in the same territories or require the skills available among the workforce, and labour market adjustment takes time. For all these reasons, balancing job creation and job destruction is a key policy challenge. Certainly, it is now clear that greening trajectories are seldom linear.

The recent round of country reports (2018) highlights key constraints on green jobs growth, including poverty, low incomes and informal employment (especially in developing countries), which can force people into environmentally detrimental activities; weak policies and enforcement of regulations; and weak markets for green goods and services owing to inadequate government support.

The growth in demand for skills for green jobs continues to be driven by environmental change, government policy, technology and markets

The changing environment, policies and regulations, green technology and innovation, green productivity and green markets are all stimulating demand for skills for green jobs, both directly and indirectly through supply chains. While for the most part the same factors were identified in 2011, there have been some subtle shifts. International agendas have played a more prominent role, notably through the UN 2030 Agenda for Sustainable Development and the Paris Agreement. Green technologies continue to advance, linked to growth in consumer markets for green products and services in high-income countries (HICs) and increasingly in low-income countries (LICs) too, as technologies become more affordable and efficient, and owing to technological diffusion through global trade and investment as well as growing awareness about issues of climate change vulnerability and the need for adaptive measures. Behind all these drivers is the important background factor of societal awareness of, and attention to, the issues of climate change and sustainability, which shows signs of having strengthened in recent years.

New drivers of change were only rarely identified. One of these is labour migration. On the one hand, this adversely affects labour supply and causes a “brain drain” and skills shortages in some countries (e.g. Guyana). On the other hand, climate-spurred migration affecting poorer populations, including indigenous people (e.g. in Brazil and many countries in Asia and the Pacific), creates the need for new sets of skills in new labour markets, including core skills, which are portable. Digitalization has also been an important trend globally since 2011, highlighting the need to continue advancing information and communications technologies (ICT) for the green economy and developing green skills within this sector to promote sustainable development (e.g. in Ghana, the Republic of Korea, Mauritius, the Philippines and Tajikistan).

Skills gaps and shortages are increasing, posing a challenge to the green transition

The most widespread effect of the green transition on employment is the need to reskill or upskill within existing occupations. New and emerging green occupations are more rare and tend to emerge at higher skill levels. Low-skilled occupations tend to require limited adaptation to greener work processes such as simply greater environmental awareness (see table ES 1).

Table ES 1. Changes in skills required, by skill level of occupation

SKILL LEVEL	NATURE OF CHANGE	TYPICAL SKILLS RESPONSE	EXAMPLE OCCUPATIONS
Low-skilled occupations	Occupations change in a generic way, e.g. requiring increased environmental awareness or simple adaptations to work procedures	On-the-job learning or short reskilling and upskilling programmes	Refuse/waste collectors, dumpers
Medium-skilled occupations	Some new green occupations Significant changes to some existing occupations in terms of technical skills and knowledge	Short to longer upskilling and reskilling programmes; TVET courses	<i>New occupations:</i> wind turbine operators; solar panel installers <i>Changing occupations:</i> roofers; technicians in heating, ventilation and air conditioning; plumbers
High-skilled occupations	Locus of most new green occupations Significant changes to some existing occupations in terms of technical skills and knowledge	University degree; longer upskilling programmes	<i>New occupations:</i> agricultural meteorologists, climate change scientists; energy auditors, energy consultants; carbon trading analysts <i>Changing occupations:</i> building facilities managers; architects; engineers

Source: “Skills for green jobs” country reports, ILO, 2018.

Jobs in the transition to more sustainable economies require both technical (specific to each occupation) and core (soft) skills (for examples of core skills, see table ES 2). Although data are scarce, there are enough examples to suggest that gaps in and shortages of both kinds of skills are likely to be widespread, especially in LICs, and that these may constitute a constraint on the transition to an environmentally sustainable economy. No evidence was found to suggest that this situation has improved since 2011. Developing countries are especially challenged by a lack of professionals and a shortage of university graduates in general, especially those trained in science, technology, engineering and mathematics (STEM) skills. Even in HICs, including those with well-developed skills anticipation systems, a lack of both technical and transferable core skills remains a significant cause of recruitment problems for employers.

Table ES 2. Main core skills required for green jobs, by skill level of occupation

REQUIRED ACROSS THE LABOUR FORCE	REQUIRED IN MEDIUM-TO HIGH-SKILLED OCCUPATIONS
• Environmental awareness and protection; willingness and capability to learn about sustainable development • Adaptability and transferability skills to enable workers to learn and apply the new technologies and processes required to green their jobs • Teamwork skills reflecting the need for organizations to work collectively on tackling their environmental footprint • Resilience to see through the changes required • Communication and negotiation skills to promote required change to colleagues and customers • Entrepreneurial skills to seize the opportunities of low-carbon technologies and environmental mitigation and adaptation • Occupational safety and health (OSH)	• Analytical thinking (including risk and systems analysis) to interpret and understand the need for change and the measures required • Coordination, management and business skills that can encompass holistic and interdisciplinary approaches incorporating economic, social and ecological objectives • Innovation skills to identify opportunities and create new strategies to respond to green challenges • Marketing skills to promote greener products and services • Consulting skills to advise consumers about green solutions and to spread the use of green technologies • Networking, IT and language skills to perform in global markets • 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

Source: "Skills for green jobs" country reports, ILO, 2018.

The current pattern of green jobs growth and occupational change varies across sectors

Renewable energy has been a particularly important source of green jobs across a wide range of countries, not least owing to the strong focus placed on this sector in NDCs under the Paris Agreement. The environmental goods and services sector, which includes waste, energy and water management, has also developed significantly, with support from government policies and measures. In construction the main employment effects are variable, depending on the degree to which the existing built environment is greened through retro-fitting or, conversely, where the focus is on ensuring that new construction is greener. In these three sectors – renewable energy, environmental goods and services, and construction – most occupations have changed in some way.

In other sectors, the employment effects of the green transition are variable and complex, as are the repercussions on occupational skills (see table ES 3). Some parts of manufacturing, notably the automotive sector, are gradually changing their output to produce more energy-efficient versions of the same product, with limited net employment gains. Other parts of manufacturing are producing green products and creating jobs in the supply chains of green sectors: an example is the production of wind turbines. Agriculture, though subject to significant green challenges and a major source of employment in most developing countries, does not appear to have undergone significant changes in skills thus far. The potential for green jobs in transportation, tourism and extractive industries is yet to be fully realized.

Table ES 3. Nature and extent of occupational change in key sectors

SECTOR	NATURE AND EXTENT OF OCCUPATIONAL CHANGE TO DATE	EXAMPLES OF NEW AND CHANGING OCCUPATIONAL PROFILES
Renewable energy 	One of the most significant sectors for development of new occupational profiles, spreading into closely related existing trades (solar energy systems installation)	MSL: solar photovoltaic/wind turbine/biomass systems: installers, technicians, plant managers, quality engineers HSL: engineers and system designers (overlap with manufacturing)
Environmental goods and services, including water and waste management 	Significant occupational change in waste and recycling, including R&D functions to create new or improved waste management and recycling New occupations of environmental consulting and environmental auditing	MSL: environmental engineering technicians; soil, waste and water engineers (conservationists); environmental science and engineering technicians; health and other protection technicians HSL: atmospheric and space scientists; soil and water conservationists; landscape architects; environmental engineers (restoration planners, certification specialists, economists); climate change analysts; industrial ecologists; energy managers (auditors)

Table 3. (cont.)

SECTOR	NATURE AND EXTENT OF OCCUPATIONAL CHANGE TO DATE	EXAMPLES OF NEW AND CHANGING OCCUPATIONAL PROFILES
Construction and building services 	Mainly skills being added on to and/or adapted by existing occupations; all main trades and professions likely to be affected in some way, and increasingly, across all countries	MSL: carpenters, plumbers, electricians, heating engineers, roofers, painters and decorators, plasterers, building services technicians HSL: facilities managers, architects, engineers, energy auditors and energy consultants (overlap with environmental goods and services)
Manufacturing 	New skills are needed related to reduction of environmental impacts and this may involve new occupations, e.g. pollution control officers Most strongly affected are manufacturers involved in design and manufacture of products for the “greenest” sectors, e.g. renewable energy and green construction	MSL: occupations related to reducing environmental impacts, e.g. pollution control officers, energy auditors (overlap with environmental goods and services) HSL: occupations related to design and production of new products and systems, e.g. product designers, production engineers
Agriculture and forestry 	Mainly skills being added on to and/or adapted by existing occupations. Greatest occupational effects likely to be felt at higher skill levels where new occupations are in demand	MSL: adoption of organic farming techniques; agricultural technicians involved in crop diversification, application of improved technologies. HSL: soil and water conservationists; environmental restoration planners (certification specialists, economists); water resource specialists and water/wastewater engineers’ agricultural meteorologists
Transportation services 	Mostly changing existing occupations through addition of knowledge and skills, e.g. use of electric vehicles; conversion of existing vehicles to new technologies and compressed natural gas	MSL: occupations related to use, conversion (greening) and maintenance of existing vehicles HSL: R&D occupations related to design of greener transport systems, e.g. engineers, systems analysts
Tourism 	Mostly changing existing occupations through addition of knowledge and skills, e.g. eco-tourism	MSL: occupations related to eco-tourism
Extractive industries 	Mostly changing existing occupations through addition of knowledge and skills. Evidence of widespread effects to date lacking	HSL: R&D occupations related to design of greener extractive processes systems, e.g. engineers

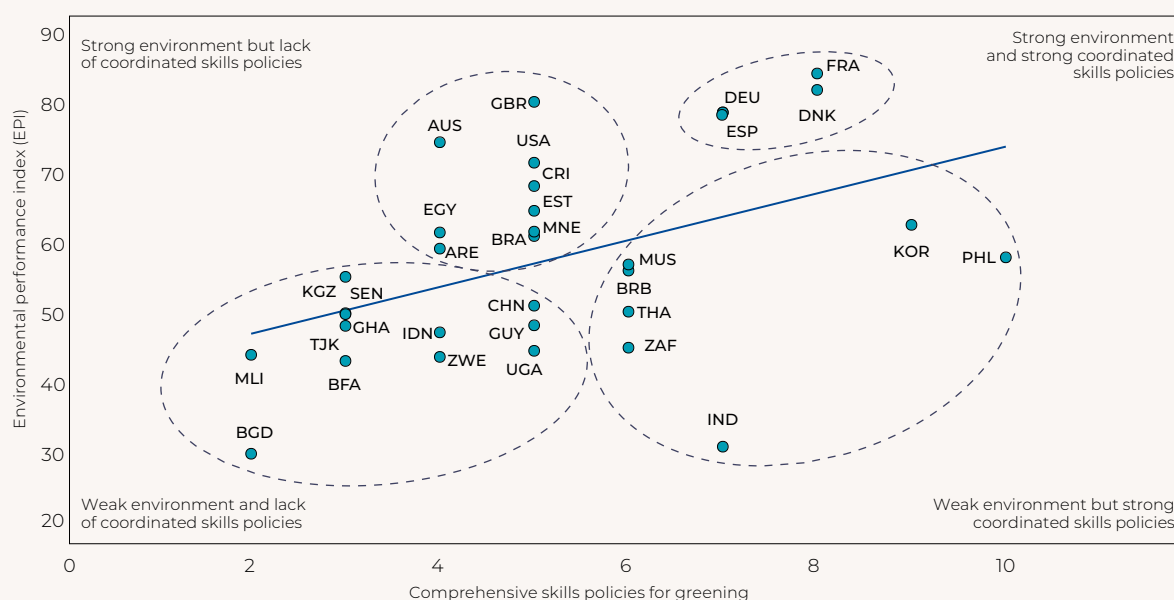
Note: **HSL:** higher skill level; **MSL:** medium skill level.

Source: “Skills for green jobs” country reports, ILO, 2018.

Although policy has developed since 2011, comprehensive and coordinated approaches to skills for green jobs are still lacking in most countries

All countries have sets of policies on environmental sustainability and climate change that form overarching frameworks for consideration of capacity development, occupations and skills. Some countries already had such frameworks in place in 2011, when the first review of skills for green jobs was conducted, while others have since then either put them in place, consolidated them and/or made them more comprehensive in coverage. How these environmental policies are put into practice, and how effectively they are linked to employment and skills policies, varies widely. Analysis conducted using data from the Environmental Performance Index (EPI) and country reports suggests that four groups of countries can be identified (see figure ES 9). Only a small group of European HICs (France, Denmark, Germany and Spain) demonstrate both strong environmental performance and strong comprehensive and coordinated skills policies. Another group, comprising mostly HICs and UMICs, is strong in environmental policies but weak on the skills side. A third group demonstrate strong skills policies but weaker performance on the environmental side. Finally, a large group of mostly LICs are still in the early phases of addressing both environmental and skills issues.

Figure ES 9. Countries grouped according to performance in environmental and skills policies

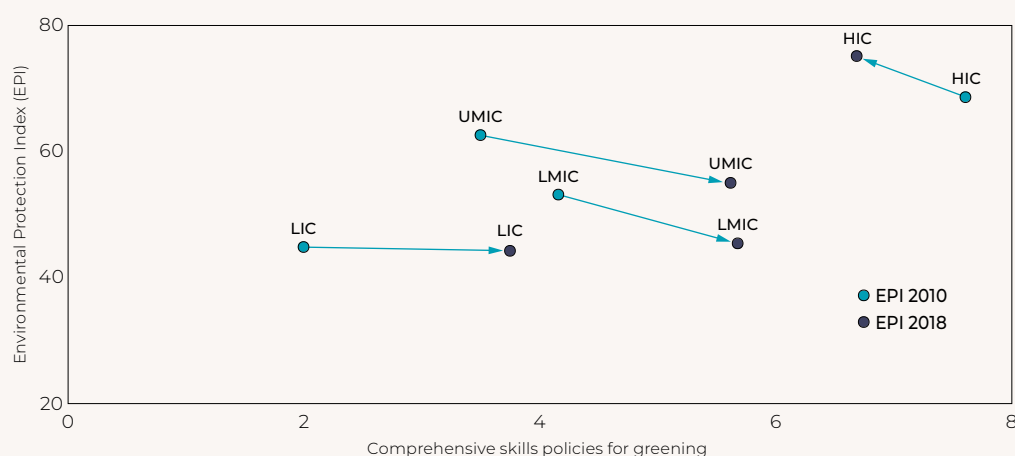


Note: Y axis: the EPI uses the distance-to-target technique for indicator construction, which situates each country relative to targets for worst and best performance corresponding to scores of 0 and 100 respectively. X axis: the presence of comprehensive skills policies for greening was calculated on a 0–10 scale.

Country codes are used as follows: Australia (AUS), Bangladesh (BGD), Barbados (BRB), Brazil (BRA), Burkina Faso (BFA), China (CHN), Costa Rica (CRI), Denmark (DNK), Egypt (EGY), Estonia (EST), France (FRA), Germany (DEU), Ghana (GHA), Guyana (GUY), India (IND), Indonesia (IDN), Republic of Korea (KOR), Kyrgyzstan (KGZ), Mali (MLI), Mauritius (MUS), Montenegro (MNE), the Philippines (PHL), Senegal (SEN), South Africa (ZAF), Spain (ESP), Tajikistan (TJK), Thailand (THA), Uganda (UGA), the United Arab Emirates (ARE), the United Kingdom (GBR), the United States (USA) and Zimbabwe (ZWE).

Source: Authors' calculations based on Wendling et al., 2018; qualitative analysis of country reports and an expert survey.

Figure ES 10. Countries' progress in environmental and comprehensive skills policies, by income level, 2010 and 2018



Note: HIC: high-income countries; LIC: low-income countries; LMIC: low-middle-income countries; UMIC: upper-middle-income countries (based on World Bank typology by income level). Y axis: the EPI uses the distance-to-target technique for indicator construction, which situates each country relative to targets for worst and best performance corresponding to scores of 0 and 100 respectively. X axis: the presence of comprehensive skills policies for greening was calculated on a 0–10 scale.

Source: Authors' calculations based on Wendling et al., 2018; qualitative analysis of country reports and an expert survey (2010 and 2018 rounds).

Since 2011, those HICs that already had comprehensive policies in place for both environmental and skills agendas have earned dividends in the form of better environmental performance. At the same time, many HICs have seen policy adjustments and reversals, demonstrating the fragility and non-linearity of policy development and implementation, and have lost ground in respect of comprehensive skills policies. In LICs and MICs, on the other hand, although environmental performance has deteriorated further, owing to the persistence of resource-based economic growth and in spite of the environmental policy and regulation efforts many of them have made, progress has been made towards comprehensive skills policies for the green transition – partly in recognition of the need to improve environmental performance and partly in acknowledgement that human capital is a main driver of economic progress and well-being (see figure ES 10).

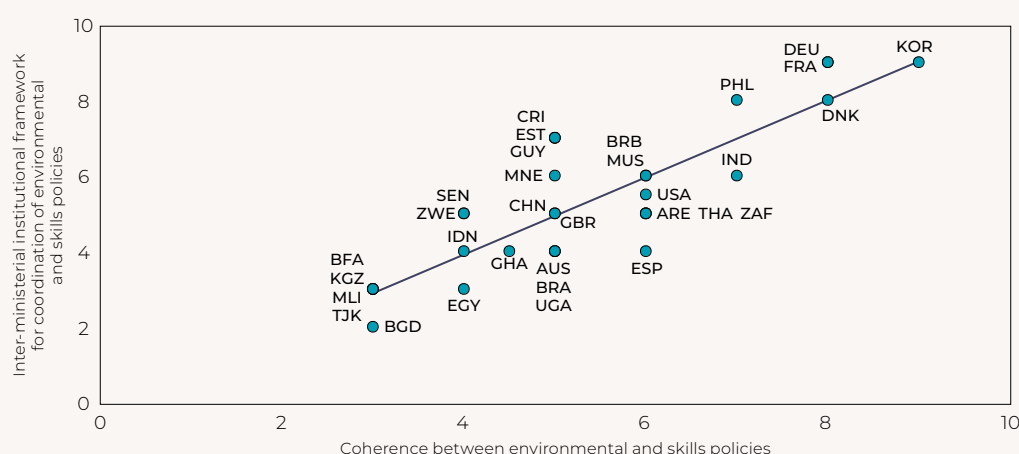
More generally, skills development for green jobs can be characterized as somewhat unsystematic, sometimes taking place as part of overall government policy but often carried out by other actors, including civil society groups as well as regional and local government authorities and social partners, working to fill gaps from the bottom upwards. This is leading to an overall picture of training in skills for greener jobs that is fragmented and led by individual regions, sectors and projects. Such interventions may be effective to a certain extent: they are usually driven by well-understood and pressing needs of communities and businesses. However, such approaches cannot give sufficient attention to broader policy coordination, important equity considerations and a longer-term strategic perspective.

Weak policy coordination remains a common feature across countries

At governmental level, responsibility for the areas of policy relevant to skills for green jobs still tends to be distributed across more than one ministry. The country studies indicate that processes to facilitate systematic policy coordination across ministries are rare. In general, coordination tends to occur for specific purposes, with inadequate monitoring and follow-up. There continue to be weak links in the chain from environmental policies down to the level of skills and training. Ministries dealing with education and training and employment are weakly represented in policy-making on climate change and environment. Often, existing decision-making structures and processes do not deal effectively with cross-ministerial topics. Yet evidence suggests there is a strong correlation between well-matched environmental and skills policies and existing institutional mechanisms for inter-ministerial coordination (see figure ES 11). Such mechanisms are also important for achieving a greater balance between strategic social and economic policies and careful assessment of their environmental impacts.

There is not a single country where coordination between environmental and skills policies was weak in 2011 that has systematically dealt with the issue since. Interestingly, this situation contrasts with the structures and processes put in place in many countries to work towards the SDGs or deal with issues such as disaster management. There is an opportunity to learn from such processes and apply the lessons to skills for green jobs.

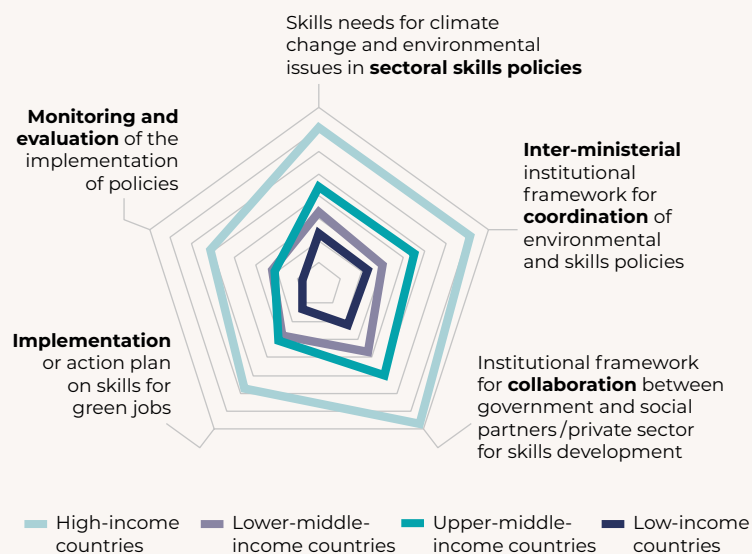
Figure ES 11. Inter-ministerial coordination and coherence between skills and environment policies



Note: $R^2 = 0.73$. 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' calculations, based on qualitative analysis of country reports and an expert survey.

Figure ES 12. Important factors in skills development policies for greening, with relative performance, by income level



Note: HIC: high-income countries; LIC: low-income countries; LMIC: low-middle-income countries; UMIC: upper-middle-income countries (based on World Bank typology by income level).

Source: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

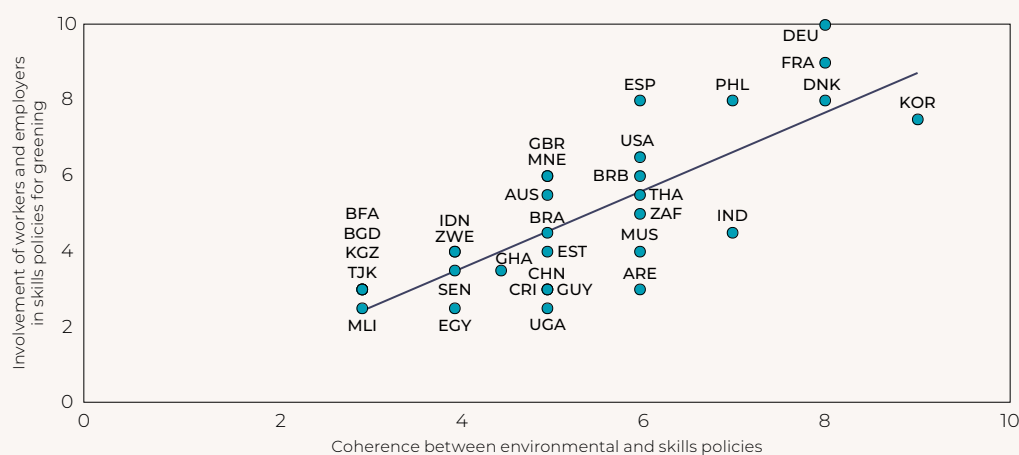
While in HICs coordination within government as well as with social partners is facilitated by the presence of institutional structures, such structures are rare in LICs and many MICs. The policy coordination gap that is such a common feature at national level of the skills for green jobs landscape is sometimes offset, at least in part, by policies and plans at sectoral or subnational governmental levels. Sectoral plans to foster skills for green jobs are most common in those sectors most directly affected by climate change and environmental depletion, and hence by government taxes and incentives (such as energy, transport, construction and waste management).

Implementation and enforcement of policies continue to be among the biggest challenges facing all countries, and the greatest challenge of all is monitoring and evaluation of policy performance, for all country income groups (figure ES 12).

Institutional arrangements for the involvement of social partners in policy-making do not necessarily translate into their actual involvement

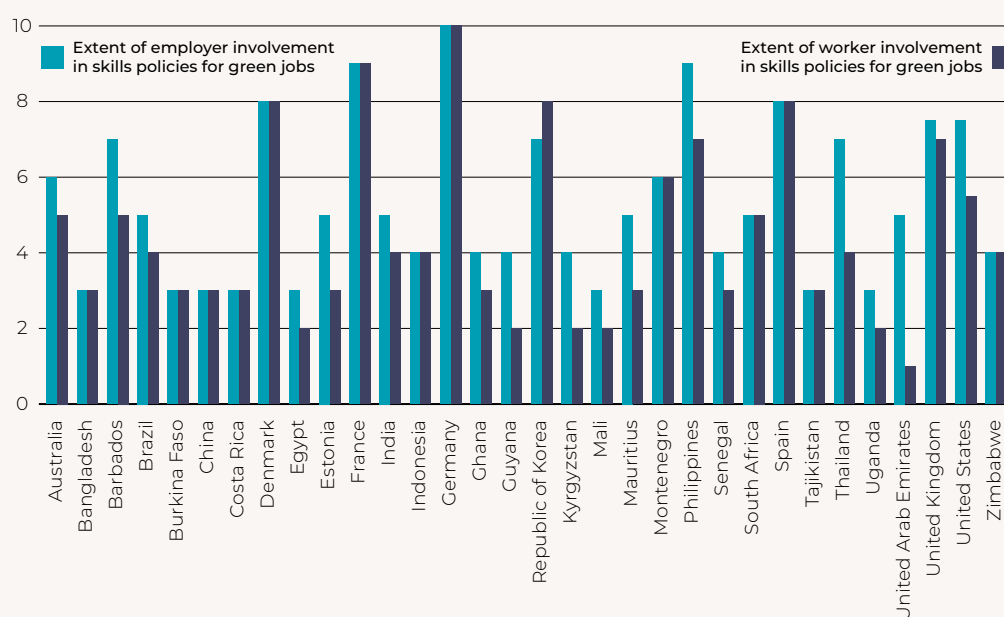
Policy coordination also requires involvement of stakeholders outside government. The importance of involving private-sector stakeholders, both employers and workers, in policy decisions and in the design of skills development measures is difficult to overstate. This is key in ensuring that education and training deliver skills relevant to the needs of the labour market. There is much variation in the extent of such involvement, reflecting, in part, variation in the nature and reach of general mechanisms for the involvement of social partners and other groups in policy formulation and implementation. In LICs social partner organizations and mechanisms are generally underdeveloped, partly because the informal economy typically accounts for a significant share of employment, and partly because there is lack of enforcement of the freedom of association in the informal sector and legislative provisions to allow the informal sector to organize. However, the higher the level of involvement of employers and workers in the coordination mechanism, the greater the coherence between environmental and skills policies. This is an indication of the important role that the private sector and trade unions play in the transition to sustainable economies in general, and with regard to skills policies and their coordination with environmental policies in particular (see figure ES 13).

Figure ES 13. Involvement of employers and workers in skills policies, and coherence between environmental and skills policies



Note: $R^2=0.61$. 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' calculations, based on qualitative analysis of country reports and an expert survey.

Figure ES 14. Involvement of employers and workers in skills policies for green jobs

Source: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

However, the mere presence of institutional mechanisms does not guarantee the actual involvement of employers' and workers' organizations in skills policies for green jobs. Particularly worrying is the low level of trade union involvement in many countries (see figure ES 14): their role is difficult to overstate when it comes to just transition measures and the inclusion of training clauses in collective agreements.

A further reason for pursuing the greater involvement of the social partners in policy decisions is the key role of employers, workers' organizations and sectoral organizations in providing skills for green jobs, both through specific training programmes and through sectoral agreements.

Beyond employers and trade unions, a range of other stakeholders are involved in activities related to skills for green jobs, though they are not necessarily integrated into policy-making. NGOs are a significant actor in developing countries, where in some cases they lead skills training for green jobs.

Most countries lack comprehensive information on gaps and shortages in skills for green jobs

Identification and anticipation of skills needs have been gaining ground since 2011, but remain weak in respect of providing comprehensive information on demand and supply related to skills for green jobs. Among the 32 countries covered in this report, permanent mechanisms dedicated to anticipating and monitoring skills needs specifically for an environmentally sustainable economy are rare. Some countries have set up a specific institutional body or systematic monitoring mechanism dedicated to identifying the skills needed for green jobs, such as the National Observatory for Jobs and Occupations of the Green Economy in France. In countries that have no system at all for monitoring skills needs (for green jobs or generally), which is the case for most LICs, identification of such needs is usually performed on an ad hoc basis.

Systematic, innovative and institutionalized mechanisms for skills anticipation, in which the private sector is directly involved, exist in only a few countries. Most countries lack information on supply and demand. This in turn makes it difficult to develop specific skills policies, shape technical and vocational education and training (TVET) appropriately, and adapt skills training and active labour market programmes (ALMPs) to current and future demand.

Skills for green jobs are increasingly captured in skills development programmes, but these remain fragmented

TVET systems have been adapting to changing skills demand, but to date include only limited elements dedicated to producing skills for green jobs. Most countries have not developed a systematic approach since 2011, even though a number of training programmes, public and private, delivered through technical or vocational colleges, and formal or informal apprenticeship programmes, have been developed. Some of examples of TVET measures are set out in table ES 4.

To compensate for deficiencies in skills supply from TVET, the private sector also develops the skills it needs itself. Indeed, private-sector engagement in TVET is regarded as essential in all countries, in order to establish a system that delivers skills effectively for specific sectors and enterprises. The evidence shows, however, that since 2011 there have been few examples of systematic private-sector involvement in greening skills initiatives that are sustainable in the longer term. There are signs of specific sectoral or company initiatives, and some governments are using specific financial incentives and regulations to focus on greening TVET and skills development (Guyana, Philippines, Republic of Korea, United States). But there are also indications that, without incentives, the private sector struggles to act on its own.

Table ES 4. Examples of TVET development measures incorporating green components

TVET DEVELOPMENT MEASURES	COUNTRIES
Developing, adapting and/or updating the occupational standards for existing qualifications in national qualification systems to incorporate components related to skills for green jobs.	Estonia, Ghana, India, Indonesia, Republic of Korea, Philippines, Thailand.
Discussing relevant topics in national or sectoral skills councils and committees on education, research and development or skills development, which often include experts and other stakeholders.	Australia, Republic of Korea, Kyrgyzstan, Mauritius, Montenegro, Thailand, United Arab Emirates.
Adapting existing education programmes and qualifications and/or developing a small number of new ones, often sector-specific.	Most countries adapt existing education programmes to some extent. New programmes are less common, but have been created in Barbados, Germany, Kyrgyzstan, the Philippines and Spain.
Adapting TVET regulations.	

Source: "Skills for green jobs" country reports, ILO, 2018.

Specific disadvantaged and vulnerable groups should be included in skills development programmes, enabling a green transition that is also just for all

While many countries aim to include disadvantaged and vulnerable groups in their skills development programmes for green jobs, these groups remain largely under-represented. Some development has taken place in ALMPs and with the support of public employment services since 2011. Although approaches targeted on skills for green jobs are still absent in most of the countries in our sample, there are some interesting initiatives aimed at specific groups – youth, older workers, people with disabilities, indigenous people, women, migrant workers, unemployed people, informal workers and those living in rural areas. Other initiatives have focused on establishing dedicated funding programmes for skills for green jobs, or retraining unemployed people to take up roles that support the environmentally sustainable economy.

Even though there are indications that gender issues are being addressed in the TVET sector, in order to attract more female students to science- and technology-related programmes, enrolments in universities and TVET still follow traditional gender stereotypes, with more male students in technology-driven areas. The inclusion of women in apprenticeship and skills training for environmentally sustainable jobs is essential for overcoming disparities in the labour market as well as skill shortages in certain occupations.

Employers' and workers' organizations have an important role to play, both in policy-making and, even more, in policy implementation, in ensuring a just and inclusive transition to an environmentally sustainable economy with better-quality jobs, and open and fair access to the acquisition of relevant skills.

To seize the momentum, countries will need to integrate forward-looking skills strategies in their climate and environmental policies

The transition to an environmentally sustainable and low-carbon economy will generate many new jobs, cause some job losses and alter the skills composition of most jobs. Skills development strategies will need to support displaced workers at the same time as they enable the green transition and encourage job generation. The *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (ILO, 2015) highlight the importance of inclusive skills development policies. Skills development is an important pillar in a just and inclusive transition, but other measures will be equally important. A comprehensive approach should also include social dialogue, ALMPs, social protection, counselling and effective labour market institutions to provide job-matching and career counselling services.

Coordination with macroeconomic, sustainable investment, industrial and enterprise policies, including incentives for knowledge transfer and technology diffusion, will be also be essential in enabling businesses to implement greener and resource-efficient production practices, to align the supply of skills with growing demand and to facilitate the efficient reallocation of workers to newly created green jobs. The ILO Human Resources Development Recommendation, 2004 (No. 195), recognizes that education, training and lifelong learning are of fundamental importance and should form an integral part of, and be consistent with, comprehensive economic, fiscal, social and labour market policies. Action planning on skills development will have to be integrated with key climate and environmental policies and regulations, including NDCs, to ensure that skills needs are met and climate commitments are implemented. Furthermore, skills policies and training measures will need to adopt a longer-term and systematic approach to skills development in the context of greening.

The new jobs created in the environmentally sustainable economy will require somewhat higher qualifications and new sets of skills. Upskilling and reskilling workers, especially those most affected by the transition, will mean implementing lifelong learning strategies rather than front-loading qualifications that are expected to suffice for an entire career. The green transition will not be a single force claiming a massive adjustment of the current and potential workforce. Automation, demographic change, global trade and other megatrends will also have substantial impacts. Multiple changes will require multiple transitions managed throughout careers. Access to skills training, raising environmental awareness and climate literacy for current workers, even those not affected by job displacement, will be essential for the implementation of greener ways of production and service delivery.

The Global Commission on the Future of Work has stressed the importance of investment in people's capabilities and universal entitlements to lifelong learning (ILO, 2019). It has also underlined the need to step up investments in labour market institutions to support people through future work transitions. Other systemic elements of lifelong learning will need to include innovative and diverse ways of financing, combining private and public contributions, and allowing individuals to access funding and gain recognition for their learning outcomes, whether attained formally or informally. Social dialogue will remain part and parcel of the provision of learning and skills for a just transition and sustainable development.



1. INTRODUCTION

1.1 Background

Changes in the Earth's climate and ecosystems are starting to have dramatic impacts on economies and societies. In 2008, the International Labour Conference stated that skills⁵ development should form part of an effective response to such challenges, and in 2011 the ILO joined forces with the European Centre for the Development of Vocational Training (Cedefop) to produce a first report called *Skills for green jobs: A global view* (Strietska-Ilina et al., 2011). Based on 21 country studies, the report provided good practice examples of how national policies for greening economies are complemented by identification of skills needs and efficient skills response strategies. This new edition provides an update to that 2011 report.

The transition to environmental sustainability (the “green transition”) continues to affect existing occupations, where reskilling or upskilling is needed, and – more rarely – to create new green occupations. New occupations tend to emerge at higher skill levels, whereas lower-skilled occupations tend to require just more environmental awareness or simple adaptations to work processes.

The current report is based on 32 national studies prepared in 2017–18.⁶ Twenty-six of the country reports have been coordinated by the ILO, covering: Australia, Bangladesh, Brazil, Burkina Faso, Barbados, China, Costa Rica, Egypt, India, Indonesia, Ghana, Guyana, the Republic of Korea, Kyrgyzstan, Mali, Mauritius, Montenegro, the Philippines, Senegal, South Africa, Tajikistan, Thailand, Uganda, the United Arab Emirates, the United States and Zimbabwe.⁷ Cedefop has coordinated and updated country reports for six European countries, all EU member States: Denmark, Estonia, France, Germany, Spain and the United Kingdom. All studies have been conducted using the same research methodology and criteria for selection of case studies, and following identical structures. As well as providing

5. The term “skills” is used throughout this report as an overarching term which refers to the knowledge, competence and experience needed to perform a specific task or job. Skills development in this context comprises all forms of human resources development: lifelong learning, including initial and continuing vocational education and training, and life-wide learning, including formal and informal/non-formal learning.

6. Unless referenced otherwise, all country-related information and examples used in this are based on the national background studies listed in Annex 1. The full texts of the ILO country reports are available at: https://www.ilo.org/skills/projects/WCMS_706847/lang--en/index.htm. The full texts of the Cedefop country reports are available at: https://www.ilo.org/skills/projects/WCMS_707582/lang--en/index.htm

7. Relevant preliminary findings of the *ILO assessment of supply and demand for technical and vocational skills to support green jobs opportunities for young women and men in Zimbabwe* (ILO, forthcoming 2020) were added to the global analysis as the 32nd country study in 2019. Although not undertaken for the same purposes and based on a different methodology, the assessment contributed relevant and valuable information.

the background research material for this report, most of these country studies were also used for the ILO flagship report *World Employment and Social Outlook: Greening with jobs* (ILO, 2018a), which analysed trends towards decent work and environmental sustainability, and assessed the impact on the world of work of a transition towards a low-carbon, resource-efficient economy.

The current report provides a more granular insight into skills challenges and response strategies for a just transition, extended to cover additional countries and regions. Together, these 32 countries account for 63 per cent of world employment, 65 per cent of global GDP and 63 per cent of carbon dioxide emissions. The report also includes a global quantitative outlook on occupational skills demand in two policy scenarios.

1.2 Changing policy context

Since 2011, climate change and environmental deterioration have continued, intensifying concerns and prompting new global policy efforts. Key international policy accords have been reached, most notably the UN Sustainable Development Goals (SDGs) for 2015–30 and the 2015 Paris Agreement on Climate Change. The International Labour Conference, at its 102nd Session in 2013, adopted a resolution and set of conclusions promoting decent work, sustainable development and green jobs in response to climate change (ILO, 2013a). In 2015, the ILO's Governing Body unanimously adopted guidelines for a just transition towards environmentally sustainable economies and societies for all (ILO, 2015a), which particularly highlighted skills development as a key policy area requiring institutional attention in greening economies. The same point was highlighted in the Solidarity and Just Transition Declaration adopted at the 24th Conference of the Parties (COP24) to the United Nations Framework Convention on Climate Change (UNFCCC) in Katowice in December 2018.⁸

1.3 Objectives

The aim of this report is to provide a qualitative comparative analysis across the 32 countries, using the country reports as the principal source, examining the role of training measures in countries' efforts to meet their commitments to implement the Paris Agreement, and quantifying the occupational skill needs likely to arise by 2030 in two policy scenarios.

The main objectives of this global qualitative and quantitative analysis are to identify:

- the scale of the need for reskilling and upskilling to realize the employment potential of the green transition;
- the changes in occupations, skills gaps and skills shortages likely to arise in efforts to meet the skills demand of the green transition;

8. https://cop24.gov.pl/fileadmin/user_upload/Solidarity_and_Just_Transition_Silesia_Declaration_2_.pdf [accessed 25 Aug. 2019].

- the progress made since 2011 in the countries surveyed then in coordinating skills and environmental policy matters across ministries and between public and private sectors;
- the specific needs of vulnerable population and disadvantaged groups in adjusting to change, and effective skills policy measures to increase productivity and support a just transition.

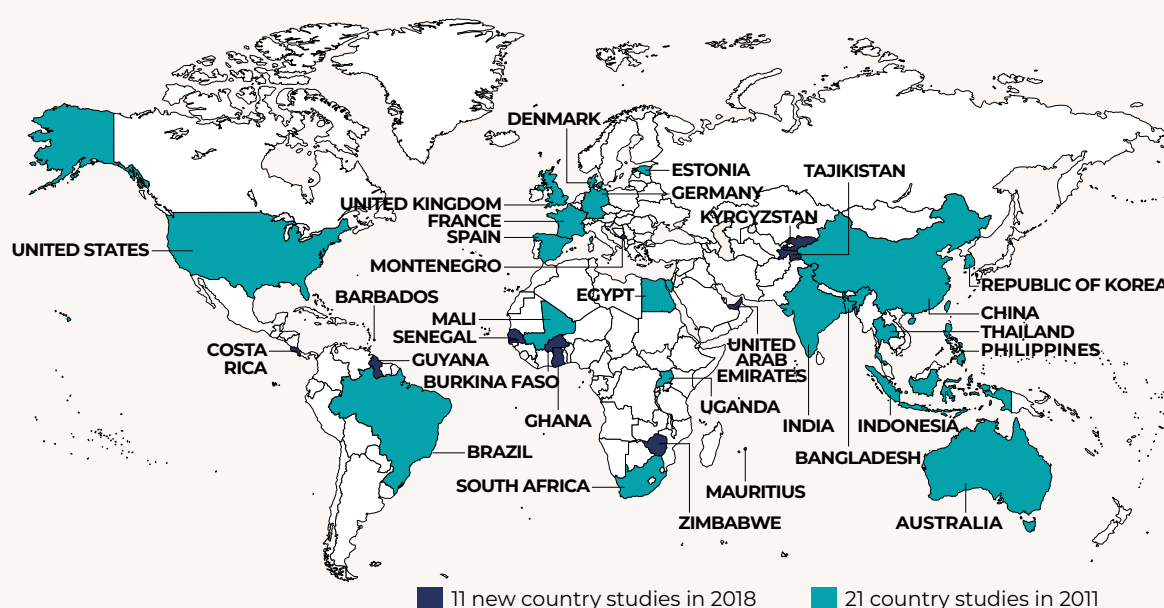
1.4 Methodology and limitations

The research methodology has sought to identify common patterns and differences across the countries studied, taking into account geographical regions and income levels; and to analyse progress since 2011 where data permit (21 of the countries produced reports in both 2011 and 2018, as shown in figure 1.1).

There are necessarily limitations to such a comparative analysis. The information available varies widely across countries, and quite often topics covered well in 2011 have not been addressed to the same extent (or at all) in 2018, and vice versa. It is also difficult to establish a sound basis for comparing different “types” of country. Broadly speaking, the report has been able to find some differences between countries according to income, but typically only in terms of low(er)-income and high(er)-income countries – the available data do not support a more detailed analysis. Use is also made of the distinction between developed and developing countries in contexts where this is more appropriate. Qualitative country studies were complemented by a small-scale qualitative survey among experts, the results of which were correlated with the available data.

The qualitative country studies are complemented by a quantitative analysis in two global scenarios (that of energy transition and that of a circular economy) explored

Figure 1.1 Map of countries included in the global analysis



by the ILO (2018), focusing mainly on the implications for occupations and related skills needs. This analysis was conducted using a multi-regional input-output model (EXIOBASE v3) to analyse transactions between 163 industries across 44 countries in order to quantify the occupational skills needs of the transition to energy sustainability and to a circular economy. By weighting the results to reflect employment composition in other countries, global scenarios were produced. Expanding on the ILO's exploration of the likely job impacts by 2030 of keeping the rise in global temperature below the 2°C ceiling set by the Paris Agreement on Climate Change (ILO, 2018a), this is the first global study to analyse the implications of the transition to low-carbon and resource-efficient economies for skills, gender and occupations.

1.5 Report structure

The report is structured as follows. This introduction is followed by a second chapter which examines the drivers of the green transition. The third chapter explores skills policies adopted in response to the greening agenda, and examines coherence between environmental and skills policies, including a comparison with the 2011 results. The employment effects of the process of greening the economy are discussed in Chapter 4. Chapter 5 analyses qualitative changes and skills gaps in occupations across the sectors most strongly affected by the green transition. Chapter 6 quantifies the impact on occupational skill needs in the energy transition and circular economy global scenarios in declining and growing industries by 2030. It also includes estimates and examples of the technical and core skills that will potentially be in greatest demand in the transition to a low-carbon economy. Chapter 7 takes stock of the policy instruments and implementation measures that have been put in place to support the development of skills for a green transition. Chapter 8 provides conclusions, forward-looking recommendations and proposals for practical policy measures.

This new edition of the report brings unique qualitative and quantitative insights to bear on skills and occupational needs, and reviews good skills development practices that both address climate change and enhance the just transition to environmental sustainability.



2. THE GREEN TRANSITION: WHAT IS DRIVING SKILLS CHANGE?

There are four main groups of interlinked factors stimulating the growth of skills for green jobs: the changing environment; policy and regulation; green technology and innovation; and green markets. These are largely the same factors identified in 2011, with some subtle shifts; new factors hardly feature (these are discussed briefly in the concluding section of the chapter). International agendas play a heightened role; green technologies continue to advance, linked to growth in consumer markets for green products and services (especially in higher-income countries); and in lower-income countries especially, issues of climate change vulnerability and adaptive measures have become more pressing.

2.1 The changing environment

The consequences of climate change are widespread and varied. The previous study (Strietska-Illina et al., 2011) noted that climate change was the predominant factor in the changing environment as a driver of skills for green jobs, referring to increasing climate variability, reduction in biodiversity, concern over pollution and degradation of natural resources. The effects of a changing environment remain a key concern for developing countries especially.

The physical environment is a key component of economic development and welfare (Barbier, 2015). Therefore, countries that rely on natural resources for development – most of which are developing countries (Narain et al., 2008) – are particularly vulnerable to current and future climatic changes. This observation applied in 2011 and remains pertinent today; however, the 2018 country reports reflect increased discussion of the changing environment within developed countries. This may be prompted by greater public awareness of environmental problems; improved evidence-based scientific understanding of climate change and environmental degradation; more acute and measurable environmental changes; and greater policy attention to and ownership of to these issues.

Countries whose economies rely on the exploitation of natural resources are facing increasing pressures of resource scarcity and severe environmental impacts as a result of intensive extraction and industrial processes. The impacts are particularly severe for developing owing to over-reliance on agriculture and extractive industries that cause deforestation, lake silting, lack of control of toxic pollutants and the release of GHG emissions. This damage to the material base of economic

growth – the environment itself – is driving a shift to a “green economy” as a more sustainable form of development that does not rely on finite resources (such as oil and mineral extraction in Brazil) or cause negative environmental effects (such as deforestation in Ghana and Senegal). A focus on these less degrading forms of growth is driving the demand for the skills required in green jobs in renewable technologies and alternative forms of employment in service sectors rather than industry.

As well as increasing awareness of the environmental damage caused by extracting natural resources, climate change creates and exacerbates vulnerabilities. These may take the form of exposure to hazards (e.g. rising sea levels, droughts, floods, tropical cyclones etc.), sensitivity to hazards (e.g. reliance of economies on rain-dependent agriculture) and the capacity to adapt to hazards (determined by a range of interacting social, political and economic relations) (Field et al., eds, 2014). In all these ways developing countries are especially vulnerable to the effects of climate change,⁹ which may explain in part why these effects are given more attention as drivers of skills for green jobs in developing countries. These concerns were mentioned in the 2011 report. For example, Burkina Faso and Ghana both note the dependence of the economy on agricultural production, which is itself largely dependent on rainfall that is becoming increasingly variable and unpredictable.

Heightened anxiety about the effects of climate change, broader societal awareness of the issue and already perceptible effects with negative consequences, including the threat to development, may all contribute to the increased attention given to climate change adaptation and resilience since 2011. Adaptation entails enhancing capacity to cope with the effects of climate change, taking into account the bio-physical characteristics of the country as well as wider socio-economic drivers of vulnerability (Noble et al., 2014). The urgency of adaptation is most acute in countries that are particularly vulnerable to climate change risks and impacts, for example low-level coastal countries or small island developing states (SIDS), such as Barbados, Guyana and Mauritius, and countries such as Bangladesh where rising sea levels, flooding, and the higher frequency and intensity of tropical storms are already undermining development strategies and destroying livelihoods and communities. Although climate change vulnerabilities are greater in developing countries, developed countries also note the importance of adaptation as an important tool for reducing vulnerability, though in these countries it is discussed to a much lesser degree, because their capacity to adapt is already high and sufficient to deal with current impacts.

9. Indeed, one of the indicators the UN uses to identify “less developed countries” is vulnerability to environmental shocks, such as natural hazards. See <https://www.un.org/development/desa/dpad/least-developed-country-category.html> [accessed 25 Aug. 2019].

2.2 Policy and regulation

Policy and regulation are important aspects of governance that can support the introduction of green legislation and incentives to foster sustainability, and drive the development of skills for green jobs. Both are significant at subnational and national levels, and have gained increased international prominence since 2011.

The 2011 country studies for both developed and developing countries noted the importance of policy and regulation in reducing or preventing environmental damage and in promoting cleaner production, largely at national level through laws, targets and incentives, though national green policies were not universal. Since 2011 key international policy initiatives on the environment have been taken: most notably the UN Sustainable Development Goals (SDGs) for 2015–30 and the Paris Climate Change Agreement of 2015, launched by the 21st Conference of the Parties (COP21) to the UNFCCC, adopted in 1992. The SDGs act as a blueprint in addressing issues of poverty, inequality, climate and environment by providing international goals and targets to inform national policy. The Paris Agreement states the goal of keeping the increase in global average temperature to below 1.5°C,¹⁰ and requires each country to state its nationally determined contribution (NDC) to this end.¹¹ All 32 countries covered in the present report have signed the Agreement – although President Trump announced in 2017 his intention to withdraw the United States and sent the notification to the UNFCCC in 2019.¹² Both these agendas represent a general increased international awareness of the need for a sustainable global “greening”. They figure more prominently as a driver for skills for green jobs in reports from developing countries than in those from developed countries (see

Table 2.1 References to international environmental agreements in country reports

COUNTRY GROUP	NUMBER OF MENTIONS WITHIN REPORTS			NOT MENTIONED
	SDGS/MDGS	UNFCCC/PARIS AGREEMENT/COP21	NDC	
LICs	4	2	4	1
LMICs	5	4	4	0
UMICs	4	6	5	1
HICs	2	3	0	7
Total	16	15	13	9

Notes: LIC = low-income countries; LMIC = lower-middle-income countries; UMIC = upper-middle-income countries; HIC = high-income countries. MDGs = Millennium Development Goals; SDGs = Sustainable Development Goals. UNFCCC = United Nations Framework Convention on Climate Change; COP21 = 21st Conference of the Parties. See Annex 4 for a breakdown of the data by country.

Source: Authors' analysis based on *Skills for green jobs* country reports (ILO, 2018).

10. The call for global warming to be limited to 1.5°C, rather than 2°C, above pre-industrial levels was made by the Intergovernmental Panel on Climate Change in its report *Global warming of 1.5°C* (IPCC, 2018). The report concluded that we are already seeing the consequences of 1°C of global warming through more extreme weather, rising sea levels and other changes, and highlighted a number of climate change impacts that could be avoided by limiting global warming to 1.5°C.

11. NDCs are prepared and communicated by each country adhering to the Paris Agreement and are used to inform domestic mitigation measures in line with the targets to reduce greenhouse gas emissions. These are country-specific, in line with domestic circumstances and capabilities.

12. <https://unfccc.int/news/unfccc-statement-on-the-us-decision-to-withdraw-from-paris-agreement> [accessed 25 Aug. 2019].

table 2.1). This is interesting, as it could indicate that the existence of international guidelines and targets has been important in informing policy at a national level in developing countries.

At the national level, all 32 country reports mention national action plans or policies that promote sustainability or emphasize the importance of “greening”. In the 2018 reports, most countries offered more explicit discussion of their green policies than in the 2011 reports. This is not to suggest that these policies did not exist in 2011, but rather that there has generally been an overall increase in the number, scope and sophistication of these approaches. This may be attributable in part to the new prominence of international agendas, noted above, along with an increased awareness of sustainability more broadly. Interestingly, there is a division here between developed and developing countries, echoing a similar pattern found in 2011: developed countries tend to focus more on policy incentives for business and technology (Spain) and consumer behaviour (UK), while developing countries give more emphasis to the importance of management and environmental protection through government. Though national policy is noted as a driver in developing countries, it does not predominate here as it does in developed countries. This difference is related to the significance of other drivers in developing countries – notably the changing environment – and to the generally stronger governance systems in developed countries; developing countries note the need to strengthen existing mechanisms to improve the accountability and efficiency of policy, and action in these areas may be given a higher priority than policy itself as a significant driver of skills for green jobs.

This awareness of the need to improve the effective enforcement of environmental regulation in developing countries was also a theme in 2011. The 2018 reports attribute problems with implementation to lack of effective institutions (e.g. in Bangladesh, Mali and Uganda), lack of effective frameworks (e.g. in Brazil and China) and poor coordination between different actors (e.g. in Thailand). Despite these mismatches and the need to strengthen policy in practice, improvements have been made since 2011; this should not be forgotten when considering further recommendations (see Chapter 8), as significant progress towards sustainable growth and green jobs is continually being made. For instance, policy and regulation generally have also sought to support and promote green technology and innovation in both developed and developing countries.

2.3 Green technology and innovation

Green technology involves the application of knowledge, devices and mechanisms, design and skills to generate products or activities that have a less environmentally degrading effect or can be used to improve environmental conditions. The 2011 report identified the development and application of new green technologies as one of the main drivers of “greening” in skills and occupations. Developed countries were at the forefront of innovation and development in green technology, owing to their extensive resource bases, high levels of education and financial support, and well-established research and development capabilities. In developing countries, the emphasis was on gaining the skills required to adopt, adapt and access these technologies as a starting point.

Since 2011 there has been significant development of green technologies, and the 2018 country reports show a greater diversity in their application. Renewable energy technologies (solar, wind, hydroelectric, geothermal etc.) are particularly prominent. One of the drivers of this trend is heightened concern over changing environments, prompting the use of these technologies to mitigate GHG emissions. This is happening in both developing and developed countries, though the reasons are slightly different for each group: developing countries want to reduce their climate change vulnerability (as discussed above), while developed countries want to have cleaner production. Another driver behind such technologies is anxiety over resource scarcity and the security of energy supplies, which is stimulating the development of off-grid and renewable alternatives in both LICs (e.g. Egypt, Mali, Uganda, Zimbabwe) and HICs (e.g. France, the United States and the United Arab Emirates).

Though existing and new green technologies can be seen as an independent driver of skills for green jobs, they are tied to other drivers. For instance, certain policy agendas have promoted developing green technologies as a way of fostering green growth. In the United Kingdom, the Energy Act 2013 is hailed as the main driver of the green economy, having set targets to lower carbon emissions and encouraged investment in offshore wind power. Uganda shows a similar policy emphasis on green innovation in its National Strategy to Strengthen Human Resources and Skills to Advance Green, Low Emission and Climate Resilient Development (2013–22), and the improvements in research and training institutions made to facilitate its implementation. This focus on research and development suggests a shift in developing countries away from an exclusive focus on access to existing technologies. Similar moves are taking place in Mauritius, through the Smart City Scheme (see box 2.1), and Ghana, in the prioritization of climate-resilient infrastructure: in both cases, green innovation and design are being developed domestically, driving development of an array of skills for green jobs associated with these projects.

Box 2.1 Mauritius: The Smart City Scheme

The Smart City Scheme, launched in 2015, is an economic development programme to build intelligent, innovative and sustainable cities. By facilitating innovation and creating investment opportunities, the scheme aims to enhance and valorize the environmental assets of Mauritius to create a socially inclusive living, working and leisure space that is environmentally friendly. This ambitious strategy involves creative urban planning and technological development to generate an innovative mixed-use complex (residential, commercial and entertainment) through clean technology, climate mitigation tools, and low-emission and energy-efficient infrastructure. The Smart City Scheme aims to generate low-carbon, low-water and low-impact environments in line with SDG 11 to make cities and human settlements inclusive, safe, resilient and sustainable.

Source: Skills for green jobs in Mauritius (ILO, 2018).

A key difference between 2018 and 2011 is an increased demand for green technology, not just from governments but from consumers in both developed and developing countries. This point emphasizes the interconnected nature of drivers and is discussed in more detail in the next section.

2.4 Green markets

As in 2011, the significance of green markets in generating demand for skills for green jobs is greater in developed than in developing countries. The concept of green markets is broadly understood as referring to market mechanisms designed to promote and meet demand for green technologies and to fulfil green policies. Markets for greener products and services are also driven by consumer demand and changing consumer preferences. Green markets and services are becoming one of the key drivers of change, fostering innovation and technology-driven transformation. In addition, green market opportunities facilitate the creation of green enterprises that deliver green goods or services to respond rapidly to demand (ILO, 2016b). The concept of green markets has previously been linked to strong regulation, the creation of more market opportunities – e.g. through cleaner production and improved energy efficiency – and consumer preferences. Examination of the 2018 country reports reveals the last of these to be particularly significant for developed countries, where improved education and environmental awareness are reflected in a “greening” of attitudes and consumer demands. This shift has been taken a step further by Estonia, and significantly also by China – an MIC – where discussions are taking place about the importance of a “circular economy”¹³ in driving the need for skills for green jobs in terms of green thinking, training and work, and technology.

As noted above, there are already thriving markets that are driving the development of green technologies. For example, there is increasing consumer demand for clean energy (e.g. in the United States), energy-efficient homes (e.g. in Australia) and more water-efficient technology to respond to rising consumption (e.g. in the United Arab Emirates). These demands are driving skills for green jobs through training, development of technology and policy incentives.

Though green markets are still more significant in developed countries, the division between developed and developing countries on this point is less marked than it was in 2011, suggesting a significant role for consumer demand across the spectrum of development. For instance, in Thailand skills for green jobs are being driven by the demand for more efficient and widely available information technology (IT) services. Uganda also provides a very interesting case (see box 2.2). One possible explanation of this relative increase in the importance of green markets in developing countries could lie in general development: positive growth rates in these countries since 2011 is associated with the development of consumer markets, such that a rising demand for green technologies and products in these countries would be expected.

Financial incentives are a key aspect of the operation of green markets. China has introduced a range of economic mechanisms explicitly linked to the development of low-carbon industry and the encouragement of private investors to focus on low-polluting sectors. These include green industrial policies, mechanisms for carbon trading, green finance and credit, trading rights for pollution and waste, and standards for green products. The range of these mechanisms has grown since 2011 and there is evidence of their increased uptake in a number of countries, both developed and developing.

¹³ A “circular economy” is a model for sustainability in resource use and consumption which supports moving away from an extract–manufacture–use–discard model and embraces the recycling, repair, reuse, remanufacture, rental and longer durability of goods (ILO, 2018).

Box 2.2 Uganda: Developing technology and markets

In Uganda, the greening of skills is being driven by policy capitalizing on market demands among an expanding working-age population, in particular the demand for reliable and renewable energy generation capacity. The country report suggests this will be done through research and training in green technologies to meet this demand. The Ugandan Government also seeks to use market incentives to make agricultural practices more sustainable and competitive as part of its National Strategy to Strengthen Human Resources and Skills to Advance Green, Low Emission and Climate Resilient Development (2013–22). Such an approach, explicitly linking governmental policies and strategies to market-driven initiatives and human development, is very advanced for a developing country.

Source: *Skills for green jobs in Uganda* (ILO, 2018).

Furthermore, these incentives are important in complementing other market mechanisms and supporting other drivers of skills for green jobs. For instance, the Australia country report noted that market forces alone may not be able to overcome the reluctance of Australians to switch to electric vehicles; incentives and flexible regulations are needed to achieve a significant reduction in emissions through the use of electric vehicles. Indeed, one of the lessons from the period between 2011 and 2018 has been that markets often rely substantially on government support and may find it hard to become “free-standing”. In 2012 Spain abolished feed-in tariffs that had encouraged investment in renewable energy since 1994, and in 2015 the UK government withdrew a range of green subsidies including those for onshore wind, biomass conversions and smaller solar panels, along with plans to make all new homes carbon neutral. In both countries, these decisions led to market contraction. In contrast, the market for organic agricultural produce has grown in many European countries, demonstrating the willingness of consumers to buy green products even when these are more expensive – perhaps a sign of the greater societal awareness of the need for sustainability mentioned at the start of this chapter.

2.5 Conclusions

The main drivers of skills for green jobs remain the same as those identified in the 2011 ILO report: the changing environment, policy and regulation, green technology and innovation, and green markets. However, there have been shifts in the relative importance of these drivers, and some new themes have emerged. For instance, in some countries (such as Brazil, Guyana and India) labour migration is encouraging the development of skills for green jobs to support mobility among poorer population groups. Digitalization has also been an important trend globally since 2011. This was mentioned in some of the 2018 country reports (Ghana, the Republic of Korea, Mauritius, the Philippines and Tajikistan), referring to the need to continue advancing information and communications technology (ICT) services within the green economy and to develop green skills within this sector to promote sustainable development.

Notable changes since the 2011 report include the increased attention given to issues of climate change vulnerability and adaptation measures, especially in LICs;

an internationalization of green and environmental policy through the SDGs and the Paris Agreement, which has acted as a driver of national policy; advances in the development and accessibility of green technologies; and growing consumer demand for more environmentally friendly or green products. Importantly, these drivers do not act in isolation but form a complex web of dynamic and interconnected factors encouraging the development of skills for green jobs.

The previous report noted a distinction between the drivers in developed and developing countries. In developed countries, market forces dominated, whereas for developing countries, environmental change and policy and regulation were the most important. Though there is still a difference in the relative importance of different drivers – environmental change remains prominent in developing countries, while government regulation looms larger in more developed countries – the picture is more complex than this may suggest. Regulation and governance – especially in the international arena – play a role in both developed and developing countries, as do green technology and innovation; and there is some suggestion that green markets are playing an increasing part in developing countries.

One theme that emerged during analysis of the 2018 country reports was increased societal awareness of and attention to the issues of climate change and sustainability. Though the reasons for this are not easy to define precisely, and are likely to involve a complex mix of factors, it is undoubtedly the case that governments, civil society and society itself are shifting to a greater “green awareness” and the need for more environmentally friendly behaviour (Oktay, 2012). For instance, since 2011 the effects of climate change are now better understood, part of everyday discourses, and increasingly experienced by a range of actors. Although it is unclear whether the increased attention to sustainability is largely discursive, or whether it is generating concrete action, this general move to a “greening” of issues in the public sphere is a positive one that provides an important background to the drivers discussed here.



3. KEY CHALLENGES: THE POLICY CONTEXT

Government policy plays a key role in the quest for a green transition. While all countries have now elaborated a body of environmental policies, a sign of progress since 2011, comprehensive and systematic approaches to skills for green jobs tend to be lacking. Some countries are still in the early phases of addressing the skills challenge and lack effective policies. Other countries either use existing policies and processes in responding to the need for skills for green jobs or have adopted specific policies, strategies and plans aimed at meeting this need. In both cases, policies and plans are often developed piecemeal at subnational and sectoral levels. In spite of significant progress in many developing countries since 2011, further efforts are still required, especially with regard to policy implementation. In some developed countries where well-developed bodies of policy exist, progress has been patchy; in some there have even been policy reversals. Insufficient or absent policy coordination and weak implementation remain common across countries, with room for improvement almost everywhere. The involvement of social partners and civil society in policy development and implementation in this area tends to reflect the general approach. There is an increasing number of examples of how social partners can improve green jobs policies, but further efforts are necessary.

3.1 Visions and strategies for greening the economy

3.1.1 The nature of policies, strategies and plans for the green transition

All countries now have sets of policies dealing with environmental sustainability and climate change, and these form overarching frameworks for consideration of capacity development, occupations and skills. Some countries already had such frameworks in place in 2011; others have put them in place more recently, or have consolidated them and/or made them more comprehensive in coverage since 2011. COP21 and the NDCs to which it gave rise provided a significant stimulus in this process, as noted in section 2.2 and discussed further in section 3.1.5.

China provides a good example of the types of policies that are often adopted (see box 3.1). It also demonstrates how such a framework of policies can then provide a platform on which more ambitious plans can be built: within this framework, a

Box 3.1 Evolution of green policies and measures since 2011: The example of China

During the period covered by the 11th Five-Year Plan (2006–10), the Chinese Government promulgated several plans, regulations and policies relating to the green transition, including the National Environmental Protection 11th Five-Year Plan, the Forestry Development 11th Five-Year and Medium- and Long-term Plan, the Energy Conservation Law, the Clean Production Audit Interim Measures and the Clean Production Promotion Law, in addition to the Renewable Energy Law issued in 2005. The two following Five-Year Plans (covering the years 2011–20) also highlight green growth and give extended coverage to green development; although not explicitly labelled as “green economy” policies, these plans play a significant role in guiding China’s green transition at the macro level. In 2014 the Amendment of Environmental Protection Law was passed, updating the law of 1989 and imposing stricter obligations and penalties on enterprises regarding pollution prevention and control, as well as potentially offering incentives to relevant industries and enterprises. In 2015, the Integrated Reform Plan for Promoting Ecological Civilization was adopted, setting out a comprehensive plan for sweeping reforms of how China uses natural resources and for the prevention of pollution. The number of instruments promulgated in this developing policy area increased from 116 in the period 2000–10 to 167 in the period 2011–15, with notable increases particularly in relation to environmental fiscal measures, green pricing and ecological compensation. China has also launched low-carbon pilot programmes in some provinces and cities, including in carbon emissions trading.

Source: *Skills for green jobs in China* (ILO, 2018).

large number of wide-ranging policy tools have been deployed to guide or adjust economic activities in mining, production and circulation or consumption processes, including environmental credit systems and fiscal policies.

Most countries have continued to take steps forward since 2011 in terms of general environmental policies. At the same time, many countries have face challenges relating to the implementation of policies and laws once enacted. Weak enforcement of environmental regulations is still an issue in some countries, especially where they may pose challenges for established industries, e.g. illegal mining in Ghana (known as “galamsey”), or where environmental pressures and lack of alternative sources of income or subsistence mean that individuals continue to carry out environmentally deleterious activities, e.g. the destruction of forest for charcoal production in Mali. Such issues undermine attempts to take steps towards the greening of economies. Lack of institutional capacity to design, adopt, evaluate and effectively implement policies and legislation responding to climate change is a critical bottleneck, particularly in developing and emerging economies.

In Brazil, an acute economic slump and rising fiscal deficit, the worst since the 1930s, has prevented further creation of green jobs above the 2011 level, and there has been a “re-primarization” of the economy, which has put the environment under renewed pressure. In addition, major public spending cuts have reduced investment in training and skills for green jobs. Changes in the Government’s political priorities in recent years in Brazil have undermined many achievements in environmental policies and related social policies put in place since the 2000s.

Policies and strategies aimed at protecting the environment often make reference to economic aspects and may, for example, establish penalties for environmentally unfriendly activities or incentives to encourage green ones. Strategies and policies dedicated specifically to the green economy typically follow on from – and thus are developed after – the enactment of this general environmental legislation, as the example from Senegal demonstrates (box 3.2). As a consequence of this systemic “lag”, green economy policies can take time to develop. In Montenegro, for example, while there is a comprehensive policy framework regarding sustainable development, policies in the area of greening the economy remain relatively modest.

Box 3.2 The relationship between development planning and the green economy: The example of Senegal

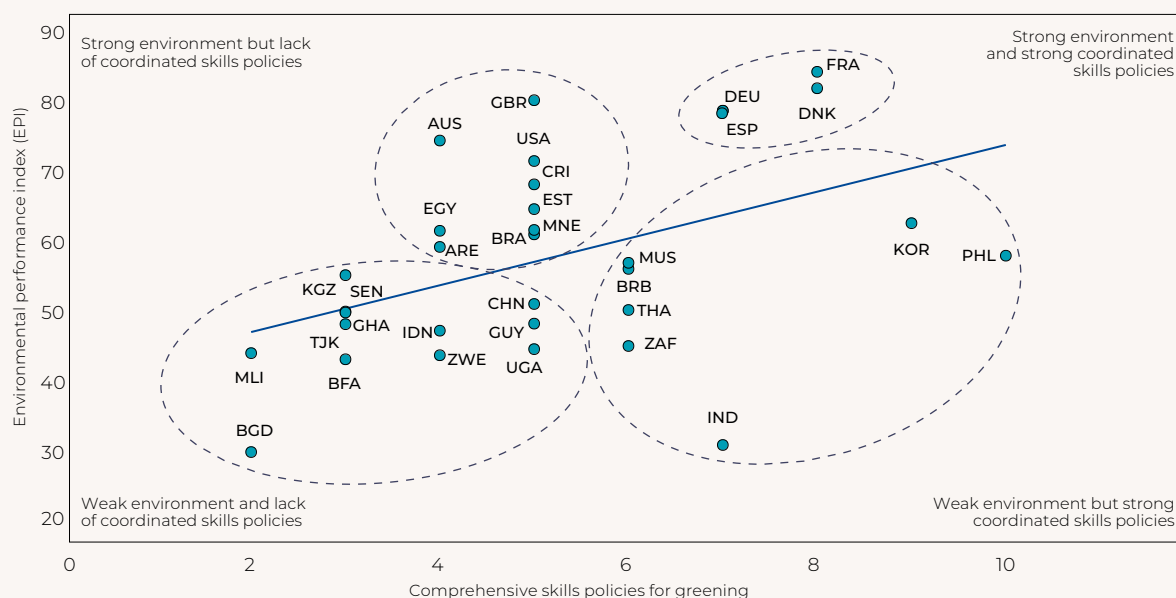
Senegal’s Plan for Emergence was adopted in 2014 and is the key national reference document on economic and social policy. It sets out a long-term vision over a period of 20 years (to 2035), a ten-year strategy that sets the course for the year 2023 and a five-year Priority Action Plan for the period 2014–18. The promotion of the green economy and the mobilization of funds for green jobs are explicitly mentioned as objectives in the field of environmental policy. As well as its National Strategy for Sustainable Development, Senegal has also endorsed its National Strategy For the Promotion of Green Jobs (2015–20).

Source: Skills for green jobs in Senegal (ILO, 2018).

3.1.2 Skills for environmental sustainability and green jobs at policy level

As noted above, all countries have sets of policies on environmental sustainability and climate change that form overarching frameworks for consideration of capacity development, occupations and skills. How these environmental policies are put into practice, and how effectively they are linked to employment and skills policies, vary widely. Correlation of the country reports with data from the Environmental Performance Index (EPI) shows that countries fall into four broad groups in respect of how they deal with skills and training for green jobs in policy terms (see figure 3.1). Only a small group of European HICs (in the upper right-hand part of the figure – Denmark, France, Germany and Spain) demonstrate both strong environmental performance and strong, comprehensive, coordinated skills policies. Another group (upper left), consisting mostly of HICs and MICs, are strong in environmental policies but weak on the skills side. A third group of MICs (lower right) demonstrate strong skills policies but weaker performance on the environmental side. Finally, a large group of mostly LICs (lower left) are still in the early stages of addressing both environment and skills in policy terms.

Among the top-performing countries, there is wide variety in how countries enhance their skills policies to support environmental sustainability and green jobs. While France is very systematic, creating specific institutions and policies in this area (see box 3.6 below), other countries often use mainstream policy-making processes and related plans and strategies, national or sectoral. This approach is quite common in developed countries (see Cedefop, 2019). Denmark provides perhaps the most extreme example of a country where existing policies, plans and processes are seen as adequate for and flexible enough to deal with the advent of green jobs, so

Figure 3.1 Countries grouped according to performance in environmental and skills policies

Notes: Y axis: the EPI uses the distance-to-target technique for indicator construction, which situates each country relative to targets for worst and best performance corresponding to scores of 0 and 100 respectively. X axis: the presence of comprehensive skills policies for greening was calculated on a 0–10 scale.

Country codes: Australia (AUS), Bangladesh (BGD), Barbados (BRB), Brazil (BRA), Burkina Faso (BFA), China (CHN), Costa Rica (CRI), Denmark (DNK), Egypt (EGY), Estonia (EST), France (FRA), Germany (DEU), Ghana (GHA), Guyana (GUY), India (IND), Indonesia (IDN), Republic of Korea (KOR), Kyrgyzstan (KGZ), Mali (MLI), Mauritius (MUS), Montenegro (MNE), the Philippines (PHL), Senegal (SEN), South Africa (ZAF), Spain (ESP), Tajikistan (TJK), Thailand (THA), Uganda (UGA), the United Arab Emirates (ARE), the United Kingdom (GBR), the United States (USA) and Zimbabwe (ZWE).

Source: Authors' calculations based on Wendling et al., 2018, qualitative analysis of country reports and an expert survey.

that, for example, new skills can be easily incorporated into existing occupational training programmes and curricula; no specific national measures related to skills for green jobs are therefore regarded as necessary.

A number of countries have developed national policy measures and plans on skills and training for green jobs. This approach appears to be increasingly common in developing economies (e.g. Guyana, India, the Philippines, Senegal and Uganda), perhaps because (as noted in Chapter 2) they are more directly and severely affected by climate change and environmental degradation than developed countries, and also because they often lack effective mainstream mechanisms for national policy formation and implementation, and see opportunities to add a green dimension to development processes that are already under way. The Philippines provides a unique example of the simultaneous creation of policy and legal frameworks for green jobs and related human resource development planning, as described in box 3.3.

In spite of the progress made by most developing countries since 2011 (see further below), skills for green jobs remain a significant gap in the national policy landscape. This is a particular issue for many LICs (e.g. Bangladesh, Mali, Tajikistan). In Zimbabwe, substantial policy directives have been issued on the inclusion of climate change in education; however actual implementation is still very fragmented, with very few technical and vocational education and training (TVET) courses being offered.

Box 3.3 Providing a legal framework for skills and training for green jobs: The Philippines Green Jobs Act and National Green Jobs Human Resource Development Plan

Enacted in 2016, the Philippines Green Jobs Act is the first piece of legislation in the country's history specifically designed to generate, sustain and incentivize "green jobs" in order to develop an environmentally friendly economy. Prior to the Act, there was no legal concept relating to green jobs. The Act explicitly defines what is meant by green jobs and consolidates various policy ideas. It promotes training for green jobs by mandating the Department of Education and the Commission on Higher Education to develop and implement curricula that would support the skills and knowledge requirements of a green economy. It tasks the Technical Education and Skills Development Authority (TESDA) and the Professional Regulation Commission with developing training regulations and qualifications frameworks, respectively, to facilitate the certification of skilled and professional green personnel. It mandates various government offices, including the Department of Labour and Employment, the Department of Trade and Industry and the Department of Tourism, to promote green jobs in their respective sectors. The Green Jobs Act also introduces a range of new financial incentives to encourage enterprises to create further green jobs and training. Furthermore, under the Act, the Department of Labour and Employment has been tasked with formulating a National Green Jobs Human Resource Development (HRD) Plan in coordination with other government agencies. The Plan, which is currently under development, will integrate the international Just Transition framework and include measures on education and skills development, labour market interventions, social protection, enterprise development, social dialogue, policy coherence and financing.

Source: *Skills for green jobs in Philippines* (ILO, 2018).

Many UMICs and HICs demonstrate fairly good environmental performance and related policies, but either fail to couple them with effective training and other social policies (Australia, UK, US) or choose not to do, relying on the market to solve supply–demand inconsistencies. Montenegro, for instance, has adopted the general approach within its vocational educational system of incorporating skills for green jobs into all skills development programmes as a cross-cutting issue; while this raises awareness of climate change and sustainable development, concrete skills for concrete green jobs are developed only sporadically. The country lacks any specific policies or programmes on skills for green jobs.

3.1.3 Policy action at sectoral, regional and project levels

Whichever of the broad scenarios outlined above applies, policies and plans on skills for green jobs are often incorporated into existing policy-making processes and plans that take a sectoral, regional or project-based approach. Economic and employment policies frequently have a sectoral or regional dimension which provides a convenient vehicle for the inclusion of a green aspect. Incorporating skills for green jobs at sectoral, regional and project levels can be part of national policy or undertaken autonomously in response to sectoral/regional/local needs, or a combination of the two. Sometimes action at this level in effect fills policy gaps at national level.

An example of sectoral action as part of a national approach is provided by the Philippines, which in 2016 adopted its “greening of industry road maps” to integrate green economic development into its industry sector policies. An example of action at subnational level is provided by the Republic of Korea where, in the context of national green policies, 16 local government bodies have established their own regional green growth plans and created regional green growth committees (see box 3.6 below). In the United Arab Emirates, where a federal government structure operates, regional-level approaches for greening are being introduced independently within the emirates, with Dubai in the forefront followed by Abu Dhabi. Further examples of action at subnational level are provided by Australia and the United States; in both of these countries gaps in national policy are being filled at state level, the national lead on green issues having faltered. In Australia, some state governments (Queensland, South Australia, Victoria) have taken steps to adopt their own emissions reduction targets, and several city councils have adopted strategies to manage emissions. An example of a state-level intervention in the United States is shown in box 3.4.

In some countries, most frequently LMICs and LICs, projects and programmes funded by state or international institutions play a key role. In Montenegro, most development of skills for green jobs is carried out within projects supported by international organizations; and in Bangladesh, international development aid drives skills training for green jobs.

Where comprehensive and systematic national policies on skills for green jobs are lacking (which means in most countries), the overall picture is one of scattered, ad

Box 3.4 State-level action in the US: The example of California

In the United States, action at state level has been an important driver of clean energy policy, and is likely to become more important as federal policy for clean energy and climate change response is scaled back. The state of California has long been a leader in environmental policy and in the creation of employment opportunities in the clean energy economy. The state has ambitious climate and energy goals, including a renewable electricity standard requiring 33 per cent of electricity consumed in 2020 to come from wind, solar and geothermal energy sources, and the Million Solar Roofs Initiative, requiring the installation of solar panels on 1 million roofs in the state.

The California Clean Energy Jobs Act, known as Proposition 39 or “Prop 39”, passed in 2013, channelled funds into the Clean Energy Job Creation Fund for five years,^a resulting in about US\$550 million annually for investment in energy efficiency and renewable energy. Proposition 39 created a significant source of demand for the construction industry, and, to ensure the creation of high-quality jobs, tied grants to the hiring of graduates of three- to five-year state-certified apprenticeship programmes funded by employers and workers. One important factor in determining job quality is the inclusion of labour unions or worker associations in designing legislation and collaborating on implementation strategies. Pre-apprenticeship programmes using standards set by the US Department of Labor are also specified in the legislation. Proposition 39 further recognizes that many school janitors and other maintenance workers need only incremental training in order to be qualified to maintain and use more efficient energy systems.

^a Parts of the programme are continuing up to mid-2020.

Source: *Skills for green jobs in the United States* (ILO, forthcoming 2019).

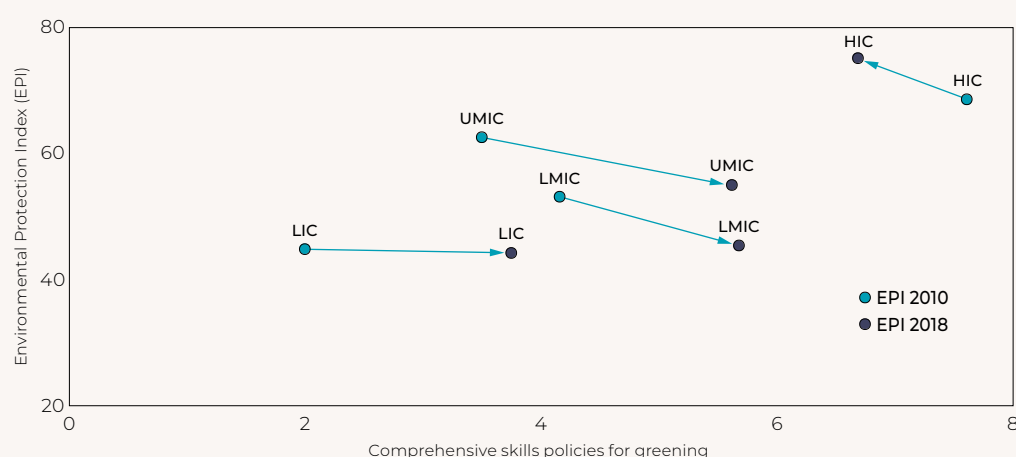
hoc consideration of green occupations and the associated training needs. The main causes for the deficiencies in national policies are lack of coordination at governmental level (see section 3.2 Policy coordination”) and lack of labour market data and capacity (technical and financial) owing to the underdevelopment of skills anticipation systems (see subsection Erreur ! Source du renvoi introuvable.”).

3.1.4 Developments since 2011

As noted above, since 2011 countries have generally made progress in respect of green policies. Those HICs that already had comprehensive policies in place to pursue both environmental and skills agendas have earned dividends in the form of better environmental performance. At the same time, many HICs have seen policy adjustments and reversals, demonstrating the fragility and non-linearity of policy development and implementation, and have lost ground in respect of comprehensive skills policies. In LICs and MICs, on the other hand, although environmental performance has further deteriorated, owing to the persistence of resource-based economic growth and in spite of the environmental policy and regulation efforts many of them have made, there has been progress towards comprehensive skills policies for the green transition – partly in recognition of the need to improve environmental performance and partly in acknowledgement that human capital is a main driver of economic progress and well-being (see figure 3.2).

In the previous report (Strietska-Illina et al., 2011, pp. 32–41, 57), it was noted that green policy and regulation were particularly poorly developed in three LICs, namely Bangladesh, Mali and Uganda. At that point, these countries did not have well-developed policies for either environmental protection or skills development for a greener economy. All three countries have since demonstrated significant progress.

Figure 3.2 Countries' progress in environmental and comprehensive skills policies, by income level, 2010 and 2018



Notes: HIC: high-income countries; LIC: low-income countries; LMIC: low-middle-income countries; UMIC: upper-middle-income countries (based on World Bank typology). Y axis: the EPI uses the distance-to-target technique for indicator construction, which situates each country relative to targets for worst and best performance corresponding to scores of 0 and 100, respectively. X axis: the presence of comprehensive skills policies for greening was calculated on a 0–10 scale.

Source: Wendling et al., 2018; Emerson et al., 2010; qualitative analysis of country reports and an expert survey (2010 and 2018 rounds).

Uganda has taken most steps in relation to policies on the green economy (details of the progress made are provided in Annex 8). However, in all three cases, policies most closely related to the green economy have been adopted only relatively recently, and a question mark still remains over actual implementation. Bangladesh and Mali continue to lack national strategies on skills and training for the green economy.

It was also reported in 2011 that China and South Africa, while having internally sound and comprehensive environmental policies, were deficient in respect of skills development policies for a greener economy. Although the green economy features more strongly in current policy, the situation with respect to skills has developed only moderately.

Some developing countries have shown notable progress since 2011 in strengthening their policy base. The Philippines, for example, passed laws and strategies for organic agriculture and ecotourism in 2010 and 2013 respectively, and in 2016 took the broader step of launching “greening of industry roadmaps” and enacting the Green Jobs Act, under which a Green Jobs Human Resource Development Plan is currently being developed (see box 3.3 above). India, too, has enhanced its policy framework: since 2010 it has encouraged privately owned small businesses with a focus on green initiatives, and in 2015 launched the national Skill Council for Green Jobs.

All those countries that had well-developed policy frameworks in 2011 were economically advanced HICs. France remains at the forefront in policy terms, with a sound framework of environmental policies coupled to comprehensive skills policies for greening including coverage of sectors such as agriculture that are overlooked in some other developed countries. However, progress since 2011 in a number of the countries with well-developed policy frameworks in 2011 (Australia, Republic of Korea, the United Kingdom and the United States) has varied, with changes or reversals in some policies. In Australia, climate policy at national level has experienced what the country report calls “bitter and seemingly intractable debates” dating back to 2009, resulting in a loss of policy clarity and certitude to the detriment of investment in renewables and new energy generation capacity. This is reflected in a decline in employment in the renewable energy industry from 13,000 in the financial year 2014/15 to 11,150 the following year, a drop attributed to “policy confusion”. In the Republic of Korea, a government focus on green growth and related progress since 2011, most notably within the framework of the Green New Deal introduced in 2009, was replaced in 2013 with a focus on the creative economy and a switch of priority towards market-driven green technology convergence. In the United Kingdom, a number of green subsidies have been withdrawn since 2011, along with plans to make all new homes carbon neutral, with negative effects on the industries concerned, e.g. domestic solar energy generation. In the United States, the decision to withdraw from the Paris Agreement is expected to have knock-on effects on green industry and jobs.

On the positive side, in all these countries action at subnational government levels (states, regions and local municipalities such as Seoul City in the Republic of Korea) has to some extent filled the gaps opened up by these political changes at national/federal levels. Nonetheless, as the Republic of Korea country report points out, the sustainability of green policies is at risk when they depend heavily on central government.

3.1.5 The role of skills development measures in nationally determined contributions

In December 2015, parties to the UNFCCC reached a ground-breaking agreement to combat climate change through accelerated action and increased investments towards a low-carbon future (see section 2.2 above). The Paris Agreement entered into force on 4 November 2016 and at the time of writing has been ratified by 185 out of 197 parties.¹⁴

Article 4, paragraph 2 of this historic agreement calls upon each country to outline and communicate the action it will take towards this end in the form of a nationally determined contribution (NDC).¹⁵ The NDCs are a planning mechanism designed to scale up the national response to climate change and its impacts through adaptation and mitigation measures in targeted economic sectors. So far, 183 States have submitted their NDCs.¹⁶

Indications of priority sectors in NDCs reflect national commitments to the implementation of the measures specified and are likely to generate skills demand in those sectors. In the analysis of NDCs for the 32 countries surveyed for this report, the energy sector was prioritized in all countries, mostly under mitigation (see figure 3.3). Agriculture was also frequently mentioned as a priority sector by both

Figure 3.3 Relative priority given to the targeted economic sectors in NDCs for 32 sample countries, by income level



Notes: HIC: high-income countries; UMIC: upper-middle-income countries; LMIC: lower-middle-income countries; LIC: low-income countries (based on World Bank typology by income level).

Source: Data computed from NDCs at the UNFCCC Registry, available at: <https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx> [accessed 25 Aug. 2019].

¹⁴ See <https://unfccc.int/process/the-paris-agreement/status-of-ratification> [accessed 25 Aug. 2019].

¹⁵ An intended NDC (INDC) is automatically transformed into an NDC when the State concerned ratifies the Paris Agreement.

¹⁶ As of 3 April 2019: see the UNFCCC's NDC Registry, available at: <https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx> [accessed 25 Aug. 2019].

Box 3.5 Training and capacity development measures under the Paris Agreement

Article 6, para. 8: “Parties recognize the importance of integrated, holistic and balanced non-market approaches being available to Parties to assist in the implementation of their nationally determined contributions, in the context of sustainable development and poverty eradication, in a coordinated and effective manner, including through, inter alia, mitigation, adaptation, finance, technology transfer and **capacity-building**, as appropriate.”

Article 11, para. 1: “**Capacity-building** under this Agreement should enhance the capacity and ability of developing country Parties, in particular countries with the least capacity, such as the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take effective climate change action, including, inter alia, to implement adaptation and mitigation actions, and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of **education, training and public awareness**, and the transparent, timely and accurate communication of information.”

Article 12: “Parties shall cooperate in taking measures, as appropriate, to enhance climate change **education, training, public awareness**, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement.”

Source: https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf [accessed 25 Aug. 2019].

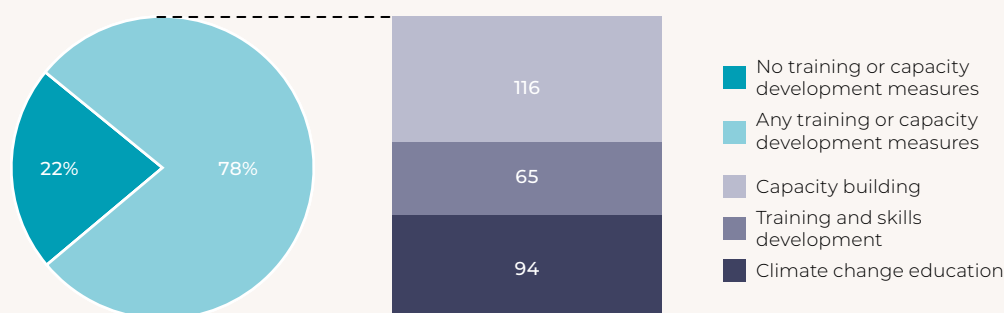
developed and developing countries, followed by industry (more often among HICs) and waste management (especially relevant for LMICs). Other key sectors targeted in NDCs were transport, tourism and fisheries.

To translate all these planned investments in targeted economic sectors into reality, relevant skills training will need to be implemented. Education and training measures are key enablers in the effective implementation of the NDCs. Capacity building and climate change education have been actively promoted as guiding principles since 1992 (article 6 of the UNFCCC) and lie at the heart of the Paris Agreement (articles 6, 11 and 12: see box 3.5).

Therefore, effectively designed NDCs need to integrate climate change literacy, skills training and capacity building at national and sectoral levels. A glance at the set of 169 NDCs available via the NDC Explorer shows that around four in five make some reference to skills interventions and training provisions; 116 NDCs mention capacity building, 65 NDCs mention training and 94 mention climate education, in contribution to either adaptation or mitigation measures or both (see figure 3.4).

The mapping of the NDCs of the 32 countries surveyed for this report showed that almost three-quarters of them included some sort of training or capacity-building measures in their NDCs as part of their national commitments to climate action and sectoral planning (figure 3.5). Capacity building is the most popular type of measure mentioned, but only a few countries make clear reference to specific sectors. Skills development and training are mentioned by 13 of the 32 countries, with clear references to skills for youth employment in Egypt, upskilling measures for

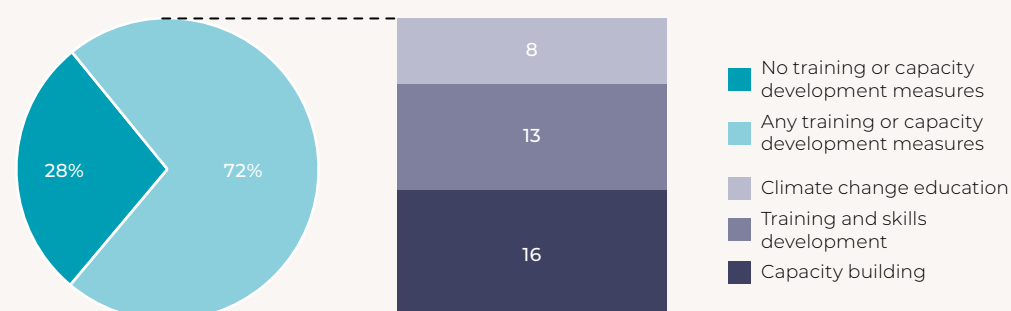
Figure 3.4 Share of available NDCs that mention capacity development and skills training, and types of measures specified



Note: 169 NDCs available in the NDC Explorer. The pie chart shows percentage shares; the bar chart shows the numbers of NDCs that contain capacity-development, education and skills training measures. The types of measures are not mutually exclusive.

Source: Data computed from NDC Explorer, Jan. 2019. Available at: <https://klimalog.die-gdi.de/ndc> [accessed 25 Aug. 2019].

Figure 3.5 Share of NDCs in the 32 countries surveyed that mention capacity development and skills training in their NDCs, and types of measures specified



Note: 32 sample countries' NDCs. The pie chart shows percentage shares; the bar chart shows the numbers of NDCs that contain capacity development, education and skills training measures. The types of measures are not mutually exclusive.

Source: Data computed from NDCs at the UNFCCC Registry, available at: <https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx> [accessed Jan. 2019]; for the UK, from Committee on Climate Change, 2016.

technology deployment in Ghana and the United Kingdom, and skills development for priority sectors in Barbados and India. Climate change education and environmental awareness-raising were highlighted by eight countries.

Only a few countries explicitly address sectoral skills needs, or mention systemic national skills policies and programmes to mainstream the greening component, in their NDCs.

3.2 Policy coordination

3.2.1 Policy coordination at national level¹⁷

Poor policy coordination – between government ministries, and also between government and other stakeholders, especially social partners – was identified in 2011 as an important constraint on effective policies on skills for green jobs. Such a lack of coordination was identified as being closely related to a country's level of development, and especially to its level of “institutional maturity and thus policy-making capacity among key players, including social partners” (Strietska-Ilina et al., 2011, p. 163). Alongside improved coherence at national level, decentralized approaches at sectoral and local levels were recognized as having the potential to achieve policy coordination and coherence “on the ground”; indeed, they might grow into “systematic and comprehensive policy development and implementation” (Strietska-Ilina et al., 2011, p. 164). Thus, a combination of top-down coordinated policy-making and bottom-up initiatives could provide effective and more sustainable support to the green transition.

At governmental level, responsibility for the areas of policy relevant to skills for green jobs is still distributed across more than one ministry in all countries covered. While ministries responsible for environmental policy have charge of policies on topics such as climate change, disaster management and biodiversity, a wide range of other ministries may be concerned with the issue of the green transition, such as those responsible for the economy, employment/labour, agriculture, energy, industry and trade. Ministries responsible for education and training tend to be least involved. This type of situation can result in outcomes such as those in Indonesia, where regulations for the roles of energy manager and energy auditor have been put in place by the Ministry of Energy and Mineral Resources, but there are no regulations for any other green jobs or the development of skills for green jobs. A comprehensive approach also needs to involve ministries responsible for education and training.

In almost every country, there continues to be room to improve coordination, as in 2011. Certainly, there are many instances of cooperation and collaboration between ministries with environmental portfolios on the one hand and ministries with economic, industrial or employment/labour market portfolios on the other. These may be centred on the production of research investigations, policies or strategies related to the greening of the economy. For example, in the United Kingdom the 2011 policy paper entitled *Enabling the transition to a green economy* involved three ministries covering, respectively, business, innovation and skills; energy and climate change; and the environment, food and rural affairs. In Barbados, while there is no formal arrangement for coordination between the Ministry of Labour, the Ministry of Environment (Division of Energy), the Ministry of Agriculture and the Ministry of Education to identify, develop and administer the requisite training programmes, the ministries work “hand in hand” at the operational level, their respective technical officers working together to integrate sustainability and green economy concepts into all the programmes being developed and implemented.

There are, however, also many examples of lack of coordination. For example, in Senegal a national strategy on green jobs (in this case implemented by the ministry

¹⁷ It should be noted that in some countries the main responsibility for green policies may lie at subnational, e.g. regional, level.

in charge of the environment) coexists with a national employment policy (implemented by the ministry in charge of employment): while steps are being taken to integrate the green jobs strategy into the new national employment policy, prior coordination would have helped to integrate the two policies better. In other countries, national strategies for the development of education and training do not specifically address the development of skills for green jobs. In China, a joint conference mechanism involving various ministries has been set up to discuss the policies and measures relevant to skills development for jobs, but there is still no inter-ministerial coordination mechanism on provision for skills for green jobs.

Policy coordination also involves stakeholders outside government; this involvement varies across countries, reflecting, in part, the nature of different countries' general mechanisms for the involvement of social partners and other groups in policy formation and implementation. Thus, for example, in the United States and the United Kingdom social dialogue mechanisms have historically been weak, whereas Germany and France have long traditions of organized involvement of employers and trade unions in policy-making. In LICs social partner organizations are generally underdeveloped, partly because the informal economy often accounts for a significant share of employment, and partly because existing mechanisms are poorly developed.

While national coordination bodies related to skills for green jobs are rare, they have become more numerous since the 2011 report, as shown in box 3.6.

Where institutional mechanisms for inter-ministerial coordination of policies are in place, coherence between environmental and skills policies is stronger (see figure 3.6.). In general, however, coordination tends to occur for specific purposes, often at specific junctures, rather than systematically, and without adequate monitoring and evaluation, raising questions about the degree to which skills for green jobs are integrated into policy cycles. Continuous processes for systematic policy coordination across government ministries are rare. Why might this be? In part, this deficiency is related to the general challenge that large organizations face in coordinating different units, departments or sections with different functions and sometimes overlapping responsibilities. But there is also evidence to suggest that economic greening and skills for green jobs have not been adequately integrated into the mainstream portfolios of relevant ministries covering the economy, the labour market, and education and training. In Bangladesh, the National Skills Development Policy does not deal with skills for green jobs. Lack of coordination is also exacerbated by the division of responsibility for TVET between two ministries: this is a global problem, but to take just one example, in Tajikistan the responsibility is split between the Ministry for Education and Science and the Ministry for Labour. Some countries (e.g. Bangladesh and Indonesia) also suffer from poor TVET infrastructure and qualifications systems, making them poorly prepared to deal with the challenge of adjusting training provision to the greening of the economy.

Another likely reason for poor coordination is the underdeveloped nature of skills anticipation mechanisms in most countries (see subsection 7.2.1 below), so that countries are ill-equipped to make systematic estimates of the supply of and demand for labour in general, still less that related particularly to green jobs. In short, there are general underlying institutional weaknesses in a number of areas that provide poor foundations on which to try to ensure coordination on skills for green jobs.

Box 3.6 Examples of national coordination bodies related to skills for green jobs

France

France was in the forefront of policy coordination, implementing the Grenelle de l'environnement (environment round table) in 2007 and linking the public sector with civil society and social partners at national, sectoral and local levels. In 2012, a new principle of a national climate conference to be held annually was introduced to re-ignite enthusiasm for the multi-level governance process introduced by the Grenelle, which had begun to run out of steam. These conferences bring together the five partners that met within the framework of the Grenelle (a process called "governance of the five"). These developments were anchored in the preparations for COP21, which took place in Paris in 2015. Alongside these developments, the National Observatory for Jobs and Occupations of the Green Economy (Onemev) was created in 2010 by the Ministry of Environment to analyse employment shifts in the green economy and produce relevant methodologies and statistics. It brings together a broad range of institutions including relevant national ministries and agencies, key public employment service organizations, the main TVET association, the national statistical institute, research bodies (including the Centre for Studies and Research on Employment and Skills), and regional employment and training observatories.

India

The Skill Council for Green Jobs, established in 2015 by the Government of India under the National Skill Development Mission and promoted by the Ministry of New and Renewable Energy and the Confederation of Indian Industry, directly runs the country's green skills development programmes. Its objective is to identify skills needs within the green business sector and to implement nationwide, industry-led, collaborative skills development and entrepreneur development initiatives. Its governing council includes representatives of government ministries and employer bodies as well as individual employers.

Republic of Korea

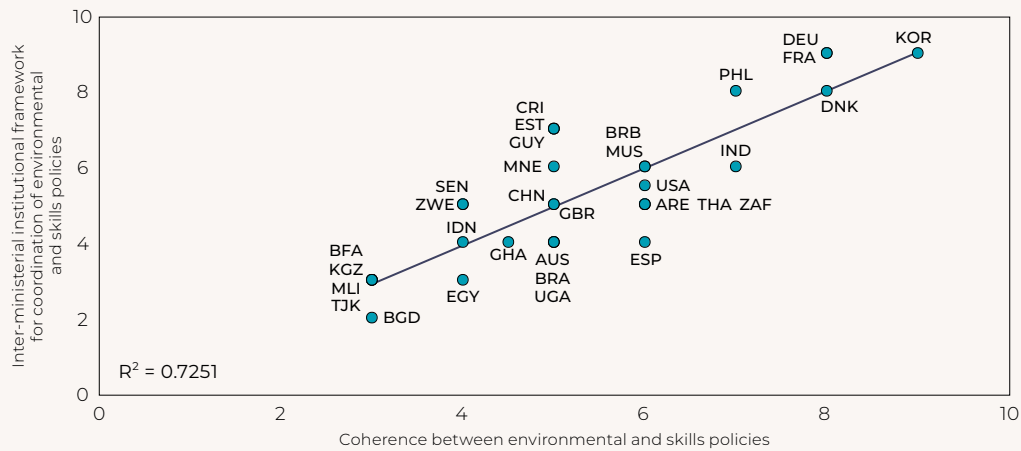
The Green Growth Committee was set up in 2009, its 47 members comprising 29 business and social leaders and 18 public servants and chiefs of government-funded think-tanks. Since 2015, it has operated under the auspices of the Prime Minister's Office. It has responsibility for establishing a five-year green growth plan and coordinating and supporting policies for low-carbon green growth, including those relating to skills development developed by various ministries (for the environment, trade, industry, energy, science and technology, employment and labour as well as education). Some 16 local government bodies have also established their own regional green growth plans and created regional green growth committees.

Philippines

The Technical Education and Skills Development Authority (TESDA) is the government agency tasked with managing and supervising TVET and skills development. TESDA's board members are drawn from a number of government ministries and social partner organizations. TESDA's activities to date include setting up a Green Technology Centre, starting the process of greening training regulations, and orienting TESDA regional offices on greening TVET. Most recently, TESDA has developed a framework for greening the TVET system which has been institutionalized through a policy launch.

Sources: *Skills for green jobs: 2018 update*, France (Cedefop, 2019); *Skills for green jobs in India* (ILO, 2018); *Skills for green jobs in Republic of Korea* (ILO, 2018); *Skills for green jobs in Philippines* (ILO, 2018).

Figure 3.6 Inter-ministerial coordination and coherence between skills and environment policies



Notes: R^2 values: the closer the value to 1, the stronger the positive linear correlation between variables. Inter-ministerial coordination refers to coordination of policies and their implementation across different ministries (e.g. labour, energy, education, environment, social protection, gender etc.) and other governmental agencies. Institutional frameworks, such as inter-ministerial committees, support such coordination. Broad criteria of coherence between skills and environmental policies were provided in Strietska-Ilina et al., 2011: coordination, responsiveness to industry and workers' needs, good coverage and complementarity, and active use of social partners in the decision-making process; also, policies should be well-informed by research and labour market information and clearly linked to actions, including financing, monitoring and evaluation mechanisms.

Sources: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

Interestingly, the lack of policy coordination over skills for green jobs contrasts with structures and processes put in place in many countries to work towards the SDGs or deal with issues such as disaster management. These topics are inherently inter-disciplinary, and the imperatives attached to disaster response have an immediacy about them that makes coordinated preparations indispensable if serious short-term repercussions are to be avoided. Many countries have accordingly introduced coordination mechanisms – often quite elaborate ones – around these issues to take into account various relevant concerns and organizations. These include, for example, joint commissions in Costa Rica covering agriculture and forestry, transportation and energy, which will coordinate the inter-sectoral implementation agendas under the National Climate Change Strategy.

Nonetheless, even in the case of the SDGs consideration of skills for green jobs is suboptimal, probably for the same reasons discussed above. For instance, in Indonesia, while the vice-president and ministers of the economy, human development, maritime affairs, and security are all involved in coordinating, monitoring and evaluating SDG implementation, the Ministry of Manpower, among others, is involved only under the direction of the coordinating ministries. Furthermore, it is still not clear how Indonesia will respond to the SDGs in terms of green jobs and skills. In some countries, therefore, the SDGs may represent a missed opportunity to improve policy coordination for skills for green jobs. If an adequate coordination mechanism is not created for the implementation of NDCs, these may turn out to be another missed opportunity.

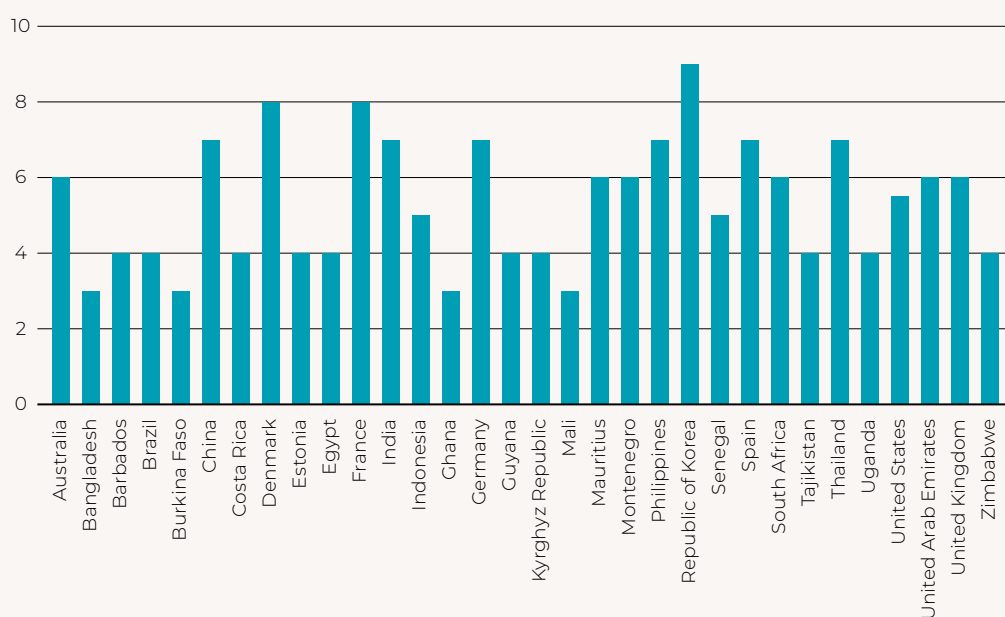
3.2.2 Policy coordination at sectoral and subnational levels

The policy coordination “gap” that is such a common feature at national level of the skills for green jobs landscape is sometimes offset, at least in part, by policies and plans at sectoral or subnational governmental levels. Sectoral plans to nurture skills for green jobs are most common in those sectors most directly affected by climate change and environmental depletion, and hence where government taxes and incentives loom largest (such as energy, transport, construction and waste management). The use of available sectoral approaches and institutions will therefore be essential in planning the implementation of NDCs and related skills development. Many countries, both developed and developing, have established sectoral approaches to skills identification and development with respect to the green agenda that either compensate for or complement policies at national level (figure 3.7).

Sectoral policies can be part of an explicit national policy to eschew national coordination in favour of “letting the market decide”, as in the United Kingdom. In South Africa, where there is still a lack of national policy coordination, a National Environmental Skills Development Planning Forum has been set up, as described in box 3.7.

Planning and coordination at subnational levels can also help fill the gap in national coordination. While the subnational level is not always relevant for policy coordination, some countries, especially larger ones and those with a federal governance structure, find it more efficient as a locus of policy coordination. This is the case in Australia, China, the United Arab Emirates, the United Kingdom and the United States (see figure 3.8).

Figure 3.7 The extent to which climate change, environmental issues and related training needs are present and/or considered in sectoral skills development policies (on a scale of 1–10)



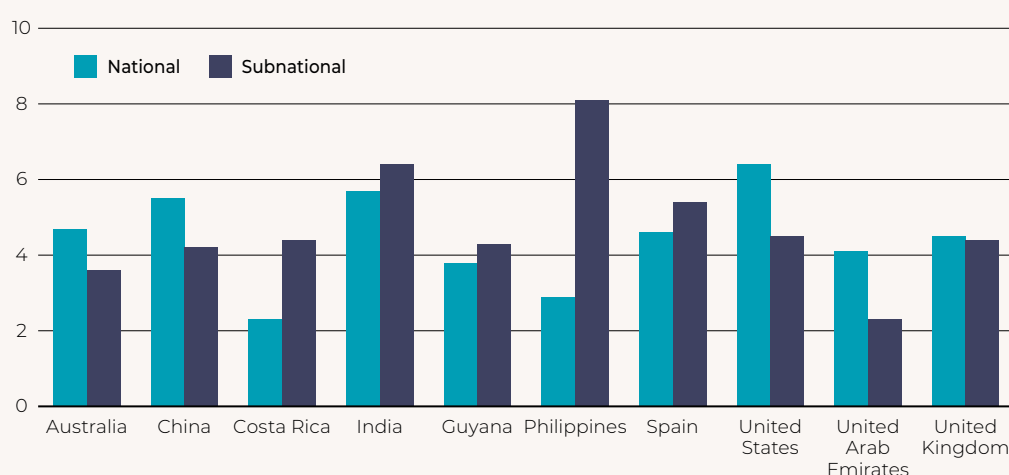
Sources: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

Box 3.7 Developing coordination in the environment sector in South Africa

The National Environmental Skills Development Planning Forum was first convened by the Department of Environmental Affairs in 2010 to provide a skills-focused professional body for the environmental sector in response to skills development needs identified during the development of the Environmental Sector Skills Plan (2010). Since that date, the Forum has played an important role in changing the green skills development landscape, engaging with stakeholders from government agencies and partner institutions, and encouraging a dialogue between them around the development of green skills. By advising and assisting the Department of Environmental Affairs Sector Education, Training and Development Unit, the Forum has acted as a catalyst for the identification and addressing of gaps in rolling out the Environmental Sector Skills Plan.

Source: *Skills for green jobs in South Africa* (ILO, 2018).

Figure 3.8 Coordination between environmental and skills policies at national and subnational levels (on a scale of 1–10)



Note: The first bar for each country, over the country name, corresponds to national level.

Sources: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

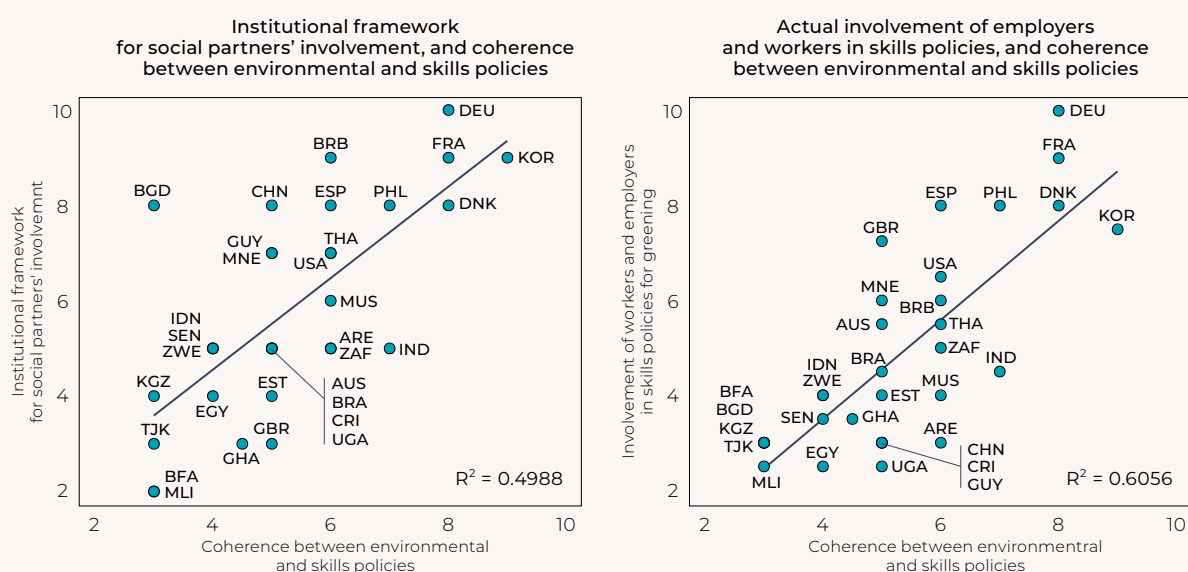
In the United States, for example, some progress has been made in improving coordination regarding education and training for new and emerging occupations and upskilling through the establishment of workforce development boards at state level and community workforce agreements (see subsection 3.2.3 and box 3.8 below). These initiatives aim to systematize and coordinate the provision of training and education, and to align them with the needs of green economy employers. Actions at state and regional levels have also been important in Australia to counterbalance the changes in policy at federal level, as noted in subsection 3.1.3 Policy action at sectoral, regional and project .

3.2.3 Involvement of social partners and other stakeholders in policy-making

As noted above, the involvement of social partners in policies for green jobs and skills is shaped in part by the general position of social partners in each country. The presence of institutional platforms for social partners' involvement increases coherence between environmental and skills policies, facilitating exchange of ideas and information between government and the private sector, and supporting relevant planning (see figure 3.9). In India, industry-led sector skills councils are responsible for the development of national occupational standards and qualification packs for various jobs specified within the National Skills Qualifications Framework. These councils are to be strengthened by making them more representative, expanding their outreach and increasing their efficiency. In the Philippines, despite the lack of any reference to the role of social partners in the Green Jobs Act, the process of its implementation, led by the Government, ensures that tripartite partners play an active role throughout and that social dialogue is thereby strengthened.

However, even where general social dialogue mechanisms exist, they are not necessarily part of green jobs policy development. For example, in Bangladesh there is no role for the Tripartite Consultative Council or social dialogue in skills development for the green economy. Also, there is a gap between the existence of institutional frameworks for social partners' involvement and their actual involvement on questions related to skills for environmental sustainability. It is the actual involvement of employers and workers in the formulation and implementation of policy that is strongly correlated with policy coherence (see figure 3.9).

Figure 3.9 Institutional frameworks for social partners' involvement in policy-making, actual involvement, and coherence between environmental and skills policies (on a scale of 1–10)



Note: R² values: the closer the value to 1, the stronger the positive linear correlation between variables.

Sources: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

Where social partner engagement is weak, this can have negative consequences for skills for green jobs. In the United States, the stimulus package introduced in 2009 after the financial crisis included nearly US\$100 billion for clean energy, of which a portion was set aside for training programmes. However, while many people were trained for green jobs, for instance as solar panel installers, many were unable to find employment in green jobs because of insufficient labour demand. An important cause of this imbalance was a lack of coordination between workforce development providers and employers. In contrast, community workforce agreements, first introduced in 2010, have begun to flourish as a way for both labour unions and employers to coordinate with skills and education providers to ensure that decent jobs exist in greening sectors, as shown in box 3.8.

Box 3.8 Using collaboration to ensure decent jobs in the green economy

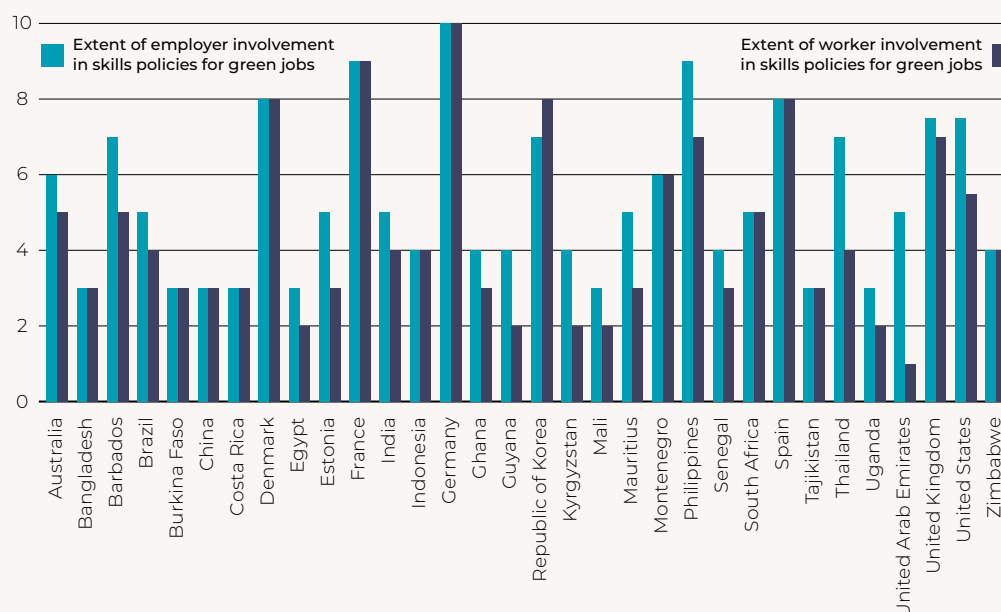
United States

Community workforce agreements (CWAs) bring together labour unions, trades councils and employers, and sometimes also local government officials, to ensure both job access and job quality. So far they have been used successfully in the construction industry. A CWA is a legally binding agreement between labour and management, and can include private and/or public entities. To ensure the creation of decent jobs and career pathways, worker recruitment goals include the following stipulations: a designated percentage of total work hours to be performed by members of the targeted workforce; a designated percentage of total hours to be performed by apprentices; a set percentage of first-year apprentices and/or of total apprentices to come from the targeted hiring category. Community needs are represented in these agreements, and therefore CWAs have been effective at including populations who are traditionally unrepresented or under-represented in labour-management negotiations or policy decision-making. CWAs have been implemented in, among other places, Cleveland, Los Angeles, New York, Oakland and San Francisco.

China

In China, social partners do not have a prominent role in policy-making and social dialogue is rarely used in relation to green skills provision. However, in recent years China's policies to cap coal consumption have been leading to the laying off of many thousands of workers and the opening up of new employment opportunities in the renewable energy, clean energy and energy efficiency industries. Significantly, most newly created jobs are decent jobs requiring higher technical skills and with better working environments. With the goal of resettling laid-off workers, local government, firms and employers' representatives are negotiating job placement arrangements. The provision of training in new skills for some laid-off workers is one of the options in such negotiations. Though not explicitly social dialogue, these negotiations could help some workers to ask employers for green skills retraining. The Government has already launched a series of proactive employment policies on relocating redundant workers.

Source: *Skills for green jobs in the United States* (ILO, forthcoming 2019); *Skills for green jobs in China* (ILO, 2018).

Figure 3.10 Involvement of employers and workers in skills policies for green jobs (on a scale of 1–10)

Source: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

Trade unions have an important role to play in respect of helping to ensure that green jobs constitute high-quality, decent employment through their participation in designing legislation and collaborating on implementation strategies. However, in many countries at all income levels the role of unions is not adequate, and often they are involved to a lesser degree than employers (figure 3.10). At the same time, the countries performing best in coordination of skills and environmental policies demonstrate high and equal involvement of employers and workers.

Good practices in involving trade unions in skills policies for greening are nevertheless evident in many countries, including those where they play a less prominent role than employers. These good practices need to be spread more widely. In the United States, the California Energy Agency collaborates with a number of organizations in implementing Proposition 39 (see box 3.4 above): the state Department of Education, community colleges, the Chancellor's Office, the Conservation Corps, the Public Utilities Commission, the Workforce Development Board, the Department of Industrial Relations and the Division of the State Architect in the Department of General Services. In the United Kingdom there has been a notable rise in trade union activity in relation to green skills. The educational arm of the Trades Union Congress, unionlearn, has worked with many different stakeholders through its green economy agenda, using dissemination and awareness-raising activities, partnerships and policy advocacy, and has set up green skills partnerships. The University and College Union has formed the Greener Jobs Alliance, which builds trade union activities in localities and regions, and also has an input into curricula in schools and in further (post-16) and higher education. In the Philippines, social dialogue takes the form of stakeholder consultations conducted in crafting legislation and policy, and in development planning. On the one hand, in drawing up the "greening of industry roadmaps"

the relevant government ministry consulted industry associations and representatives, but workers' representatives were not prominent in the consultations. On the other hand, the Department of Labour and Employment has institutionalized consultations with employers and workers in its policy-making processes, such as the tripartite industry peace councils.

Beyond employers and trade unions, a range of other stakeholders are involved in activities related to the development of skills for green jobs but not necessarily integrated into policy-making. These include non-governmental organizations (NGOs) involved in relevant projects, typically funded in LICs by foreign aid organizations. Indeed, such NGOs have been identified as leading skills training for green jobs in some countries, e.g. Bangladesh. In Australia, it has been found that the existing focus on traditional social partners may need to be expanded to include a range of other civil society actors, including environmental and social justice groups, which have played an important role in sustaining the profile of issues of climate change abatement and decent work in national debate. Green-oriented not-for-profit organizations are also becoming more common. The Green Building Council of Mauritius brings together community leaders, professionals, businesses and innovators to promote a sustainable approach to the planning, design, construction and use of the built environment. It is a member of the World Green Building Council and of the rapidly growing African network of green building councils.

3.3 Policy coherence, governance and selected indicators

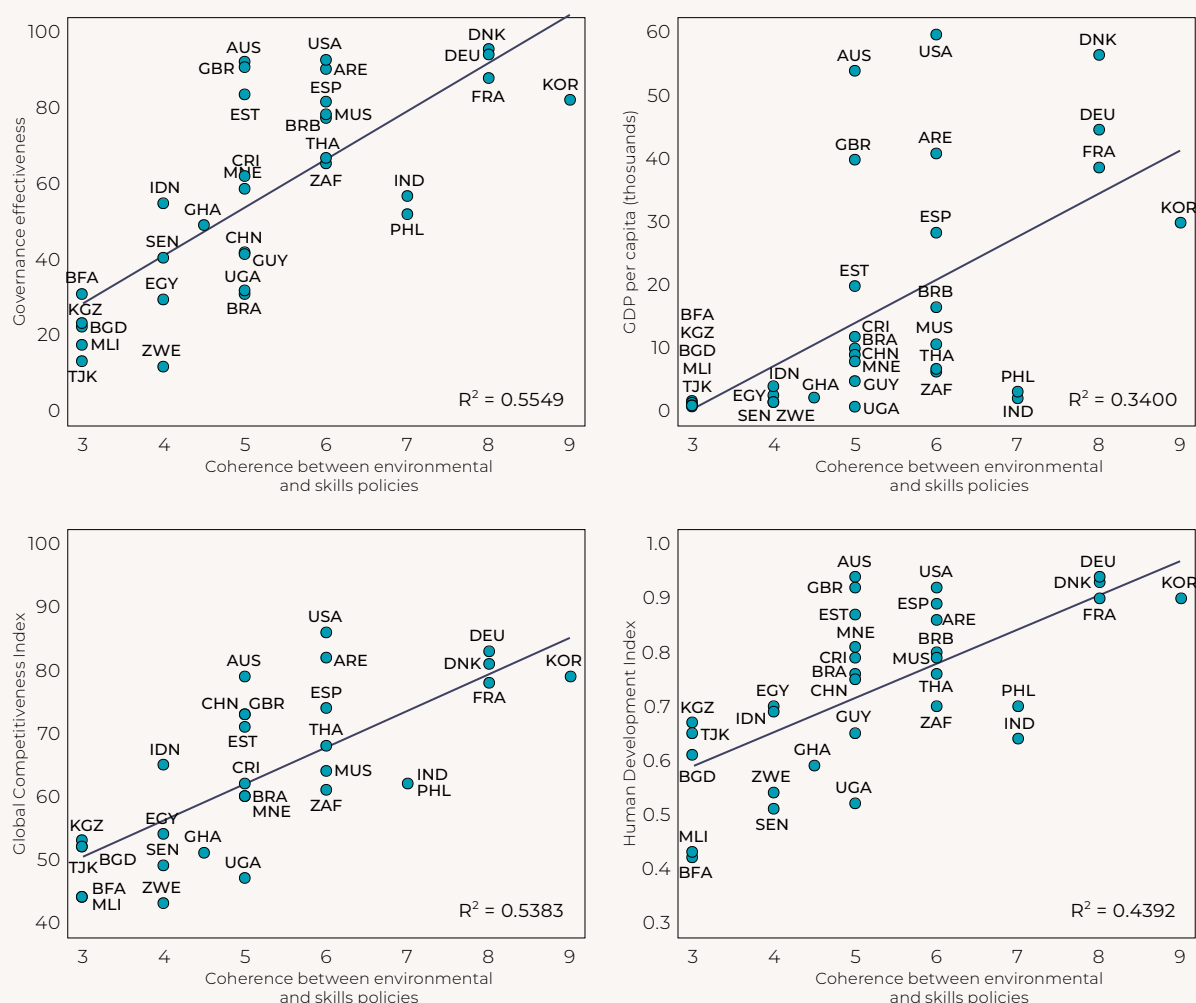
The previous section looked at the extent to which countries are including skills development issues in their environment policy planning and implementation.¹⁸ The countries that are doing this most successfully are indicated in the top right-hand quadrant of figure 3.1 above. The relative ease with which countries build such policy coherence may be affected by maturity of governance, income level, productivity and competitiveness, the environmental context and other developmental factors.

This section looks for associations between policy coherence and a number of indicators (see Annex 3) and, with the help of regression analysis, attempts to provide additional insights into the question of what factors contribute to strong coordination mechanisms and policies. Policy coherence between skills and environmental policies (captured on a scale of 0–10) was correlated with a governance effectiveness index, gross domestic product (GDP) per capita, the Global Competitiveness Index (GCI) and the Human Development Index (HDI) (figure 3.11).

Establishing a statistical correlation between policy coherence and these indicators does not, of course, of itself establish causality. However, the strength of the correlation between governance effectiveness and policy coherence does indicate a degree of causality. Governance effectiveness is one of the six aggregated indicators of the broad global Worldwide Governance Indicators. It captures the quality of public services, civil services and public institutions, as well as the quality of policy formulation and implementation, and the credibility of the Government's commitment to such policies. As indicated in section 3.2, sound governance is a one

18. This section builds on the analysis of 2011 (Strietska-Ilina et al., 2011), using several of the same indicators.

Figure 3.11 Coherence between environmental and skills policies (on a scale of 1–10), correlated with selected indicators



Note: R^2 values: the closer the value to 1, the stronger the positive linear correlation between variables. All computed values are significantly different from zero, where zero means no correlation. GCI data for Barbados and Guyana are not available.

Source: Authors' analysis and relevant country indicators (see Annex 3).

of key enabling factor for effective coordination between policies but not a sufficient one: some countries, such as Australia, Estonia, the United Kingdom and the United States, have strong governance systems but not strong coherence between skills and environment policies.

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 3.1. Interestingly, the correlation of policy coherence with HDI ranking is somewhat stronger than that with GDP per capita. The HDI, in addition to including an indicator of per capita income, also includes indicators on education and health, and thus offers some indication not only of economic but also of social development.

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

Broadly, the trends continue from those identified in the 2011 report (Strietska-Illina et al., 2011, pp. 42–4). 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. Policy coherence is therefore essentially a developmental issue, requiring institutional and capacity development measures and investments, including support through international development cooperation.

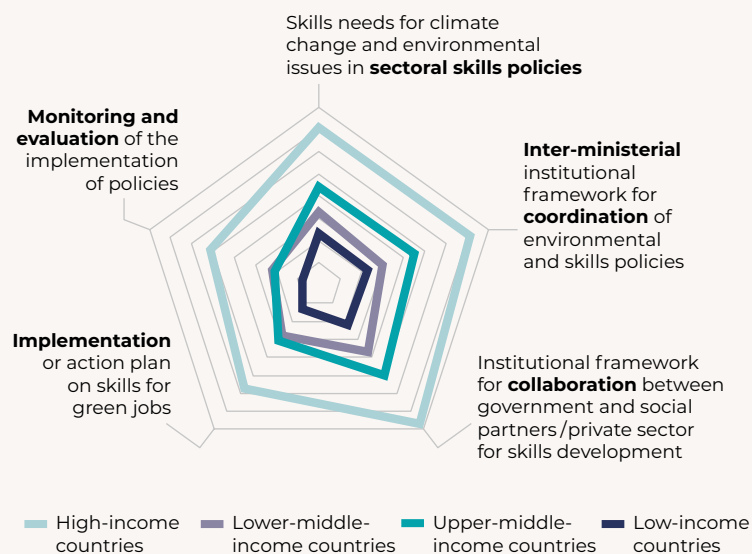
3.4 Conclusions

Countries have made progress, since 2011, in developing bodies of laws, regulations, strategies and plans covering environmental issues; but the pace at which these have been translated into economic and/or employment policies and thence into skill and training policies has varied. Some countries are still only beginning to address issues related to skills for environmental sustainability and green jobs policies. Nonetheless, there has been some degree of progress in the promulgation of policies and regulations that foster the growth of green jobs and green skills.

In particular, developing countries have sought to formulate, and continue to develop, specific policies and strategies on skills for green jobs, often stimulated by climate change commitments. However, in many cases gaps persist – for example, in policy coherence, lack of capacity, data collection and systematic anticipation of needs in skills development and training provisions – and implementation and enforcement of policies continue to present a significant challenge. Advanced economies tend to rely on overarching environmental and economic policies and processes to frame consideration of green jobs, and the experience of some of these countries demonstrates the non-linearity of policy formation and implementation: forward momentum is by no means certain. In all types of countries, the landscape of skills for green jobs includes many sectoral, regional and/or project-based policies and activities.

Among the features conducive to success in forming and implementing skills development policies for environmental sustainability and green jobs, the analysis identified institutional frameworks providing for collaboration between ministries and with social partners, sectoral approaches, action planning, and monitoring and evaluation of policies put in place. Policy-making structures and processes are not designed to deal with cross-sectoral topics, especially ones like the green transition that entail dealing with rapid occupational changes. Of all government ministries, those dealing with education and training tend to be the least integrated into coordination on green jobs. The incorporation of social partners and other stakeholders depends greatly on the general degree of their engagement in policy-making, and in most developing countries is in need of improvement. The lessons from coordination offered by the NDCs and the processes surrounding them should be exploited more thoroughly. Implementation and enforcement of policies continue to be among the biggest challenges facing all countries, and the

Figure 3.12 Important factors in skills development policies for greening, with relative performance, by country income level



Notes: HIC: high-income countries; LIC: low-income countries; LMIC: lower-middle-income countries; UMIC: upper-middle-income countries (based on World Bank typology).

Sources: Authors' calculations, based on qualitative analysis of country reports and an expert survey.

greatest challenge of all is monitoring and evaluation of policy performance, for all country income groups (see figure 3.12).

The analysis of how policy coherence on skills and environment correlates with other economic and social indicators, and how the factors conducive to success are deployed in country income groups, clearly shows that policy coherence is largely a development issue. This points to the need to develop capacity and enhance institutional mechanisms, supported by investment in the greening economies. However, some policy reversals among advanced countries, and progress demonstrated by emerging economies and developing countries, shows also how much can be done through concerted policy action and political will. It is not always about resources. Much depends on policy choice.



4. GREEN STRUCTURAL CHANGE: THE EMPLOYMENT EFFECTS OF GREENING THE ECONOMY

The employment effects of greening the economy since 2011 have been shaped by the specific contexts of individual countries, including their level of development, with developing countries most affected by climate change and environmental degradation, and by changes in agriculture. These years have seen increased green structural changes associated with the application of new green technologies and regulations on the one hand, and expanded demand and need for retraining for employment and to meet new market opportunities on the other hand. Across all countries green jobs are forecast to be a source of employment growth: this is especially so in developing countries, while recent evidence from some developed countries highlights the natural limits to green jobs growth. Sectors with the greatest employment potential are renewable energy, environmental goods and services, and construction; agriculture shows the most variation across countries in this respect. Evidence has also been found of the constraints on green jobs growth, notably: poverty, low incomes and informal employment (especially in developing countries), which can force people into environmentally detrimental activities; weak enforcement of regulations; and weak markets for green goods and services owing to inadequate government support.

This chapter examines the economic and employment trends related to the greening of the economy that have been observed since 2011. It begins by probing the nature of green structural change and shows how it varies between different types of country. It then moves on to consider observed and potential employment effects in a range of sectors. This sets the scene for the examination of occupations and skills presented in Chapter 5 on “Changing occupations and skills composition of occupations”.

4.1 Green structural change since 2011

If countries were well positioned to move forwards with greening their economies in 2011, progress since then has been variable. In HICs, growth of the green economy has tended to run in parallel with the general economic pattern, though green jobs often stand out as important areas of employment growth, sometimes increasing their share of total employment. In Denmark between 2012 and 2015, the value of green production grew from 170 billion to 192 billion Danish kroner and green jobs rose from 60,000 to 67,000. In Germany, green jobs' share of total employment rose from 4.8 per cent in 2010 to 5.2 per cent in 2012. In France, the average annual growth in employment in "eco-activities" over the period 2004–15 was 2.6 per cent, well ahead of the rest of the economy, where the annual average employment growth was 0.3 per cent. Among developing countries, major structural transformations involving the long-term shift of employment away from agriculture into other sectors has continued since 2011, although the economic experience of individual countries has shown wide variation, reflecting their vulnerability to a range of unpredictable factors, including natural disasters. This provides a wholly different context for the green transition from that of developed-country economies, as discussed further below.

A particularly important source of green jobs growth, across a wide range of countries, has been renewable energy. This has been closely related to the strong focus in national policies on meeting climate change targets (see section 2.2. Policy and regulation"). For example, in the United Kingdom, production from renewable energy activities doubled from 2010 to 2013, resulting in employment growth of 269,800 jobs, with 11,550 businesses engaged directly in the low-carbon economy in 2013 (BIS, 2015). In the United States, the clean energy sector has become much larger since 2011, particularly with the growth of solar and wind power, and technological advances to increase energy efficiency. In Bangladesh, the most significant growth has taken place in solar photovoltaics (PVs), followed by biogas: green jobs in solar energy increased steadily by 18.5 per cent per year from 60,000 in 2011 to 140,000 in 2016, compared to job growth of 1.9 per cent for the overall economy; and jobs in the biogas sector grew by more than 17.7 per cent per year, following numerous initiatives to provide rural household biogas digesters across the country (ILO, 2018a).

However, there is also evidence of the ways in which economic difficulties may reduce opportunities for the growth of green jobs. Brazil provides a good example of this, as described in the country report (p. 2):

In the first decade of the 21st century there was great expectation that Brazil would become a leader on environmental issues. However, the Brazilian economy in the mid-2010s did not follow the expected trend of transformation as it suffered slowed economic growth, including two years of recession with higher rates of unemployment (in 2014 and 2015) with a rising fiscal deficit that have slowed efforts toward fostering a green economy and skills development linked to green jobs. The crisis undermined the expected positive changes, and the severe fiscal problems and record unemployment crisis reduced opportunities for green jobs. In a broader perspective there was little room for improving demand for enhanced sustainability in the labour market in a context of a reduction, rather than an increase, in the need for employees with skills for green jobs. Empirical data show that there was no upward trend in green jobs in relation to the wider economy between 2010 and 2017.

Table 4.1 Projected green jobs in India: Cumulative employment (000) in green businesses, 2018–30

SI NO.	SECTOR	SUBSECTOR	UP TO 2020	UP TO 2030	2021–30
1	Renewable energy	Solar PV	180.0	900.0	720.0
2		Solar thermal	14.5	35.0	20.5
3		Wind	60.0	180.0	120.0
4		Small hydro	10.0	30.0	20.0
5		Biomass/cogeneration/CHP	25.0	100.0	75.0
6		Energy storage	50.0	300.0	250.0
7		Biofuels/biogas/pellets/briquettes	55.0	275.0	220.0
8		Clean cook stoves	75.0	2968.6	2893.6
Subtotal renewable energy			469.5	4788.6	4319.1
9	Green construction	Green buildings/campuses	2200.0	11000.0	8800.0
10	Green transportation		750.0	7500.0	6750.0
11	Carbon sinks		240.0	2100.0	1860.0
12	Water management		3000.0	19000.0	16000.0
13	Solid waste management		4000.0	19800.0	15800.0
14	E-waste management		170.0	582.0	412.0
Total			10829.5	64770.6	53941.1

Notes: PV: photovoltaic; CHP: combined heat and power.

Source: *Skills for green jobs in India* (ILO, 2018).

Turning to the future, it is clear that, across all countries, green jobs are forecast to be a source of employment growth, and a particularly important one in developing countries. Table 4.1 shows projections for green jobs in India to 2030. In Egypt, solar PV energy is forecast to create more than 21,000 new jobs and wind energy 75,000 by 2020, while 8 million new jobs will be created by 2050 in sustainable agriculture.

At the same time, it is important to consider whether there are natural limits to the growth of green jobs. Certainly, there is evidence for this from the period since 2011. In some countries, the share of green jobs in total employment has levelled off during these years. In Denmark, green jobs' share of total employment reached 2.4 per cent in 2015 and has remained fairly stable since then. In Germany, there has been very little growth since 2012 in occupations contributing directly to environmental protection and management. In France, Onemev has found that while the green economy in France was "set in motion" during the period 2004–11, green

employment peaked in 2012; thereafter, in the period up to 2015 growth rates in “eco-activities” stabilized, and employment in this area fell by 1.4 per cent.

Such patterns may be a natural consequence of the way in which the green transition takes place, at least in renewable energy, with an initial rise in employment as new products are designed, manufactured and installed, after which maintenance and replacement become more important, requiring fewer jobs. This sequence has been identified in Bangladesh, where it has been found that “jobs in solar home systems have reached a plateau with the slowdown in installation. In comparison, jobs in mini-grids and solar pumping are picking up as the government shifts its focus towards these applications.” At the same time, renewable energy production, which is more decentralized and dispersed than traditional fossil fuel energy generation (with the use of local solar panel facilities, wind turbines and biogas digesters, for example), may also be more labour-intensive, and hence there may be net gains in employment not only in the short term but also in the long term. Furthermore, it should be taken into account that in some sectors, jobs or occupations that might now be seen as separate will in the future be mainstreamed into other occupations, in much the same way as there was once a labour market for “typists” but now the task of typing is part of many jobs; in other words, over time, some jobs (both green and non-green) might disappear and be mainstreamed in other occupations (e.g. green plumbers will become mainstream plumbers).

4.2 Low- and high-income countries compared

The range of countries involved in the study is huge – economically, socially and culturally – reflecting the enormous diversity of the contexts in which the green transition is taking place. This diversity affects the nature of the green transition itself. To understand this, it is helpful to consider the extremes, i.e. LICs on the one hand and HICs on the other. Countries between these two ends of the wealth spectrum are going through a general process of transition that is only partly, and to varying degrees, related to the green transition. Each of these countries contains its own unique mix of elements found in LICs and HICs.

A key distinguishing feature of LICs, as noted in Chapter 2 above, is that here the environment has a more direct bearing on more individuals’ lives than is the case in HICs. These countries are most likely to be affected by climate change and environmental degradation, which in turn affects their growth prospects.¹⁹ There is also a greater reliance on agriculture and extractive industries. For example, agriculture accounts for 80 per cent of the working population in Mali and Uganda. This means a much closer relationship between the work of many people and the environment. Bad agricultural practices – often a result of poverty – may exacerbate climate change and environmental degradation. Furthermore, many LICs also face the dilemma that arises where environmentally deleterious activities are key to economic growth. In Ghana, for example, the country’s rapid economic growth has relied substantially on the extraction of minerals and crude oil, low-productivity agriculture and tree felling, as well as transportation using high-emission vehicles. Deforestation through tree felling, particularly along the banks of major rivers, has

19. One of the indicators for less developed countries concerns exposure to natural hazards: see <http://unohrrls.org/about-ldcs/criteria-for-ldcs/> [accessed 25 Aug. 2019].

been the main contributory factor in the drying out of bodies of water, including the Volta lake that feeds the Akosombo hydro-electric dam, and therefore in the consequent problems of energy supply.

At the same time, for these countries, the green transition is a means of tackling interconnected problems. Burkina Faso provides one such example, as the country report explains:

Agricultural expansion remains the main cause of deforestation ... followed by over-grazing, bush fires, demand for fuelwood and charcoal, over-exploitation of NTFPs [non-timber forest products] and mining.

To counter deforestation related to extensive agriculture, it is imperative to move from extensive agriculture to intensive agriculture with a predominance of the use of organic inputs in order to significantly reduce the environmental impact of inputs on agriculture. There is therefore a need for skills training in organic fertilizer production technologies (compost) to increase the supply of this type of input.

In less developed economies, the green policy agenda provides an additional stimulus to the general imperative for economic development while also shaping its direction. It provides added momentum behind the putting in place of, for example, basic sanitation and waste disposal systems, for the benefit of both population health and the environment, and energy-efficient mass transportation systems, both to improve the flow of goods and people and to reduce negative environmental effects and carbon emissions. It provides impetus to better exploit the opportunities for renewable energy, which also reduces reliance on costly imports, and to adopt green energy technologies that also offer cheaper ways of solving the issue of how to deliver energy “off grid” to locations not covered by the mains electricity network. For example, in Ghana, the Government is aiming to achieve a 10 per cent increase in renewable energy penetration by 2030, by establishing 55 solar mini-grids and scaling up 200,000 solar home systems for lighting – initiatives which will not only bring environmental benefits but also provide power to hitherto non-electrified rural households. Hence green technology is now woven into the fabric of the development agendas of LICs.

Just as the availability of mobile phones has enabled many countries to largely bypass the installation of fixed-line communications systems, green technologies have the potential to enable countries to pursue their development goals by building or expanding infrastructures that are green *from the start* – in contrast to HICs, where the green transition entails replacing or converting established systems. In employment terms, this means that in LICs, large numbers of the jobs being created in the course of economic development have the potential to be green jobs. As the Bangladesh country report notes:

The structural transformation that is taking place in Bangladesh is derived not merely from economic growth but also from autonomous green investment. However, current and future employment shifts and trends are likely to take place due to existing and anticipated green structural change notably in renewable energy, telecommunication and manufacturing (brick making and ready-made garments).

In contrast, in developed economies the green transition features less prominently in economic and employment policies. Two interrelated processes are important here: (1) the conversion of existing activities to greener processes (more energy-efficient and with fewer negative environmental impacts); and (2) the emergence

of markets for green goods, initially stimulated by government policy. In HICs, the environmental goods and services sector is now a well-developed feature. In general, green markets have been important sources of employment growth in recent years in developed economies; they are also emerging in developing economies, although here they face particular challenges (for contrasting examples, see box 4.1).

Box 4.1 Growing green markets

The United States

Energy efficiency is a fast-growing segment of the US economy, driven by growth in demand for products that reduce energy use and services that lower energy consumption. Industries that have experienced the most growth as a result of increased energy efficiency demand are construction, appliance manufacturing, building materials and lighting. Energy efficiency employs about 2 million people, approximately 1.6 per cent of the total US workforce. Some 70 per cent of the energy efficiency workforce is employed in construction firms, about 25 per cent in professional and business services, and 2 per cent in manufacturing. The most significant area of employment is related to heating and cooling equipment, which accounts for 48 per cent of employment; advanced building materials is the second largest area, with 17 per cent.

Bangladesh

On the basis of current employment trends, the constantly expanding renewable energy industry is expected to provide jobs for an estimated 1.1 million people by 2021. To encourage the development of the renewable energy market, the Governor of Bangladesh Bank has already allocated 5,000 million taka (US\$60 million) to small and medium-size enterprises (SMEs) involved in renewable energy. An important area for the application of renewable energy is solar-powered irrigation. Rahimafrooz Renewable Energy Ltd has introduced a solar-powered irrigation system that will help save 760 megawatts (MW) of power and 800 million litres of diesel every year if conventionally powered irrigation pumps are converted into solar power. However, farmers struggle to afford the high initial cost of setting up a solar energy pump. Nevertheless, although there is as yet no direct government subsidy for solar-powered pumps, other forms of government financing and cooperatives offer potential solutions.

Sources: Skills for green jobs in the United States (ILO, forthcoming 2019); Skills for green jobs in Bangladesh (ILO, 2018).

4.3 Employment and the green transition

This section uses a sectoral perspective to examine where green jobs are expanding and contracting. This reflects the fact that countries typically take a sectoral approach to both economic and green jobs policies, and also in reporting on employment trends. Naturally such an approach has its limitations, especially bearing in mind that new green products and services typically have effects in several sectors (see section 5.2. Occupational change in key sectors"). Some countries have sought to address this complication by assessing green jobs across sectors, within the economy as a whole (see subsection 7.2.1. Anticipating and monitoring skills needs"), but these form only a small minority of the sample of countries on which this report is based.

It is important to distinguish between sectors that feature prominently in green policies in general and sectors that feature prominently in policies, strategies and plans specifically related to green jobs.²⁰ This can be a source of confusion, since it is easy to assume that a sector that is important for, say, climate change policy is also important in terms of green jobs. This would be a mistake. Some sectors, such as transportation (logistics), are enormously important for achieving reductions in carbon emissions, yet are unlikely to experience substantial employment effects: most employment effects in this area are likely to be felt in the manufacture of energy-efficient vehicles rather than in transportation activities themselves).

Table 4.2 provides an overview of how prominently a range of sectors feature in, on the one hand, general environmental policies, strategies and plans and, on the other, in policies, strategies and plans related to green jobs. It also shows in which countries each sector features in the latter group of policies. This is a broad assessment designed to provide an indication of how the sectors compare on these two dimensions.

Owing to the nature of policy-making in this field, the ranking on the dimension related to green jobs can be taken as a broad proxy for the scale of the actual or anticipated employment effects of the green transition. As we saw in the preceding chapter, green jobs are frequently addressed as part of policy planning for individual economic sectors, since this type of sectoral approach is an intrinsic feature of policy-making in many countries. Hence green jobs tend to receive most attention in sectors where significant job destruction or creation is anticipated. As will be seen in the following subsections, there is a strong correlation between the attention devoted to a sector in green jobs-related policies and the scale of employment effects experienced or expected there.

As can be seen from table 4.2, renewable energy and environmental goods and services stand out as featuring prominently in both general environmental policies and policies on green jobs in most of the countries in our sample. Construction is also prominent in both sets of policies. At the other end of the spectrum, the retail, tourism and business and financial services sectors are typically of low prominence. Education and training services have been assessed as of medium prominence, since they seldom feature in sectoral terms in national policies related to the green transition but are often identified as significant in relation to environmental awareness. Transportation is unusual in being highly significant in terms of environmental effects, but, as noted above, experiencing comparatively low employment effects. The remaining sectors – agriculture and forestry, extractive industries and manufacturing – vary quite widely in prominence, depending upon the country and the particular types of activities concerned. In manufacturing, a useful distinction may be drawn between the production of goods directly related to the green transition, where the employment effects might be high, and the rest of the sector, where the employment impact of the green transition is felt more in terms of general environmental awareness, changes in how waste is managed/recycled etc. rather than in terms of actual numbers of jobs. In agriculture and forestry, the net gains from greening are unclear but may be significant in some contexts.

20. At this point in the report, the focus is on green jobs per se – i.e. the employment effects of the green transition in terms of job destruction and job creation. The effects of the green transition in terms of skills and occupational changes are dealt with in Chapter 5.

Table 4.2 Assessment of the relative prominence of various sectors in, respectively, general environmental policies, strategies and plans and those related directly to green jobs

SECTOR ^a	PROMINENCE IN GENERAL ENVIRONMENTAL POLICIES, STRATEGIES AND PLANS	PROMINENCE IN POLICIES, STRATEGIES AND PLANS RELATED TO GREEN JOBS	COUNTRIES WHERE PROMINENT IN POLICIES, STRATEGIES AND PLANS RELATED TO GREEN JOBS ^b
Agriculture and forestry	Medium–high	Low–medium	AUS, BRB, BRA, BFA, CRI, EGY, EST, FRA, GHA, GUY, IDN, KOR, KGZ, MLI, MUS, MNE, PHL, SEN, ESP, THA, UGA; ZWE
Business and financial services	Low	Low	GUY, KGZ
Construction and building services	High	Medium–high	BRB, CHN, DNK, EST, FRA, DEU, IND, IDN, KOR, KGZ, MUS, PHL, ESP, THA, UGA, ARE, GBR, USA
Education and training services	Medium	Medium	MUS, PHL, SEN
Environmental goods and services, including water and waste management, recycling	High	High	AUS, BGD, BRA, BFA, CRI, DNK, EGY, FRA, DEU, GUY, IDN, MLI, PHL, SEN, ESP, ZAF, THA, UGA, ARE, GBR, USA
Extractive industries	Variable	Low	BFA, GHA, GUY, KGZ
Manufacturing – subsectors producing “green goods” ^c	High	High	BGD, BRB, BRA, CRI, DNK, EGY, FRA, GUY, IDN, MLI, MUS, PHL, SEN, ZAF, ESP, THA, UGA, GBR, USA, ZWE
Manufacturing – subsectors producing other goods	Low	Low	
Renewable energy	High	High	AUS, BGD, BRB, BFA, CHN, CRI, DNK, EGY, EST, FRA, DEU, GHA, IND, IDN, KGZ, MLI, MUS, MNE, PHL, SEN, ZAF, TJK, THA, UGA, ARE, GBR, USA; ZWE
Retail	Low	Low	
Tourism	Low–medium	Low	BRB, CRI, FRA, GUY, IND, IDN, KGZ, MUS, MNE, PHL, ESP, TJK, THA, UGA
Transportation services (logistics)	High	Low	BRB, CHN, CRI, EST, FRA, IDN, KGZ, PHL, ESP, UGA, ARE

^a The telecommunications sector has a facilitative function in the green transition (see subsection 4.3.7. Telecommunications”), but is scarcely mentioned in the country reports and so is not included in this table.

^b Country names are abbreviated as follows: Australia (AUS), Bangladesh (BGD), Barbados (BRB), Brazil (BRA), Burkina Faso (BFA), China (CHN), Costa Rica (CRI), Denmark (DNK), Egypt (EGY), Estonia (EST), France (FRA), Germany (DEU), Ghana (GHA), Guyana (GUY), India (IND), Indonesia (IDN), Republic of Korea (KOR), Kyrgyzstan (KGZ), Mali (MLI), Mauritius (MUS), Montenegro (MNE), the Philippines (PHL), Senegal (SEN), South Africa (ZAF), Spain (ESP), Tajikistan (TJK), Thailand (THA), Uganda (UGA), the United Arab Emirates (ARE), the United Kingdom (GBR), the United States (USA); Zimbabwe (ZWE).

^c These are goods directly related to the green transition such as electric vehicles, solar panels, wind turbines and green building materials.

Source: Authors' analysis based on *Skills for green jobs* country reports (ILO, 2018; for Zimbabwe, forthcoming 2020).

The following subsections offer an overview of how several sectors have developed in response to the green agenda, focusing on those most affected (and so not including retail, business and financial services, or education and training services). Broadly speaking, the sectors are dealt with in descending order of employment effects experienced and anticipated. The first sectors considered (renewable energy and environmental goods and services) are those that have already seen significant employment growth in many countries, and which continue to offer substantial future potential in all countries. The last sector examined is the extractive industries: although there have been, and will be, job losses in these industries, they continue to be important to some economies, as noted above, and the greening of jobs in this sector has a vital role to play in both reducing environmental damage and supporting decent employment.

4.3.1 Renewable energy

Renewable energy, a sector that is integral to achieving internationally agreed carbon reduction targets, has already shown growth in some countries and is seen everywhere as having the potential to create significant numbers of jobs. For example, in the United States wind power generation capacity more than doubled between 2010 and 2016, and between 2013 and 2016 jobs in this subsector grew by more than 25 per cent annually, reaching over 100,000 in the latter year.²¹ In the United Kingdom, the number of jobs created by renewable energy in the wind and marine energy subsectors rose by 74 per cent between 2010 and 2013 to at least 35,000, and it is anticipated that if there is sufficient growth in deployment of these technologies around the UK coastline, there is the potential for 70,000 additional new jobs, mainly in the offshore wind industry. In China, there were 267,000 workers in wind power in 2012 and 365,000 in 2013; the forecast is for the total to rise to 800,000 by 2020. In Bangladesh, as noted in section 4.1 above, green jobs in solar energy and biogas increased substantially between 2011 and 2016 – and, significantly, it is likely that these represent new jobs rather than substitutes for jobs in traditional fossil fuel energy generation since they require, among other things, the installation and maintenance of new systems. In LICs especially, new sources of income and employment based on renewable energy can involve solutions that are “low-tech” but nonetheless highly effective at addressing local needs, e.g. improved stoves and biomass briquettes in Mali.

Awareness of the need to improve the effective enforcement of environmental regulation in developing countries was also a theme in 2011. The 2018 reports attribute problems with implementation to lack of effective institutional frameworks and mechanisms (e.g. in Bangladesh, Brazil, China, Mali and Uganda) and poor coordination between different actors (e.g. in Thailand). Despite these mismatches and the need to strengthen the practical implementation of policy decisions, improvements have been made since 2011. Significant progress towards sustainable growth and green jobs is continually being made. For instance, policy and regulation generally have sought to support and promote green technology and innovation in both developed and developing countries. Progress in the sector, however, depends crucially on the passage and implementation of government legislation, and in some countries developments since 2011 have not lived up to expectations (for an illustration, see box 4.2).

21. Although, as the US country report notes, the policies of the current US federal Administration are less positive towards renewable energy and hence these trends may not be sustained.

Box 4.2 Renewable energy in Indonesia: Potential still to be realized

Indonesia has set a target for 23 per cent of its energy to come from new and renewable energy sources by 2025. In August 2017, the state-owned electricity company signed power purchase agreements with 53 renewable energy companies. Assuming that the Government can develop 1,000MW capacity of solar energy per year, there will be 35,000 new green jobs in the industry, including the experts who conduct feasibility studies, the workers in PV and component factories, the PV engineers and designers, the PV on-grid or off-grid installers, the PV technicians who maintain the solar energy system, the energy managers, and the energy inspectors or auditors. However, significant development of the sector has not yet taken place. Energy from solar and oceanic sources is still relatively expensive; the PV industry remains underdeveloped because investors still regard the market as uncertain; it is unclear whether there are adequate numbers of experts in renewable energy sources; and hydro-electric facilities are located in rural or remote areas and need additional investment to connect them to the national grid.

Source: *Skills for green jobs in Indonesia* (ILO, 2018).

Much further growth is possible within this sector. In Zimbabwe, for example, there is scope for extending electricity supply to the 60 per cent of the Zimbabwean population that currently do not have access to power and eliminating Zimbabwe's 35 per cent energy deficit. Improving energy supply through renewable technologies and systems would also help foster the expansion of both formal and informal economic activity in the agricultural and non-agricultural sectors alike (ILO, forthcoming 2020). The new renewable energy policy released in 2019 advocates the pursuit of sustainable energy and is linked with Zimbabwe's NDC mitigation targets and the Sustainable Energy for All (SE4ALL) agenda.²² The Zimbabwe Energy Regulatory Authority has subsequently launched 39 solar power projects that have capacity to generate up 1,151.87MW with a required investment of over US\$2,3 billion.²³

4.3.2 Environmental goods and services, including waste and water management

The environmental goods and services sector, which includes waste, energy and water management, has also developed thanks to government policies and measures. It is already well established in European economies, and other countries have made progress since 2011. In the United Kingdom, the output of this sector grew by 18.7 per cent from 2010 to 2014, when it accounted for 1.6 per cent of GDP and 337,500 full-time equivalent jobs. In the Republic of Korea, the number of employees in the sector grew from 215,000 in 2010 to 443,000 in 2015 (from 0.9 per cent of all employment to 1.7 per cent), and the proportion of companies rose from 4.4 per cent in 2009 to 6.3 per cent in 2014.

The water and waste management sector is taking different trajectories in LICs and HICs. In the latter, jobs growth is focused on redesigning existing systems so that they become greener, e.g. through recycling. This activity can result in significant

22. See: <https://www.seforall.org/> [accessed 24 Nov. 2019].

23. See: <https://www.esi-africa.com/industry-sectors/renewable-energy/39-solar-power-projects-approved-for-development-in-zimbabwe/> [accessed 24 Nov. 2019].

numbers of additional jobs. It was reported in 2012 that the UK waste management sector could see as many as 36,000 new jobs created directly by 2020, the majority of them in operator and manual positions. In LICs, by contrast, water and waste management systems are frequently underdeveloped, so that the focus is on installing new systems that are green from the start. Thus, the country report for Tajikistan notes that “the processing of solid domestic waste is considered to be [a] significantly important direction of the ‘green’ economy” (p. 22).

This sector is also concerned with environmental management and improvement. Such activities are well established in HICs, while in LICs there is scope to develop them. Here, environmental protection and restoration projects are often small scale, but have potential to generate useful experience for wider application, as box 4.3 illustrates.

Box 4.3 Guyana’s Mangrove Restoration Project

Over recent decades, the mangroves of Guyana have been threatened not only by the effects of climate change, but also by human activities, such as cattle grazing, illegal solid waste disposal, illegal mangrove timber harvesting for fuel, hunting and boating. The Mangrove Restoration Project has attempted to replace some of the illegal and unsustainable income-generating activity with new livelihoods that support both mangrove conservation and sustainable economic growth for the surrounding communities. So far over 900 jobs have been directly created, and 78 community volunteers sit on eight community mangrove action committees; some of these volunteers are also deployed as mangrove community stewards. At various times, key activities have also created temporary employment: for example, 300 people were employed planting mangrove seedlings, and a further 300 were subsequently employed in monitoring the plants. Furthermore, three women’s groups became involved in agro-processing and distribution of mango and tamarind achar, meat and food seasoning and pepper sauce. Women from these groups, through their respective organizations, became members of Guyana’s National Women’s Agro-processors Network.

Source: Skills for green jobs in Guyana (ILO, 2018).

4.3.3 Construction and smart cities

Greening construction is important across all countries, and yet the employment effects in this sector are somewhat more variable than in renewable energy and environmental goods and services. There may be strong employment effects where the existing built environment is greened through retro-fitting, as box 4.4 illustrates. Where the focus is on ensuring new construction is greened, there may be some new job creation but the main effects are more likely to be in incorporating new skills into existing jobs – a trend already observed widely in this sector (see Chapter 5 on “Changing occupations and skills composition of occupations”).

The construction sector also plays a key role in putting in place the infrastructure for greening economies and societies, from small-scale local initiatives to planning at the scale of whole cities. For example, at one end of the spectrum, it is crucial to the rolling out of biogas digesters and so can be a source of significant employment spikes in the short term, e.g. through government programmes, as box 4.5 illustrates.

Box 4.4 Growth in green construction jobs in the United Kingdom

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

Source: *Skills for green jobs: 2018 update*, United Kingdom (Cedefop, 2019).

Box 4.5 Building new local renewable energy production in Burkina Faso

Since 2010 the Burkina Faso National Biodigesters Programme has set up and coordinated the promotion and production of biodigesters, which produce biogas, a renewable energy source. More than 8,500 biodigesters have been built to date. The transformation works are carried out by professionals in the sector (masons) who are trained by the programme and who are employed by biodigester construction companies present in all regions of the country. The programme provides training and employment for industry professionals while also supporting households in the production of domestic biogas for lighting and cooking from livestock excrement. This offers a range of benefits including making better use of a local agricultural byproduct, improving hygiene and separating out the methane contained in animal waste.

Source: *Skills for green jobs in Burkina Faso* (ILO, 2018).

At the other end of the spectrum, “smart cities” are an important focus of development and climate-resilient response in some countries. For example, in the United Arab Emirates a “sustainable city” has been created in Dubai, comprising 500 villas, 89 apartments and a commercial area. This first operational net zero-energy city in Dubai is a car-free area, powered by solar energy, and with UV-reflective paint employed to reduce heat gain inside houses, along with a number of other environmentally friendly features.

4.3.4 Manufacturing

The position of manufacturing in relation to the green transition is variable and complex. Some manufacturing sectors, notably the automotive industries, are gradually changing their product lines to more energy-efficient versions of the same products, such as electric vehicles. Net employment gains here are likely to be small, however, since new green jobs will largely displace existing jobs. More significant in employment terms are more general trends in the sector, e.g. towards further automation and mergers and consolidations among firms. Other manufacturing industries are delivering the products to support greening in other sectors, e.g. wind turbines, biogas digesters, smart electricity meters and green building products. Manufacturing in general is seeking to make itself more energy efficient and to reduce its impact on the environment, e.g. through recycling, as the example from Bangladesh in box 4.6 demonstrates.

Box 4.6 Greening ready-made garment manufacturing in Bangladesh

The ready-made garments (RMG) industry is by far the largest industry in Bangladesh in terms of growth, employment and foreign exchange earnings. Over 5,000 factories in the industry directly employ around 4.4 million workers, accounting for around 55 per cent of total manufacturing employment. There is a pressing need to ensure that the growth of the RMG sector does not come about at the expense of environmental degradation and inefficient use of resources. Environmental awareness-raising in the sector and availability of relevant skills will be key. In the RMG sector priority should be given to energy efficiency, waste-water treatment and green renewable technologies. Experience shows that investing in green technology is good not only in terms of reducing costs, but also in terms of acquiring more international customers. There is growing pressure from international fashion brands and buying houses for greening the RMG industry; some brands already have a strategy to move towards greater sustainability: H&M, for example, has just launched its strategy for 100 per cent circularity. This includes favouring factories that invest in energy efficiency, reduction and recycling of water, renewable energy and other green technologies. An energy audit finds that potential savings in the utility area of the RMG industry are of the order of 67,000-110,000 GWh/year. Already a large number of RMG factories have achieved environmental certification from the US Green Building Council for their green practices.

Source: *Skills for green jobs in Bangladesh* (ILO, 2018).

4.3.5 Agriculture and forestry

Agriculture and forestry hold a unique position among economic sectors in their direct relationship to climate change and environmental impacts; they are also highly significant employers in many LICs. For example, agriculture accounts for 80 per cent of the working population in Mali, and 70 per cent in Uganda; even in the Philippines, an LMIC, agriculture still contributes between 33 and 37 per cent of national employment. The green transition involves the adoption of more sustainable farming and land management practices and the spread of organic agriculture. In LICs, the green transition in agriculture is occurring within the context of a general shift of employment out of agriculture into manufacturing and services, which has typically been under way for many years; in Tajikistan, for example, agriculture's share of employment fell from 33 per cent in 2000 to 12 per cent in 2014, though it remains the largest single sector in employment terms.

These factors make it difficult to disentangle the likely employment effects of the green transition in this sector from general employment trends. Furthermore, such effects vary substantially across the countries covered in this study, reflecting the wide variation between agricultural systems and practices, from subsistence farming and smallholdings in LICs such as Mali to large, mechanized agri-businesses in HICs, for example on the US prairies.

In many LICs there is a substantial incentive to green agriculture as a means of both reducing practices that are environmentally detrimental and supporting development, as noted in Chapter 2 above on "2. The green transition: What is driving skills change?". (For two examples, see box 4.7.)

Box 4.7 Greening agriculture in Uganda and Mauritius**Uganda**

“Green growth” interventions that raise agricultural productivity, increase farm incomes and improve climate resilience have the potential to significantly raise growth and reduce poverty. It is estimated that investing in such interventions in agriculture as part of the “green growth” pathway will contribute US\$2.8 billion to GDP in 2040, mainly through increased yields. For a country with so large proportion of its labour force (70 per cent) engaged in agriculture, investments in productivity and facilitating trade will have far-reaching benefits. Indeed, the reform of the agriculture sector is a precondition for Uganda’s structural transformation. It will also provide jobs in rural areas for those who are currently leaving for the cities, where they are putting a strain on public services. The major groups of workers involved in this shift are agricultural workers, agricultural advisers, chemists, traders and farmers. There is great scope in this sector scope for creating new green jobs through retraining.

Mauritius

In Mauritius, attempts to green agriculture include the Smart Agriculture project and the Mauritian Standard for Good Agricultural Practices (MauriGAP).

- The Smart Agriculture project has been launched as a private-sector initiative by the Mauritian Chamber of Agriculture and the country’s Food and Agriculture Research Institute (FAREI). It seeks to promote agricultural practices that optimize yields while at the same time controlling the use of pesticides, chemical fertilizers and water. The project is currently being implemented over a three-year period on a pilot basis with ten small growers.
- MauriGAP specifies good agricultural practices for crop production, including methods of soil conservation, the use of compost and manure, and the maintenance of soil health through crop rotation. To achieve certification under the standard, farmers will eventually need to acquire green skills in soil management and agronomic measures, and to demonstrate use of an appropriate mix of fertilizers for the species of crops cultivated, along with other practices to maintain soil health. Generic green skills required will include organizational skills (e.g. in accurate record-keeping, certification paperwork, warranties and labour contracts) and business networking, given the likely increase in transactions with banks and other “green finance” issues and in opportunities for green marketing.

Sources: *Skills for green jobs in Uganda* (ILO, 2018); *Skills for green jobs in Mauritius* (ILO, 2018).

In Egypt, it is estimated that sustainable agriculture will create 8 million additional jobs by 2050. In Mali, according to the country report (p. 11),

the introduction of environment friendly techniques and technologies is changing the work of agriculture, making the activity more sustainable and therefore more viable. The massive creation of green jobs in the agricultural sector is a good way to promote strong economic growth, capable of helping to reduce current unemployment and offer prospects for newcomers on the labor market.

In some countries, diversification of farming and forestry into eco-tourism is also seen as providing employment opportunities (see subsection 4.3.8 on “Tourism and hospitality”).

In Zimbabwe, the types of green jobs already present in the agriculture and livestock sector have been identified, while the practice of “climate-smart” agriculture is spreading and agro-processing is increasing. In 2017, the new *Climate-smart agriculture manual for agricultural education in Zimbabwe* was introduced to agriculture colleges by the Ministry of Lands, Agriculture and Rural Resettlements in partnership with the UNFCCC's Climate Technology Centre and Network, the UN Environment Programme and other agencies. Table 4.3 illustrates the training needs in greening agriculture and its value chain in Zimbabwe.

In some HICs (Denmark, Germany, the United Arab Emirates, the United Kingdom and the United States), agriculture is not highlighted in the country reports as a notable focus of attention in relation to green jobs. Agriculture accounts for a small share of total employment in these countries (just 4 per cent in Germany, for example). Nonetheless, agriculture by definition has major environmental consequences, and therefore there is an environmental imperative that it be considered in terms of greening existing jobs. France and Spain stand out among the HICs for embracing green agricultural practices. Spain has the largest share of land devoted to organic production in the EU, and between 2010 and 2015 this area increased by 22 per cent. France's Onemev has produced a sectoral report on agriculture; and the modernization of French agriculture, as expressed in recent legislation and linked to commitments under COP21, is based on the concept of “agro-ecology”. All diplomas related to agricultural production are therefore changing; standards are evolving and expressly include the teaching of alternative techniques, particularly organic farming and phyto-protection.

Organic agriculture is often mentioned in the context of the green transition. It has the potential to enrich soil fertility, improve farm productivity, reduce pollution and destruction of the environment, and prevent depletion of natural resources. It is a particular priority in LICs, whereas in HICs its effects are likely to be minor, given the prominence of agri-businesses. In the Philippines, the Organic Agriculture Act was passed in 2010 to promote the practice of organic agriculture in the country, and there has been a sharp rise in the number of organic farming practitioners, from around 9,000 in 2011 to over 43,000 in 2016. Diversification into eco-tourism and rural tourism is also a common choice among rural enterprises (see section 4.3.8 on “Tourism and hospitality”).

Table 4.3 Types of green jobs related to the agriculture and livestock value chain in Zimbabwe

AREAS OF ACTIVITY AND RELATED JOBS	TRAINING REQUIREMENTS	TYPES OF INSTITUTIONS WHERE REQUIRED SKILLS TRAINING COULD BE PROVIDED
Farm power installation, maintenance and repair: solar for lighting, refrigeration, boreholes, irrigation, piped water schemes	Electrical, plumbing, welding	Agricultural colleges, polytechnics, vocational training colleges (VTCs)
Reduction in agricultural energy use: building energy-efficient tobacco barns; applications of clean technologies and fuel-efficient technologies in agro-processing/value addition	Mechanical/electrical engineering construction, conservation agriculture, climate smart agriculture	Universities, agricultural colleges, polytechnics, VTCs
Design, construction, commissioning, maintenance and repair of biogas digesters, using livestock waste, human waste, wood/milling waste, agricultural waste, etc.	Civil engineering, construction	Universities, polytechnics, VTCs
Composting, vermiculture	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Agro-processing/value addition making use of renewable energy: solar-based food dryers, agro-processing equipment, chick incubators, milling, refrigeration for storing and processing perishables, etc.	Mechanical/electrical engineering construction, carpentry	Universities, polytechnics, VTCs
Post-harvest conservation: storage and preservation using renewable energy, upgrading silos, etc.	Mechanical/electrical/civil engineering, construction, carpentry	Universities, agricultural colleges, polytechnics, VTCs
Growing of crops for biofuel production, e.g. sugarcane, Jatropha)	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Design, construction, operation and maintenance of wind mills for water pumping	Mechanical engineering, plumbing, welding	Universities, polytechnics, VTCs.
Production and sales of alternative cooking fuels and waste derived products, e.g. bio gels, agricultural waste turned into fuel pellets or briquettes, tiles from maize cobs waste, etc.	Mechanical, electrical engineering	Polytechnics, VTCs
Practising conservation agriculture: minimum tillage, crop residue management, fodder crops, drought-resistant and highly nutritious crops, crop rotation with cereals and legumes, intercropping, dry planting, seed banks/management, etc.	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Practising climate smart agriculture: control of soil erosion, nutrient management, reduced tillage, mulching and residue management, carbon sequestration, small-grain and short-season varieties, early planting and mulching, integrated fertility management, drought-tolerant varieties, crop diversification, small-scale irrigation	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Efficient water management: higher-efficiency irrigation systems – drip-irrigation, subsurface irrigation, in situ moisture conservation, rainwater harvesting techniques, hydroponics, etc.	Conservation agriculture, climate smart agriculture, plumbing	Agricultural colleges, polytechnics, VTCs

Table 4.3 (cont'd)

AREAS OF ACTIVITY AND RELATED JOBS	TRAINING REQUIREMENTS	TYPES OF INSTITUTIONS WHERE REQUIRED SKILLS TRAINING COULD BE PROVIDED
Indigenous livestock breeding and improved livestock management: local breeds that are more heat and drought tolerant, grazing management, breed management, herd management, breeding management	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Integrated pest management: use of alternative pesticides/fertilizers, surveillance, early warning systems and response to pest management	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Introduction of greenhouse technologies	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Growing of organic crops	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Waste management: collection and management of waste agricultural plastics (e.g. pesticide containers, ground coverage) and bags to avoid livestock chokes, etc.	Conservation agriculture, climate smart agriculture	Agricultural colleges, polytechnics, VTCs
Development of ICT applications: climate/weather applications, early pest warning systems, etc.	Information and communications technologies	Universities, polytechnics

Source: Extracted from preliminary findings: see ILO, forthcoming 2020, table 7.

4.3.6 Transportation services (logistics)

Greening in transportation involves two main trends: the transition to less polluting and lower-GHG emission vehicles; and the introduction of mass public transportation systems to reduce reliance on individual transportation. The first of these is likely to have negligible employment effects in the short term, though there will be some effects in terms of skills, as described in Chapter 5 on “Changing occupations and skills composition of occupations”. In contrast, the introduction of mass public transportation systems can have substantial employment effects in the short term during construction (see box 4.8), while in the longer term there may be some consequent job losses, e.g. for taxi drivers and bus drivers.

In LICs, the development of transportation is a key concern, as it contributes to general economic development by bringing products closer to markets and creating business opportunities. As the country report for Senegal notes: “The whole concept must be supported by green and inclusive governance.” Unfortunately, many LICs face the problem of poor-quality, polluting and energy-inefficient transport systems dominated by individual modes of transport rather than effective public systems, and sometimes addressing this issue is not a priority (e.g. in Burkina Faso where so far it has been “left behind” in the greening of jobs).

Box 4.8 Greener transportation in Dubai

Greener transportation is a major focus of Dubai's Government. The first section of Dubai's metro was inaugurated in 2009. Since then, a total of 75 kilometres have been built. By September 2017, the total number of passengers to have used it exceeded 1 billion. In addition, light rail tracks have been in operation since 2014. A 15-kilometre link to the EXPO 2020 site and seven new stations are to be finalized by 2020. Further expansion plans include 400 kilometres of metro lines and 268 kilometres of tram lines. In employment terms, it is believed that as early as 2008 there were 24,000 engineers, technicians and workers involved in construction, as well as 105 subcontractors. In recent years, employment demand has continued with a focus on electrical, mechanical and civil engineers, project managers with previous railway experience and other railway specialists such as track engineers. It remains to be seen whether these new jobs will be sustained in the future as phases of construction come to an end. Nevertheless, even once the construction work is finished, additional permanent operations and management jobs will be created.

Source: *Skills for green jobs in the United Arab Emirates* (ILO, 2018).

4.3.7 Telecommunications

This sector was mentioned in the 2011 report (Strietska-Ilina et al., 2011, p. 75, table 4.3) but receives scant attention in the 2018 country reports, which is of course a finding in itself. Our comments here are made in the light of this overall paucity of information provided in the country reports.

The role of telecommunications in the green transition is highlighted in only one of the country reports, that for Bangladesh. This absence is noteworthy, given that telecommunications is not only greening itself but also has an important enabling role more widely in the green transition, since wireless technologies and low-energy products have the potential to substantially reduce carbon emissions – for example through their role in “smart cities” (for an example, see box 2.1 above on Mauritius' Smart City Scheme).

In terms of “internal” greening within the telecommunications sector, in Bangladesh mobile telephone networks are replacing land-lines, resulting in major carbon reductions for telecommunications network operators through the use of solar power, and recycling of electronic waste products has been stepped up. Nonetheless, the development of skills for green jobs, especially for network engineers and technicians, is still at the formative stage. At the lower end of the skills range, for example in recycling and re-use of materials, on-the-job training is considered enough. This state of affairs points to the need for (re)training of the engineering and technical workforce currently employed in telecommunications.

4.3.8 Tourism and hospitality

In tourism, the employment effects of the green transition are likely to be small-scale on the whole, although for some rural localities and some countries tourism has great potential. For example, in Montenegro it has been predicted that more than 16,000 new jobs will be created between 2012 and 2020 through means such as better use of domestic and local supply chains. Nonetheless, greening tourism can face significant challenges, as illustrated in box 4.9.

Box 4.9 Greening tourism in Mauritius: Opportunities and challenges

In Mauritius, the concept of sustainable development in the tourism sector is well established. The Mauritian Standard for Sustainable Tourism (MS165) specifies the requirements that tourism operators should meet to obtain an eco-label for sustainable tourism. The application of MS165 offers benefits including improved environmental performance, maximally efficient use of resources, minimization of waste and compliance with environmental laws and regulations, as well as enhanced corporate image, competitive advantage and increased business efficiency. With a view to facilitating certification to MS165, the Mauritius Tourism Authority has developed a scheme to provide support to tourism businesses, which was launched in 2015. However, despite the provision of a matching grant equivalent to 50 per cent of the project costs up to 44,000 rupees (MUR), the response has been poor, as operators do not yet see the standard as a marketing tool. To make it more attractive, the standard is now being reviewed to align it with the Global Sustainable Tourism Council requirements for recognition and accreditation, and the ceiling for the grant is to be increased to around MUR150,000 to cover certification and consultancy costs.

Source: *Skills for green jobs in Mauritius* (ILO, 2018).

In eight out of the ten HICs in our sample, greening of tourism, including of existing jobs in the sector, does not stand out as a high priority, despite the potential significance of tourism income; only in Spain and Barbados, where tourism already accounts for a significant share of GDP, is it a notable feature.

Eco-tourism, as distinct from a general greening of tourism, is seen as having considerable potential in some countries. Definitions vary, but this example from the Philippines is quite typical: “Ecotourism, as defined by NES [the National Ecotourism Strategy and Action Plan 2013–22], is a form of sustainable tourism within a natural and cultural heritage area in which community participation, protection and management of natural resources, culture and indigenous knowledge and practices, environmental education and ethics, and economic benefits, are fostered and pursued for the enrichment of host communities and for the satisfaction of visitors” (ILO, 2019).²⁴ The NES and action plan for 2013–22 has identified a potential market of between 1.5 million and 14.2 million eco-tourists. In Zimbabwe, eco-tourism and biodiversity conservation have the potential to generate additional jobs in a sector that currently contributes 5.2 per cent of total employment (WTTC, 2017; ILO forthcoming, 2020). However, little attention has been given so far to reviewing and greening the existing curricula in the tourism and hospitality industry (ILO, 2018a).

Eco-tourism and farm tourism can also be viable options for farmers, helping them to diversify their sources of income, which can be beneficial when agriculture faces environmental pressures. In the Philippines, the Farm Tourism Development Act, passed in 2016, seeks to promote environment-friendly, efficient and sustainable farm practices; provide alternative recreation facilities and farm tourism activities for families, students and other client groups; and promote health and wellness through high-quality farm-produced food. In Thailand, the Thailand Professional Qualification Institute is developing skills standards in key sectors identified as having high potential, and these include “affluent medical and wellness tourism” as well as agriculture and innovation in biotechnology and food. This work takes place in the context of skills development planning at local level by provincial

24. See: <http://www.fao.org/faolex/results/details/en/c/LEX-FAOC179040/> [accessed 24 Nov. 2019]

vocational training coordination boards, which are chaired by provincial governors and include representatives from the public and private sectors. The private-sector group includes representatives from the Federation of Thai Industries, the Chamber of Commerce and a tourism-related organization.

4.3.9 Extractive industries

Extractive industries such as mining pose a challenge in the green transition, especially for developing economies, since, although they have major negative environmental impacts, they often play an important role in economic growth. While technological advances continue to reduce the need for labour, in some countries these industries have continued to expand their operations. The creation of decent jobs can be a challenge in this sector, partly owing to high levels of informal employment and poor working conditions. In China, putting a cap on coal consumption will have significant negative impacts on the coal-fired power and coal-mining industries, leading to job losses anticipated to total 3,962,000 by 2030; but these will be offset by job creation in wind, solar and hydro power, which are expected to yield 5,911,000 new jobs over the same period (*Skills for green jobs in China*, ILO, 2018, p. 21).

Box 4.10 Greening mining in Burkina Faso for environmental benefits and decent jobs

Since 2009, Burkina Faso has experienced a mining boom. Gold alone now accounts for nearly 43 per cent of the country's exports by value. There are two types of gold mining in the country: supervised industrial exploitation and artisanal mining. The former provides 9,000 direct jobs and 27,000 indirect jobs; the latter provides employment for 700,000 people, plus more than 500,000 who benefit from it indirectly, but is a high-risk activity, particularly in terms of pollutant discharges and water use. Mining has a high potential for green jobs, but to realize this potential requires enterprises in the field to be trained to meet environmental requirements in, for example, the use of chemicals and the management of waste. Specialists are needed in the treatment of mining waste, in greening industrial, semi-industrial and industrial mining sites, in mining and quarrying, and in the restoration of mining sites after operations are concluded; the sector also offers opportunities for brokers (work related to services and sales in gold exploitation), and in jobs related to the construction and commercialization of mines.

Source: *Skills for green jobs in Burkina Faso* (ILO, 2018).

4.4 Conclusions

This chapter has examined the structural changes taking place in employment as a result of the green transition, including how they vary across countries and sectors. The employment effects described above have important implications for occupations and skills, in particular for reskilling and upskilling existing workers. These issues are considered in Chapters 5 and 7 respectively.

While it is difficult to generalize across sectors and countries, three broad conclusions can be drawn at this stage. First, it is noteworthy that the “story” for some sectors is fairly similar across countries. Thus, renewable energy and environmental goods and services offer considerable employment potential regardless of where a country sits on the income/development spectrum. Construction, too, offers employment potential almost everywhere. This is an interesting finding in view of the enormous economic and social differences that exist between countries and the fact that different new technologies or materials might be involved in different contexts, from biogas digesters in rural localities in developing countries through to large-scale solar generation operations in HICs. In contrast, the sector with most variability in employment potential across countries is probably agriculture, which receives much more attention in LICs where it accounts for an important share of the working population.

Second, it is clear that that progress with greening activities in one part of an economy may be offset by the continuance or expansion of environmentally deleterious activities in another. Thus, in Brazil, the commitment to reduce GHG emissions was based substantially on reductions in deforestation in the 2000s. However, the combination of increasing pressure to extend the agriculture frontier, changes in environmental legislation, and poor resourcing of the environmental agencies resulted in a return to increased deforestation in the 2010s in order to convert natural habitats to areas of pasture or cultivation. At the same time, employment in the agriculture and livestock sector has declined continuously from 21.2 per cent of the national total in 2000 (16.7 million jobs) to only 12.9 per cent in 2015 (13.2 million jobs). The country's return to a primary export model, propelled by activities with high environmental impact, undermines social inclusion, owing to its inability to generate high-productivity jobs, and thereby to raise wages and increase numbers of formal jobs.

Third and finally, green trajectories are seldom linear. The period since 2011 has shone a light on the challenges to the green transition, reflected in the slowdowns and reversals in the process seen in these years. It is clear that there are a number of important obstacles and constraints to the growth of green jobs:

- **Poverty, low incomes and informal employment** pose a major challenge, especially for LICs. In agricultural areas, poverty forces people into low-productivity, marginal activities that they undertake in order to subsist in the short term, but which may degrade the very environment on which they depend in the medium to long term. This position has been exacerbated in recent years with environmental changes such as desertification. A more widespread problem that runs across all sectors is informal employment. Again, this is a particular problem in LICs. In Indonesia, 58 per cent of the workforce were in informal employment in 2016. In Ghana, informality reaches 73 per cent in the mining sector, where illegal activity threatens the environment due to the use of low-level technologies; informality is also high among low-skilled drivers and auto mechanics in

the transport sector. Informal workers everywhere are by definition beyond the reach of government regulations on the environment, and are unlikely to receive the training they need to upskill or reskill for the green transition.

- **Lack of enforcement or weak implementation of environmental legislation** continues to be a problem in many countries. In Bangladesh, the strong growth in renewable energy stands in contrast to other sectors that are not greening, but could have potential for green employment, such as materials management, telecommunications, transport, brick-making and ready-made garments; the lack of progress in these sectors is attributed primarily to inadequate policy and institutional support beyond renewable energy.
- **Market opportunities for green products and services are often poorly developed.** Such markets often need government support to get started. Many countries lack adequate incentives for greening industries (e.g. tax subsidies) and systems for certifying and regulating green products. Furthermore, even in HICs where green entrepreneurship is comparatively well developed, the period since 2011 demonstrates that government subsidies and incentives might need to be continued for some time before markets become self-sustaining.



5. CHANGING OCCUPATIONS AND SKILLS COMPOSITION OF OCCUPATIONS

The green transition continues to affect existing occupations, requiring re-skilling and/or upskilling, and – more rarely – to create new green occupations. New occupations tend to emerge at higher skill levels, whereas lower-skilled occupations tend to require just more environmental awareness or simple adaptations to work processes. It is unclear how many occupations may have been “greened” since 2011; these processes take time and tend to be incremental. At the sectoral level, renewable energy and environmental goods and services have seen most developments. Most construction occupations have also been affected in some way. Agriculture, though subject to significant green challenges, appears not to have undergone significant changes in skills so far. In manufacturing, demand for skills for green jobs is very variable. Skills for green jobs are of both a technical (occupationally specific) and generic (core skills) nature. Skills gaps and shortages are likely to be widespread. Developing countries are especially challenged by skills deficiencies at higher levels, while developed countries suffer from gaps and shortages in both technical and soft skills.

This chapter examines the nature of occupational skills change related to the green transition to date (Chapter 6 analyses future occupational and skill needs). It then examines how occupations are changing in the sectors most strongly affected by the green transition, before turning to an examination of the skills in demand, and the nature of the skills gaps and shortages that have emerged, as the green transition has gathered momentum.

5.1 How occupations and skills change as economies go green

Occupations and skills change as products and services change. New products and services, such as those involved in the green transition, introduce new work tasks which, in turn, require people to learn new skills and gather sets of the right skills. In the green transition, we see this process playing out in two main ways:

- **Existing occupations** may undergo reskilling or upskilling as existing skills are applied to new products or materials (which require new knowledge) or new skills are added into the mix of existing skill sets. For example, many construction occupations now involve the use of new green materials, requiring new knowledge and techniques.
- **New green occupations** emerge for sets of work tasks that require new bundles of skills. Solar-panel installers or wind-turbine technicians fall into this category. There may also be hybrid occupations that build new job profiles by uniting various specialist areas, such as that of agricultural meteorologist in developing countries, which combines expertise in both meteorology and agricultural sciences.

Neither of these processes is necessarily straightforward or simple, as the example in box 5.1 demonstrates.

Box 5.1 How occupations evolve as a sector goes green: Construction in Senegal

In Senegal, a plant grown locally, typha, is being used in the production of insulation materials. The production and use of these new materials require skills that can be classified into four main categories:

- engineering and technical skills (in the fields of design, architecture, eco-design, construction and technological evaluation);
- scientific skills (in physics, chemistry, etc.) that are required at the beginning of the value chain (research and development);
- operational management skills (in life-cycle management or in cooperation with external players, including regulators or clients);
- supervisory skills (to ensure compliance with technical criteria, and with laws and environmental standards).

None of these skills are in themselves new, but the mastery of environmental issues implies a major change in professional practices, with impacts on a significant number of building trades. The term “environmental management” is now also used in respect of buildings, signalling a need to take into account the life cycle of the building as a whole with respect to its environmental impacts and energy performance, from the eco-design phase to the renovation phase. These new, more environmentally friendly approaches require professionals to acquire more specialized expertise, including some skills drawn in from other trades (e.g. upstream analysis of environmental impact, concerted interventions with other professionals to meet energy performance requirements, and advisory capacity and environmental awareness on the part of site managers).

Source: *Skills for green jobs in Senegal* (ILO, 2018).

What determines whether an existing occupation is greened or a new one emerges? This depends largely on the degree of skill change, as noted in the 2011 report: where this is substantial, a new occupation emerges. It also depends on decisions taken by various stakeholders (social partners, training institutions, government ministries, the education and skills policy community) who might be involved in determining whether a new occupation needs to be formally designated and included in the national system of occupational classification. Occupations can become formalized through the creation of new qualifications and/or inclusion in an official occupational database or register, such as occurs in Germany under the auspices of employers through chambers of commerce with the involvement of trades unions. In other countries, such as the United Kingdom, such official processes of definition and recognition do not exist at all for most occupations, and there is a highly flexible labour market. These two examples arguably represent opposite ends of a continuum; most countries will have processes that fall somewhere in between. Certainly, these processes vary from country to country.

The nature of occupational and skill change also varies according to skill level. It has already been established that most new green occupations are highly skilled since they require substantially new (scientific) knowledge and skills (Strietska-Ilina et al., 2011, p. 98). Table 5.1, based on the 2018 country reports, shows the nature of change across the skill spectrum, divided into three categories. It is clear from these reports that all occupations are changing in some way as a result of the green transition, even if this involves no more than greater environmental awareness, and activities like ensuring waste materials are recycled. This applies especially to low-skilled occupations. At the medium skill level, the degree of occupational change varies; some occupations are changing and some new ones are emerging.

Table 5.1 Changes in skills as a result of the green transition, by skill level

SKILL LEVEL	NATURE OF CHANGE	EXAMPLE OCCUPATIONS
Low-skilled occupations	Generic change, i.e. environmental awareness; simple adaptations to work procedures	Refuse/waste collectors, dumpers
Medium-skilled occupations	Some new green occupations Significant changes to some existing occupations in terms of technical skills and knowledge	New occupations: wind-turbine operators, solar-panel installers Changing occupations: roofers; technicians in heating, ventilation and air conditioning; plumbers
High-skilled occupations	Locus of most new green occupations Significant changes to some existing occupations in terms of technical skills and knowledge	New occupations: agricultural meteorologists; climate-change scientists; energy auditors and energy consultancy; carbon-trading analysts Changing occupations: building facilities managers; architects; engineers

Source: Authors' analysis based on *Skills for green jobs* country reports (ILO, 2018).

The example in box 5.2 illustrates this variance in the “green response” of occupations by level of skill involved.

Box 5.2 The skills response in construction in the Philippines

Training in green practices is more important for some occupations than for others. For example, although the work of construction labourers might be different on a green construction site, these workers usually do not require much specialized training. Specialist trade workers – who need to be proficient in installing energy- and water-efficient appliances and who might use new techniques – usually require more training. Those in design occupations, such as architects and engineers, require a considerable amount of education and training specific to green construction.

Source: *Skills for green jobs in Philippines* (ILO, 2018).

The green transition can also give rise to new occupations that sit alongside existing ones. This is well demonstrated by the example from the Philippines presented in table 5.2.

Table 5.2 How new occupations exist alongside existing occupations in the Philippines

CURRENT JOB	NEW LOW-CARBON SKILLS NEEDED	NEW JOB
Electrician	Working on roofs; installation of solar panels	Solar PV fitter
Offshore oil/wind maintenance technician	Offshore wind technology	Offshore maintenance technician
Aerospace technician	Technology-specific knowledge	Wind-turbine technician

Source: *Skills for green jobs in Philippines* (ILO, 2018).

It is clear that the processes involved in moving from the introduction of new green products and services to the “solidification” of skills into existing or new occupations take time and are incremental in nature. It was noted in the 2011 report that many green occupations, and the skills required to pursue them, were then in a developmental stage (Strietska-Ilina et al., 2011, p. 97). It is not clear to what extent occupations might have moved out of this stage by now. In 2011 it was noted that national occupational databases are regularly updated, and that some green occupations had already entered national classifications, for example in the United States. It is difficult to form a clear picture of the rate at which, and the extent to which, green occupations have been placed in these databases since 2011, or new or revised qualifications have been placed in national qualifications frameworks or registers; all we can say at present is that the process has continued. For example, Spain has 21 TVET diplomas dedicated to green jobs, 17 of which have been created since 2010 (see table 7.2 below). The rate at which skills and occupations are formalized probably reflects the rate of change in individual sectors (see section 5.2 Occupational change in key sectors) and the mechanisms available in different countries.

It is important to acknowledge the possibility that new occupations may have similar skills content to existing occupations. Just as two occupations on a national database or register may share much content, so a green version of an existing occupation may share many skills with the original "pre-green" occupation. This is not surprising: new skill sets almost necessarily build on existing skill sets, and new occupational standards and qualifications are seldom, if ever, built from scratch with a blank sheet of paper, but rather adapted from existing standards and learning outcomes (Cedefop, forthcoming a). This point could be empirically tested by comparing occupational standards or learning outcomes in relevant qualifications (Cedefop, forthcoming b). However, it is clear that most countries still lack comprehensive data on occupational change and the content of new occupations related to the green transition, since the requisite structures and processes have not been put in place (there are a few exceptions, for example, France's Onemev). Occupations certainly emerge into databases/registers, but an overview is seldom taken of progress from the perspective of the green economy. This is probably because occupational standards and qualification design are dealt with through existing systems that are often organized on sectoral lines.

Furthermore, there is no guarantee that new qualifications will gain automatic acceptance in the labour market. For example, in the Republic of Korea, people holding the new qualification in renewable energy generation facility (solar power) cannot work on PV power generation facilities, since the Electricity Utility Act (2017) requires workers in the latter establishments to be qualified in electrical engineering (as a functional engineer or industrial engineer) or equivalent. In addition, there is some doubt as to whether the new qualification fully reflects the requirements of the job. Such difficulties slow down the pace of greening occupations. Close cooperation between stakeholders is required to avoid such obstacles.

5.2 Occupational change in key sectors

The degree of occupational change varies across sectors. Table 5.3 provides an indication of the nature and extent of occupational change most affected by the green transition up to 2018, as evidenced by the country reports. The table has been organized in, broadly speaking, descending order of sectoral change, beginning with sectors where the most significant changes are taking place, namely renewable energy and environmental goods and services. The construction sector is notable for the fact that the greening process is touching all occupations to some degree but is not creating new occupations to the same extent as in the first two sectors listed. Agriculture is also seeing changes, but evidence so far suggests the green transition has been patchy. Occupational change in manufacturing is highly variable. Effects in the remaining sectors included have to date been small in scale. Even though some change is implied in lower-skill occupations in many sectors, these typically only require only short training or on-the-job-learning, and so are not included in table 5.3.

Table 5.3 Nature and extent of occupational change in key sectors, to 2018

SECTOR	NATURE AND EXTENT OF OCCUPATIONAL CHANGE TO DATE	EXAMPLES OF NEW AND CHANGING OCCUPATIONAL PROFILES ^A
Renewable energy 	One of the most significant sectors for development of new occupational profiles, and common to all countries. New occupations may also come into being alongside closely related existing trades, e.g. in solar energy systems installation	Medium skill level: solar PV/wind turbine/biomass systems: installers, technicians, plant managers, quality engineers. Existing trades with new relevant knowledge and skills: electricians; plumbers; heating, ventilation and air-conditioning technicians High skill level: Engineers and system designers (overlap with manufacturing)
Environmental goods and services, including water and waste management 	One of the most significant sectors for occupational change, related to more careful management of environmental impacts and of the environment itself. Significant occupational change in waste and recycling, including research and development (R&D) functions to create new or improved waste management and recycling, collection of waste, management and operation of recycling facilities. Environmental consulting and environmental auditing are new occupations or groups of occupations. Currently more well developed in HICs than in other countries	Medium skill level: environmental engineering technicians, soil and water conservationists, environmental science and protection technicians including health and environmental engineering technicians High skill level: atmospheric and space scientists, soil and water conservationists, landscape architects, environmental engineers, climate-change analysts, environmental restoration planners, environmental certification specialists, environmental economists, industrial ecologists, water resource specialists and water/waste-water engineers, energy managers, energy auditors (Many of the above occupations may be performed by employees in larger companies in other sectors)
Construction and building 	Mainly skills being added on to and/or adapted by existing occupations; all main trades and professions likely to be increasingly affected in some way in all countries	Medium skill level: carpenters, plumbers, electricians, heating engineers, roofers, painters and decorators, plasterers, building services technicians High skill level: facilities managers; architects; engineers; energy auditors and energy consultancy (overlap with environmental goods and services)
Manufacturing 	All manufacturers will need new skills related to reduction of environmental impacts; this may involve new occupations, e.g. pollution control officers Greatest effects on manufacturers involved in design and manufacture of products for the “greenest” sectors, i.e. renewable energy (solar panel systems, wind turbines, biodigesters) and green construction (insulation, energy efficiency). Likely to involve mainly adaptations of existing occupations rather than wholly new ones, though eco-design is a new field	Medium skill level: occupations related to reducing environmental impacts, e.g. pollution control officers, energy auditors (overlap with environmental goods and services) High skill level: occupations related to design and production of new products and systems, e.g. product designers, production engineers

Table 5.3 (cont'd)

SECTOR	NATURE AND EXTENT OF OCCUPATIONAL CHANGE TO DATE	EXAMPLES OF NEW AND CHANGING OCCUPATIONAL PROFILES ^a
Agriculture and forestry 	Mainly skills being added on to and/or adapted by existing occupations Greatest effects in occupations likely to be felt at higher skill levels where new occupations in demand. Evidence of extensive and substantial change lacking; in some HICs, little evidence of widespread adoption of greener skills	Medium skill level: adoption of organic farming techniques; growth of agricultural technicians involved in crop diversification; application of improved technologies High skill level: soil and water conservationists, environmental restoration planners, environmental certification specialists, environmental economists, water resource specialists and water/waste-water engineers, agricultural meteorologists
Transportation 	Mostly changing existing occupations through addition of knowledge and skills, e.g. eco-friendly driving to reduce emissions; use of electric vehicles; conversion of existing vehicles to new technologies such as compressed natural gas requiring new knowledge and skills among vehicle mechanics/technicians	Medium skill level: occupations related to use, conversion (greening) and maintenance of existing vehicles High skill level: R&D occupations related to design of greener transport systems, e.g. engineers, systems analysts
Tourism 	Mostly changing existing occupations through addition of knowledge and skills, e.g. eco-tourism	Medium skill level: occupations related to eco-tourism
Extractive industries 	Mostly changing existing occupations through addition of knowledge and skills. Evidence of widespread effects to date lacking	High skill level: R&D occupations related to design of greener extractive processes systems, e.g. engineers

^a The occupations listed offer examples of occupational titles; the list is not exhaustive.

Source: Authors' analysis based on *Skills for green jobs* country reports (ILO, 2018).

One important feature of the green transition in relation to occupations highlighted by table 5.3 is that its effects often spread across sectors and involve a wide range of occupations. The example in table 5.4 provides a good illustration of this, showing the variety of occupations needed to bring the wild plant typha into use as an insulation material for sustainable construction and as a source for bio-energy to support livelihoods in Senegal.

Table 5.4 Occupations needed for the development and use of the typha plant as an insulation material in Senegal

FUNCTION(S) PERFORMED	OCCUPATIONS REQUIRED
Harvesting and drying the typha	Farm worker, machinery operator
Transport of raw material for storage	Carter, driver, apprentice driver
Delivery of raw material	Driver, merchant
Artisanal transformation	Basket-maker/weaver
Design and development of materials (blocks, panels, etc.)	Eco-designer, control officer in the laboratory of industrial analysis, industrial chemical analysis technician, industrial product development engineer
Acquisition of production equipment	Metal/ironworker, industrial equipment installation technician, after-sales service maintenance technician
Initial material processing	Production team leader, grinding machine operator, labourer
Materials production	Masonry leader, construction materials extrusion machine operator, bricklayer, mason, labourer, production equipment maintenance technician
Distribution of materials for construction	Merchant
Design of bioclimatic buildings	Eco-designer, construction architect, acoustic engineer, civil engineer, construction energy efficiency and HVAC engineer, engineer for cost estimation of building and public works
Construction of new buildings	Masonry leader, brick/blockmason and finisher, thermal insulation installer, plasterer, sealing applicator, thatcher, roofer, composite wood materials installer, team leader, construction site manager, climate engineering works manager, construction acoustician, construction energy efficiency engineer
Retrofitting/renovation of existing buildings	Energy retrofit work manager, renovation mason, construction energy efficiency engineer
Maintenance and servicing of typha materials in buildings	Bio-based materials maintenance technician, bio-based materials servicing technician
Recycling of typha materials in dismantled old buildings	Recycling technician, recycling operator
Training	Trainer researcher
Regulation	Construction, climate and energy engineer; construction acoustician, architect, construction cost technician, real estate diagnostician
Monitoring of regulations	Energy management consultant, thermal compliance inspector, construction energy efficiency engineer, acoustic engineer, real estate diagnostician
Communication	Environmental communication officer, environmental awareness-raiser/trainer

Source: *Skills for green jobs in Senegal* (ILO, 2018).

5.3 Types of skills in demand in the green transition

The green transition involves both technical, occupationally specific skills and generic, soft skills. Regarding technical skills, renewable energy provides a good illustration of the wide variety of skills that can be required (see table 5.5), although this is perhaps the most extreme example to be found since it is the field of greatest occupational and skills development.

Table 5.5 Occupations and skill sets in current and future demand in the renewable energy sector: The example of Barbados

CURRENTLY IN DEMAND	EMERGING NEEDS
Occupations • Electricians (certified) in dealing with both alternate (AC) and direct (DC) current • Electrical and mechanical engineers • Solar PV designers with understanding of electrical code compliance • Site assessors able to use satellite imagery • PV installers able to read and understand drawings and skilled in using hand tools • Energy auditors able to conduct audits, with sound scientific knowledge and familiarity with system dynamics • Plumbers familiar with solar heating systems	Occupations • Non-roof installers (ground/pole/ballast) • Mechanics able to work on electric batteries and fuel-cell technology • PV designers able to design batteries and off-grid systems • Engineering designers with retrofit design knowledge for sustainability (renewable energy/energy efficiency, air flow and quality, waste-water re-use etc.)
Other knowledge and skills • Energy conservation and energy efficiency knowledge and skills • IT networking skills • Sound knowledge of inverter and converter systems • Knowledge of construction standards and practices • Project management training and experience • Health and safety training	Other knowledge and skills • Knowledge of hybrid systems • Micro-grid knowledge (energy resources, generation, loads and boundaries) • Knowledge of wind-turbine technology, marine and aquatic skills, vertical wind technology • Knowledge of smart grid technology • Knowledge of waste energy systems (anaerobic digestion processes and related systems) • Electrical and computer skills for energy management systems to automatically manage solar, AC, DC and grid connectivity • Smart metering knowledge and training • Energy storage knowledge with engineering skills for batteries (lithium), compressed air tanks, water, and synthetic and alternative fuels • Advanced meteorology with application to PV systems • Agriculture cold storage using PV systems • Aquaponic and hydroponic knowledge • Smart and sustainable farming training • Wind turbine technology for fishing vessels

Source: *Skills for green jobs in Barbados* (ILO, 2018).

Renewable energy also illustrates well an important characteristic of skills related to the green transition: the way in which the skills demand for new green products and services sends ripples throughout supply chains from design and manufacture through to installation and operation. The case of India, shown in table 5.6, is a good example.

Table 5.6 Skills gaps in renewable energy in India, from product design to installation

SECTOR	AREAS	SKILLS GAPS
Bioenergy	R&D	• Knowledge on oil-bearing trees e.g. jatropha • Specialized knowledge on biodiesel, agronomy, crops, soil and climate research • Pest and disease control
	Project management	• Project implementation, management, planning and coordination
	Manufacturing	• Design and fabrication skills in biomass gasifiers • Hot gas conditioning systems • Process design
	Construction/ installation	• Erection and commissioning of large-scale and on-grid biomass power projects
	Operation	• Handling of biomass-based combustion systems • Maintenance and repair • Logistics in biomass collection
Solar	R&D	• Exposure to advanced technologies in e.g. wafers and semiconductors • Design skill in installing building-integrated PV
	Project management	• Project implementation, management, planning and co-ordination especially in handling concentrated solar power
	Manufacturing	• Module assembly • System integration in solar PV
	Construction/ installation	• Erection and commissioning of large-scale and on-grid solar power projects • Erection skills in third party installers • Grid integration of mega-projects
	Operation	• Troubleshooting solar PV circuits • Techno-commercial marketing skills • After-sales service and customer care
Wind	R&D	• Offshore wind technology • Wind resource assessment • Optimization of engineering design • Battery technology • Fatigue-resistant materials • Design of step-up gearbox
	Project management	• Design technique to match wind resource, rating and installation
	Manufacturing	• Manufacturing of high-capacity turbine gearboxes • Fabrication of wind-turbine blades of complex design
	Construction/ installation	• Installation of high-capacity wind turbines
	Operation	• Failure analysis of gearboxes

Source: *Skills for green jobs in India* (ILO, 2018).

Table 5.7 Main core skills required for green jobs, by skill level of occupation

Required across the labour force	• Environmental awareness and respect; willingness to learn about sustainable development • Adaptability and transferability skills, to enable workers to learn and apply the new technologies and processes required to green their jobs • Teamwork skills, reflecting the need for organizations to work collectively on tackling their environmental footprint • Resilience, to see through the changes required • Communication and negotiation skills, to promote required change to colleagues and customers • Entrepreneurial skills, to seize the opportunities of low-carbon technologies and environmental mitigation and adaptation
Required in medium- to high-skilled occupations	• Analytical thinking (including risk and systems analysis) to interpret and understand the need for change and the measures required • Coordination, management and business skills that can encompass holistic and interdisciplinary approaches incorporating economic, social and ecological objectives • Innovation skills, to identify opportunities and create new strategies to respond to green challenges • Marketing skills, to promote greener products and services • Consulting skills, to advise consumers about green solutions and to spread the use of green technologies • Networking, IT and language skills, to perform in global markets • Strategic and leadership skills, to enable policy-makers and business executives to set the right incentives and create conditions conducive to cleaner production and cleaner transportation

Source: Authors' analysis based on *Skills for green jobs* country reports (ILO, 2018).

Skills development in the sector could be further boosted by innovative schemes led by private companies that are prepared to equip their workers with skills, knowledge and operational expertise alongside their investment in renewable energy: for example, Oxygen Energy is planning an initiative of this kind in collaboration with the Midlands State University Incubation Hub and other stakeholders.

Alongside such technical skills, core (or soft) skills are also in demand across the labour force. These are largely unchanged since 2011. Some core skills are needed by all workers, regardless of the general skill level of their occupation; medium- to high-skilled occupations may require additional skills of this kind, as shown in table 5.7.

Skills gaps and shortages are almost inevitable whenever any new product or service appears, and the green economy is no exception. Poorly developed skills anticipation systems (see subsection 7.2.1. "Anticipating and monitoring skills needs") currently limit countries' ability to identify likely skills gaps, and to analyse future training needs and shortages systematically and comprehensively. Nonetheless, there are enough examples to suggest that gaps and shortages are likely to be widespread, especially in LICs, and to constitute a constraint in the transition to a green economy. No evidence was found to suggest that this situation might have improved since 2011.

Both general and specific gaps and shortages exist. General types of shortage have been identified in Brazil, where they include the needs for better understanding environmental legislation and its rationale; better environmental awareness throughout the workforce, so that production processes can be greened in a “bottom-up” way, rather than imposed “top-down”; better understanding of the science behind the green imperative through general school education; and more widespread “environmental citizenship”.²⁵

As noted above, many of the most important changes in skills and occupations for the green economy are taking place at higher skill levels, requiring education at university level. This represents a critical challenge for many LICs, where high-level skills in general tend to be in short supply. In Ghana, for example, a lack of professionals such as engineers, technicians and technologists is a critical part of the skills challenge; less than a fifth of university graduates pursue programmes related to science, technology, engineering and mathematics (STEM) skills. In Bangladesh, most higher-level skills (in environmental science, economics, engineering, industrial ecology etc.) are acquired through foreign education and training; the supply of relevant education is inadequate, requiring further skills development programmes. There is also a challenge in terms of the availability of training and development professionals and human resource professionals, who play a key role in linking up skills training with the greening of the economy, as noted in Ghana.

Specific skills gaps related to the green transition are myriad and depend on the specific work processes involved (as table 5.6 also demonstrates). They also span a range of skill levels: it is not just high-level skills that are often in short supply, but medium-/trade-level skills as well, as the example from Bangladesh in table 5.8 demonstrates.

Skills gaps and shortages are not confined to LICs. In the United States, the solar energy industry experienced rapid growth to 2016, and at that point some 80 per cent of firms in the industry reported difficulty in finding qualified applicants to fill vacancies. The positions that were catalogued as most difficult to fill in 2016 included those of sales, marketing and customer service personnel; managers, directors, supervisors or vice-presidents; engineers; installers; and electrician/construction staff. As is clear from this list, many of these occupations are not new green occupations: some, e.g. those in sales and marketing, have a high generic skill component but “green” knowledge, in this case of solar energy, would also be a vital element. Similarly, in 2017 it was found that about 70 per cent of wind power generation businesses in the United States had difficulty hiring qualified applicants, while about three-quarters of employers in US “energy efficiency” businesses found hiring qualified workers to be either “very difficult” (31 per cent) or “somewhat difficult” (45 per cent).

As for the reasons why employers face recruitment difficulties, in most countries such information is not routinely gathered. While the reasons will be highly specific to the labour markets of individual countries, regions and localities, it is nonetheless informative to consider data from the United States. Regarding the solar energy sector referred to above, applicants were frequently found to be deficient in two major ways: (1) lack of experience, training or technical skills; and (2) insufficient

25. “Environmental citizenship” is the idea that each of us is an integral part of a larger ecosystem and that our future depends on each one of us embracing the challenge and acting responsibly and positively towards our environment. See: <http://www.cep.unt.edu/citizen.htm> [accessed 24 Nov. 2019].

Table 5.8 Shortages in skills for green jobs in Bangladesh

SECTOR	OCCUPATIONS EXPERIENCING SKILLS SHORTAGES
Agriculture and fisheries	<i>Agriculture</i> : sustainable agriculture specialists; precision soil conservation technicians <i>Shrimp cultivation</i> : graders, scalers, de-headers, machine operators
Construction	Brownfield redevelopment specialists and site managers; masons Sustainable design specialists
Environmental goods and services	<i>Carbon trading</i> : carbon-credit traders, carbon-trading analysts and investment underwriters <i>Climate adaptation</i> : geospatial information scientists and technologists <i>Waste management</i> : hazardous waste management specialists, solid waste (energy) specialists
Manufacturing	<i>Brick manufacture</i> : brick-making technologists and supply chain managers <i>Leather tanning</i> : supervisors and machine operators <i>Ready-made garments</i> : electrical, dyeing and textile engineers, supervisors, machine operators
Renewable energy	Solar energy installation managers, solar PV installers and technicians
Transport	Compressed natural gas engineers and technicians in fuel-efficient transport

Source: *Skills for green jobs in Bangladesh* (ILO, 2018).

qualifications (certifications or education). The next most significant factors in hiring difficulties were the small size of the applicant pool and insufficient non-technical skills (e.g. work ethic, dependability, critical thinking). In the wind energy sector, the main reasons included lack of experience, training or technical skills (44 per cent); insufficient qualifications, certification or education (33 per cent); and competition for a small applicant pool (19 per cent). A 2018 survey of US employers found that 84 per cent of construction employers, 82 per cent of professional and business employers and 72 per cent of manufacturing employers in energy efficiency reported that it was somewhat difficult or very difficult to hire new employees. The main causes of hiring difficulties were lack of experience and insufficient technical skills, insufficient non-technical skills and a small applicant pool (see table 5.9).

It is, however, important to note that difficulty in filling vacancies is a fairly imprecise proxy for measuring skills shortages. As the EU Skills and Jobs Survey (Cedefop, 2015) revealed, only around one-third of reported skills shortages are due to a genuine lack of skills and qualifications; other reasons include uncompetitive salaries and poor human resources management practices. It is therefore important to improve working conditions and make markets work to resolve some skill shortages by offering competitive wages. Mobilizing social dialogue for this purposes appears vital.

Table 5.9 US energy efficiency sector: Reasons for hiring difficulty by industry, Q4 2018

CONSTRUCTION	MANUFACTURING	WHOLESALE TRADE, DISTRIBUTION AND TRANSPORT	PROFESSIONAL AND BUSINESS SERVICES
Lack of experience, training or technical skills (48%)	Lack of experience, training or technical skills (55%)	Lack of experience, training or technical skills (49%)	Lack of experience, training or technical skills (40%)
Competition/small applicant pool (24%)	Insufficient non-technical skills (39%)	Insufficient non-technical skills (27%)	Competition/small applicant pool (22%)
Insufficient non-technical skills (24%)	Difficulty finding industry-specific knowledge, skills and interest (18%)	Competition/small applicant pool (19%)	Insufficient qualifications, certifications, education (19%)

Note: Percentages refer to proportion of employers who mentioned hiring difficulties.

Source: NASEO and EFI, 2019.

5.4 Conclusions

The green transition is bringing about a wide range of changes in skills and, where there is a high degree of skills change, is giving rise to new occupations. The nature of occupational and skills change varies by skill level. The most important changes have been taking place at medium to high skill levels, and most of the new occupations that have been emerging are highly skilled.

The pace of change varies from country to country, depending partly upon the pace of change in industry but also upon institutional arrangements by which qualifications are developed and occupations are formalized. In the initial stages of skills change, private companies reskill or upskill staff according to their immediate needs (as examined further in subsection g”), but over time, other processes in the public domain come into play alongside this firm-level training. In some countries, there are long-established and well-developed approaches for setting formalized occupational and qualification standards, involving both public authorities and social partners, while in others they are still undergoing development. Since 2011, countries have continued to issue new qualifications and to give formal recognition to new occupations by incorporating them into occupational databases, though it is difficult to gauge the overall rate and scale of such changes.

The pace of change also varies across sectors. Most developments in skills and occupations have been in areas such as renewable energy and waste management, where the rate of change has been rapid. Other sectors, such as tourism, have yet to feel the full effects of the green transition. An important driver here is legislation, as we saw in Chapter 3, “3. Key challenges: The policy context”, and how well it has been enforced. For example, legislation on building insulation and recycling plays a key role in the development of skills in construction and manufacturing.

A wide range of both technical and core skills is needed to support the green transition. Furthermore, any single innovation tends to have effects on skills and occupations spreading widely across sectors, rippling through supply chains from the research and development stage to end-use by businesses and consumers, and into subsequent service activities. Most countries lack comprehensive information on gaps and shortages related to skills for green jobs, but these gaps and shortages are likely to be widespread across countries and there is no evidence to suggest much improvement since 2011. Gaps at high skill levels constitute a particularly important challenge for LICs, which tend to struggle in this respect more generally. But even for HICs, including those with well-developed skills anticipation systems, a lack of both technical and soft skills remains an important cause of recruitment problems for employers. After examining the future prospects of jobs and skills in the green transition in two scenarios in Chapter 6, we turn in Chapter 7 to look at measures that have been put in place to try to address the skills-related challenges considered in this and in the next chapter.



6. QUANTIFYING OCCUPATIONAL SKILL NEEDS IN THE ENERGY SUSTAINABILITY AND CIRCULAR ECONOMY SCENARIOS

Quantitative modelling and real-time big data analysis of job advertisements reveal the implications for occupations, skills and gender of two dimensions of a green economy: energy sustainability, or decarbonization; and the circular economy, or material use efficiency. The overall net employment effects will be positive; the associated creative destruction of jobs will have greatest effect on male-dominated medium-skill occupations, where most of the job creation and reallocation will occur. Three main impacts are expected: first, some of the jobs destroyed in an industry will be in occupations replicated in growing industries in the same country, offering job openings in which workers from shrinking industries can potentially find employment; second, net new jobs will be created that require relevant skills and adapted formal training for potential labour market entrants; third, some jobs will be lost without vacancies opening in the same occupations in different industries. Workers able to reallocate within the same occupation will be able to re-use soft as well as semi-technical or technical transferable skills, but will need some additional training. Workers who cannot reallocate can still reskill and upskill in order to benefit from the new jobs created in different occupations. This shift in occupational skill needs will require a complex set of policy measures, including reskilling and upskilling, active labour market policies, career guidance, targeted training measures to promote gender balance, and measures to facilitate workers' mobility and their social protection.

Previous chapters in this report have presented qualitative analysis based on 32 country studies. This chapter takes a quantitative approach, using a multi-regional input-output model (EXIOBASE v3) to analyse transactions between 163 industries across 44 countries. Drawing on the energy sustainability and circular economy scenarios explored by the ILO (2018), the chapter expands on the earlier results to take the analysis beyond industry-level estimates, quantifying the implications of the transition to low-carbon and resource-efficient economies for occupational skills and gender. The chapter further analyses real-time big data on scraped vacancies to explore further the skills composition of occupations affected by change under the two scenarios and related retraining needs.

6.1 Estimated employment effects of a transition to environmental sustainability

Measures taken to implement the Paris Agreement, with the aim of limiting the global rise in temperature to 2°C and further to 1.5°C compared to pre-industrial times, including those planned through NDCs (see chapter 3.1.5), will affect both the quantity and composition of employment. This chapter focuses on two important elements of the transition to environmental sustainability – the transition to clean energy and the adoption of the circular economy – that will affect the number of jobs in the economy and their distribution across economic sectors (ILO, 2018a; Montt, Wiebe et al., 2018).

Previous analyses have highlighted the changes likely to occur in the distribution of employment across industries. The ILO (2018) and Montt, Wiebe et al. (2018) note, for example, that in a scenario of energy sustainability employment will increase in the construction, electrical machinery manufacturing and copper mining sectors, while decreasing in the petroleum refinery and extraction, coal mining and coal-based electricity generation sectors. The ILO (2018), Wijkman and Skånberg (2016) and Wiebe et al. (forthcoming) highlight the reallocation of employment from extractive industries to reprocessing following the adoption of principles associated with the circular economy.

Previous estimates of the employment impact of the transition to energy sustainability or the circular economy have assumed that the labour market will adjust naturally to changes in demand for renewable electricity, energy efficiency, recycling and other “green” goods and services. However, the transition cannot take place if the skills to meet the demand for new jobs are not available in the labour market (ILO, 2018a; Strietska-Ilina et al., 2011).

The ILO (2018) explored the energy sustainability and circular economy scenarios and their effects on employment by industry. Here, further analysis expands on these previous results, moving beyond industry-level estimates to provide insights into occupational effects, quantifying for the first time the implications of the transition to low-carbon and resource-efficient economies for skills, gender and occupations.

In both the sustainable energy and the circular economy scenarios, job creation outpaces job destruction. Net job creation stands at around 18 million in the energy sustainability scenario and at more than 7 million in the circular economy scenario. Many of the jobs destroyed can be reallocated: that is, for most jobs lost, a job in the same occupation opens up in the same country in another industry. Reallocation in this way could fill almost 40 million new jobs in the circular economy scenario and more than 5 million jobs in the sustainable energy scenario. However, irrespective of efforts to reallocate jobs in this way, some jobs will be destroyed without vacancies opening for the same occupation in another industry. This is the case for over 1.5 million jobs in the energy sustainability scenario and somewhat under 30 million jobs in the circular economy scenario. Nevertheless, these job losses can be avoided if workers are retrained for new occupations likely to emerge or expand under the two transition scenarios.

Our results also show that most job creation and reallocation is concentrated among medium-skill occupations, with the greatest impact on male-dominated occupations. The number of net new medium-skill jobs amounts to over 12 million

Box 6.1 Estimating green economy employment scenarios using EXIOBASE

The scenarios explored in this chapter were constructed using EXIOBASE v3, a multi-regional input–output model (MRIO) that maps the world economy and the linkages between industries across the world (Stadler et al., 2018). Estimating scenarios using MRIOs allows the simulation of detailed specifications of technologies and processes, with full understanding of the mechanisms generating the results. EXIOBASE v3 offers greater precision than other MRIOs, detailing the transactions between 163 industries across 44 countries and five regions. The scenarios estimate and localize at regional and industry level the numbers of both direct and indirect jobs expected to be created and destroyed under various scenarios.

All the scenarios estimate employment and environmental outcomes by 2030. Each specific environmentally sustainable scenario is compared to a business-as-usual scenario. All the scenarios draw on projections of GDP growth made by the IMF and the IEA, and of population growth made by the UN. The scenarios do not assume any windfall investment in the green economy, but assume that projected GDP growth and policy measures will promote investment in green technologies. Importantly, as is common in analyses based on MRIOs, relative prices and the world trade structure are assumed to remain constant. In making these assumptions, the models ignore adjustment effects but offer a clear picture of the linkages across industries and the sectors most affected under each scenario. If, for example, technological change drives down the cost of a specific green technology and the technology matures, the associated labour requirements could diminish, reducing the employment benefits of adopting this technology. Moreover, each scenario estimates the impact of a change in technology or in demand for a particular set of products. In order to identify the specific effects on each industry, the relative demand for other unspecified products and technological processes is deemed to remain unchanged. Also, to verify the specific impact of these scenarios, estimates do not take account of other drivers of the future of work, notably technological change, globalization and alternative business models. Technological change, unaccounted for in these models, may be particularly important in relatively immature industries which, as technology develops, may act to lower costs by improving material or energy efficiency or by reducing labour requirements.

Source: Adapted from ILO, 2018a. For further methodological details about the data set and the estimates, see ILO, 2018a, Appendix 2.1.

in the sustainable energy scenario and 8 million in the circular economy scenario.²⁶ The overall skills level in the economy will increase as a result of net job losses in low-skilled occupations (of a little under 10 million in the circular economy scenario) and some net job creation among high-skilled occupations (of almost 6 million in the circular economy scenario and 1.5 million in the sustainable energy scenario).

26. It could be that technological change will automate many of the medium-skill jobs created by the transition to energy sustainability and the circular economy. In the case of building and related trades workers, an occupation expected to see the creation of over 3.5 million jobs in a transition to energy sustainability, Frey and Osborne (2017) note that although this work requires a high degree of adaptability and is thus at low risk of automation, technologies that advance the prefabrication of construction components reduce the need for adaptability and increase the likelihood of automation. In the case of sales workers, an occupation expected to see the creation of almost 15 million jobs in a transition to the circular economy, Frey and Osborne (2017) suggest that while they require social intelligence, which is at low risk of automation, the majority of jobs held by sales workers require a low level of creative intelligence, putting them at high risk of automation. These arguments, and the methodology used to define which occupations are at risk of automation, have been criticized on the basis that they ignore the diversity of tasks that are automatable, which is likely to give rise to technology automating some of the tasks involved in a job rather than eliminating the job completely (see e.g. Arntz, Gregory and Zierahn, 2016; Autor, 2015).

Across both scenarios and at the occupational level, job creation is highest among sales workers, building and related trades workers, and labourers in mining, construction, manufacturing and transport, while reallocation is highest among metals, machinery and related trades workers, science and engineering associates and professionals, and drivers and mobile plant operators.

Sections 6.2 and 6.3 below set out in more detail the employment and skills implications under each scenario. Box 6.1 provides a methodological description of the estimation of employment projections at the industry level (for more details on how results at industry level were obtained, see ILO, 2018a; for details of the methodology used to obtain results at the occupation, gender and skill levels, see Annex 5 below).

6.2 Energy sustainability scenario

6.2.1 Redistribution of jobs across industries

The transition to energy sustainability implies change in the amount of energy produced and in the way it is produced, altering employment in the energy sector.²⁷ Furthermore, changes in the energy sector affect employment in other sectors, as businesses purchase goods and services that serve as inputs to energy generation. Indeed, the energy sector has comparatively strong linkages to the rest of the economy (WEF and IHS CERA, 2012), so changes in the energy sector spill over and affect employment throughout the economy.

The ILO (2018) finds that taking action in the energy sector to meet the 2°C goal, according to the IEA scenario, will create 18 million new net jobs by 2030. Job creation, estimated at close to 25 million jobs, will be highest in construction, the manufacture of electric machinery and the mining of copper ores. Job destruction, estimated at over 6 million jobs, is concentrated in petroleum extraction and refining, coal mining and the generation of electricity from coal.

Table 6.1 lists the industries that will experience the greatest job creation and destruction. Montt, Wiebe et al. (2018) note that although some countries or regions may experience comparatively small net job creation, they will still experience substantial labour market changes through reallocation.

6.2.2 Occupational and gender effects

The job potential associated with the energy transition will be realized if the labour market adjusts to changing demand for skills through geographical mobility, training and the provision of at least decent, if not better, working conditions and pay. For example, if global electricity production from solar energy is to increase by 59 per cent by 2030, as assumed in the energy sustainability scenario, skills demand in solar installation, solar panel manufacturing, and the mining and processing of silicon will increase. The ILO (2018) estimates that around 800,000 jobs will be created in the solar industry; other industries, such as construction and the

²⁷ Montt, Maitre and Amo-Agyei, 2018, map employment in the electricity generation sector against trends in the share of renewables, highlighting how the shift towards sustainability in electricity generation has created employment in the sector.

Table 6.1 Sectors most affected by the transition to energy sustainability, scenario to 2030

INDUSTRIES SET TO EXPERIENCE THE HIGHEST JOB DEMAND GROWTH		INDUSTRIES SET TO EXPERIENCE THE STRONGEST JOB DEMAND DECLINE	
SECTOR	JOBS CREATED (MILLIONS)	SECTOR	JOBS LOST (MILLIONS)
Construction	6.5	Petroleum refining	1.6
Manufacture of electrical machinery and apparatus	2.5	Extraction of crude petroleum and related services, excluding surveying	1.4
Mining of copper ores and concentrates	1.2	Production of electricity by coal	0.8
Production of electricity by hydropower	0.8	Mining of coal and lignite; peat extraction	0.7
Cultivation of vegetables, fruit, nuts	0.8	Private households with employed persons	0.5
Production of electricity by solar PV	0.8	Manufacture of gas; distribution of gaseous fuels through mains	0.3
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	0.7	Extraction of natural gas and services related to natural gas extraction, excluding surveying	0.2

Notes: Difference in employment by industry between the energy sustainability scenario and the IEA (2015) 6°C (business-as-usual) scenario by 2030. For further details on the data and methods used, see ILO, 2018a, Appendix 2.1.

Source: ILO, 2018a.

manufacture of electrical machinery – and their respective value chains – will also experience job gains, if skills for these jobs are available.

However, results at the industry level alone are of little use in seeking to identify the specific skills, skill levels or occupations that will be in higher demand, as they do not provide information about the types of jobs that will be created. Nor do they provide information about occupations likely to see jobs destroyed, or to require workers to reallocate to another industry or sector. To identify the likely occupational-level change, we use labour force surveys to analyse the typical occupational structure for each of the 163 industries analysed in ILO, 2018a. Annex 5 provides more details on how labour force surveys are used to identify the occupational structure of each industry.²⁸

28. As described in Annex 5, these results are based on the occupational structures observed in each industry around the year 2014, because there are no projections available for how the occupational composition of each industry will change in the future. Thus the results assume that, to a large extent, the respective shares of the occupations that made up a particular industry around 2014 will be similar in 2030. The same is true for the gender composition of these occupations. Annex 5 provides more details about this assumption and shows that it is a tenable one as most occupations have maintained a relatively constant share within industries over a five-, ten- or 15-year period.

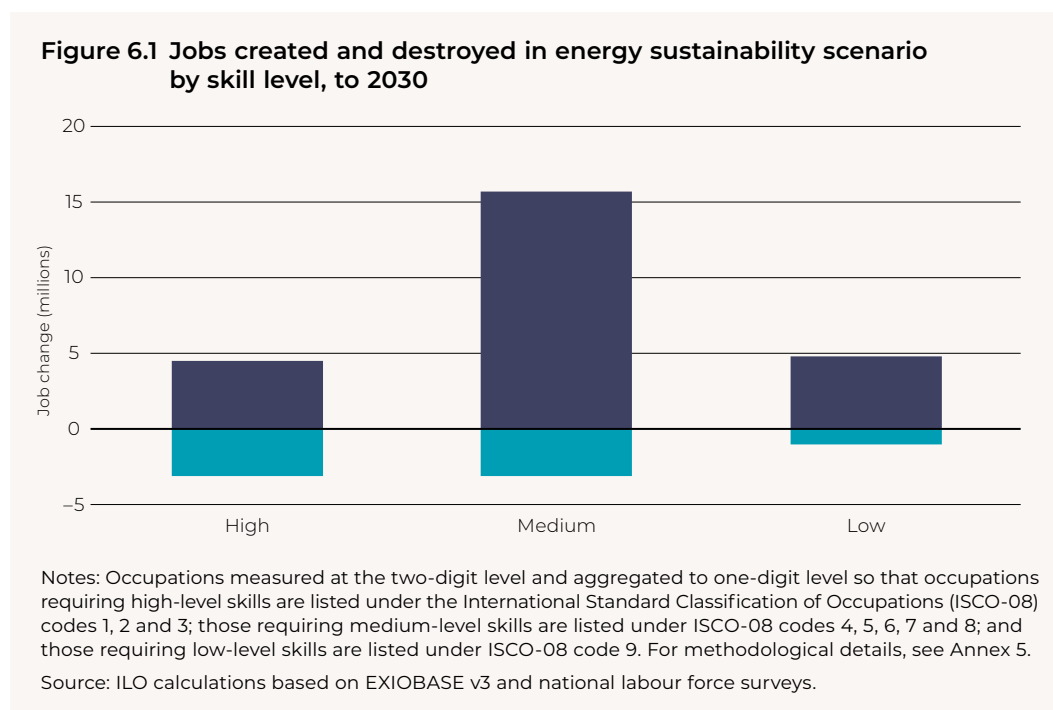


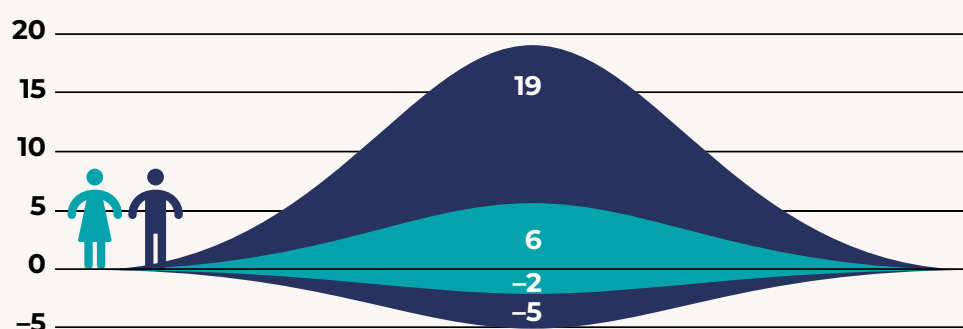
Figure 6.1 shows the expected change at high, medium and low skill levels, detailing the number of jobs at each skill level that will be created and destroyed across the globe. From this it is clear that job creation in the energy sustainability scenario is concentrated among medium-skill occupations. Of the nearly 25 million jobs created under this scenario up to 2030, almost 16 million fall into the medium-skill category; the remainder are distributed approximately equally among high- and low-skill occupations.²⁹ Job destruction is roughly equally distributed among high- and medium-skill occupations, with less impact at the low-skill level. For each skill level category, and on aggregate across the world, job creation is greater than job destruction. These results suggest that the growth in medium-skill level jobs under a transition to energy sustainability can partly offset the trend of skill-biased technological change in many advanced and emerging economies caused by medium-skill jobs being off-shored and replaced by automation.

Employment disruption is concentrated in male-dominated occupations. In the energy sustainability scenario and also in the business-as-usual scenario, both job destruction and job creation are concentrated in occupations in which a majority of the workforce are men. As a result, as shown in figure 6.2, though the energy transition will tend to destroy jobs currently occupied by men, it will also create many more job opportunities in occupations that are predominantly occupied by men.

This gender effect highlights a key assumption of the model underlying this chapter. The projections assume that underlying trends – except for those explicitly modelled – remain the same. This applies to the industrial and trade structure of countries (those which stand to benefit the most are those that have already developed the industries that will grow the most in an energy transition) and to the

²⁹ Following common practice in the literature, we take high-skilled occupations to be those listed under ISCO-08 codes 1, 2 or 3; medium-skill occupations as those listed under ISCO-08 codes 4, 5, 6, 7 or 8; and low-skill occupations as those listed under ISCO-08 code 9.

Figure 6.2 Jobs created and destroyed in energy sustainability scenario by gender, to 2030 (millions)



Note: For methodological details, see Annex 5.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

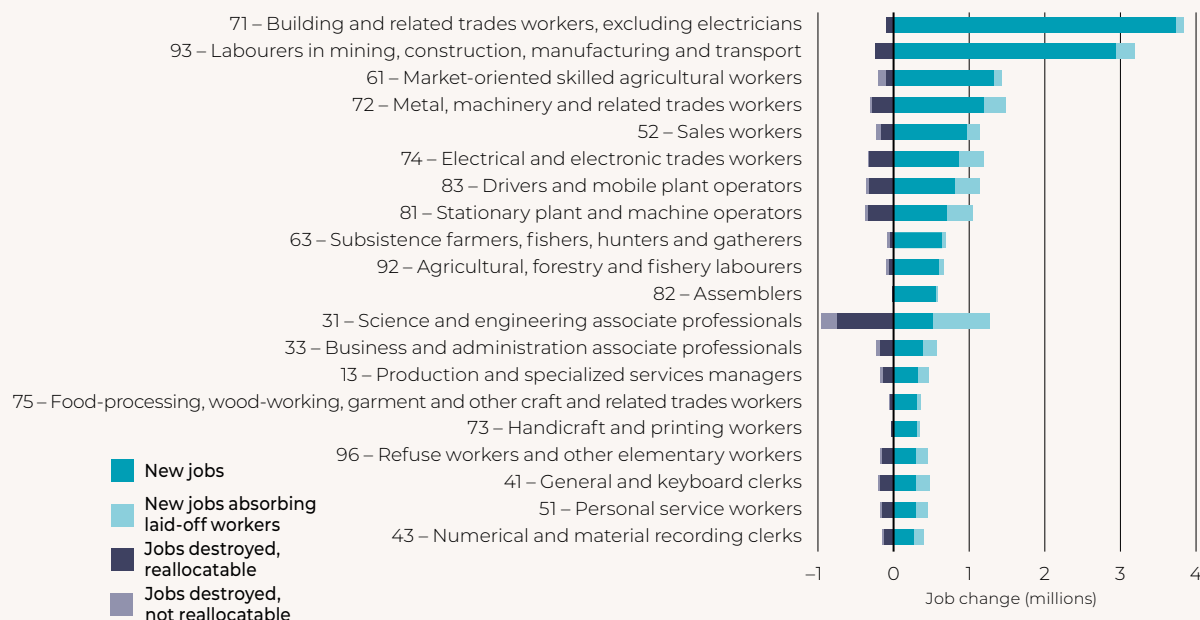
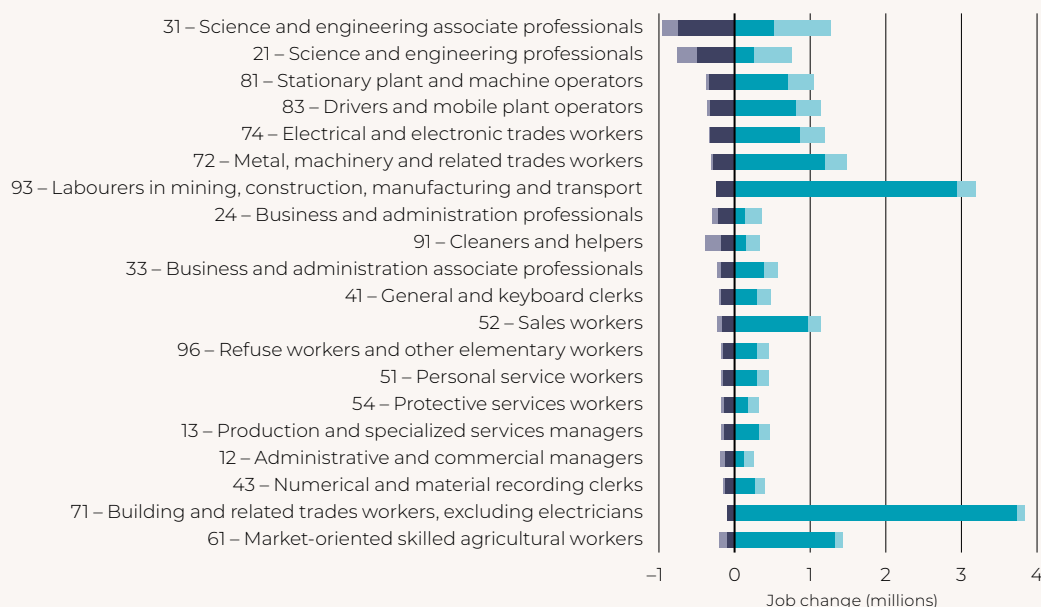
gender distribution of workers across occupations. However, to make this assumption is not equivalent to predicting that the gender projection will be realized, as it is subject to policy decisions. The formulation of skills development policy must thus take this into account and consider gender so that the energy transition does not accentuate gender inequalities. Without policy interventions to facilitate women's access to training and jobs in occupations that will expand under the energy transition, that transition will very probably create more employment opportunities for men than for women.

Overall, nearly 25 million jobs will be created in the transition to energy sustainability. Of these, over 5 million can be filled through reallocation, whereby workers who may lose their jobs because of the downsizing of particular industries will find that jobs become available in the same occupation in another industry within the same country. As result, a little under 20 million new jobs will be created which will not be filled through reallocation and which will require workforce trained in these occupations.

Between 1.5 and 2 million workers whose jobs are lost owing to the energy transition may not find equivalent vacancies in another industry: these jobs are not reallocatable. However, of the 84 occupations analysed, fewer than five will experience net job destruction of more than 100,000 jobs worldwide, meaning that for the vast majority of the 7 million workers who will potentially lose their jobs because of the downsizing of particular industries, a job in the same occupation but another industry will appear.

6.2.3 Changes in specific occupations

Some occupations will experience high levels of job creation with little or no job destruction, requiring a policy focus on skills development. Other occupations will experience high levels of both job creation and job destruction, requiring a policy focus on reskilling and reallocation of workers across industries with some retraining to adapt workers' skills to the new sectoral context. Figure 6.3 identifies the 20 occupations which will experience the highest levels of net job creation (Panel A) and those which will experience the highest levels of reallocation (Panel B). Annex 6 provides more detailed estimates for each occupation, along with the skill level associated it.

Figure 6.3 Jobs created and destroyed in an energy transition scenario by occupation, to 2030**Panel A. Occupations with the highest number of new net jobs created in a low-carbon energy scenario****Panel B. Occupations with the highest reallocation of jobs across industries or economies in a low-carbon energy scenario**

Notes: Occupations measured at the ISCO-08 two-digit level. Panel A shows the 20 occupations with the highest level of new jobs. Panel B shows the 20 occupations with the highest level of new jobs absorbing laid-off workers. "New jobs absorbing laid-off workers" are jobs that can be filled by similar (reallocatable) jobs lost in other industries in the same country or region ("Jobs destroyed, reallocatable"). "New jobs" are jobs created that cannot be filled by jobs lost in similar occupations from other industries in the same country or region. "Jobs destroyed, not reallocatable" are jobs for which vacancies in the same occupations in other industries within the same country or region will not be found. See Annex 5 for methodological details and Annex 6 for the underlying data for all occupations.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

The occupations that will experience the highest level of new net jobs (Panel A, ■ bar), requiring the skilling of new workers as well as those who may need to move from one industry to another, include building and related trades workers (ISCO-08 two-digit code 71: over 3.5 million), labourers in mining, construction, manufacturing and transport (93: almost 3 million), and market-oriented skilled agricultural workers (61), metal, machinery and related trades workers (72) and sales workers (52): over or almost 1 million each. As described further below, a circular economy scenario displaces many workers in construction and labourers in mining, suggesting that these new net jobs could be filled through reallocation if efforts to promote energy sustainability are made in parallel with those to establish a circular economy.

Other occupations will experience both creation and destruction of jobs, prompting workers to bring their skill sets to other industries in the same countries (see Panel B: new jobs, absorbing laid-off workers – ■ bar; and lost jobs, reallocatable – ■ bar). This will entail the reallocation of almost 750,000 science and engineering associate professionals (31), around 500,000 science and engineering professionals (21), and over 300,000 each of stationary plant and machine operators (81), drivers and mobile plant operators (83) and electrical and electronic trades workers (74).

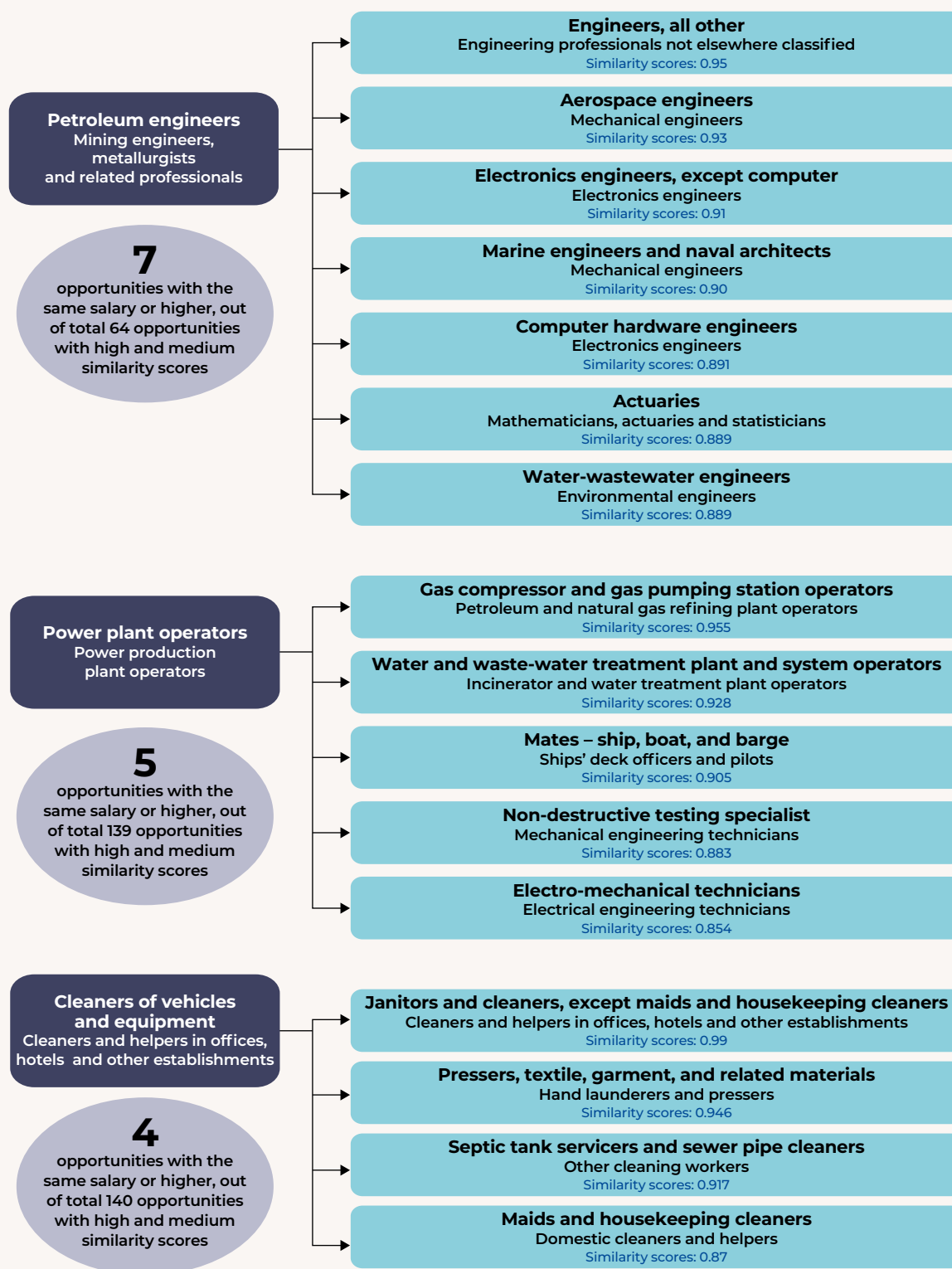
6.2.4 Examples of job transition paths

Jobs lost that cannot be reallocated to the same occupation in another industry amount to between 1.5 and 2 million in this scenario. The numbers are highest for science and engineering professionals (21), science and engineering associate professionals (31), and cleaners and helpers (91). The scenarios explored here do not account for the possibility of international mobility, which could facilitate the re-employment of these workers as these occupations are also among those that will experience net job creation. An analysis allowing for international mobility eliminates practically all the employment losses potentially experienced by all three of the groups identified above.

Workers who lose their jobs and are not likely to find jobs in the same occupation in growing industries can be reskilled and upskilled for the new jobs created as the result of the energy transition. In order to illustrate some viable transition paths for such workers, real-time big data on scraped job advertisements in the United States from Burning Glass Technologies (BGT) were used as a proxy for global skills data. Of course, such an approach has its limitations and should be treated with caution, as an illustration of possible job paths rather than as career or policy guidance.

The viability of job transitions depends on groups of tasks that need to be accomplished in specific jobs. The main assumption underlying the similarity scores is therefore that those who currently hold jobs that require specific skills and knowledge typically possesses the skills and knowledge in question. The real-time big data approach accordingly aims to assess the viability of a job transition by calculating the similarity between the job requirements of any given two jobs in terms of the overlap between the activities or tasks that need to be performed. The same method was applied by the World Economic Forum (WEF and BCG, 2019, p. 64). The similarity scores also take into account wage continuity before and after the job transition, the ideal being that the new job is at least as well paid as the previous one. More detail can be found in Annex 7.

Figure 6.4 Transition paths for selected shrinking occupations under the energy sustainability scenario



Note: The calculations are based on a similarity score methodology elaborated by BGT for the WEF (WEF and BCG, 2019). The score takes into account possible job transitions based on a similarity of requirements of two jobs and overlap of tasks, skills and knowledge, education and years of work experience without wage losses.

Source: Own calculations based on real-time data on vacancies, BGT. US data (2017) are used as a proxy.

The results of illustrative calculations of similarity scores show that there will be many options for transition to new jobs under the energy sustainability scenario. For instance, petroleum engineers (science and engineering professionals – 21) may find jobs in other branches of engineering in growing industries which will be viable choices in terms of income (see figure 6.4). They may opt to become marine engineers, electronics engineers, computer hardware engineers or waste-water engineers, or to use their professional skills in other types of engineering, including environmental engineering. Of course, even where similarity scores are high, such paths may still imply some level of reskilling or upskilling.

Similarly, power plant operators (science and engineering associate professionals – 31) can find jobs as gas pumping station operators (owing to the shift to the natural gas), water and waste-water treatment plant system operators and electromechanical engineering technicians in other areas. Some reskilling and upskilling may be needed, especially in relation to the specific machinery and technologies used in new jobs. Cleaners of vehicles and equipment (cleaners and helpers – 91) can with some minimal retraining move to become janitors and cleaners in offices, hotels, households, or in establishments in growing industries, septic tank sewer pipe services etc.

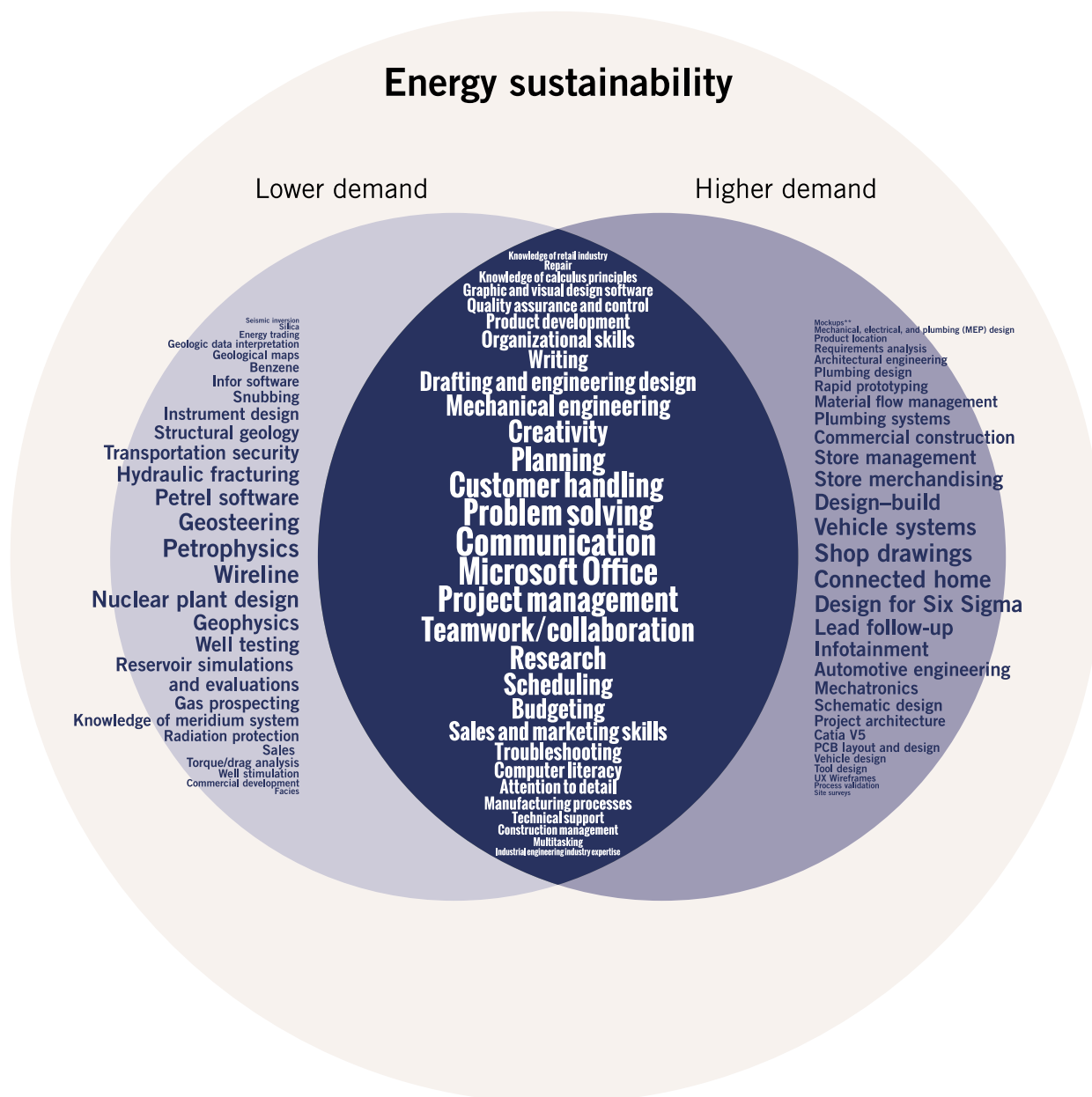
6.2.5 Re-using skills in growing industries

In identifying the jobs which will be reallocatable between declining and growing industries within the same occupation, it is assumed that the core sets of both technical and soft skills and knowledge will be re-used, as they remain the same in principle within that occupation. The real-time big data for the United States in 2017 (BGT data sets) used as a proxy allow us to take a closer look at the disaggregated level at the skills demanded in the same occupations in those industries where job losses or gains are expected under the energy sustainability scenario and where job shifts are likely to occur.

The analysis of skills demanded in job advertisements for science and engineering professionals and associated professionals, related to the industries expected to decline and those expected to grow, is presented in word clouds (figures 6.5, 6.6) based on the frequency with which the skills are requested within these occupational categories and industrial sectors (those most requested appear larger). The industrial categories have been clustered into those expected to grow and those expected to decline. In the middle, an overlap of skills required in both declining and growing industries appears. The figure shows clearly that there will be three types of skills that can be re-used and that therefore constitute the core employability skills potentially useful for securing a new job. For instance, for occupational category 21, science and engineering professionals, these three categories of core employability skills include the following examples (figure 6.5):

1. *soft skills, both cognitive and non-cognitive*: communication, problem solving, teamwork, collaboration, creativity;
2. *semi-technical transferable skills*, i.e. skills that have a substantial soft component: customer handling, project management, research, scheduling, budgeting, sales and marketing;
3. *technical transferable skills*: mechanical engineering, drafting and engineering design, quality assurance and control, product development.

Figure 6.5 Overlap of skills for science and engineering professionals in declining and growing industries (energy sustainability scenario)

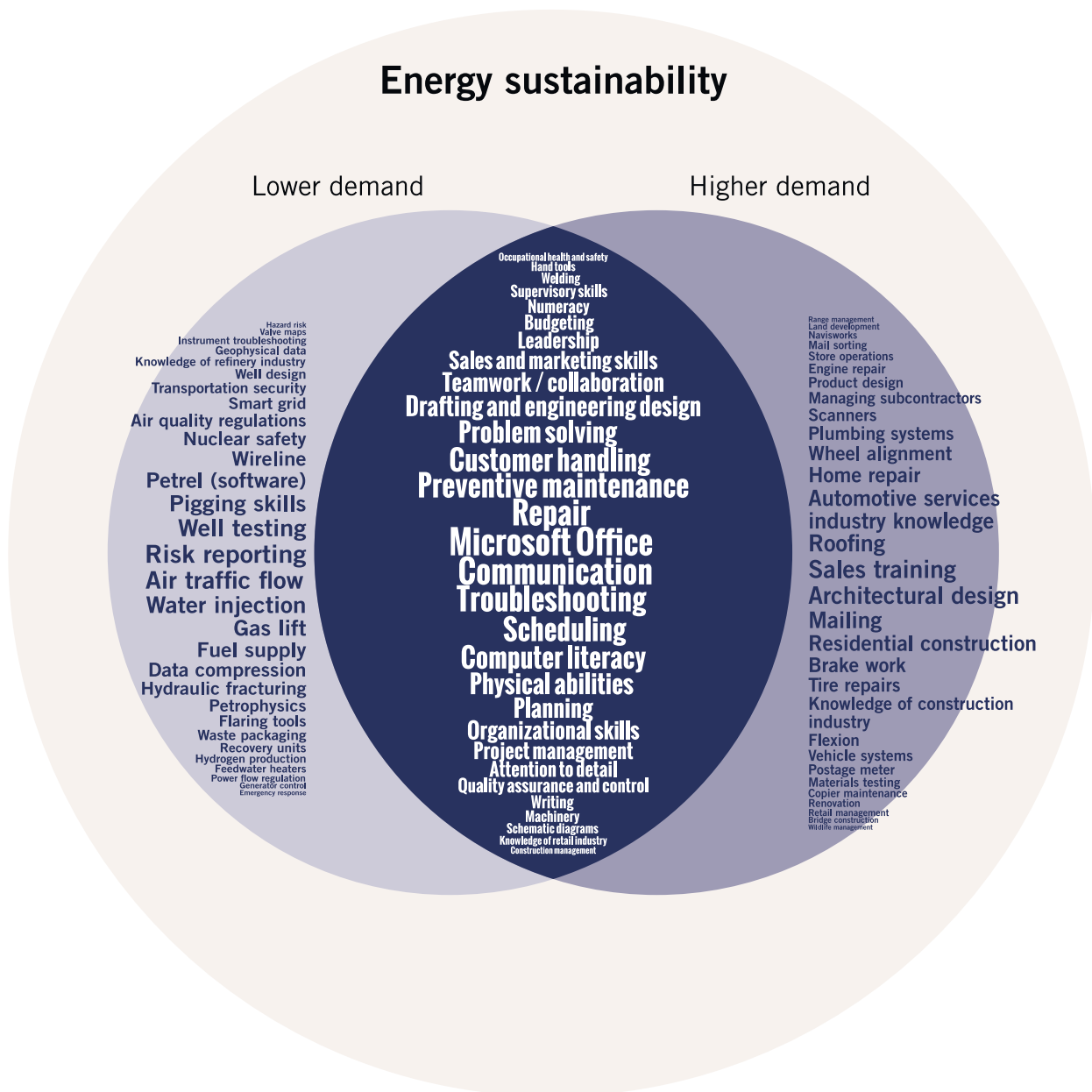


Note: Based on the frequency with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with those most requested appearing larger. The dark blue area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

Technical transferable skills may be occupation-specific. For instance, in the case of science and engineering associate professionals (31) such skills will be repair and preventive maintenance (figure 6.6). However, occupation-specific does not imply job-specific, as these skills will be important for securing jobs in a range of growing sectors. This observation has important implications for TVET policies, pointing to the need to adjust the initial training of the future workforce in such a way that a good set of soft, semi-technical and transferable technical skills are at the core of curricula and competency standards.

Figure 6.6 Overlap of skills for science and engineering associate professionals in declining and growing industries (energy sustainability scenario)



Note: Based on the frequency with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with those most requested appearing larger. The blue area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

It is important to understand that real-time job advertisements are not likely to mention the whole variety of technical skills required, as the job title itself would assume a certain set of technical skills. Employers therefore tend to mention other skills, often soft skills, in their advertisements. In reality, both soft and technical skills will be needed to secure a job. Non-transferable skills (those not showing in the overlap) tend to be technology and industry sensitive, and this is where most reskilling will be needed. For instance, in the case of science and engineering professionals (21), learning about connected homes systems, vehicle systems, design-build, many specific software skills and also industry-specific skills will be needed (figure 6.5); in

Figure 6.7 Top skills needed in high-, medium- and low-skill occupations under the energy sustainability scenario



Note: The word clouds indicate the skills in demand in the fastest-growing occupations in growing industries, clustered by ISCO-08 skill level (ISCO-08, ILO, Geneva, 2012: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf). The word cloud is based on frequencies. US data are used as a proxy.

Source: Own calculations based on real-time data on vacancies, BGT (US data, 2017).

the case of science and engineering associate professionals (31), skills in demand include architectural design, roofing, residential construction, home repair, and repair and installation skills related to the automotive industry (figure 6.6).

The real-time big data analysis also allows us to identify the top skills most wanted at each main skill level of occupations (figure 6.7). It appears that soft skills are indeed important, along with semi-technical and technical transferable skills, confirming the previous findings. For example, for high-skilled occupations project management, scheduling and budgeting, along with communication skills, come out on top. For medium-skill occupations communication, customer handling, sales and marketing skills are the most prominent; also important are heating, ventilation and air-conditioning skills, plumbing skills and food preparation skills. For low-skill jobs, demand is highest for soft and basic skills.

Although the re-use of skills – soft, semi-technical and technical transferable – will increase workers' employability, this may not happen automatically. Workers' skills need to be validated and recognized, while some new technical skills will require skills upgrading and retraining measures.

6.3 Circular economy scenario

6.3.1 Redistribution of jobs across industries

Resource efficiency is a key component of any economy, particularly as global economic growth approaches planetary limits (ILO, 2012; Montt, Harsdorff and Fraga, 2018; UNEP, 2011). The circular economy is an alternative to a linear model of extraction–manufacture–use–disposal, relying instead on the re-use, repair, recycling and retention of material goods. Through changes to the incentive structure for enterprises that encourage the production of more durable goods and goods that serve as inputs into other production streams when they are no longer usable, the circular economy keeps products, components and materials at a high level of utility and value. The circular economy thus maximizes both product life and the value of resources by promoting the re-use, refurbishment, remanufacture and recycling of inputs and components (EMF, 2013).

Embracing circular modes of production has benefits for enterprises. It reduces short-term costs (through lower material bills and warranty risks), adds new profit tools and helps towards the identification and diversification of long-term strategic opportunities. At the production level, the circular economy reduces complexity and makes product cycles more manageable while also improving customer interaction and loyalty. The adoption of technologies to advance the circular economy is now cost effective, and major enterprises have taken concrete steps towards it (EMF, 2013). As incentives play a major role in encouraging firms to move towards the circular economy, governments have also begun to lay out plans to promote waste prevention and the design of products that encourage longer product life-times as well as re-usability, repairability and recyclability (e.g. European Parliament, 2016; Scottish Government, 2015).

The ILO (2018), Wijkman and Skånberg (2016) and Wiebe et al. (forthcoming) estimate the employment implications of adopting a circular economy. They all highlight a small net employment creation potential, while noting a relevant reallocation of employment away from extractive industries and towards waste management

Table 6.2 Sectors most affected by the transition to a circular economy, scenario to 2030

INDUSTRIES SET TO EXPERIENCE THE HIGHEST JOB DEMAND GROWTH		INDUSTRIES SET TO EXPERIENCE THE STRONGEST JOB DEMAND DECLINE	
SECTOR	JOBS CREATED (MILLIONS)	SECTOR	JOBS LOST (MILLIONS)
Reprocessing of secondary steel into new steel	17.5	Manufacture of basic iron and steel and of ferro-alloys and first products thereof	15.6
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	16.7	Mining of copper ores and concentrates	14.1
Production of electricity by solar PV	8.7	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	5.8
Wholesale trade and commission trade, except of motor vehicles and motorcycles	7.7	Manufacture of glass and glass products	5.2
Sale, maintenance, repair of motor vehicles, motor vehicle parts, motorcycles, motor cycles parts and accessories	4.3	Mining of iron ores	4.8
Research and development	3.4	Mining of coal and lignite; peat extraction	3.2
Reprocessing of secondary wood material into new wood material	3.0	Mining of nickel ores and concentrates	3.1

Notes: Difference in employment by industry between the circular economy scenario and the IEA 6°C (business-as-usual) scenario (IEA, 2015) by 2030. For further details on the data and methods used, see ILO, 2018a, Appendix 2.1.

Source: ILO calculations based on EXIOBASE v3.

and the repurposing of materials for re-use. In particular, the ILO (2018) models the growth in the recycling of materials and the repair of goods, in place of the extraction of raw materials and the production of new goods. Because of the value chains involved in both the extraction and the repurposing of materials, and in the production of final goods and related revenues, there are direct, indirect and induced employment effects.

The scenario of a circular economy as proposed by the ILO (2018) results in over 7 million net new jobs created when compared to a business-as-usual scenario.³⁰ This overall net job creation comes with an important reallocation of employment between sectors, involving nearly 50 million jobs. As shown in table 6.2, employment creation is led by the reprocessing of materials (e.g. steel, wood, zinc, copper,

30. The results set out here are an update of those presented in ILO, 2018, and are consistent with Wiebe et al., forthcoming.

aluminium) to be used as inputs in industries that would have otherwise drawn these materials from value chains associated with the extraction of natural resources. Other leading sectors in employment creation are retail trade and research and development, among others. Retail trade growth reflects induced effects: as a result of repair and recycling, household income increases, and the extra money is then spent on other goods and services. Job destruction is concentrated in value chains associated with the processing of raw materials, as they are replaced by recycled materials which require no extraction and make fewer demands on fossil fuel energy.

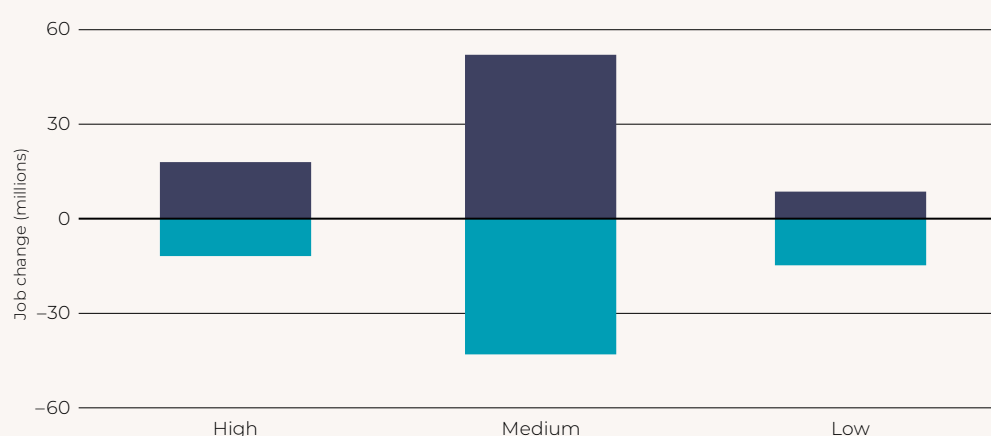
6.3.2 Occupational and gender effects

Embracing the circular economy brings about job creation and reallocation, with consequent impacts on demand for skills. As with the energy sustainability scenario discussed above, the employment effects of the circular economy scenario are most prominent among medium-skill occupations, where most reallocation and net job creation is expected to occur.

The changes associated with the circular economy scenario result in an overall skills distribution that has a higher concentration of medium-skill jobs and a slight overall shift towards higher-level skills. Over 8 million net medium-level skill jobs and almost 6 million net high-level skill jobs will be created, with almost 7 million net low-level skill jobs destroyed (figure 6.8).

As in the energy sustainability scenario, both job destruction and job creation in a circular economy are concentrated in male-dominated occupations. Over 50 million jobs occupied by men are likely to shift industry, with job destruction slightly higher than job creation, resulting in a net loss for jobs occupied by men of around 5 million. Barring any changes to the gender distribution across jobs and occupations, over 24 million jobs will be created for women, with around 12 million

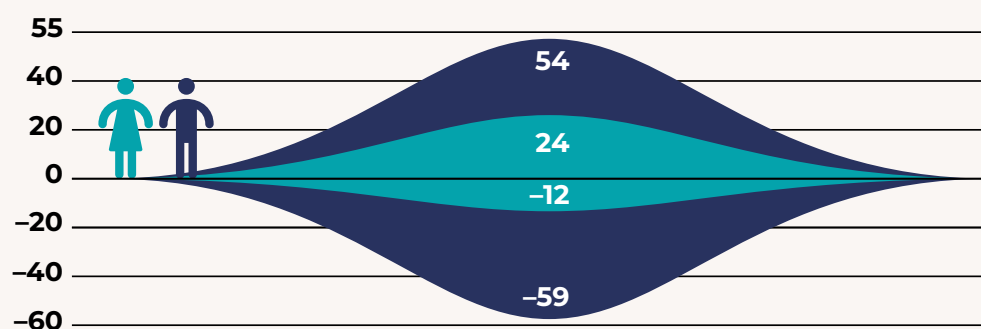
Figure 6.8 Jobs created and destroyed in circular economy scenario by skill level, to 2030



Notes: Occupations measured at the two-digit level and aggregated to one-digit level so that occupations requiring high-level skills are listed under ISCO-08 codes 1, 2 and 3; those requiring medium-level skills are listed under ISCO-08 codes 4, 5, 6, 7 and 8; and those requiring low-level skills are listed under ISCO-08 code 9. For methodological details, see Annex 5.two-digit

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

Figure 6.9 Jobs created and destroyed in circular economy scenario by gender, to 2030 (millions)



Notes: For methodological details, see Annex 5.

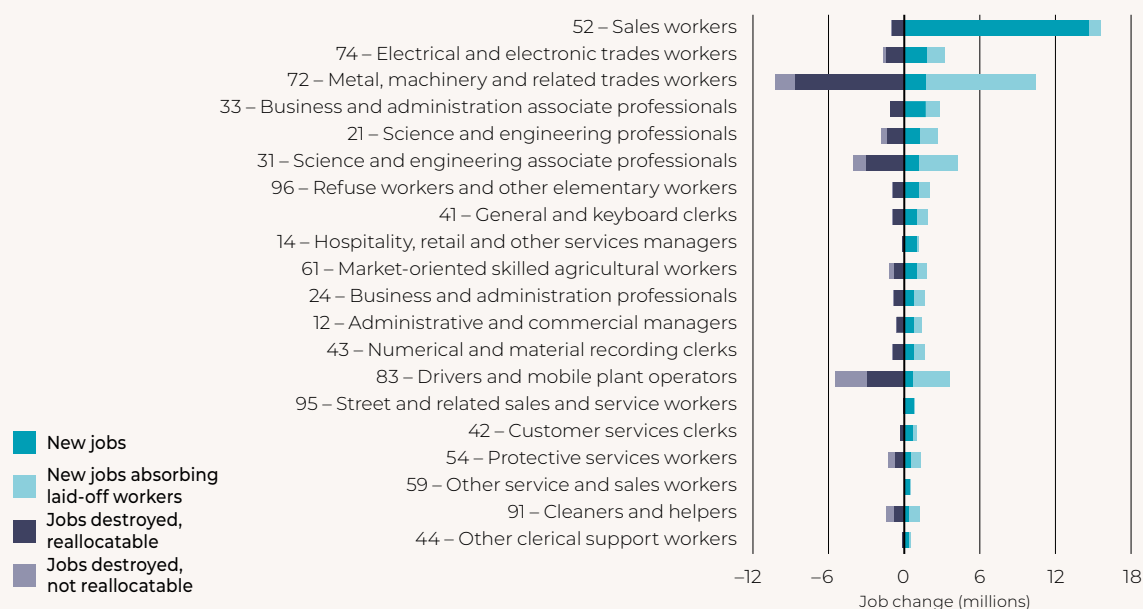
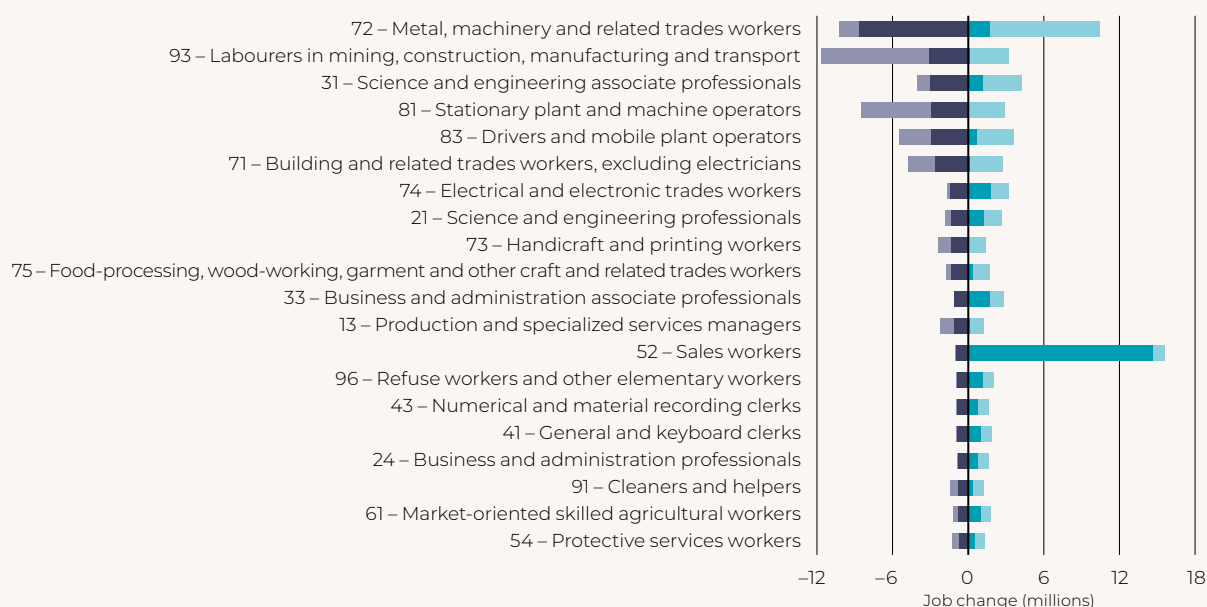
Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

lost (figure 6.9). Advancing the circular economy thus increases employment chances for women, albeit not on a large enough scale to offset prevailing gender employment inequalities, and with the caveat that some of this equalizing tendency comes at the expense of net job losses for men.

A circular economy, as modelled in this scenario, promotes material efficiency through the recycling and repair of goods. These changes affect a broad range of economic sectors as a result of value chains, not just those directly related to gains in the repair and recycling industries and losses in the material extraction industries (see table 6.2). In this scenario, around 78 million jobs are created and around 71 million are destroyed. Of those workers whose jobs that are destroyed, a large share (amounting to around 49 million) will find vacancies in the same occupations in other industries within the same country; that is, they can be absorbed into new jobs through reallocation. The remaining new jobs that will be created, some 29 million, will require a trained workforce; and around 22 million jobs will be destroyed without vacancies in the same occupations opening up in other industries in the same country. Figure 6.10 shows the 20 occupations that will lead net job creation (Panel A) and reallocation (Panel B) in the circular economy scenario. (Detailed results for every occupation are set out in Annex 6.)

6.3.3 Changes in specific occupations

Net job creation is highest for sales workers (ISCO-08 two-digit code 52), with over 15 million jobs created overall, of which roughly 1 million will result from the reallocation of sales jobs from some industries to new industries. This is a result of the growth in household consumption (induced effects) and the consequent growth in the retail trade sector. For the same reason, business administration (33), administrative and commercial management (12) and hospitality (14) are expected to be among the occupations with the highest net growth, that is, with the highest numbers of vacancies that cannot be filled by workers from similar jobs lost in other industries (new jobs – ■ bars in figure 6.10). High levels of net growth are also expected in occupations common in several industries and directly related to the circular economy: electrical and electronic trades workers (74), metal, machinery and related trades workers (72), science and engineering professionals and associates (21, 31) and refuse workers (96).

Figure 6.10 Jobs created and destroyed in a circular economy scenario by occupation, to 2030**Panel A. Occupations with the highest number of new net jobs created in a circular economy scenario****Panel B. Occupations with the highest reallocation of jobs across industries or economies in a circular economy scenario**

Notes: Occupations measured at the ISCO-08 two-digit level. Panel A shows the 20 occupations with the highest level of new jobs. Panel B shows the 20 occupations with the highest level of the new jobs absorbing laid-off workers. “New jobs absorbing laid-off workers” are jobs in the same occupation in industries experiencing job losses that can be filled by similar (reallocatable) jobs in other industries in the same country or region (“Jobs destroyed, reallocatable”). “New jobs” are jobs created that cannot be filled by jobs lost in similar occupations from other industries in the same country or region. “Jobs destroyed, not reallocatable” are those jobs for which vacancies in the same occupations in other industries within the same country or region will not be found. See Annex 5 for methodological details and Annex 6 for the underlying data for all occupations.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

The potential for many of the jobs created under the circular economy to absorb workers laid off from similar jobs in industries that experience job losses calls for policies to promote mobility within occupations accompanied by reskilling, career counselling and social protection measures (this process of reallocation is shown in figure 6.10 through the ■ bars for new jobs absorbing laid-off workers and the ■ bars for jobs destroyed that can be reallocated). For example, workers in the metal, machinery and related trades (72) and science and engineering associate professionals (31) can move from industries related to the extraction of materials and manufacture of goods to those related to the repurposing of materials and the repair of goods.

6.3.4 Examples of job transition paths

While the great majority of jobs lost in the energy sustainability scenario are reallocatable to new jobs in the same occupations in other industries, this is not the case in the circular economy scenario. In the latter, a much larger proportion of workers who may experience job losses may not find equivalent vacancies in the same occupation (see “Jobs destroyed, not reallocatable” – ■ bars – in figure 6.10). This is particularly the case for labourers in mining, construction, manufacturing and transport (93). Over 8 million jobs in this low-skilled occupation do not find equivalent new jobs in the circular economy scenario. Similarly, some 10 million jobs currently held by stationary plant and machine operators (81), drivers and mobile plant operators (83) and building and related trades workers, excluding electricians (71), will disappear without jobs in the same occupational categories appearing elsewhere in the same countries. Some of these jobs will appear in other countries, however, calling for a discussion about relevant migration policy.

This situation requires recognition of the skills currently held by these workers, so that retraining programmes can be designed to cater to the needs of emerging industries and/or industrial policy incentives be introduced to develop industries that can benefit from these skill sets in the regions most affected. It also points to the importance of policy coherence, articulating climate change and just transition policies with sectoral and investment policies, active labour market policies, effective labour market institutions and career counselling services, and access to reskilling and upskilling possibilities.

Figure 6.11 sets out some illustrations of viable job transitions in the circular economy scenario, taking into account the similarity scores in task composition, related requirements in knowledge and skills, and wage continuity (further methodological details can be found in Annex 7). For instance, construction labourers can reskill to become rail-track laying and maintenance operators or plumbers; loading machine operators can work in metal, paper, textiles, shoe-making or heat treating equipment operation; industrial truck and tractor operators can reskill as locomotive engine drivers, crane operators, sailors and marine workers, delivery service and taxi drivers; roofers can become other types of finishers and material layers; and pipelayers can work as glaziers, other material layers and finishers, or solar thermal installers and technicians.

However, some of the viable transitions are still concentrated within occupations more broadly defined. Similarity scores for transitions to new jobs whose numbers may be boosted under the circular economy scenario, such as sales workers, are lower, implying the need for larger-scale reskilling or upskilling as the tasks and

Figure 6.11 Transition paths for selected shrinking occupations in the circular economy scenario

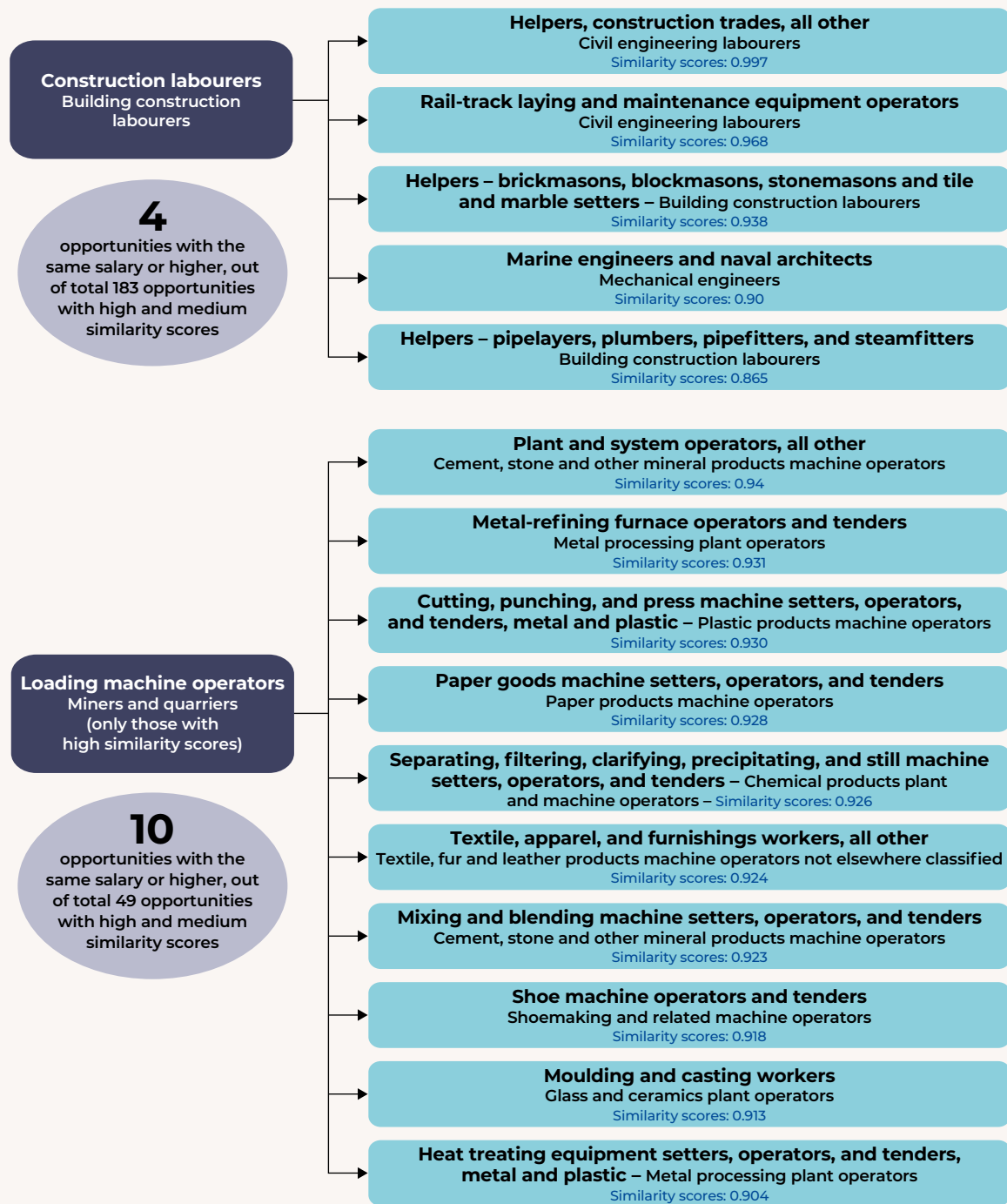
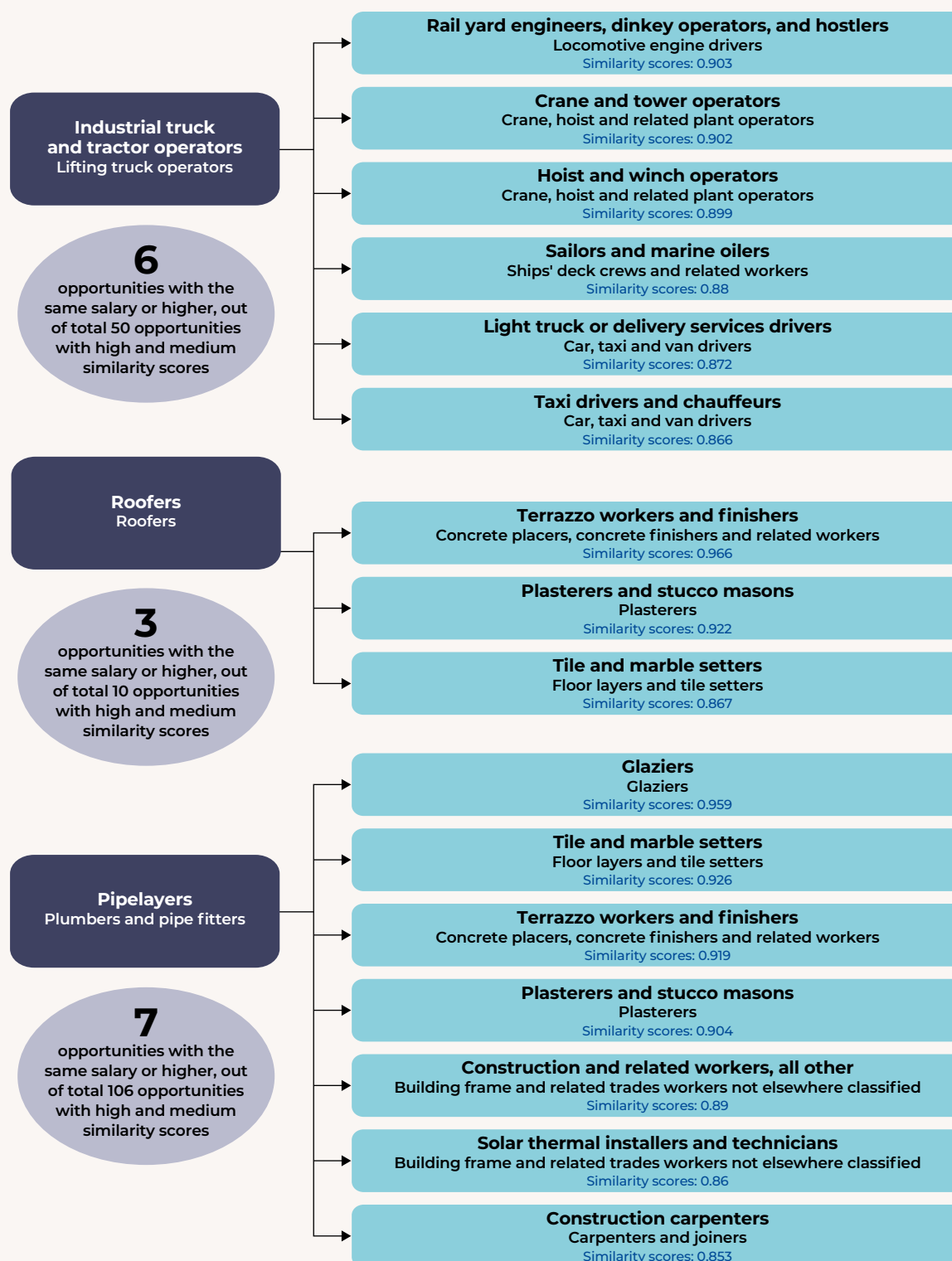


Figure 6.11 (cont'd)



Note: Calculations based on a similarity score methodology elaborated by BGT for WEF (WEF and BCG, 2019). The score takes into account possible job transitions based on a similarity of requirements of two jobs and overlap of tasks, skills and knowledge, education and years of work experience without wage losses.

Source: Own calculations based on real-time data on vacancies, BGT. US data (2017) are used as a proxy.

related skills and knowledge are not the same. It should also be noted that some job losses under the circular economy scenario can be offset by the job gains associated with implementation of energy sustainability policies. This is particularly relevant for such occupations as building and related trades workers and labourers in mining, construction, manufacturing and transport. Indeed, many jobs enjoying high similarity scores will only increase in number if investments in energy-efficient construction and in manufacturing, installation and maintenance related to renewable energy occur. Concerted action in implementing greening policies embracing different economic activities will therefore reduce the risk of job losses and will yield a double dividend of tackling both environmental and employment issues.

6.3.5 Re-using skills in growing industries

Figures 6.12–6.16 present the analysis of skills demand, as expressed in job advertisements related to the industries expected to decline and those expected to grow, in the form of word clouds. Using the BGT US data for 2017 as a proxy, we are able to look more closely at the specific skills demanded in the same occupations in industries where job losses and gains respectively are expected under the circular economy scenario, and where job shifts are likely to occur. Based on the frequency with which skills within the occupational categories in declining and growing industries occur in the advertisements, these skills have been ranked, with those most often requested appearing larger. In the middle of each diagram, an overlap of skills required in both declining and growing industries appears.

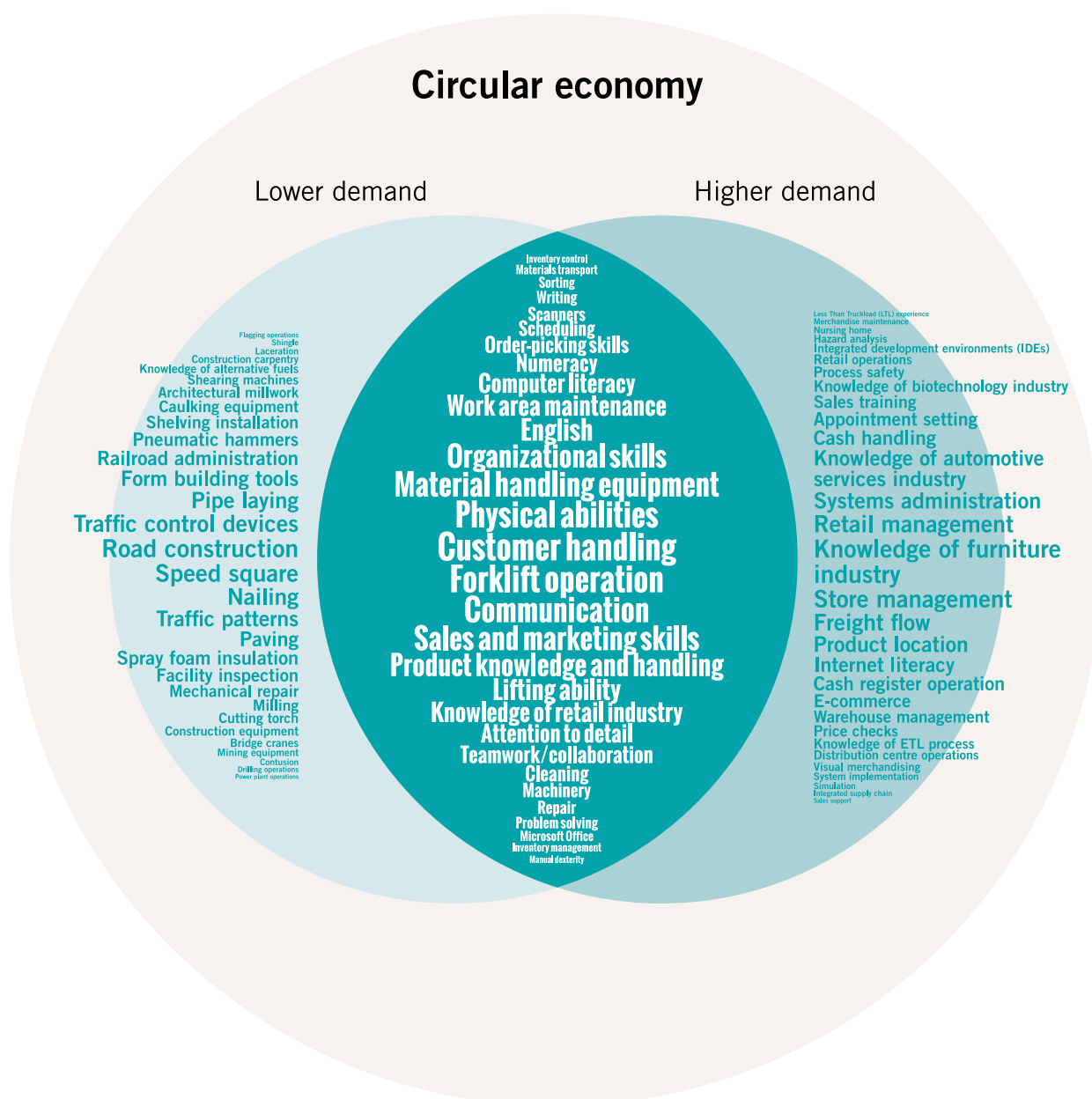
As in the energy sustainability scenario, there are three core types of skills that workers who lose their jobs can re-use in new jobs in the same occupations within growing industries: soft skills, semi-technical transferable skills and technical transferable skills. Some of the skill sets that may ensure employability are quite demanding.

For instance, in the case of labourers in mining, construction, manufacturing and transport (93) – a low-skill occupation – soft skills in demand include communication, organizational skills, attention to detail, teamwork/collaboration, problem solving, and literacy and numeracy skills, including computer literacy (figure 6.12). A much larger group of skills in the overlap area which may secure future employability of workers in this occupation belongs to the category of semi-technical transferable skills; these include customer handling, sales and marketing, product knowledge and handling, knowledge of retail industry, work area maintenance, order picking skills, scheduling, cleaning and repair.

The sets of skills which will be in higher demand in which current workers in mining, construction, manufacturing and transport might be less proficient include those related to sales and logistics (e.g. cash handling, store management, product location, e-commerce, sales training, price checks), the knowledge of specific industries (e.g. furniture, automotive, biotechnology) and Internet literacy. Reskilling and upskilling measures will have to take these new requirements into account.

The skills in demand in both declining and growing industries in the occupation of drivers and mobile plant operators (83) also include not only soft skills (communication, numeracy, problem solving) but many more semi-technical skills (customer handling, sales and marketing, hazardous materials, driving, product knowledge and handling, scheduling) and some technical transferable skills (forklift operation, road construction, vehicle maintenance, inventory management and control, repair)

Figure 6.12 Overlap of skills for labourers in mining, construction, manufacturing and transport, in declining and growing industries (circular economy scenario)



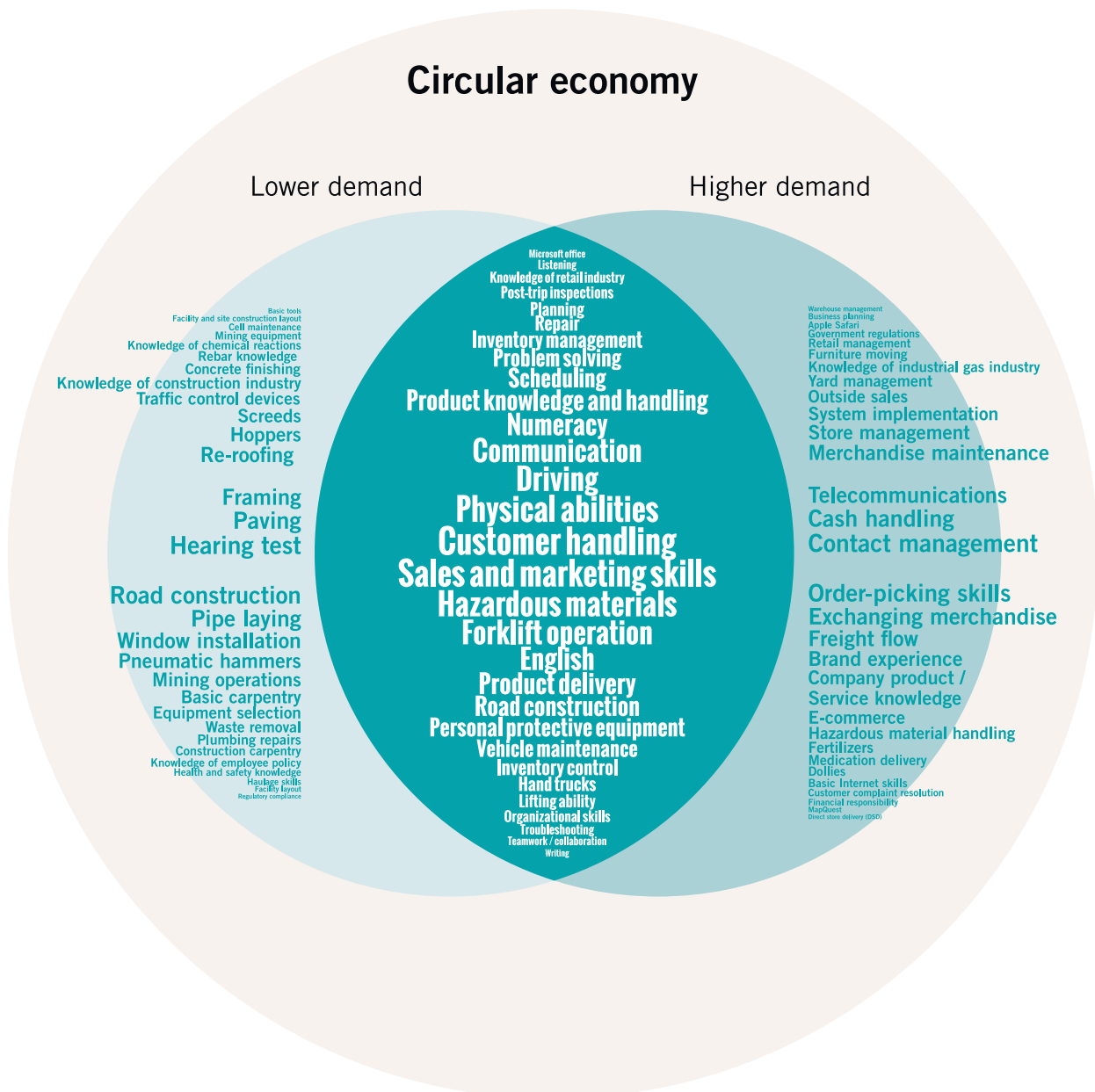
Note: Based on the frequency with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with those most requested appearing larger. The green area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

(figure 6.13). The new skills which will be in demand are almost exclusively technical, and mostly related to sales and logistics, such as contact management, order-picking, cash handling skills.

Stationary plant and machine operators (81) can re-use their soft skills (communication, language, literacy and numeracy, including computer literacy) and many semi-technical (customer handling, sales and marketing, work area and preventive maintenance, packaging) and technical (repair, forklift operation, machinery) skills

Figure 6.13 Overlap of skills for drivers and mobile plant operators, in declining and growing industries (circular economy scenario)



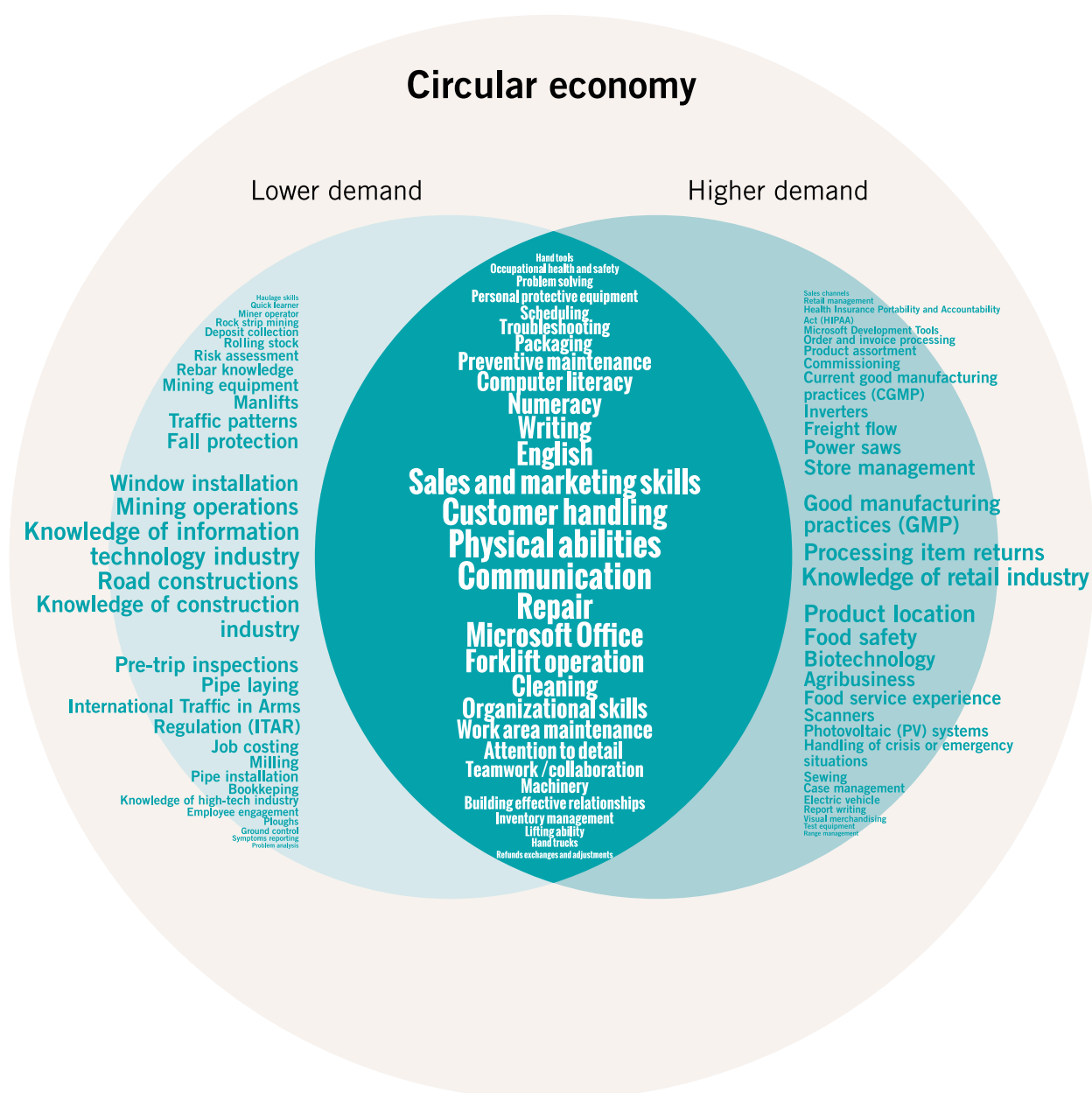
Note: Based on the frequencies with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with those most requested appearing larger. The blue area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

(figure 6.14). Again, the new skills required will be almost exclusively technical and concentrated in sets of skills required for an understanding of specific industries (retail, agribusiness, biotechnology); demand will be high for skills in product and store management, product processing and quality control standards in manufacturing, and knowledge of PV systems.

In the case of metal, machinery and related trades workers (72) under the circular economy scenario the largest group of employability skills will be semi-technical

Figure 6.14 Overlap of skills for stationary plant and machine operators, in declining and growing industries (circular economy scenario)



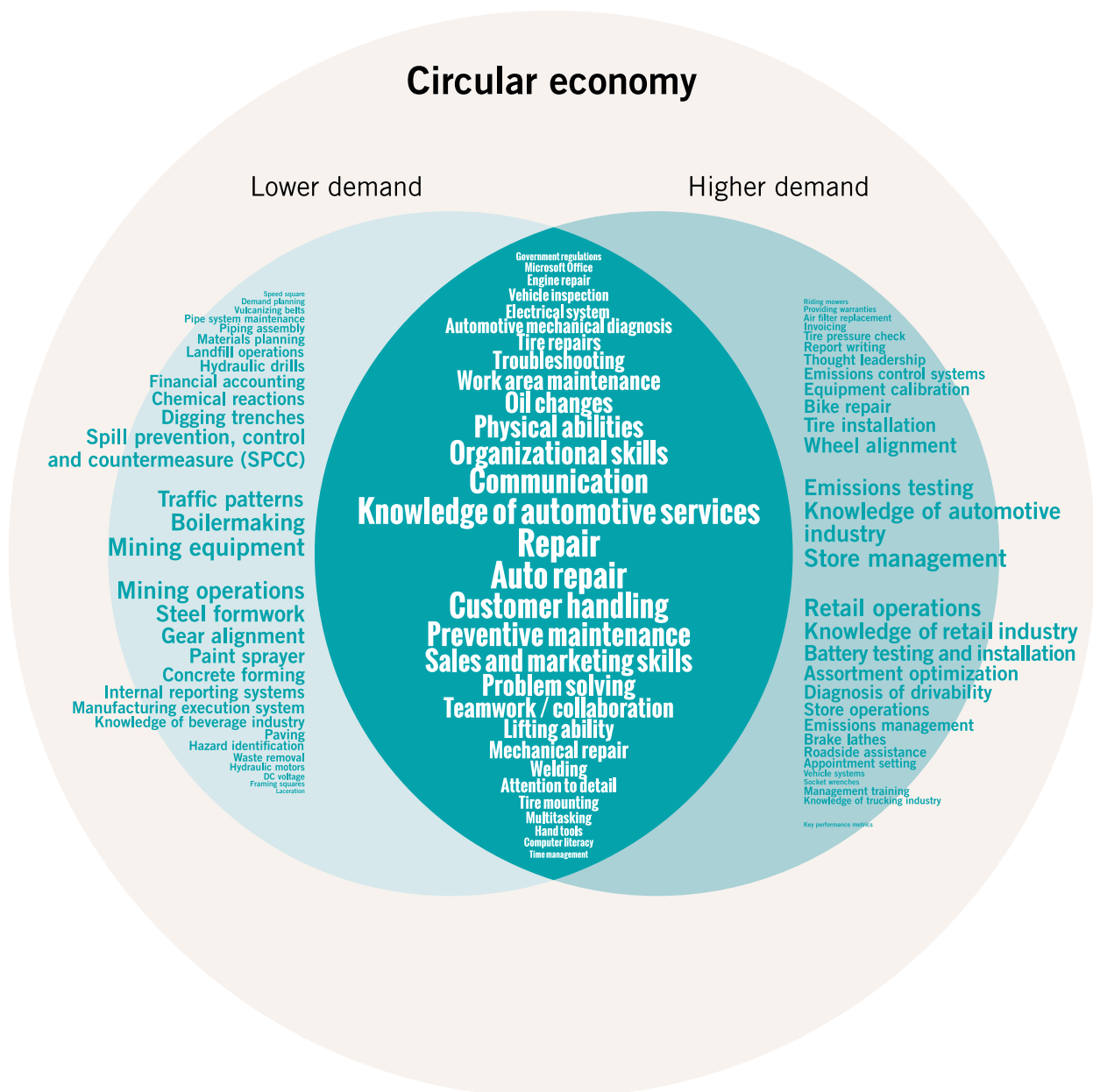
Note: Based on the frequencies with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with those most requested appearing larger. The blue area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

(repair, customer handling, maintenance, sales and marketing); soft skills will also be re-usable (figure 6.15). New skills which will be required for this occupation revolve around retail operations, and installation, diagnostics and emissions testing skills in the automotive industry.

Building and related trades workers, excluding electricians (71), will be able to re-use a similar set of soft and semi-technical skills along with transferable technical skills in, for example, heating, ventilation and air conditioning, plumbing, equipment maintenance and testing, and occupational health and safety (figure 6.16). There

Figure 6.15 Overlap of skills for metal, machinery and related trades workers, in declining and growing industries (circular economy scenario)



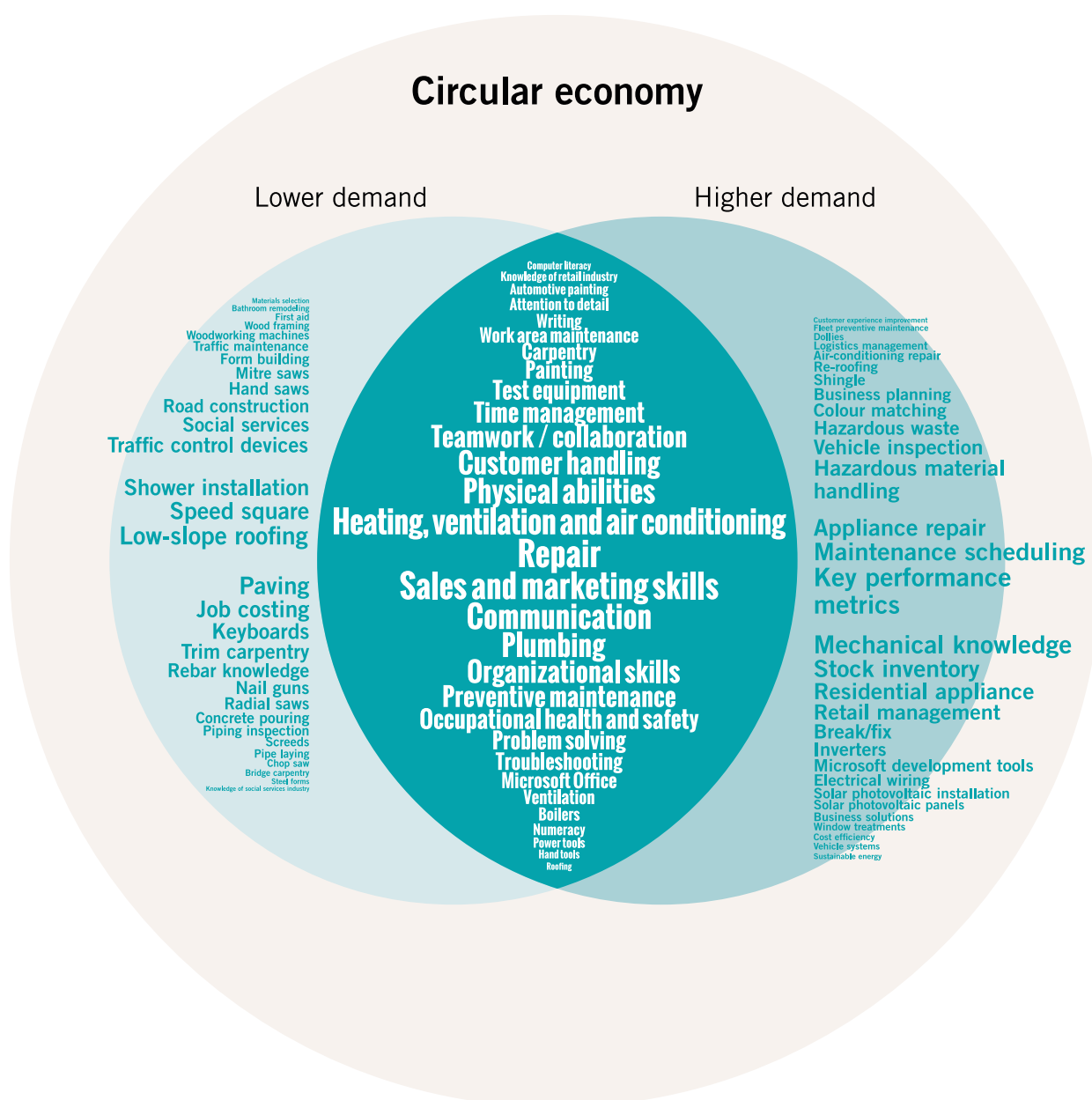
Note: Based on the frequencies with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with those most requested appearing larger. The blue area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

will be growing demand will be for mechanical knowledge and skills in key performance metrics, maintenance scheduling, appliance repair, stock inventory and retail management, and handling of hazardous materials.

It comes as no surprise that most of the top skills for employability in growing industries are soft skills, as they are common across occupations (figure 6.17). Thus communication, problem solving, teamwork, numeracy and IT literacy skills are prominent at all skill levels. Some soft skills are sensitive to skill level, such as leadership or presentation skills, which are important for high-skill occupations. Some

Figure 6.16 Overlap of skills for building and related trades workers, in declining and growing industries (circular economy scenario)



Note: Based on the frequencies with which the different skills are requested within the occupational category by growing or declining industries, skills have been ranked, with most requested appearing larger. The blue area in the middle shows a large overlap of skills within the same occupation in both declining and growing industries. US data are used as a proxy.

Source: Calculations based on real-time data on vacancies, BGT (US data, 2017).

semi-technical transferable skills, such as customer handling and sales and marketing, are also valid across skill levels. Technical skills are more specific to skill level: examples here would be enterprise resource planning for the high-skill level, plumbing for the medium-skill level and vehicle inspection for the low-skill level.

Real-time data analysis therefore shows that although the transition to a circular economy may be disruptive, there will be many skills which workers can re-use in new jobs in the same or similar occupations in growing industries. Such employability skills will include soft skills, semi-technical and technical transferable skills.

Figure 6.17 Top skills needed in high-, medium- and low-skill occupations under the circular economy scenario



Note: The word clouds indicate the skills in demand in the fastest-growing occupations in growing industries, clustered by ISCO-08 skill level (ISCO-08, ILO, Geneva, 2012: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf). The word cloud is based on frequencies. US data (2017) are used as a proxy.

Source: Own calculations based on real-time data on vacancies, BGT (US data, 2017).

However, retraining will be necessary to equip workers with the new technical skills specific to jobs in growing industries and with skills at the level required. Skills validation, recognition and certification measures, coupled with career guidance services and some additional upskilling, can help workers through the transition and into new jobs.

6.4 Conclusions

The modelled global analysis in this chapter has quantified the impact on skills, gender and occupations of a transition to energy sustainability and a circular economy. Both energy sustainability and the circular economy will create more jobs than will be destroyed. Overall job creation is concentrated among medium-skill jobs and may potentially offset other labour market disruptions caused by globalization, offshoring and technological change, typically associated with a destruction of jobs at this skill level.

The net job creation outcome in both scenarios reveals three types of impact at the occupational level associated with job creation and destruction.

First, for the large majority of occupations affected by the transition either to energy sustainability or to the circular economy, jobs lost in one industry will be matched by equivalent jobs created in another industry. The additional analysis of real-time big data demonstrated some possible job transition paths to kinship occupations in growing industries where tasks, skills and knowledge requirements will be similar and salaries equal or rising, making reallocation feasible. The sets of skills that workers will be able to re-use in growing industries include not only soft skills (e.g. communication, problem solving), but also semi-technical transferable skills (e.g. sales and marketing, scheduling, budgeting) and technical transferable skills (e.g. engineering, repair, plumbing). This is an important finding with significant implications for the design of curricula and competency standards in initial TVET.

Facilitating the reallocation of workers also requires the recognition of workers' existing skills – both those earned in formal or non-formal training and those acquired through experience on the job – so that workers' skills from one occupation in a particular industry are recognized as relevant in the same occupation in another industry. Skills certification and skills recognition programmes could prove particularly useful to this end. Skills recognition should extend across national borders, so that those who lose jobs in one country may more easily find equivalent openings in another. Skills recognition should be complemented by appropriate labour migration policies to promote the hiring of capable workers in emerging industries wherever they are situated.

Reallocation of workers within occupational clusters does not mean that they will not need any reskilling or upskilling. On the contrary, the analysis has identified many new technical skills required for a successful reallocation of workers. Retraining and skills development programmes will need to build on the current skills of workers and help them to adapt and develop their skills to enhance their relevance to the new industries in which new jobs will be found.

Although theoretically possible, perfect reallocation is unlikely. For a variety of reasons, some workers will be unwilling or unable to move to other industries or regions. The loss of jobs will affect incomes, requiring the development of social protection policies to complement reskilling measures, so that these workers maintain

their income security and/or are able to find jobs in other occupations in the same region. This is especially important for maintaining social cohesion and preventing raising poverty and inequality.

Second, there will be a net creation of jobs above and beyond the jobs that can be filled by reallocation. This particularly concerns building and related trade workers and labourers in construction, manufacturing and transport under the energy sustainability scenarios, and sales workers under the circular economy scenario. These new jobs, concentrated at the medium-skill level but including some high-skill jobs, call for the development of the corresponding skills in formal training programmes for future workers. They also call for skills upgrading programmes, as net job destruction is expected among low-skill occupations, while net job creation is expected among both high- and medium-skill jobs. Such programmes will ensure that skills needs are met and that workers who may lose their jobs have the opportunity to benefit from the better jobs that appear as a result of the transition.

Third, some jobs will be destroyed without vacancies opening up in the same occupation in different industries, posing a potential risk of unemployment. However, given the second impact noted above, many new jobs will be generated in new occupations. Training programmes to reskill laid-off workers who cannot find jobs in their former occupations to equip them for entry into newly growing occupations will be essential. Such programmes can be delivered through ALMPs and should be coupled with career guidance and social protection policies.

Developing complementary industrial policies that promote both environmental sustainability and job creation could help countries and regions where jobs are lost to benefit from the skills that become available in the labour market as fossil-fuel and extractive industries downsize. The two scenarios considered in this chapter provide a clear example of such complementarity. Among the occupations that will suffer from net job destruction in the circular economy scenario are labourers in mining, construction and transport, and building and related trades workers, excluding electricians, with net losses expected to be around 8 million and 2 million, respectively. These two occupations are among those that will experience the highest net job creation in the energy sustainability scenario, at almost 4 million and 3 million, respectively. Promoting the establishment of industries related to energy sustainability in locations close to those that may lose jobs on the path towards the circular economy may facilitate the re-employment of workers with minimal expense in retraining or mobility programmes.

Gender considerations should be mainstreamed in all these policy responses. An important finding from this chapter is that male-dominated occupations will be most affected by both job losses and job creation. Including gender considerations in the policy response, particularly in the case of skills development to meet the demands of new jobs, could alleviate the gender imbalance in the affected occupations.

The results presented in this chapter speak to the skills, gender and occupational-level implications of two dimensions of a green economy: energy sustainability (or decarbonization) and the circular economy (or material use efficiency). There are other transitions necessary to advance sustainable economies that will also have implications for skills. These include, as already noted by the ILO (2012) and ILO and Cedefop (2011), sustainability in agriculture, forestry and fisheries, transport and construction, each of which will also have direct, indirect and induced implications for skills, gender and occupations.



7. SKILLS DEVELOPMENT POLICIES AND MEASURES FOR A GREEN TRANSITION

Within measures to adjust skills to the green economy a link with decent jobs is imperative, with the aim of facilitating a just transition. Most countries have initiatives in place for skills anticipation in relation to skills for green jobs, although some are ad hoc rather than systematic. TVET is under development across the world, but in only relatively few contexts includes systems fully dedicated to developing skills for green jobs. Most countries in the sample have not developed a systematic approach to incorporating skills for green jobs into their TVET systems since 2011. The initial and continuing involvement of the private sector in TVET is of pivotal importance in delivering skills for green jobs, yet its participation is unequally developed across countries. Sometimes, owing to the lack of a well-functioning TVET system, the private sector develops the skills it needs itself.

Active labour market policies (ALMPs) are not specifically targeting skills for green jobs. Countries do, however, mention broader objectives and future orientations for ALMPs, especially in ensuring a just and inclusive transition into a green economy, and targeting specific disadvantaged and vulnerable groups (unemployed people, indigenous populations, women).

In all these measures, broad groups of stakeholders are involved. An important role is played by employers' and workers' organizations in policy-making, and even more in policy implementation to work towards an inclusive and fair transition with an adequate supply of skills for green jobs.

The preceding chapters have provided an examination of trends in respect of occupations and skills related to the green economy, as well as an analysis of related policies. This chapter examines the policy tools and measures put into operation to address the skills challenges raised by the green transition. To place this analysis in context, the chapter begins with a brief overview of the constellation of policies that frame these tools and measures, which were first discussed in Chapter 3, “3. Key challenges: The policy context”.

7.1 The policy context

Policies related to skills for green jobs take two main forms: they either arise as part of broader environmental and economic policies; or they are created specifically. The latter seem to be particularly common in LICs, where they are often stimulated by international drivers – either international environmental agendas or foreign development agencies. Box 7.1 provides three illustrative examples.

Box 7.1 Examples of national policies related to skills for green jobs

The first two examples presented here show a general green development strategy that takes jobs into account, while the third is specifically focused on green jobs.

Guyana's Green State Development Strategy (GSDS) sets out how the country will achieve a “green shift” characterized by green and inclusive structural transformation. This will entail increasing access to skills, creating decent jobs for all, diversifying the economic base by accessing new markets, participating in the green economy, and equitably distributing the benefits and opportunities derived from it. The two main objectives are, first, an economy characterized by value added goods and services, resource productivity, improved environmental services and resilience to shocks; and second, stable and inclusive growth.

The Philippines Green Jobs Act (PGJA), passed into law in April 2016, contains specific clauses that promote skills for green jobs, sustainable growth and resilience against climate change through means such as identifying skills needs; maintaining a database of green occupations; formulating training regulations; skills assessment and certification; curriculum development; the implementation of training programmes; and fiscal incentives to encourage enterprises to provide training. On top of fiscal and non-fiscal incentives already granted or provided under existing measures, the PGJA provides two additional financial incentives to encourage enterprises to create green jobs, conduct research to reduce their environmental impact, hire employees skilled in environmental preservation, and train or educate their current employees. These are, first, a deduction from taxable income, equivalent to 50 per cent of the total expenses for skills training and research and development; and second, exemption from tax and import duties on imports of capital equipment – on condition that this equipment is used directly and exclusively in the promotion of green jobs. To facilitate the implementation of the Act, the PGJA mandates the Department of Labour and Employment to formulate a National Green Jobs Human Resource Development Plan (see box 3.3 above).

Senegal's National Strategy for the Promotion of Green Jobs serves as a reference framework for green jobs. In this context, and in collaboration with the United Nations Development Programme (UNDP), the Support Programme for the Creation of Green Job Opportunities was formulated to promote the creation of green jobs. More specifically, its objectives are to promote opportunities for green, decent job creation in innovative sectors and the provision of green jobs; to strengthen technical and entrepreneurial capacities in order to reduce skills gaps; to develop partnerships for stakeholder involvement and the mobilization of supplementary financing; and to monitor and consolidate the green jobs created.

Source: *Skills for green jobs in Guyana* (ILO, 2018); *Skills for green jobs in Philippines* (ILO, 2018); *Skills for green jobs in Senegal* (ILO, 2018).

Overall, however, skills for green jobs represent an important gap in the policy landscape, with most countries lacking policies that cover the topic systematically and comprehensively. This means that while government incentives or subsidies might exist to encourage, say, the installation of solar panels, the adoption of recycling methods or the use of insulation materials in building trades, it is frequently left to a wide variety of stakeholders to determine and respond to the skills needs arising from these initiatives.

Whatever the overarching national policy context, skills for green jobs are typically dealt with through a variety of strategies and plans related to particular sectors or regions, or undertaken as time-limited projects. A variety of actors are involved in such plans, including not just public authorities but also social partners and stakeholders from civil society. The picture that emerges is one of markedly varying attention to the issue of skills, with policies and plans most common in areas of most rapid and greatest change (e.g. renewable energy and construction). Overall, it is a picture of wide variety and a predominance of ad hoc responses to the challenges of the green transition.

In contexts such as these, what types of measures have been developed? The remainder of the chapter addresses this question.

7.2 Measures to adjust skills to the green economy

This section discusses specific policy actions taken to adjust skills to the green economy. It deals with policies, programmes, regulations and other measures that were implemented between 2011 and 2018 to adjust the competencies of the current and potential workforce, retrain workers and upgrade skills for jobs in the green economy. The five subsections cover, respectively, anticipating and monitoring skill needs; TVET; private-sector skills training; ALMPs; and mechanisms for validation or recognition of prior learning (RPL).

Government interventions and sectoral approaches to develop skills for green jobs usually relate to decent jobs, with provisions relating to wage levels, hours of work, overtime, occupational safety and health (OSH) and welfare benefits, as well as safeguards for basic human rights and social protection (see e.g. the three cases outlined in box 7.1 above). This linkage is explicitly emphasized in LMICs such as Ghana, Indonesia and the Philippines. In general, skills anticipation systems, TVET systems and ALMPs are all directed at delivering skills for decent jobs.

7.2.1 Anticipating and monitoring skills needs

The monitoring, anticipation and forecasting of skills are in general high on political agendas. For instance, in Europe, at both national and EU level, large-scale initiatives are under way to better capture future skills needs;³¹ the OECD is working on the topic;³² the ILO is helping countries to improve their skills anticipation systems and labour market information, and implements a Skills for Trade and Economic

31. See: <http://www.cedefop.europa.eu/en/themes/identifying-skills-needs>; <https://skillspanorama.cedefop.europa.eu/en> [accessed 6 May 2019].

32. See: <http://www.oecd.org/publications/getting-skills-right-assessing-and-anticipating-changing-skill-needs-9789264252073-en.htm> [accessed 6 May 2019].

Diversification (STED) programme to anticipate skills at sectoral level,³³ and UNESCO is supporting the development of education management information systems (EMIS).³⁴ The following paragraphs discuss key features of skills anticipation in relation to green jobs and skills. A clear definition and demarcation of “skills for green jobs”, the absence of which was noted in the 2011 report, is still not available; in any case (as also noted in the 2011 report: Strietska-Ilina et al., 2011, p. 146), every job can become greener, and its content and conditions be modified to acknowledge the concepts of sustainability and decent work.

Among the 32 countries covered in the present report, permanent mechanisms dedicated to anticipating and monitoring skills needs specifically for a green economy are rare. In eight countries, most of them LICs or LMICs (Bangladesh, Brazil, Egypt, Ghana, Kyrgyzstan, Mali, Tajikistan and Uganda), there is no system at all in place at a national level for identification of current and future skills needs for any kind of job in the labour market (green or non-green), and only a small number of countries have set up a specific institutional body or systematic monitoring mechanism in relation to green jobs (as discussed below under the heading “Systematic mechanisms: Incorporation into pre-existing structures”).

In countries that have no system at all (green or non-green), skills needs are usually identified on an ad hoc basis. In Bangladesh, for example, companies identify their own skills needs, and provide on-the-job training for blue-collar jobs while recruiting trained people from the open market for white-collar jobs. In relation to green skills, the response is limited to some NGOs, renewable energy companies, waste management companies and the Infrastructure Development Company Ltd. In Uganda, where a similar ad hoc approach to on-the-job training of blue collar workers and recruiting trained white-collar workers has been followed, a “Green Jobs Programme” has recently been approved: the aims of this government initiative include the creation of green and decent employment, and the promotion of workplace reskilling, along with training in new skills for both those who have already undergone training and those who have not.

There are also examples of systems for anticipating skills needs that, after the initial impetus to establish them has passed, have become largely inactive; these throw into sharp relief some of the challenges involved. One such case is Egypt, where an (unstructured) system was in place for gathering and analysing labour market information involving numerous institutions. The European Training Foundation (ETF) and other international organizations (including the ILO) provided further support to develop the Egyptian Education Training and Employment Observatory. Unfortunately, the objectives of the observatory were not met, owing to political changes, lack of funding and limited institutional back-up. The observatory still exists, within the organizational structure of the Information and Decision Support Centre, but has become virtually dormant.

One particular problem facing skills anticipation in developing countries is that these economies include high proportions of informal jobs, making it difficult to gather the information necessary to anticipate skills needs and plan the necessary skills provision. Not only is informality itself one of the main causes of skills mismatches; lack of adequate information, of reliable data and of access to

33. See: <https://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/lang--en/index.htm> [accessed 24 Nov. 2019].

34. See: <https://en.unesco.org/themes/education-policy-planning/emis-2018> [accessed 6 May 2019].

formal education are major obstacles in policy formulation for formalization of the economy (see Palmer, 2017). In Indonesia, for instance, in August 2016, about 42.4 per cent of the workforce was employed in formal positions, while 57.6 per cent was in informal jobs.

In the following paragraphs, we discuss both systematic and less systematic approaches and measures adopted with a view to anticipating and monitoring skills needs for green jobs.

Systematic mechanisms: Incorporation into pre-existing structures

Most countries that do identify the supply of and need for skills in green jobs do so by incorporating these specific needs into their **pre-existing general skills anticipation mechanisms**, which are usually applied periodically. The kinds of mechanisms most commonly mentioned in the country reports are shown in table 7.1 below. As can be seen from the examples, countries may use more than one of these mechanisms.

Another way countries report taking skills for green jobs into account through their existing anticipation systems is by **revising their national frameworks of occupations** to include new (green) professions or to distinguish “green occupations” by labelling them as such. One example is China’s revision of its *Dictionary of occupations in China* (see box 7.2).

Table 7.1 Incorporating skills for green jobs anticipation into pre-existing mechanisms

TYPE OF MECHANISM	DESCRIPTION OF MECHANISM	COUNTRY EXAMPLES
National labour market information systems	One or more institutions involved in gathering and analysing quantitative and/or qualitative labour market information through employer surveys and other types of regular surveys and data collection	Predominantly UMICs and HICs, e.g. Barbados, Costa Rica, Guyana, Indonesia, Republic of Korea, Mauritius, Senegal, Spain, Tajikistan, Thailand
Sector-based anticipation mechanisms	Gathering and analysing quantitative and/or qualitative labour market information through focused (non-national) surveys and/or sectoral skills councils/expert groups/focus groups	Predominantly HICs, where institutions are more developed, e.g. Estonia, France, Republic of Korea, Mauritius, Senegal, UK
Collaboration between stakeholders on multiple levels	Partnerships among various stakeholders, ranging from employers, corporations and/or TVET institutions/ authorities to national and local government agencies	Countries at various levels of income and development, including Barbados, Costa Rica, Estonia, France, Republic of Korea, Philippines, South Africa

Sources: *Skills for green jobs* country reports (ILO, 2018); (Cedefop, 2019a).

Box 7.2 Identifying and labelling “green occupations”: The example of China

In 2010, as part of the five-year process of revising the *Dictionary of occupations in China* (first issued in 1999), a label was included for green occupations, using the Chinese pinyin initial “L” as its logo. In the new edition of the dictionary, which was approved and made public in 2015, a total of 17 occupations were marked as “green”, accounting for 8.5 per cent of all the occupations specified. These green professional activities include environmental monitoring, protection and management; improving the ecological environment; the production of energy from solar, wind, biomass and other renewable sources; and the provision of large-capacity, high-efficiency transportation and activities in other production areas, such as waste recovery and recycling. Other activities classified as “green professions” in the dictionary include scientific research; technological research and development; and planning and designing new ways of organizing social activities. The dictionary does not, however, provide any details of the criteria used to label an occupation “green”, and admits that the occupations so labelled green do not constitute an exhaustive compendium.

Source: *Skills for green jobs in China* (ILO, 2018).

Some countries have created **institutions or collaborations between organizations** to focus on identifying and analysing skills needs for green jobs. Thus Costa Rica has established the National Institute of Apprenticeship (see box 7.3); Estonia the System of Labour Market Monitoring and Future Skills Forecasting (Cedefop, 2019a); and France Onemev (see box 3.6) and the Observatory of Occupations (Cedefop, 2019a). In the Republic of Korea, green-specific bodies have been set up with a regional focus. The Seoul skills councils are NGOs composed of business organizations, representative companies, related academic institutions and research institutes in each industrial sector, selected by the Ministry of Trade, Industry and Energy and the Korea Industrial Technology Advancing Agency. The skills councils specifically relevant to green industry are the Renewable Energy Skills Council and the Energy Saving (both of which were set up in 2016 and are currently in the pilot stage).

Box 7.3 A multi-level approach to identifying skills needs for green jobs: Costa Rica’s National Institute of Apprenticeship

The main tasks of the Costa Rican National Institute of Apprenticeship (Instituto Nacional de Aprendizaje: INA) are the design and execution of training programmes in collaboration with other public and private institutions, and offering technical assistance to institutions and companies in the creation and delivery of professional training. In respect of skills for green jobs, INA provides technical training based on current needs, mainly for organizations and companies for which environmental management is an operative principle (a proactive response to the trend towards a green economy) or those taking actions to comply with environmental legislation (a reactive response).

INA keeps in direct contact with companies in the country in order to identify training needs for occupations among all productive sectors in the shift to a greener economy. Its identification of the skills needed is based on information gathered through three channels:

1. direct requests from companies or workers;
2. studies of demand conducted regularly by the Institute itself;
3. agreements or other mechanisms established with chambers of commerce, associations of enterprises or government bodies.

The constant flow of information and feedback ensures a timely response to labour market trends.

Source: *Skills for green jobs in Costa Rica* (ILO, 2018).

Employer surveys conducted within labour market information systems vary in the topics they cover. Barbados, for example, includes, as well as initial screening questions, questions about company profile, employment practices, skills gaps and demands, recent school leavers/graduates, future workforce needs and planning, and investment in employee learning and development. In a 2013 study of skills needs for green jobs in Costa Rica, questions were included to determine the level of awareness among participating SMEs about government initiatives related to climate change. In the Republic of Korea, a national employer survey on status and supply includes questions about the size of businesses, the size of their workforce and its characteristics.

Some countries include skills for green jobs in such surveys by adding **themed topics** such as environmental management, or by focusing part of the survey on **priority sectors** in terms of greening jobs and introducing new “green” professions (such as renewable energy). In the Republic of Korea, for example, the Ministry of Environment has conducted separate surveys on the status of environmental technology staffing in business organizations in relation to 40 technology “road-maps”. The United States has included a “green economy sector” in its Occupational Information Network (O*NET), maintained by the US Department of Labor. In this database, jobs in the green sector are sorted into three categories: (1) traditional occupations for which demand has increased owing to the growth of the green sector; (2) occupations that require upskilling or additional (green) credentials; and (3) new and emerging occupations.

In Kyrgyzstan, two measures have been introduced that are not mentioned specifically in other countries, namely:

- analysis of staff training: gathering data on demography, the qualification structure of regional workforces and the structure of TVET services (in respect of both people and occupations) in order to analyse how the needs of regional economies match up to those of the labour market with a view to further rationalization of primary and secondary TVET systems;
- tracking graduates by means of a tracer study: monitoring newly qualified graduates to determine their success in entering the labour market within the nine months after graduation.

Less systematic mechanisms: One-off initiatives in skills anticipation

Countries that do not incorporate skills for green jobs into their general skills anticipation systems (or do not have such systems) mostly identify such skills needs or priority sectors on an ad hoc basis, through **studies performed by international organizations** (Philippines), **expert focus groups** (Republic of Korea, Tajikistan) or **one-off labour market studies** at national or sectoral level (Barbados, Germany, India, Kyrgyzstan, Thailand, United Kingdom). These one-off studies may run alongside more systematic, broader skills anticipation approaches but are also used in countries where such approaches are under development or not yet in place.

An example of a one-off study is that carried out by the Chamber of Industries of Costa Rica (Cámara de Industrias de Costa Rica: CICR). The study surveyed 100 of the 800 members, assessing skills and awareness trends in the shift towards a carbon-neutral economy. The results showed that a majority of businesses – over 75 per cent of micro and small businesses and 40–70 per cent of medium and large businesses – were not aware of the Government’s environmental commitments.

A more in-depth study was performed by RenewableUK in 2013 for its report *Working for a green Britain and Northern Ireland*, providing an assessment of the number of people employed in several subsectors of the renewable energy field (onshore wind, offshore wind and marine energy) as well as the types of functions and jobs they performed (planning, manufacture, construction etc.). It found that the jobs of 34,373 people depended, directly and indirectly, on these subsectors in 2013. The association's forecast for the period up to 2023 estimates that an additional 70,000 jobs could be created (under the most positive scenario), with the occupational profile in the sector skewed towards relatively higher-skill occupations compared to the UK economy as a whole. It is expected that a higher proportion of these jobs will be in management, technical and professional occupations. The study also found that around a third of employers had already experienced difficulty in filling vacancies as of 2013, up from a quarter in 2010. The most commonly cited reason for such difficulties is the availability of skills.

When we compare the state of play in 2011 and 2018, we see that skills anticipation is clearly under development. More countries are now reporting on systematic approaches towards measuring skills for green jobs, and integrating this element more fully into pre-existing systems. Only a few countries only rely on ad hoc and one-off skills anticipation systems.

7.2.2 Technical and vocational education and training

TVET is in development across the world and has gained in prominence over the past decade. It is seen as a major contributor to reaching the SDGs – especially SDG 4, “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” – and in many countries as a way to contribute to decent jobs and employment growth. This focus is especially marked in the developing countries in our sample (e.g. the Philippines and Uganda). Despite overall system developments in TVET, only a few of these countries have systems or measures in place that are fully dedicated to developing skills for green jobs.

Most countries are involved in continuous development of their TVET systems – of the system itself, curricula, occupational standards, apprenticeship systems etc. Their approaches, however, vary markedly. Whereas some countries develop their systems in response to demographic changes or changes in skills demands, others take a more structural approach, for example through privatization of their system. The Australian Government, for instance, has been incrementally contracting out publicly funded vocational training activities over the past two decades (since 1998), attempting to create a “training market” by opening up funding to competition between public and private providers. The reasoning behind this approach was that competition would promote efficiency and innovation, and create incentives for trainers to tailor provision to the needs of both students and firms. However, the country report mentions analyses from 2014 that identified systemic problems in the design and implementation of the training market, resulting in a deterioration of the quality of publicly funded TVET activities, especially for the development of inclusive and green skills, reducing access to appropriately skilled labour for employers.

Uganda has recently reformed its skills delivery system by establishing the Skilling Uganda Task Force. This consists of a number of sector skills councils whose purpose is to facilitate cooperation between the Government and the private sector in

identifying training needs and reforming training curricula. In Denmark, an Advisory Council for Initial Vocational Training was appointed by the Minister of Education in order to continuously update the competencies provided by the vocational education and training system. This council works with around 50 trade committees which include representatives from trade union and employer organizations. Also, the Council for Adult and Further Education in Denmark has underlined the need to focus on special competencies in relation to energy optimization and sustainability in its strategic plan of 2014. A large number of adult labour market training programmes are offered related to energy, environment and waste handling.

The development of skills for green jobs through TVET is most often done through the addition of green components to existing qualifications or education programmes. The following sections examine two dimensions of this work: (1) the development of TVET qualifications and programmes and (2) their delivery. They discuss the most commonly described measures related to the development and delivery of TVET and present some examples of systems dedicated specifically to skills for green jobs. No explicit distinction is made between initial and continuing TVET owing to a lack of specific information on the latter. While this section is therefore focused mostly on initial TVET, subsection 7.2.3. Private-sector skills training" is focused more on reskilling while working.

Structures in place to develop TVET qualifications and programmes related to skills for green jobs

Only a small number of countries report having developed TVET programmes for newly created occupations, and even fewer have provided detailed information on these programmes.

Echoing the findings presented in the previous subsection on skills anticipation systems, **most countries in the sample have not developed a systematic approach** to incorporating skills for green jobs into their TVET systems, and into the development or renewal of their TVET qualifications, since 2011. If this is done at all, it is done by incorporating a focus on skills for green jobs into existing policies, strategies, frameworks and/or education systems in general (not TVET only), by including components on skills for green jobs. This incorporation of green components is usually focused on several priority sectors (such as renewable energy and sustainable development) and is often achieved through more than one of the measures set out in table 7.2.

Only a few countries (e.g. Australia, Guyana and the Republic of Korea) have indicated that there are (national) policies in place related to training in skills for green jobs. The approach varies from one country to another. In the Republic of Korea, the Green Growth Initiative was implemented in 2009, providing financial support for R&D projects and personnel development programmes related to green technology. In order to obtain this support, universities and training institutions were required to design and implement a green technology R&D project or training programme. Since the initiative was introduced, many universities and colleges have redesigned their four-year curricula to reflect green technology development, and vocational colleges have responded by launching new two-year courses related to skills for green jobs.

In Guyana, by contrast, the policy focus is not directly on training in skills for green jobs, but rather on raising awareness of climate change and other green issues

Table 7.2 Examples of TVET development measures incorporating green components

MEASURES	COUNTRIES	EXAMPLE
Developing, adapting and/or updating occupational standards for existing qualifications in national qualification frameworks to incorporate components related to skills for green jobs	Estonia, Germany, Ghana, India, Indonesia, Rep. of Korea, Philippines, Spain, Thailand	Since 2010, Spain has been “greening” its existing TVET diplomas as well as developing new ones specifically for green jobs. As at mid-2017, there were 21 TVET diplomas dedicated to green jobs, 17 of which had been created since 2010. There are also 78 new diplomas including content that responds to green criteria (such as the application of environmental regulations) and 35 diplomas that include transversal green content
Discussing relevant topics in national or sectoral skills councils and committees on education, research and development or skills development, which often include experts and other stakeholders	Australia, Rep. of Korea, Kyrgyzstan, Mauritius, Montenegro, Thailand, UAE	In the Republic of Korea , a total of 16 regional councils (RCs) are active across the country. Of these, the Seoul RC has been most active in providing green skills training and has commissioned its Northern Vocational Training Centre to provide two six-month training programmes in new and renewable energy facilities and green car maintenance. Each programme can train 30 people each time it is run
Adapting existing education programmes and/or developing a small number of new ones, often sector-specific	Most countries adapt existing education programmes to some extent; new programmes are less common: examples in Barbados, Kyrgyzstan	In Barbados , the Samuel Jackman Prescod Polytechnic has incorporated four three-month programmes in relation to green jobs: (1) solar panel installation, (2) PV electrical installation, (3) energy advisory and (4) wind energy. The Barbados Vocational Training Board has incorporated two apprenticeship programmes in relation to green jobs: one for solar water heating technicians, and another in skills for horticulture/landscaping

Sources: *Skills for green jobs* country reports (ILO, 2018); Cedefop, 2019a.

in nursery, primary and secondary schools. This approach uses videos, interactive learning methods, quizzes and incentives to inform students and encourage behavioural change towards better water management and preservation of the environment.

Another example of raising environmental awareness is the “Power Saving – Check” programme in Germany, which trains and qualifies long-term unemployed people to instruct low-income households on power-saving opportunities. (For more detail on this programme, see subsection 7.2.4 on “Active labour market policies”). In Montenegro, particular topics related to sustainable development have been introduced at all levels of education. For high schools, these topics include climate change, the green economy, environmental protection, sustainable cities and villages, biodiversity, health education, human rights education and entrepreneurial learning.

As far as more specific measures for the (re)structuring of TVET are concerned, some countries have set up a vocational training board or other institution with primary responsibility for skills development planning in TVET (including skills

for green jobs). Examples are the Barbados Vocational Training Board, India's Infrastructure Leasing and Financial Services Skills Development Corporation and Thailand's Professional Qualification Institute. The only explicit example of a specific course teaching skills for green jobs, however, is the first of these, which plans to introduce a training course designed for developing skills in irrigation and the harvesting of rainwater.

Finally, it is important to note that some of the countries that do not take a systematic approach to incorporating skills for green jobs in their TVET systems are still working on the development of a general TVET system (or national qualification framework) and intend to include skills for green jobs and occupations during a later stage of development or shortly after implementation. Ghana, for example, launched its national qualification framework in 2012 and aims to match existing qualifications with labour force requirements while keeping in mind future improvements and adapting the system as modernization requires. Also, a number of one-off capacity-building programmes have been carried out in collaboration with international partners in Ghana, mostly at a global or regional level. These partners include the Netherlands Climate Change Studies Assistance Programme, the Adaptation Learning Programme for Africa Initiative, the Green Climate Fund and the Climate Change Education in Schools Programme.

Delivery of TVET programmes related to skills for green jobs

Overall, the most commonly described national system delivering TVET programmes involves a combination of public and private training schools, technical or vocational colleges or institutions and/or formal or informal apprenticeship programmes. In the following paragraphs, we will describe examples of the TVET systems and their approaches to “greening” skills or professions from Brazil, Kyrgyzstan, Mali, Mauritius and Tajikistan. The first examples (Brazil, Kyrgyzstan, Mali, Tajikistan) mostly describe the delivery of programmes by public institutions, often in some form of cooperation with private companies. The last example (Mauritius) showcases the involvement of private training providers. Together, these examples show that co-funding and employer contributions (levies) are widely applied to support TVET for skills for green jobs. The examples also highlight a further difference in approach between countries that have developed delivery for specific sectors (Brazil), those that have delivered provision for specific occupations (Kyrgyzstan, Mauritius) and others that have integrated environmental citizenship into all agricultural TVET programmes (Mali).

In **Brazil**, the most important public institutions delivering vocational training are universities and federal educational institutes of science and technology, administered by the federal Government. The private sector contributes to this through a collective system of five training institutions (referred to as the “S System”) which are funded by contributions based on a percentage of companies' payrolls. The S System is responsible for meeting vocational education demands for industry, commerce, transportation, rural, and small and medium-sized companies. The institution responsible for vocational training for small and medium-sized companies is the most prominent of the five in delivering activities that encourage “greening” in entrepreneurship, supporting environmental courses, consultancy and environmental preservation activities. Furthermore, since 2011 an effort has been made to expand and democratize access to TVET provision through the creation of a National

Programme of Access to Technical Education and Employment (PRONATEC). This programme offers free courses in initial and continuing education through a partnership with federal, state and municipal TVET networks, including the S System, and with private institutions. Initially, only 18 out of 227 technological courses were identified as offering components associated with skills for green jobs. In order to improve this proportion, the Ministry of Environment began an association with PRONATEC to increase the delivery of education related to environmental policies through three major programmes:

- Environmental PRONATEC (PRONATEC Ambiental), which supports sustainable production chains and strives to meet specific labour market demands in green economic activities;
- Extractivist PRONATEC (PRONATEC Bolsa Verde – Extrativismo), which aims to strengthen sustainable practices and production chains in the extractive industries, and at the same time to reduce illiteracy and increase formal education for those living in remote areas;
- Waste Collector PRONATEC (PRONATEC Catador), which aims to improve professional qualifications among collectors of recyclable materials, recognize their tacit and social skills.

As well as these major programmes, the association offers 72 initial and continuing education courses that strive to close the gap in relation to greener professional education.³⁵

Kyrgyzstan provides training of qualified workers through primary vocational education and training (PVET), and training of specialists to technical expert level through secondary vocational education and training (SVET). In 2002, the Ministry of Education and Science created an expert council on ecology, which prepared regulations for the introduction of a number of ecological training courses, on ecology, ecology and rational environmental management, bio-ecology, environment protection, complex usage and protection of water resources, agro-ecology, geo-ecology and technical measures of environmental safety. These courses have since been incorporated by many higher education institutions, and a special course on environment protection and rational use of national resources has been introduced in the PVET and SVET systems. Furthermore, schools are introducing additional courses on ecology, using training programmes and practical guides on ecological upbringing that have been developed, and have trained local trainers to introduce these concepts.

In **Mali**, three bodies carry out the public delivery of vocational training, labour force integration and job creation: a support fund, a youth employment agency and the National Agency for Employment. Although none of the structures have directly incorporated aspects pertaining to skills for green jobs, there have been activities related to environmental citizenship and large-scale, labour-intensive work in the agricultural sector. At present, the vocational training sector in Mali does not offer courses specifically tailored to green employment, but it strives to integrate skills for green jobs into vocational education and training by offering training centres opportunities to integrate relevant skills into current pathways and qualifications, and/or develop new frameworks on skills for green jobs. There are also some specialized

³⁵. This number may have been affected by budget cuts to the Ministry of Education; no data have been available on how many of these courses are effectively offered.

training initiatives under way, which are establishing training centres in relation to sustainable development, climate change and green economy dynamics (focusing on renewable energy, environment and agriculture). The Renewable Energy Agency, for example, operates in partnership with the support fund to develop training courses for graduates of vocational education and training centres to equip them with renewable energy skills. The agency also provides opportunities for students to take up three-month internships in enterprises working with (experimental) renewable energy. Another example is the SOLEKTRA-Solar Academy, founded in 2016, which is dedicated to solar energy and offers training at three levels: training unskilled youth to become skilled workers; training senior technicians to baccalaureate and higher technical degree level; and training at engineer level. These modules include training on general electricity, installations, design of large projects and management of PV power plant systems.

In **Tajikistan**, there are short vocational training courses run by the Adult Education Centre under the Agency of Labour and Employment, but these do not have a specific focus on green jobs and occupations. Training is targeted mainly at youth, migrant workers and women. Since 2016, with the support of international donors (e.g. the Asian Development Bank), competency-based standards on, for example, clean energy and energy efficiency, are being piloted in some TVET institutions.

In **Mauritius**, the main provider of TVET programmes is the Mauritius Institute of Training and Development (MITD), spanning about 350 private institutions. Since 2003, employers have paid a training levy that is used to finance the training of employees across a range of economic sectors. Through the levy grant system managed by the Human Resources Development Council, employers can recover up to 75 per cent of course fees, depending on their tax rates. The MITD collaborates with ministries and the Human Resources Development Council to design courses in response to training needs and demands. The MITD offers the courses continuously and takes applications at any time. Courses are only delivered, however, when enough students have applied. The MITD has committed itself to further greening of its courses; some examples of existing MITD initiatives in providing skills for green jobs are given in box 7.4.

Finally, some countries have indicated that they are still mainly focused on improving the quality of their TVET education in general (South Africa) and expanding access to it (Brazil). In Burkina Faso, policies related to TVET are still focused primarily on the standardization of the training system and curricula, the expansion of access to a greater number of citizens, and the establishment of an effective and sustainable financing mechanism for training. Vocational education and training provision in Burkina Faso relevant to the green economy is generally found in the agri-food, electrical engineering, and hotel and catering sectors.

As for the final outputs of TVET programmes, some insight into the numbers of graduates in sectors involved is provided by Costa Rica. Table 7.3 shows the number of graduates from 2010 to 2016, broken down by gender, for a set of new and adapted training programmes in the environmental management subsector.

This example also illustrates an issue discussed in other countries: the skew in the respective proportions of men and women in educational programmes, which often show a larger number of male students in technically orientated programmes and female students mostly in programmes with management or service elements. The same skew is found when observing the distribution of men and women

Box 7.4 Examples of initiatives related to skills for green jobs undertaken by the Mauritius Institute of Training and Development (MITD)

Technicians for PV solar power: Short training courses are offered for technicians in the field of PV solar power technology, with a view to building capacity in renewable energy production. These courses are delivered as soon as 10–15 applications have been registered. The MITD has invested in equipment to be used during the training sessions, such as a stand-alone PV energy generation system to showcase the production of renewable energy. The system is also being used to train practising technicians in the industry.

Environmental protection sensitization: A module on environmental protection has been included in MITD training programmes to develop awareness of environment protection and key sustainable development issues (climate change, biodiversity, sustainable consumption, waste reduction, resource efficiency). The module has been incorporated into all training courses, although delivery varies by course. In training courses where only a basic knowledge of environmental sustainability is needed, the module provides participants with a competency at that level; in other training courses, the module treats the topic of sustainable development and green practices in more detail. The curricula also incorporate competencies on safe handling and disposal of hazardous wastes such as used engine oils, paint materials and thinners etc. The objective is to bring about a change in culture at the workplace with regard to the use of hazardous materials. OSH is also incorporated into all training courses.

Regional workshop on hydrocarbon refrigerant for air conditioning: Mauritius is currently phasing out hydrochlorofluorocarbon (HCFC) refrigerants such as R22 in accordance with the provisions of the 1987 Montreal Protocol. In 2017 The MITD held a one-off regional workshop for Africa on hydrocarbon refrigerant for air-conditioning units, focusing on the use of the R290 refrigerant, an ozone-friendly hydrocarbon, instead of R22. Participants from other African countries including Kenya, Lesotho, Namibia and Zimbabwe, as well as Mauritius itself, were invited to attend. The MITD also conducted training for participants in the Seychelles. The courses also cover the conversion of existing equipment using chlorofluorocarbon (CFC) and HCFC refrigerants to eco-friendly refrigerants.

Energy auditors: The MITD has organized specific training programmes to build local capacity for energy auditors, in collaboration with the UK firm Energy Associates Ltd. In the same vein, further training has also been organized on practical energy management audit and thermal imaging of buildings. These courses aim to train people in the techniques for carrying out energy audits and measures for increasing the energy efficiency of buildings. The course is offered periodically, when enough candidates have signed up.

Source: *Skills for green jobs in Mauritius* (ILO, 2018).

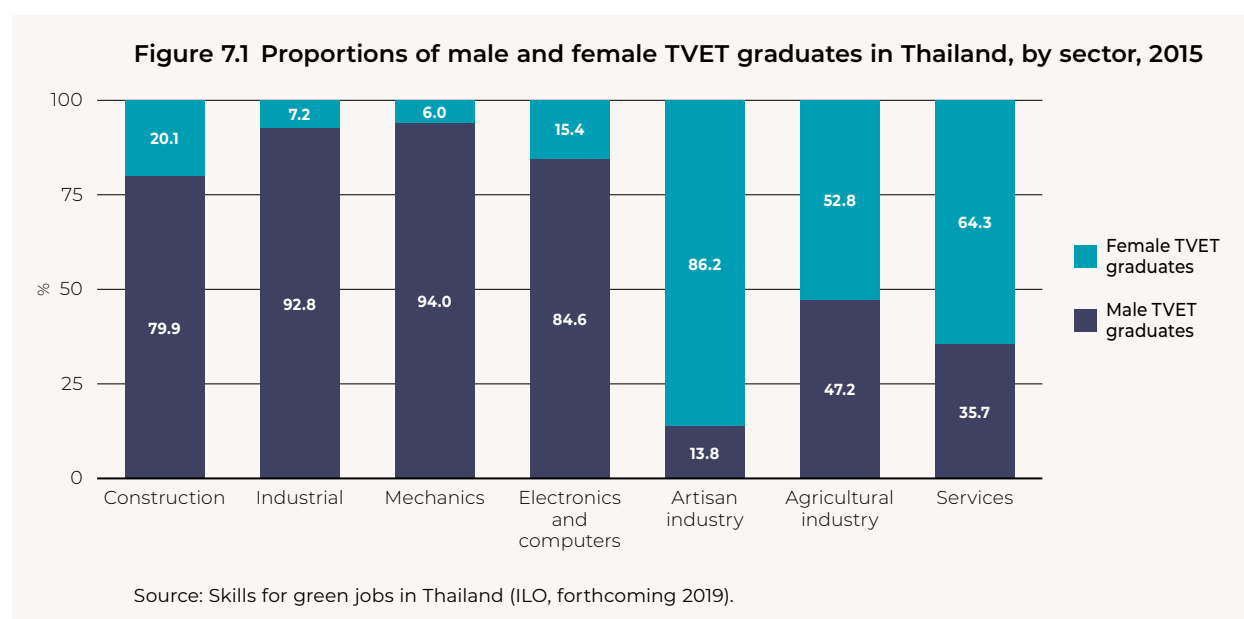
across labour market sectors in general, as illustrated by the example of Thailand in figure 7.1. This figure shows that the sectors mainly attracting male TVET graduates are also those mentioned by most countries as priority sectors in relation to the shift to a green economy.

Overall, most countries do emphasize the importance of restructuring their education systems to match the changing needs of their economies, although the extent to which greening has been a part of restructuring efforts since 2011 varies greatly.

Table 7.3 Number of graduates from training programmes in environmental management in Costa Rica, 2010–16

PROGRAMME	2010		2011		2012		2013		2014		2015		2016		SUBTOTAL		TOTAL
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	
Operator of water supply systems for community aqueducts (formerly: assistant or operator for water purification plant)	73	10	16	1	59	7	36	13	22	5	53	5	49	10	308	51	359
Operator of centres for the collection of useable materials (formerly: collector of solid waste)	83	146	55	98	44	139	48	208	77	229	80	131	92	135	479	1086	1565
Operator for sewage water treatment for environmental management (formerly: technician in operation of plants for sewage treatment)	18	8	18	5	6	7	11	6	26	7	24	7	23	8	126	46	174
Operator of swimming pools			26	2	55	5	48	6	95	23	118	15	78	20	420	60	480
Assistant in environmental management systems implementation											8	14	13	13	21	27	48
Environmental management systems implementation													6	7	6	7	13

Source: *Skills for green jobs in Costa Rica* (ILO, 2018).



7.2.3 Private-sector skills training

A distinction can be made between, on the one hand, the involvement of the private sector in (green) skills governance, anticipation and (initial) TVET and, on the other hand, the private sector taking control of the development of skills for green jobs. Both types of private-sector involvement in the development of skills for green jobs are discussed in the country reports.

TVET design and delivery in many countries involves the private sector, as the analysis presented here has already demonstrated (see subsections 7.2.1 on “Anticipating and monitoring skills needs” and 7.2.2 on “Technical and vocational education and training”), and as will be further demonstrated in section 7.3. Involvement of stakeholders: Institutional set-up and social dialogue”. However, the depth of private-sector engagement varies widely.

At one end of the spectrum are countries like Germany. Here, the involvement of the private sector in skills training is an intrinsic part of the dual TVET system. Within such systems, TVET programmes and qualifications are revised on the basis of discussions within economic sectors to include greening elements. Countries at this end of the spectrum, with well-developed institutional arrangements, tend to be developed economies.

At the other end of the spectrum are countries where TVET systems are in development. In India, for instance, despite various initiatives, the Government acknowledges a continuing vast mismatch between supply of and demand for skilled workers. To correct this, there needs to be deeper collaboration between the private sector, formal education institutions and government initiatives. As the country report for India notes, the private sector can support (green) skills training in sectors such as construction, automobiles, tourism and hospitality, and ICT. In the Republic of Korea, stakeholders in TVET such as the Government, education and training institutions, and industrial groups are clearly aware of the need for industry participation, but in practice this participation is subject to various limitations. Organizations such as industry associations have been established only recently, and are consequently weak in terms of function and expertise. In Mali, as in many LICs, TVET is available only to a small minority of youth. Apprenticeship in the informal economy provides many out-of-school youths with the opportunity to learn a trade and enter the labour market. There is, however, no indication of any skills for green jobs being developed or validated. Also, in Tajikistan the level of social partnership is still quite low, leading to limited private-sector involvement in any kind of skills development, let alone in developing skills for green jobs.

There are many countries that can be positioned along the spectrum somewhere between Germany at one end and countries where the private sector has not (yet) established its role in TVET at the other. Many of these have already established structures to involve private-sector actors at a higher policy level, and are working to further stimulate such involvement at lower levels. These structures might also provide a forum for discussion of greening skills development. In the Philippines, for instance, there are private-sector representatives on the TESDA board, and they are consulted in the preparation of labour market intelligence reports. In Senegal, too, the importance of the private sector in vocational training was recognized very early (in 2000) by the State, which has since then embarked on a policy of partnership-based governance of TVET, so that today the private sector is deeply involved in high-level decision-making and funding.

Sometimes, if the TVET system is not functioning well (e.g. if it does not respond effectively to sectoral demands), the **private sector develops the skills it needs itself** (as for example in Guyana, India and South Africa). This approach is more common among MICs. In South Africa, for instance, there is relatively little participation by the private sector, or by civil society, in the development of skills for green jobs. The sectoral education and training authorities were not delivering what the private sector demanded, and so private enterprises relied more and more on their own strategies for meeting their skills needs and training for occupations as they saw fit. The environmental skills needed by the private sector to facilitate their compliance with national regulations, e.g. on waste-water treatment and pollution management, often require high-level technologies and associated skills. These skills and expertise are usually brought in from international firms, or from foreign companies investing in South Africa. One such example is European Veolia Water Technologies, which offers water treatment technologies and services to the South African market.

In the same vein, other countries point to the private sector as needing to take the lead in greening the skills supply. In Guyana, for instance, the pace of progress towards a green and circular economy is heavily influenced by private-sector investment and innovation, both key requirements for stimulating employment, technology adoption and skills demand across sectors. Within the framework of Guyana's Education for Sustainable Development Policy (2015), the key policy objective to this end is to deepen private-sector participation in accessing and delivering the skills needed for Guyana's green economy programme. Of key importance in this context are the small but significant number of private-sector, industry-aligned training and professional development schools. A similar development is under way in India: since 2010, its private sector has started training and building green skills development programmes to meet in-house as well as external demand. The present Government has placed great emphasis on privately owned small businesses with a focus on green initiatives. Box 7.5 provides a couple of examples.

Box 7.5 Examples of greening initiatives in India's private sector

Changing the corporate social responsibility (CSR) landscape: India's CSR landscape is witnessing improvements. More companies are opting for sustainable supply chains, and this demands changes in the skill sets of employees to match the demand for skills for green jobs. The number of firms committing to human rights policies rose from 40 in 2015 to 54 in 2016.

Business sustainability reporting: While not mandatory, preparing sustainability reports is a rising trend in India. The rate of reporting grew by more than 20 per cent between 1999 and 2009. About 63 per cent of the top 100 companies and 77 per cent of companies outside the top 100 now prepare sustainability reports. These reports highlight the changes needed in the skills development system.

Source: Skills for green jobs in India (ILO, 2018).

Most countries (all the European countries in the sample, plus, for example, Kyrgyzstan, the Philippines, Senegal and Uganda) acknowledge the importance of on-the-job training and have developed apprenticeship-like schemes. For instance, Kyrgyzstan has a large proportion of workers without vocational training and a smaller proportion of qualified workers who are in need of further training; there are,

however, few cases where the private sector provides training and knowledge on skills for green jobs to its staff, so that private-sector engagement in greening skills is virtually absent. In Uganda, private organizations are involved in skills development within their sectors, but since 2010 there has been no evidence of a green focus.

In some countries, **specific private-sector initiatives for the development of skills for green jobs have been launched** since 2010: one example is presented in box 7.6.

Box 7.6 The private sector takes the lead in skills development in Indonesia

In Indonesia, skills development for green jobs to support **energy conservation** has been developed since 2012, when the Association of Energy Conservation Experts (Himpunan Ahli Konservasi Energi: HAKE) was founded. HAKE awards certification to individuals (about 550 by 2016) in energy management and energy audit. Its graduates work in companies or factories that consider energy management and conservation to be a material aspect of their operations. Some of the graduates are hired by the Government to conduct energy audits.

The green economy in **building and construction** is driven by a number of regulations at national and provincial level. The Green Building Council Indonesia (GBCI) is an association that moves the green building and construction agenda forward, promoting “greenship ratings” based on, among other things, skills development for green building. The GBCI runs two types of training programme: the Greenship Associate Programme, which provides education on general knowledge and information about green building concepts; and the Greenship Professional Programme, which is designed to enable practitioners to assess buildings, houses, interior design, and zones/areas according to green building principles. Similar initiatives have been taken in tourism and agriculture.

Source: *Skills for green jobs in Indonesia* (ILO, 2018).

At the level of individual companies, Spain offers the example of the environmental training programme operated by the company Acciona, called “Acciona University”. In 2015, this programme provided 34,618 training hours to employees in green and environmental subjects, delivered not only through short courses and one-day activities but also through courses of longer duration, organized in cooperation with the University of Alcalá (Madrid). In the United Kingdom, the Skills Academy for Sustainable Manufacturing and Innovation is based at the Nissan car manufacturing plant in the north-east of England.

Training needs can also be met through **collaboration between companies**; this can be especially helpful for SMEs that may lack the time and resources to provide training on their own. Some inter-company vocational training centres (*überbetriebliche Bildungszentren*) in Germany focus on environmental issues, and some have developed into multi-functional education centres, increasingly active in the field of advanced training and continuing education, including master craftsperson programmes. In this context, they play an important role in the promotion of skills for green jobs (and related technologies), especially in the absence of other support measures that might offer training in skills for green jobs to SMEs. Very often, new advanced content for skills programmes related to skills for green jobs is developed in such centres and thereby made accessible to a large number of firms, especially SMEs.

Some countries operate **specific financial incentives** to encourage green industries and skills. In Guyana, at least two commercial financial institutions and IPED, a microfinance organization, offer green financing either as parties to a public–private arrangement and/or independently. Skills training is a common feature of these green financing arrangements. Guyana’s Micro and Small Enterprise Development Programme, which provides competitive financing for green business, offers skills training coupons that beneficiaries trade in for a variety of business development and management training programmes delivered by pre-approved training organizations and/or experts. In the Republic of Korea, private-sector participation in TVET has been based mainly on government incentives through financial support, rather than voluntary participation by companies. Some experts have criticized this approach, as it is difficult to guarantee sustainability on the basis of non-voluntary participation. In Thailand, the Skill Development Promotion Act of 2002 is a key law encouraging skills development in the private sector. This Act allows the cost of training to be deducted from tax payments, which can result in savings equal to twice the actual training costs. However, the demand for training depends on each company’s needs, which are not necessarily for green-oriented skills.

Overall, private-sector engagement on some scale is regarded as essential in all countries, both in terms of establishing a sustainable and functional TVET system and in terms of in-sector and in-house skills development. The evidence, however, shows that since 2011 there have continued to be few examples of private-sector greening initiatives that are sustainable in the longer term. There is evidence of specific sectoral or company initiatives, and of the use by governments of specific financial incentives focused on greening skills development. But there are also indications that, without incentives, the private sector struggles to act on its own.

7.2.4 Active labour market policies

A large share of the countries in the sample either indicated that there are no ALMPs in place targeted at developing skills for green employment (12 out of 32) or did not provide information on this topic at all (5 out of 32). Only a few examples were provided of a national strategy or targeted initiatives of public employment services (PES) focused on skills for green jobs; these will be discussed later in this section. Most countries did, however, acknowledge the need for and express a commitment to developing policies and PES programmes relevant for transitioning to a “green” or carbon-neutral economy, including ALMPs to pre-empt potential skills shortages and to support groups rendered vulnerable by the transition. These vulnerable groups in many cases include young people who are either already unemployed or at risk of unemployment as a result of certain jobs and industrial activities being phased out in the greening process (see the example of China below). In other cases, PES initiatives are focused on tackling unemployment among indigenous peoples (Guyana, Philippines), disabled people (Mali, Mauritius, Philippines), SMEs (Guyana, South Africa) or migrant workers (Philippines, Tajikistan).

An interesting example is the Emergency Skills Training Programme in the Philippines, launched by TESDA in 2017. This programme will retrain and upgrade the skills of returning overseas Filipino workers, and will also provide support for direct relatives of police officers and soldiers who died or were wounded in the line of duty; rehabilitated former drug dependants and their families; people with disabilities; indigenous people; informal settlers; human trafficking victims and their families; and women. Courses available through this programme offer training in

(among others things) traditional skills such as motorcycle and small engine servicing, carpentry, masonry, food processing, welding, plumbing, and electrical installation and maintenance. An example of an innovative employment programme aimed specifically at people with disabilities is “Bushlink”, established by Northside Enterprise Inc. in 2009, in Australia. This programme provides gardening and bush regeneration services around the northern beaches of Sydney, collaborates with nature reserves to regenerate the bushland, works with disengaged students of the Beach School (a coastal protection project aimed at supporting people with disabilities and special needs) and provides on-demand “corporate volunteering days” for businesses and organizations.

The types of ALMPs reported vary greatly, not least owing to the differences among target groups. Measures deployed by **PES** in general are most commonly mentioned, followed by the establishment of **funding systems** to which individuals or companies can apply for training or retraining. France provides a unique example among the selected countries of a national PES (Pôle emploi) that monitors and reports on developments in relation to skills for green jobs and occupations, and matches vacancies with jobseekers (Cedefop, 2019a). Its workshops provide employees with up-to-date information and (when needed) direct them to specialized training if immediate routing to employment is not possible. Germany provides a further example, in this case targeted on a particular group and a particular activity (Cedefop, 2010a): its “Power Saving – Check” programme targets **long-term unemployed** people and trains them to instruct low-income households on power-saving opportunities. Some 210,000 households have been visited since 2009, and the aim is to visit a further 125,000 by the end of 2019. In 2016, more than 900 individuals participated in the programme, of whom 40 per cent had successfully been integrated into the labour market within the same year. Another targeted example is found in the Philippines. In 2014, a specific programme, JobSearch, was launched to increase the employability of unemployed young people (aged 18–24) with less than a year of accumulated work experience by providing job-search assistance, (free) technical and life-skills training, placement in internships and job referrals. A further interesting example of a “pre-training” programme is found in the United States, where pre-apprenticeship programmes are provided that prepare individuals to enter and succeed in registered apprenticeship programmes. Both classroom-based and practical, technology-based training is offered, with a focus on basic competencies such as mathematics, literacy, English and work-readiness. These programmes help increase opportunities for under-represented, disadvantaged and/or low-skilled individuals. In Estonia, an existing measure – the Estonian Unemployment Insurance Fund – was adapted in 2017 to offer additional services designed to prevent unemployment. These new services are directed at both employees and employers: to provide employees who lack skills or whose skills are outdated with support in changing jobs or remaining employed, and to support employers in finding and training suitable workers and in restructuring their companies.

No specific career guidance or counselling initiatives related to skills for green jobs have been identified. Nor did the country reports provide any examples of funds specifically targeted at the development of the skills for green jobs that will be needed in the transition to a green economy. There are, however, some examples of funds provided for processes associated with that transition. Barbados’s National Employment Bureau provides a **retraining fund** (the National Insurance Scheme) to offer active jobseekers opportunities to improve their skills. After applying for

unemployment benefits, they can access courses associated with the retraining fund, including those with green components, at three institutions: the Samuel Jackman Prescod Polytechnic, the Barbados Community College and the Barbados Vocational Training Board. China provides a fund (US\$15.4 billion) dedicated to cushioning the **effects of job losses** on families and society arising from the phasing out of traditional heavy industries. Between 2016 and 2018, China expected to lay off about 1.8 million workers in the coal and steel industries (15 per cent of the workforce in those sectors) to reduce industrial overcapacity. However, although the Government has developed a proactive framework to deal with these laid-off workers, including skills training, no specific attention is paid to training in skills for green jobs. Also, China's recently announced plans to add large new coal-fired power plant capacity are likely to undermine the previous efforts (Shearer, Yu and Nace, 2019). In some countries, funding is provided through collaboration with international donor organizations: in Egypt, for example, the Green Climate Fund and the European Bank for Reconstruction and Development are to join forces in contributing to a US\$1 billion renewable energy project. This collaboration will support the Egyptian Government in its Sustainable Energy Strategy, which aims to source 20 per cent of Egypt's energy from low-emission renewable sources by 2022 and allows independent power producers to invest in the first wave of (private) renewable energy production.

Another type of measure mentioned in the country reports is the development of a **policy framework or strategy to address labour market concerns**. An example still in development, but without a focus on training in skills for green jobs, is Guyana, which is still in the planning stage of its economic restructuring and green transition, has been developing its Green State Development Strategy, and in 2017 produced a draft of the framework that will serve as a guide in the transition. It has identified policy objectives on skills for green jobs in relation to the transition into increased "green economy participation" by specific priority groups. For youth, the focus will be on youth-specific green job creation and entrepreneurship training; national education on sustainable development, climate change and biodiversity; greening TVET; increasing the capacity of STEM programmes; and training in job-market readiness at secondary school level. Other priority sectors of the framework are hinterland communities, farming/mining/forestry subsectors, energy-sector technicians, geographic vulnerabilities, and micro and small enterprises. Several measures have already been implemented on the basis of this framework; a selection are discussed in more detail in box 7.7.

Other examples of measures mentioned in only one or a few country reports involve governmental initiatives outside the employment arena (Spain), sectoral and charitable/non-profit-making organizations (United Kingdom, United Arab Emirates) and the organization of job fairs (Indonesia, Philippines).

The 2011 report indicated that many countries had not identified ALMPs to cushion workers – even those in formal employment – against the effects of transition to a greener economy. The 2018 reports provide evidence that since then ALMPs related to skills for green jobs have been put in place, not only in the developed countries, but – as the examples outlined above show – also in developing economies.

Box 7.7 ALMPs within a labour market framework: Examples from Guyana

Rupununi Innovation Fund: Resulting from a multi-sector partnership between Conservation International, the Inter-American Development Bank and the Guyanese Government, this fund provides access to low-interest start-up financing to help entrepreneurs in indigenous communities to develop enterprises that are climate resilient and environmentally sustainable – in particular within agriculture, fishing, and eco- and nature tourism. Beneficiaries receive entrepreneurial training, access to market support, and training in awareness and capacity building for ecological systems maintenance, and are involved in forest conservation mandates.

Green Loans Programme: Established as an addition to the Rupununi Innovation Fund, this programme provides investment on favourable terms, offering 25 per cent discounts on their lending services, no late payment fees and zero pre-payment penalties for solar energy products, water treatment recycling and water filters, energy-saving appliances, air filters, wind-power and hand-powered projects, and low-carbon enterprises including high-end fruits, vegetables and aquaculture.

Small Enterprise Development and Building Alternative Livelihoods Programme: Implemented by the Ministry of Business, this programme is designed to foster the inclusion of SMEs and vulnerable groups in Guyana's green transition through loans distributed across industries. By June 2017, a total of 125 loans had been made across twelve industries, providing employment security for a total of 580 people.

Shade-house Production and Marketing Project: This project helped to construct and rehabilitate crop shade-houses, and provided training through the National Agricultural Research and Extension Institute to a total of 320 people in hydroponic vegetable production.

Youth Innovation Project: This national initiative to strengthen youth participation in the labour market facilitates access to financial capital for proposals that address a community, national and/or national development challenge while also contributing to the green economy. Proposals are eligible for support in the following areas: science, technology, engineering, agriculture, anthropology, archaeology, the arts, architecture, mathematics and spirituality.

Source: *Skills for green jobs in Guyana* (ILO, 2018).

7.2.5 Mechanisms for validation or recognition of prior learning

Alongside established systems for recognizing formal learning, some countries have developed mechanisms to recognize and validate non-formal and informal learning, and many more are in the process of doing so (UNESCO, 2015, p. 7). Recognition of all types of learning can result in benefits in the labour market for both the individual and employers: for the former, better employment and earning opportunities, higher self-esteem and improved preparation for formal education and training; for the latter, lower training costs. However, only two countries out of the 32 in the 2018 skills for green jobs sample reported any information regarding mechanisms for the validation or recognition of prior skills; and in both of those cases, the mechanisms are described in terms of a desire or commitment and are yet to be implemented. However, developed economies, for example in Europe, do have established validation and recognition systems in place (in France, for instance, the “validation of experience” procedure) (Cedefop, 2019a).

In Barbados, the Ministry of Labour and Social Development found that almost 41 per cent of the unemployed labour force has no formal qualification or certification, resulting in difficulties finding employment. It has therefore pledged to support the implementation of a system of “prior learning assessment and recognition” to acknowledge skills and competencies already acquired outside traditional academic and training settings (i.e. through on-the job training or other informal learning opportunities). To achieve this, workers will be given opportunities to demonstrate their competencies to a recognized certification body (which is still to be established) so that they can be examined by skilled and experienced assessors. Also, the ministry and relevant partners will conduct curriculum and programme assessments to introduce the use of competency-based education and training methodologies in training institutions and in providing necessary technical assistance.

India reports the country’s workforce as largely unorganized, unskilled or semi-skilled. These workers often pick up skills informally – through observation, working under guidance or complete self-learning – a process that limits their opportunities to improve their skills, in turn affecting productivity and quality of output. The adoption of an RPL framework could improve this situation by allowing workers to be assessed and certified on their current competencies in line with the National Skills Qualifications Framework. Furthermore, such a system would be a key instrument in mapping the existing skills in the unorganized sector, and in integrating the informal sector into the formal skilling landscape. The RPL process would include a pre-assessment, skills gap training and a final assessment, providing individuals with both horizontal and vertical pathways to acquiring additional skills to improve their livelihoods. The Government is to provide detailed guidelines for RPL initiatives to ensure quality and consistent outcomes, while striving for equitable access to these programmes.

In summary, validation and recognition mechanisms do exist, and can be applied to skills for green jobs, but the country reports do not provide specific evidence of this particular application.

7.3 Involvement of stakeholders: Institutional set-up and social dialogue

As we have seen in the previous sections, stakeholder groups are involved in skills anticipation, in the development and delivery of TVET programmes, in private-sector skills training and in ALMPs. This involvement may take place within consultative frameworks or in the practical implementation of activities related to skills for green jobs. In general, the countries in the sample participate in a variety of multi-stakeholder consultative mechanisms related to the anticipation of skills needs and development. Examples of mechanisms put in place specifically focusing on green skills and occupations are very limited, and will be discussed individually. As stated before, in most countries the development of new skills and professions is demand-driven. Even though this does result in the incorporation of green elements, it is often limited to a number of priority sectors such as renewable energy, agriculture, transport and tourism.

7.3.1 Stakeholders involved and their roles

There are many types of stakeholder groups involved in **multi-stakeholder consultative frameworks** (in general), including government agencies, training institutions, certification bodies, private-sector companies, international institutions, business, industry and professional associations, and (less commonly mentioned) trade unions. Examples of **general mechanisms** described in the country reports involve coordination between ministries, sectoral associations, councils (skills, TVET) and committees, advisory boards and working groups. Which social partners are involved and what role they play within these mechanisms varies from country to country, and often depends on the sectors or topics to which the mechanisms are related, as well as the level on which the partnership operates (national, regional or local). Often, the issue of skills for green jobs is closely linked in this context with that of decent jobs, in order to ensure that those who obtain skills for green jobs also enter into decent employment contracts (this is explicitly mentioned in the context of the US Community Workforce Agreement). Table 7.4 provides some additional insight into this variety by summarizing the range of general activities these mechanisms can perform, and which stakeholder types may be (but are not necessarily) involved.

Even though most countries indicate that their mechanisms do not include specific elements focused on skills for green jobs, they do acknowledge the importance of establishing or improving coordination in multi-stakeholder consultative frameworks and increasing their involvement in workforce development and policy coherence.

Table 7.4 Stakeholder involvement in developing skills for green jobs: Activities and groups potentially involved

ACTIVITIES	STAKEHOLDERS POTENTIALLY INVOLVED
Policy development, coordination and monitoring	Government agencies, international institutions, business, industry and professional associations, trade unions
Developing or updating qualification standards, training regulations and/or qualification frameworks	Government agencies, training institutions, certification bodies, business, industry and professional associations, trade unions
Developing training and retraining programmes, curriculum design	Government agencies, training institutions, private sector companies, trade unions, international institutions
Participating in focus groups, advisory boards, working groups, tripartite committees	Government agencies, training institutions, private-sector companies, international institutions, business, industry and professional associations, trade unions
Performing training assessments and awarding qualifications	Government agencies, training institutions, certification bodies, private sector companies
Quality assurance (of education programmes and qualifications)	Government agencies, training institutions, certification bodies, trade unions
Performing or collaborating in studies (on skills needs and supply, labour market composition, sectoral developments etc.)	Government agencies, training institutions, private sector companies, international institutions, trade unions

Source: *Skills for green jobs* country reports (all countries that provided enough information) (ILO, 2018).

Employers' and workers' organizations (trade unions) play a vital role in developing and implementing policies on skills for green jobs, especially when it comes to ensuring that the green transition is also a fair transition, in which disadvantaged and vulnerable groups do not face unequal challenges in making the transition towards skills for green jobs. Trade unions and employers' organizations are also members of broader councils that are consulted on general economic, educational and environmental issues – as, for instance, in Australia, Denmark, Germany, Mauritius, Montenegro and the United Kingdom.

7.3.2 Institutional arrangements for stakeholder involvement dedicated to the development of skills for green jobs

Most dedicated mechanisms or multi-stakeholder consultative frameworks are “green” committees or councils. This section will describe examples of these main categories, and will also describe examples of an association, a public organization and a non-profit-making initiative related to the development of skills for green jobs.

In the Republic of Korea, the **Green Growth Committee** (GGC) was set up in 2009 in order to support the “Green Growth” policy. This committee, most of whose members are government ministers, integrates the functions of the National Energy Commission and the Sustainable Development Committee. Initially set up under the presidency at the time, since 2013 it has been placed under the aegis of the Prime Minister's Office (resulting in reduced function and prestige). The GGC's main tasks are to establish a five-year Green Growth Plan, as well as policy coordination between ministries and support for low-carbon green growth. It has several subcommittees: the Green Growth Strategy Subcommittee, the Climate Response Subcommittee, the Energy Subcommittee and the Green Technology Subcommittee. The operations of the GGC are supported through the Green Growth Support Team, whose members are drawn from the Prime Minister's Office. Also, 16 local government bodies have created regional green growth committees, each developing a regional green growth plan through coordination with the GGC.

In the United Arab Emirates, the **Emirates Green Development Council** was formed in 2015 to transform the economy to a more sustainable one through the development, coordination and monitoring of a national greening policy. Its members are drawn from various federal agencies and representatives of local authorities,³⁶ including the Ministry of Climate Change and Environment, the Ministry of Economy, the Ministry of Energy, the Ministry of Finance, the Ministry of Foreign Affairs, the Ministry of Public Works and the Executive Council; the Environment Agency of Abu Dhabi, the Dubai Supreme Council of Energy, the Environment and Protected Areas Authority in Sharjah, the Executive Council of the Emirate of Ajman, Fujairah Municipality and the Environment Protection and Development Authority in Ras Al Khaimah.

Another example of a council is India's **Skill Council for Green Jobs** (SCGJ). Established in 2015, the SCGJ is promoted by the Ministry of New and Renewable Energy and the Confederation of Indian Industry. Its objective is to identify the skills needs of service users and providers in the “green business” sector, as well as

³⁶ It should be noted that there is no indication that this council includes representatives from industry sectors, educational providers, or authorities related to labour or education.

implementing initiatives in skills development and entrepreneur development at a nationwide level through collaboration with the industrial sector. The SCGJ has established over 320 training centres across 24 states, involving over 500 certified trainers and over 150 certified assessors in the training and certification of more than 13,000 candidates.

A more **sector-driven** example of a social dialogue mechanism is found in the Barbados Renewable Energy Association (BREA), an NGO with 60 members from across the Caribbean. It has a role in advocacy for renewable energy on the island, which it pursues through capacity building via education and training as well as research and development. BREA conducts consultation sessions with stakeholders to identify specific training programmes or interventions. These are then provided by industry experts to enhance the skills and competencies of workers in the renewable energy sector as well as the international competitiveness of the sector. To fund these interventions, BREA has partnered with key agencies such as the Caribbean Development Bank, the Barbados Investment and Development Corporation and the US AID Caribbean Clean Energy Programme. To strengthen its research and development efforts, starting with the transportation sector (specifically, electric vehicle studies), BREA has entered into partnerships with leading training institutions, such as the University of Berkeley.

An example of a **designated national authority** that serves as a supporting (public) organization is the Thailand Greenhouse Gas Management Organization (TGO). This was established in 2007 under the Ministry of Natural Resources and Environment to ensure that Thailand reaches its goals on GHG emissions for 2020 and 2030. It serves as a centre of collaboration between the Government, the private sector and international organizations, and strives to enhance both public and private capacity building in respect of GHG management. The TGO established the Climate Change International Technical and Training Centre (CITC) to establish capacity building and skills development on GHGs and climate change adaptation in the South-East Asia region. The CITC's main activities are developing and providing training courses (including e-learning), establishing networking platforms for the member States of the Association of South-East Asian Nations, disseminating knowledge and acting as a learning resource centre. In the process of curriculum development, all stakeholders were involved in assessing training needs. The CITC has provided courses (for over 1,000 participants by 2014) in five knowledge clusters: GHG inventory management, climate change management, climate change adaptation, mitigation mechanisms, and the financing and economics of climate change. All courses are provided without charge, funded by the Thai Government.

In the Philippines, two separate mechanisms are described in the 2018 country report in relation to skills for green jobs: a non-profit-making initiative promoting “green building” and an organization driving the development of skills for green jobs in the private sector. The former is the Philippine Green Building Initiative (PGBI), launched by a **non-profit-making group of professional associations** accredited by the Professional Regulation Commission. Its members include (among others) United Architects of the Philippines; the Philippine Society of Ventilating, Air Conditioning and Refrigerating Engineers; the Philippine Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers; the Integrated Electrical Engineers of the Philippines; the Geological Society of the Philippines; the Philippine Institute of Interior Designers; the Heritage Conservation Society; and the International Council of Monuments and Sites. The PGBI independently serves

as a certifying body for Excellence in Design for Greater Efficiencies (EDGE) projects in the Philippines, thus promoting energy-efficient and environment-friendly design and construction.

The latter mechanism is the Technical Education and Skills Development Authority (TESDA), a government agency that operates on two levels. On the one hand, it drives advocacy and curriculum design on skills for green jobs, e.g. through holding forums and discussions on the green TVET agenda and its roll-out in 2016. Interestingly, as part of the green movement, TESDA requires trainees to plant (at least) one tree, to avoid the use of plastic, and to practise re-use and recycling. On the other hand, TESDA drives the greening of skills in the private sector more directly through the promulgation of **training regulations**. The TESDA board requires all TESDA training programmes to comply with a set of (competency- and outcome-based) training regulations, in order to assure the quality of training. These regulations include minimum standards for trainers, training tools, equipment and facilities, and provide for three areas of competence (basic, common, core). The composition of the **working group** for the development of these training regulations is tripartite, actively involving industry associations in the process.

Aside from dedicated mechanisms, there are examples of countries that work in partnerships at an international level, often in relation to environmental partnership agreements. For example, Burkina Faso is involved in the Environmental Poverty Initiative, the UNFCCC, Africa's Partnership for Action on Green Economy, Switch Africa and the Green Climate Fund (in collaboration with the African Development Bank).

Overall, this section shows that even though some examples of dedicated mechanisms exist, there is still much that can be done in relation to establishing cooperation and coordination in multi-stakeholder or tripartite consultative framework mechanisms. As the US country report states: "When labour unions that can represent the interests of workers, employer associations who can voice the needs of employers, and political decision makers who can affect policy outcomes are all at the table, the result is a more coordinated and effective system that is responsive to employer needs and that ensures the creation of decent employment opportunities."

7.4 Conclusions

While the 2011 round of national reports described the contextual changes of economies going green, they did not identify very many systematic policies and measures adopted to adjust skills to the green economy. In contrast, the 2018 country reports do discuss targeted policies and measures for skills development for green jobs.

Nationwide policies on skills development for the green transition are scarce. The measures and policies that have been introduced are usually linked to and/or oriented towards decent jobs in the formal economy. However, in many low- and middle-income economies a large proportion of people work in the informal economy, where they are at risk of non-decent work arrangements. In these countries, the availability of measures to develop skills for work that is both decent and green continues to be limited. This situation often also coincides with low levels of social dialogue.

Nevertheless, despite a lack of nationwide policies on skills development for the green transition, **specific initiatives do contribute to a systematic change** in how skills for green jobs are developed. Although there is still a high level of ad hoc activity in all types of measures, many countries do incorporate systematic mechanisms in their overall systems related to skills for green jobs – for example in changing TVET curricula, or in the increasing involvement of employers in skills development. Also, in the context of overarching developments (as a result of drivers discussed in previous chapters), skills development systems themselves change, sometimes even without clear top-down government interventions.

The **anticipation and monitoring of skill needs** is being pursued by many countries, either by integrating green elements into pre-existing monitoring mechanisms or through ad hoc and one-off studies and consultations organized in specific sectors with a view to the green transition.

TVET is generally in development globally, and the greening aspect is receiving attention in the development of new programmes and qualifications, both for new occupations and to integrate green skills into existing occupational profiles. A trend with regard to the income level or state of development of countries is difficult to identify. It seems that LICs especially – supported by development organizations – have worked on “greening TVET”.³⁷ Enrolment of TVET students still follows traditional gender patterns, with more male than female students in the STEM areas.

Private-sector skills training focuses on continuing TVET as it relates to the re-skilling and retraining of those already in employment. In this area, many initiatives are identified in which private-sector organizations are involved in the development and delivery of initial and continuing TVET, and others in which companies, sectors and sometimes trade unions organize the skills development themselves. This activity is partly a response to a lack of relevant provision from public skills development structures (such as TVET institutions and universities). This area has seen major developments in terms of new initiatives since 2011, but these are highly dependent on sectoral approaches, making it hard to identify systematic and structural changes beyond what individual sectors are doing.

In the area of **ALMPs**, some development has taken place since 2011, although approaches targeted on skills for green jobs are absent in a majority of the countries studied. Nonetheless, many countries have taken interesting initiatives in relation to combating unemployment among indigenous peoples in the green economy; establishing dedicated funding programmes for skills for green jobs; and retraining unemployed people to take up roles that support the green economy. The country reports do show a cross-cutting theme in their increased focus on the inclusion of a range of vulnerable groups with regard to employment programmes, TVET and retraining measures to reduce inequality and increase opportunities. The vulnerable groups mentioned most often are youth, people with disabilities, indigenous people, women, migrant workers (including returning expatriates), unemployed people and those living in rural regions. In this regard, greening jobs is intertwined with ensuring a just transition.

37. See e.g. the work of the inter-agency group on this topic: *Greening technical vocational education and training and skills development for the world of work*, available at: https://www.ilo.org/wcmsp5/groups/public/---ed_emp/--ifp_skills/documents/genericdocument/wcms_182353.pdf [accessed 7 May 2019].

On **validation and RPL**, there is little evidence available to illustrate any widespread approaches specific to skills for green jobs.

Policies and measures to enhance social dialogue are supported, developed and implemented by broad groups of **stakeholders**. Social partners, sector organizations, individual companies and NGOs are all involved in the development and delivery of TVET programmes, and also in retraining of workers and the unemployed. This involvement is increasingly resulting in the development of official mechanisms such as sector skills councils or consultation boards. Nonetheless, it remains the case that stakeholder involvement is not economy-wide but is concentrated in the specific sectors most likely to be affected by the transition towards a green economy.

All in all, in comparison to 2011, the 2018 reports show countries more explicitly working on specific policies and measures to provide the skills for green jobs, providing a slightly more systematic approach to enabling people to contribute to the transition to a green economy.



8. CONCLUSIONS AND RECOMMENDATIONS

This global report offers new insights into key trends in changing skills demand across occupations, and into current and future developments in skills policies and training measures to achieve a just transition to the green economy. Through qualitative research based on 32 country studies coupled with quantitative modelling in two global scenarios (energy transition and circular economy), it presents in detail the estimated impact of this transition on global employment by occupation and gender, and on reskilling and upskilling requirements. The right skills for the right jobs are an essential prerequisite for the transition to environmental sustainability, and also for boosting productivity, making full use of the employment potential of the economy, and cushioning the negative effects of disruptive changes. Analysis of the report's findings in the context of progress achieved since 2011, when the first round of research was conducted (Strietska-Illina et al., 2011), reveals some progress but also a great deal that remains to be done.

8.1 A sense of urgency for climate action has resulted in major global accords, but more needs to be done at national level

Rising global anthropogenic GHG and carbon dioxide emissions have been causing environmental degradation, loss of biodiversity, desertification, rising sea levels and changing climate patterns. A sense of urgency and heightened anxiety about the consequences of climate change, and its effects on economies, societies and individuals, has resulted in major accords on climate change and sustainable development: 2015 was marked by the adoption of the UN 2030 Agenda and the Paris Agreement on Climate Change.

However, the climate of national politics has not everywhere mirrored the “global warming” of international talks and agreements. In many countries, there has been significant delay in linking public policy to action; in some, there has even been backward movement in policy and regulation. The mere acceptance of global deals is not enough: their success depends entirely on national commitments and implementation. Progress in national policies and actions has been uneven and is falling below the level of ambition needed.

A large proportion of NDCs – the key vehicles of implementation of the Paris Agreement – make reference to training measures that would help to implement sectoral and national climate policies. But most of these provisions concern institutional capacity building and climate education; only a few countries explicitly address skills development measures in the sections of their NDCs that deal with national and sectoral planning. This should set alarm bells ringing, for commitments in the energy, agriculture, waste, manufacturing, transport and tourism sectors set out in NDCs are all subject to the availability of relevant skills in these industries.

8.2 The green transition can generate millions of jobs, but these are conditional on the availability of relevant skills and training

Currently, skills gaps and shortages are getting worse, posing a challenge to the green transition. It is alarming that the same situation was identified back in 2011. While there are many examples of good practices, especially at sectoral and sub-national levels, there is little evidence to suggest a significant systematic improvement in this situation. Developing countries in particular are challenged by a lack of professionals and a shortage of university graduates in general, especially those trained in STEM skills. Even in advanced economies, including those with well-developed skills anticipation systems, a lack of both technical and transferable core skills remains a significant cause of recruitment problems for employers and of negative effects on labour productivity.

When we turn to the future scenarios, the quantified modelled estimates of the impact on skills, gender in employment and occupations of a transition to energy sustainability and a circular economy by 2030 suggest that a cumulative total of over 100 million jobs can potentially be created under both scenarios – but also that close to 80 million may be destroyed. This implies both a net positive impact on jobs and a sizeable workforce transition. Overall, job creation will be concentrated among medium-skill jobs, with the potential to offset other labour market disruptions caused by globalization, offshoring and technological change, all trends that are typically associated with a destruction of jobs at this skill level. Both scenarios point to three types of impact at the occupational level associated with job creation and destruction.

First, for the large majority of occupations, jobs lost in one industry will be matched by equivalent jobs created in another industry. The sets of skills that workers will be able to re-use in growing industries include not only soft skills (e.g. communication, problem solving) but also semi-technical transferable skills (e.g. sales and marketing, scheduling, budgeting) and technical transferable skills (e.g. engineering, repair, plumbing). This is an important finding with significant implications for the design of curricula and competency standards in TVET. In addition, however, many new technical skills will be required for the successful reallocation of workers. Retraining and skills development programmes will need to build on workers' current skills and help them to adapt and develop their skills to enhance their relevance to the new industries in which new jobs will be found. It will be important to complement training measures with social protection systems and career counselling, so that laid-off workers maintain their income security and are able to reskill and find jobs in other occupations in the same region.

Second, there will be a net creation of jobs above and beyond those that can be filled by reallocation. This particularly concerns workers in building and related trades and labourers in construction, manufacturing and transport under the energy sustainability scenario, and sales workers under the circular economy scenario. These new jobs, concentrated at the medium to high skill levels, call for the development of the corresponding skills in formal training programmes for future workers and for upskilling through lifelong learning for current workers.

Third, some jobs will be destroyed without vacancies opening up in the same occupations in different industries, posing a potential risk of unemployment, particularly in male-dominated occupations. However, many new jobs will be generated in new occupations; so training programmes will need to be available to reskill laid-off workers for entry into these newly growing occupations. Such programmes can be delivered through ALMPs and should also be coupled with career guidance and social protection policies. Including gender considerations in the policy response could alleviate the gender imbalance in the occupations affected.

With effective reskilling and upskilling measures, job losses can be minimized and the positive job impact amplified; but these positive outcomes depend crucially on the efficient design and delivery of training measures, in combination with other policies.

8.3 Policies have developed since 2011 but remain fragmented

Overall, comprehensive and systematic national and sectoral approaches to skills for green jobs remain the exception rather than the rule. Despite accelerated efforts in advancing the sustainable development agenda and the growth in demand for skills for the green transition, there continue to be weak links in the chain of policy-making and implementation processes down to the level of skills and training. Although environmental, economic and employment policies are often comparatively well linked, sometimes through sectoral approaches that support jobs, this cannot be said for the final link in the chain, into education and training systems. Often this is because the ministries dealing with education and workforce training are not involved in relevant policy decision-making processes and coordination structures.

Countries have made progress, since 2011, in developing bodies of law, regulations, strategies and plans covering environmental issues; but the pace at which these have been translated into skills and training policies has varied. Some countries are still only beginning to address issues related to skills for environmental sustainability and green jobs policies.

Developing countries have sought to formulate, and continue to develop, specific policies and strategies on skills for green jobs, often stimulated by commitments on responding to climate change. However, in many cases gaps persist – for example, in policy coherence, capacity, data collection, and systematic anticipation of needs in skills development and training provisions – and implementation and enforcement of policies continue to present a significant challenge. Advanced economies tend to rely on overarching environmental and economic policies and processes to frame consideration of green jobs, and the experience of some of these countries

demonstrates the non-linearity of policy formation and implementation: forward momentum is by no means certain. A large part of skills development for green jobs continues to be ad hoc. Sometimes this is part of overall government policy to “let the market decide”. Elsewhere, other actors, including regional and local government authorities and social partners, and also civil society groups and individuals, fill the gap from the bottom upwards, leading to an overall picture of training in skills for green jobs that is fragmented and led by individual regions, sectors and projects. Individually, these interventions may be effective; but they lack coordination and do not necessarily meet needs where they are greatest, often reflecting other factors such as the availability of external aid.

Overall, the existence of many scattered plans and activities suggests a need for countries to strive for greater policy coherence to realize all the potential employment benefits of the green transition. As noted in the 2011 report, a combination of top-down coordinated policy-making and bottom-up initiatives could provide effective support to the green transition; indeed, bottom-up initiatives might grow into systematic and comprehensive policy development and implementation. There is little evidence, however, that this has yet happened. Countries need to build their capacity for bottom-up development in relation to national policy frameworks. In this respect, countries’ NDCs may offer a basis for stepping up plans and activities related to skills for green jobs in sectors that have been prioritized for adaptation and mitigation measures. NDCs, along with the UN’s SDGs, have together provided an important stimulus to policy development which countries should ensure bears fruit in the coming years, not least in addressing some of the policy coordination issues described in the following section.

8.4 Improving governance mechanisms will support better coordination and reduce skills mismatches

Good coordination of policies and actions across government ministries and with the private sector, including both employers and workers, is a key requirement for preventing and reducing skills mismatches. However, policy-making structures and processes are not designed by default to deal with cross-sectoral topics. Ministries dealing with the workforce and its training often tend to be excluded from decision-making, while the incorporation of social partners and other stakeholders depends greatly on the general degree of their engagement in policy-making, and in most developing countries is in need of improvement. The lessons about coordination offered by the NDCs and the processes surrounding them should be applied more thoroughly across policy-making and implementation.

Better-established institutional coordination is needed among line ministries and agencies, with the active involvement of social partners, to accelerate the just transition. Human resources development bodies and national or sectoral skills councils could play a central role not only in driving well-informed policy- and decision-making in greening economies, but also in developing and designing appropriate and effective measures to reduce skills shortages and gaps. Employers’ and workers’ organizations have a vital part to play in developing and implementing policies on skills for green jobs, and also in ensuring that the green transition is fair and inclusive, with priority attention given to the needs of disadvantaged and vulnerable groups.

8.5 Lower-income countries face particular challenges

One of the causes of low incomes in developing countries is reliance on poor agricultural practices. Many countries are trapped in a vicious circle in which poor populations, lacking alternative means of livelihood, are forced into activities that have negative environmental impacts, while at the same time ecosystems are under pressure from climate change due to lack of economic alternatives. The economies of LICs are also frequently over-dependent on natural resources, e.g. through mining, for foreign currency income.

Importantly, the green transition is a source of sustainable solutions. Markets and technologies have developed in LICs since 2011. Furthermore, it is notable that many LICs deploy creative and highly cost-effective low-tech solutions that tackle more than one environmental issue at once. Green solutions often work at grass-roots level to ameliorate the challenges people face when they are shown how green approaches can improve their lives directly. This is evidenced by the many local, small-scale but highly effective interventions now taking place, e.g. changing fuel for cooking stoves or introducing biogas digesters.

Equally, the period since 2011 demonstrates clearly that even though many developing countries have made progress by putting in place a sound framework of environmental policies, realizing the potential of those policies in terms of green jobs is another matter. Many countries whose situation in 2011 looked promising have since had difficulties with policy implementation. Typically, they lack strong institutions to enforce environmental regulations, and enforcement is made even more difficult by the size of the informal economy – which poses a challenge for greening because it is, by definition, unregulated – as well as by a lack of viable alternative sources of income for people forced by economic circumstances (exacerbated by the global financial crisis) into environmentally deleterious activities.

Given the lack of clear, targeted policies on skills for green jobs in many developing countries, development organizations and international institutions provide an important impetus behind the creation of specific measures for skills development. As TVET is a key priority, and the SDGs a key reference point, for many development organizations, the support they provide in upgrading and developing TVET curricula also includes reviewing those curricula in terms of sustainable development and climate action. The same can be said about setting up educational management and information systems which include skills anticipation mechanisms. Finally, development organizations engaged in skilling and reskilling workers often emphasize the importance of cooperation between government authorities and private partners.

8.6 Higher-income countries need to re-energize their efforts on green jobs and skills

In 2011, HICs typically had well-developed environmental regulations and had already responded to the green jobs challenge with a diverse range of policies and plans. However, the experience of some of these countries since 2011 has shown that the green transition pathway is neither straight nor easy. There have been policy changes and even reversals; and in some countries the growth in some types of green jobs has levelled off. Today, there are wider and more general concerns that countries may not be making enough progress to avert dramatic climate change. The question therefore arises: how can progress be re-energized?

One answer may lie in the robustness of the policies and processes in place. The evidence here suggests that countries without a strong social dialogue on green jobs and/or without strong and well-established structures and processes to take the agenda forward are at greater risk of policy change. Certainly, a country such as France, which has put in place dedicated structures (e.g. its Onemev observatory) alongside the usual policy-making channels seems thereby to have insulated itself against sudden policy reversals or changes. Countries need to ensure, therefore, that policies related to skills for green jobs are built through social consensus and robust and dedicated policy-making structures and processes.

Successful structures of this kind involve a wide range of stakeholders, including the social partners, in order to build a social consensus, which may itself serve as a further means of refreshing progress. The 2011 report established the importance of building strong stakeholder involvement for effective policy and provision to develop skills for green jobs. As well as seizing opportunities to improve social dialogue mechanisms, countries need to bring in a wider range of stakeholders from civil society, including from marginalized and indigenous communities, who often face the greatest threats from environmental change. Such action is crucial to ensure jobs are decent as well as suited to the green transition, and to build on the progress that has already been made in raising social awareness of the human impact on the environment.

Another factor that may help to re-energize the green transition is a stronger focus on green markets and technology. The emergence of green markets and the development of green technologies have grown in importance since 2011. Green technology is no longer a question primarily of access: many LICs, for example, are innovating in green technology, which is being applied to mitigating the effects of climate change. Green markets, like the European market in organic food, are also developing.

In many ways these positive developments have gone hand in hand with increased awareness of environmental matters. At the same time, the operation of many markets, and the development and deployment of many technologies, continue to depend on government subsidies. Where governments have removed or reduced subsidies for “green behaviour” by companies and consumers, progress has often stalled. This suggests that governments need a better understanding of the conditions under which green markets reach the “tipping point” at which they become self-sustaining and subsidies can safely be scaled back. This is also important for matching the demand with the supply of skills, and for continued environmental awareness-raising through education and training programmes.

8.7 Labour market intelligence and skills anticipation should enhance understanding of changing skills demand in the green transition

Identification and anticipation of skills needs have been gaining ground since 2011, but remain weak in respect of providing thorough coverage and robust data on demand and supply in relation to skills for green jobs. Analysis of the country reports shows clearly that data on labour supply and demand and on skills gaps and shortages are still in need of development in most countries, as was the case in 2011. Data tend to be most thoroughly developed in respect of renewable energy, reflecting both the scale and rapid pace of change in this sector; elsewhere, they are often in short supply. The main reason for this is the general underdevelopment of skills anticipation systems. The significance of this cannot be overstated: skills anticipation systems are a vital missing link between environmental policy on the one hand and labour market and training policy on the other. Without good-quality, systematic and reliable data on green jobs and labour market information, effective and focused planning of skills development is difficult to achieve. And without that, we cannot know with any accuracy how successful policies and activities have been in narrowing skills gaps or indeed in addressing other issues such as gender equality. Furthermore, existing anticipation systems in low- and middle-income countries struggle to capture developments and skills needs in the informal sectors of the economy (agriculture, manufacturing, waste etc.), which in turn receive less attention in terms of creating green /decent jobs than formal sectors such as energy and construction. Countries therefore need to equip themselves with the anticipation, forecasting and monitoring tools they need to respond to the demand for skills for green jobs, and to assess progress in respect of social equality and gender mainstreaming.

The period since 2011 also shows that the emergence and “formalization” of skills for green jobs and occupations can take time, especially where work tasks are changing quickly and where the mechanisms for designing occupational standards and qualifications are not well developed and social partners are not fully engaged with them. Such delays make recruitment processes more difficult for employers and individuals, given the difficulty of matching someone’s skill profile to an emerging occupation. To tackle these issues, countries need not only well-functioning skills anticipation systems but also well-functioning education and qualification systems and labour market institutions (e.g. public employment services).

Other solutions include setting up a dedicated institution to systematically monitor skills needs for green jobs (e.g. France’s Onemev); increased international cooperation, with peer learning and knowledge sharing on skills for green jobs and how to implement specific measures (e.g. through South–South and triangular cooperation: see e.g. ILO, 2018b); forming a global platform of resources on green competency standards and qualification and training programmes; and industry certification and agreements on cross-border industry competency standards (e.g. through ASEAN).

8.8 Countries need to mainstream skills for green jobs in their systems and make these skills better recognizable

At the level of specific measures and policies, the recent round of country reports provides evidence of numerous initiatives in all countries. This shows that, even without a clear national strategy for skills development of green jobs, many initiatives are put in place to provide the skills needed. There is a distinction to be made here between establishing new, specific systems to generate and promote skills for green jobs and integrating green aspects into existing systems. The second approach is applied more often in HICs, while LICs, with support from development organizations and often in the absence of well-functioning systems of governance and social partnership, have made an effort to establish dedicated mechanisms for skills for green jobs. Skills for green jobs can be very specific to a particular occupation or a sector, not necessarily requiring completely new training programmes; they can, however, also include more soft, core skills, reflecting the fact that there may be green alternatives for all kinds of processes, products and services. In both lower- and higher-income countries, core skills, including environmental awareness, could be mainstreamed in TVET systems and earlier childhood and youth training, in lifelong learning, including workplace skills training, and in ALMPs.

A significant factor is that many initiatives are still ad hoc by nature. There are cases where specific initiatives have led to systematic changes, but many are still restricted to particular projects, sectors, subnational areas or even companies. Countries should be encouraged to mainstream good practices at these subsidiary levels into more holistic and overarching skills for green jobs policies to make skills supply more even and sustainable. Having better and more regular skills monitoring and anticipation systems could help shape more systematic skills policies.

Climate change affects all of us, and everyone can make a contribution to solving climate change problems. Climate action starts with climate education and training. Skills for green jobs, but also more generally education for sustainable development, are already being more closely integrated into national core curricula and should be further integrated in the future. In addition, reaching out to the informal economy and vulnerable groups and ensuring gender mainstreaming are important to broaden the application of greening policies and measures.

Finally, it is important to ensure that acquiring skills for green jobs pays off. People who have acquired relevant skills should have these credentials recognized and be able to use them to access better employment opportunities, wages and career progress. Countries could invest in the improvement of systems that recognize skills for green jobs through RPL, badges and certificates, digital learning etc. This is especially important in the context of growing opportunities offered by the Massive Open Online Courses and other open sources of training. The recognition of workers' existing skills – both those earned in formal or non-formal training and those acquired through experience on the job – also helps to facilitate the reallocation of workers across and within occupations from declining to growing industries. Skills recognition should extend across national borders, so that those who lose jobs in one country may more easily find equivalent openings in another. Skills recognition should therefore be complemented by appropriate labour migration policies to promote the hiring of capable workers in emerging industries wherever they are situated.

8.9 To seize the momentum, countries will need to integrate forward-looking skills strategies in their climate and environmental policies

The transition to an environmentally sustainable and low-carbon economy will generate many new jobs, cause some job losses and alter the skills composition of most jobs. Skills development strategies will need to support displaced workers at the same time as they enable the green transition and encourage job generation and productivity growth. The ILO's *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (ILO, 2015a) highlight the importance of inclusive skills development policies. Skills development measures are an important pillar and enabler of industrial, investment and other productive transformation policies for a just transition. A comprehensive approach should also include social dialogue, ALMPs, social protection, counselling and effective labour market institutions to provide job-matching and career counselling services.

Coordination with macroeconomic, sustainable investment, industrial and enterprise policies, including incentives for knowledge transfer and technology diffusion, will be also be essential in enabling businesses to implement greener and more resource-efficient production practices, to align the supply of skills with growing demand and to facilitate the efficient reallocation of workers to newly created green jobs. The ILO Human Resources Development Recommendation, 2004 (No. 195), recognizes that education, training and lifelong learning are of fundamental importance and should form an integral part of, and be consistent with, comprehensive economic, fiscal, social and labour market policies. Action planning on skills development will have to be integrated with key climate and environmental policies and regulations, including NDCs, to ensure that skills needs are met and climate commitments are implemented. Furthermore, skills policies and training measures will need to adopt a longer-term and more systematic approach to skills development in the context of greening.

The new jobs created in the environmentally sustainable economy will require somewhat higher qualifications and new sets of skills. Upskilling and reskilling workers, especially those most affected by the transition, will mean implementing lifelong learning strategies rather than front-loading qualifications that are expected to suffice for an entire career. The green transition will not be a single event claiming a massive adjustment of the current and potential workforce. Automation, demographic change, global trade and other megatrends will also have substantial impacts. Multiple changes will require multiple transitions managed throughout careers. Access to skills training, raising environmental awareness and climate literacy for current workers, even those not affected by job displacement, will be essential for the implementation of greener ways of production and service delivery.

The Global Commission on the Future of Work has stressed the importance of investment in people's capabilities and universal entitlements to lifelong learning (ILO, 2019b). It has also underlined the need to step up investments in labour market institutions to support people through future work transitions. Other systemic elements of lifelong learning will need to include innovative and diverse ways of financing, combining private and public contributions, and allowing individuals to access funding and gain recognition for their learning outcomes, whether attained formally or informally.

8.10 Social dialogue will remain part and parcel of ensuring relevance of education and training and for achieving a just transition for all

The importance of social dialogue as a key means to improve the quality of policies on training provision and their relevance for the world of work is hard to overestimate. Social dialogue will remain part and parcel of enhancing the employability and productivity of current and potential workers. It will also remain a principal way to ensure equity in access to training, reskilling and upskilling measures, job matching and employment, and will therefore remain the means of buffering negative consequences of transitional disruptions. Governance structures for social dialogue at national and sectoral levels are an important engine for driving policy coherence and achieving a just transition. Institutional capacity building and awareness raising on the roles of various stakeholders in the just transition will therefore be important.

However, the mere presence of institutional mechanisms does not guarantee the actual involvement of stakeholders. Particularly worrying is the weak level of trade union involvement in many countries: the importance of their role is difficult to overstate when it comes to just transition measures and the inclusion of training clauses in collective agreements. Employers' organizations have a significant role to play in transferring information on changing demand for skills for use in labour market intelligence in order to improve the relevance of training. Their role is also very important with respect to the further use of skills at the workplace and in the provision of the workplace learning.

As modelled estimates in the two green transition scenarios have demonstrated, the volume of reskilling and upskilling needs will be massive. How efficiently social partners and governments will join forces to share the costs of and responsibilities for the delivery of training and retraining measures is a question worth more than a hundred million jobs. Workers, enterprises and governments – all have very high stakes in the greening agenda. Joint and well-coordinated action, and shared responsibility, will bring gains for all.

GLOSSARY AND KEY TECHNICAL TERMS

Unless otherwise referenced, the following definitions and explanations are taken from the glossary in Strietska-Illina et al., 2011, pp. 171–78 and ILO, 2015b, pp. 10–13.

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.

adaptation: In the context of environmental degradation, policies and efforts to anticipate the negative effects of degradation and prevent or minimize the damage these effects can cause. For example, adaptation policies in the context of climate change include, but are not confined to, building irrigation infrastructure and providing cash transfers to limit the effects of changing rain patterns on crops and household incomes (ILO, 2018a, p. 185).

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.

big data: The term refers generally to data in quantities too large to analyse using traditional processing software/techniques. The quantitative analysis presented in Chapter 6 of this report used a large-scale real-time database and detailed online job posting that enabled the systematic collection of information and in-depth analysis of the content of job advertisements in a range of countries to identifying changes in occupations and labour markets.

carbon footprint: The greenhouse gas (see *below*) emissions embedded in the goods and services consumed by a person, group or economy. It takes into account the entire value chain, thus incorporating the emissions associated with the production of goods and services in other countries. The footprint can be extended to material and resource use footprints or to a more general environmental footprint (ILO, 2018a, p. 185).

circular economy: A model for sustainability in resource use and consumption which supports moving away from an extract–manufacture–use–discard model and embraces the recycling, repair, reuse, remanufacture and longer durability of goods (ILO, 2018a).

Clean Development Mechanism (CDM): A mechanism introduced by the Kyoto Protocol (signed in 1997) to encourage project-based emissions reduction activities in developing countries. Certified emissions reductions are generated from projects that lead to certifiable reductions in emissions that would otherwise not occur.

clean technology: see **green technology**

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.

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.

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.

curriculum: A detailed description of the objectives, content, duration, expected outcomes, learning and training methods of an education or training programme.

decent work: A term that sums up the aspirations of people in their working lives – for opportunity and income; for rights, voice and recognition; for family stability and personal development; and for 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.

delphi method: A method of conducting an expert survey in two or more rounds, whereby, in the second and subsequent rounds of the survey, the results of the previous round(s) are provided as feedback.

desertification: The transformation of arable or habitable land into desert, usually as a result of a change in climate or destructive land use. (Strietska-Ilina et al., Glossary, ILO, 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.

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.

environmental footprint: see **carbon footprint**

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.

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.

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 a country's 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.

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.

green innovation: Improvements in products, processes, marketing methods, organizations or institutions that yield higher environmental benefit. Such innovation can include technological and non-technological change.

green jobs: 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. It also covers activities related both to mitigation of and adaptation to climate change.

green transition: Transition to environmentally sustainable economies and societies (see *also* greening the economy).

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 gases (GHGs): 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, carbon dioxide, is rapidly accumulating in the atmosphere as a result of human activities.

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.

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.

indirect employment effects: Creation or loss of jobs in supplier industries and through the value chain.

induced job effects: Creation of jobs as wage incomes are spent generating demand in additional industries (or the loss of jobs as decreasing expenditure reduces demand).

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 within and outside informal (small unregistered or unincorporated) . 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.

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.

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.

input–output modelling: An empirical tool that relies on the construction of a matrix or table listing all subsectors in an economy and detailing how outputs from one sector are used as inputs in others. This model draws on information from the national accounts and is most widely employed methodology for assessing green jobs. This modelling mostly is used to illustrate the specific scenario or assess the impact (ILO, 2013b; Cedefop et al., 2016).

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.

Just Transition framework: A policy framework adopted in 2015 by the ILO’s Governing Body (see ILO 2015a). The framework is comprehensive and comprises macroeconomic and growth policies, industrial and sectoral policies, enterprise policies, skills development, occupational safety and health, social protection, ALMPs, rights at work, and social dialogue and tripartism.

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; forecasts of changes in the labour market; the skills composition of the current labour force; and prospective changes over time.

low-carbon economy: An economy that produces minimal greenhouse gas emissions. Its fundamental aims are to achieve high energy efficiency, and to use clean and renewable energy via technological innovation, while maintaining the same levels of energy security, electricity supply and economic growth. (ILO, 2015b).

mitigation: Policies and measures that limit environmental degradation by targeting its causes. For example, mitigation policies in the context of climate change include, but are not confined to, replacing fossil fuel with renewables as an energy source in the production of electricity. Also called abatement policies or efforts (ILO, 2018a, p. 188).

nationally determined contributions (NDCs): A planning mechanism designed to scale up the national response to climate change and its impacts through adaptation and mitigation measures in targeted economic sectors to achieve the long-term goals of the Paris Agreement (see *below*) (UNFCCC, available at: <https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs>).

non-formal learning: Organized and systematic learning activity conducted outside the formal education system.

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.

on-grid and off-grid systems: Systems to supply energy to the end-user either through a central interlocking system of electricity transmission lines and power stations (on-grid) or through decentralized power supply solutions (off-grid), such as solar home systems.

on-the-job training: Training undertaken in the workplace which uses the tasks of the job as the basis for training and practice.

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.

Paris Agreement: The Paris Agreement on Climate Change was launched in December 2015 by the 21st Conference of the Parties (COP21) to the UNFCCC, adopted in 1992.

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. (See *also* **core skills**).

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, and environmental and community organizations and leaders.

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 the 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.

scraped vacancies: This refers to the process of extracting information and data from a website, transforming the information on a web page into structured data for further analysis. Web scraping is also known as web harvesting or web data extraction. With the overwhelming quantity of data available on the Internet, web scraping has become the essential approach to aggregating big data sets. See: <https://www.kdnuggets.com/2018/09/octoparse-web-scraping.html>.

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.

skills development: Understood in broad terms to mean basic education, initial training and lifelong learning.

skills for green jobs: Skills (see *above*) that are necessary to successfully perform tasks for green jobs (see *above*) and to make any job greener. The term includes both core and technical skills, and covers all types of occupations that contribute to the process of greening products, services and processes, not only in environmental activities but also in other sectors (ILO, 2015b).

skills gaps: A term to describe the qualitative mismatch between the supply of human resources and the requirements of the labour market. “Skills gaps” exist where the existing workforce does not have adequate types or levels of skills to meet business objectives; or where new entrants to the labour market are apparently trained and qualified for occupations but still lack some or all of the skills required (ILO, 2015b).

skills levy/training levy: A tax imposed on enterprises, the proceeds from which are used to finance training activities.

skills needs anticipation: Any forward-looking diagnostics used to identify skills needs expected on future labour markets, performed by any type of method, quantitative or qualitative, including interaction, exchange and signalling between labour market actors (ILO, 2015b).

skills shortage: An overarching term which covers both skills gaps and labour shortages. A skills shortage is a genuine lack of adequately skilled individuals available in the accessible labour market with the type of skill being sought, leading to a difficulty in recruitment, with employers unable to recruit staff with the skills that they are looking for at the going rate of pay. This could result from a basic lack of people (when unemployment levels are very low), significant geographical imbalances in supply (sufficient skilled people in the labour market, but not with easy access 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 (ILO, 2015b).

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.

sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development includes three components – economic development, social development and environmental protection – as interdependent and mutually reinforcing pillars (ILO, 2015b).

Sustainable Development Goals (SDGs): in 2015 the 2030 Agenda for Sustainable Development (2030 Agenda) was adopted by all UN member States. The 17 SDGs constituted an urgent call for global action in ending poverty, improving health and education, reducing inequalities, catalysing economic growth, and tackling climate change in both developed and developing countries (Sustainable Development Knowledge Platform: <https://sustainabledevelopment.un.org/sdgs>).

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.

transferable skills: see **core skills, portable skills**.

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”.

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ANNEX 1.

LIST OF COUNTRY REPORTS

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- **United Kingdom:** *Skills for green jobs: 2018 update* (Cedefop, 2019).

ANNEX 2.

COUNTRIES IN SAMPLE BY INCOME LEVEL

Table A2.1 Countries in sample by income level

COUNTRY NAME	COUNTRY CODE	INCOME LEVEL	COUNTRY NAME	COUNTRY CODE	INCOME LEVEL
Australia	AUS	HIC	Korea, Republic of	KOR	HIC
Bangladesh	BGD	LMIC	Kyrgyzstan	KGZ	LMIC
Barbados	BRB	HIC	Mali	MLI	LIC
Brazil	BRA	UMIC	Mauritius	MUS	UMIC
Burkina Faso	BFA	LIC	Montenegro	MNE	UMIC
China	CHN	UMIC	Philippines	PHL	LMIC
Costa Rica	CRI	UMIC	Senegal	SEN	LIC
Denmark	DNK	HIC	Spain	ESP	HIC
Estonia	EST	HIC	South Africa	ZAF	UMIC
Egypt	EGY	LMIC	Tajikistan	TJK	LIC
France	FRA	HIC	Thailand	THA	UMIC
India	IND	LMIC	Uganda	UGA	LIC
Indonesia	IDN	LMIC	United Arab Emirates	ARE	HIC
Ghana	GHA	LMIC	United Kingdom	GBR	HIC
Germany	DEU	HIC	United States	USA	HIC
Guyana	GUY	UMIC	Zimbabwe	ZWE	LIC

Note: According to World Bank classification by GNI per capita, as of Aug. 2018. LIC: low-income economies (US\$995 or less); LMIC: lower-middle-income economies (US\$996–3 895); UMIC: upper-middle-income economies (US\$3 896–12 055); HIC: high-income economies (US\$12 056 or more).

Source: World Bank data: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.

ANNEX 3.

RELEVANT COUNTRY INDICATORS

Table A3.1 Population, GDP and carbon dioxide emissions

COUNTRY NAME	COUNTRY CODE	TOTAL POPULATION, 000s, 2017	% OF WORLD POPULATION, 2017	GDP, CURRENT US\$ MILLIONS, 2017	% OF WORLD GDP, 2017	GDP PER CAPITA, CURRENT US\$, 2017	GDP GROWTH, ANNUAL (%)			CO ₂ EMISSIONS, 2014			
							2015	2016	2017	KG PER PPP US\$ OF GDP	KT	% OF WORLD EMISSIONS	TONNES PER CAPITA
Australia	AUS	24598.93	0.33	1323421.07	1.64	53799.94	2.35	2.83	1.96	0.33	361261.84	1.00	15.37
Bangladesh	BGD	164669.75	2.19	249723.86	0.31	1516.51	6.55	7.11	7.28	0.15	73189.65	0.20	0.46
Barbados	BRB	285.72	0.00	4673.50	0.01	16356.98	0.90	2.01	1.00	0.26	1272.45	0.00	4.49
Brazil	BRA	209288.28	2.78	2055505.50	2.54	9821.41	-3.55	-3.47	0.98	0.16	529808.16	1.47	2.59
Burkina Faso	BFA	19193.38	0.25	12322.86	0.02	642.04	3.89	5.93	6.30	0.10	2849.26	0.01	0.16
China	CHN	1386395.00	18.41	12237700.48	15.12	8826.99	6.90	6.70	6.90	0.56	10291926.88	28.48	7.54
Costa Rica	CRI	4905.77	0.07	57285.98	0.07	11677.27	3.63	4.25	3.28	0.11	7759.37	0.02	1.63
Denmark	DNK	5769.60	0.08	324871.97	0.40	56307.51	1.61	1.96	2.24	0.12	33498.05	0.09	5.94
Egypt	EGY	97553.15	1.30	235369.13	0.29	2412.73	4.37	4.35	4.18	0.21	201894.02	0.56	2.20
Estonia	EST	1315.48	0.02	25921.08	0.03	19704.66	1.67	2.06	4.85	0.52	19519.44	0.05	14.85
France	FRA	67118.65	0.89	2582501.31	3.19	38476.66	1.07	1.19	1.82	0.11	303275.57	0.84	4.57
Germany	DEU	82695.00	1.10	3677439.13	4.54	44469.91	1.74	1.94	2.22	0.19	719883.44	1.99	8.89
Ghana	GHA	28833.63	0.38	58996.78	0.07	2046.11	2.18	3.45	8.14	0.13	14466.32	0.04	0.54
Guyana	GUY	777.86	0.01	3621.05	0.00	4655.14	3.16	3.32	2.92	0.36	2009.52	0.01	2.63
India	IND	1339180.13	17.78	2600818.24	3.21	1942.10	8.15	7.11	6.68	0.30	2238377.14	6.19	1.73

COUNTRY NAME	COUNTRY CODE	TOTAL POPULATION, 000s, 2017	% OF WORLD POPULATION, 2017	GDP, CURRENT US\$ MILLIONS, 2017	% OF WORLD GDP, 2017	GDP PER CAPITA, CURRENT US\$, 2017	GDP GROWTH, ANNUAL (%)			CO ₂ EMISSIONS, 2014			
							2015	2016	2017	KG PER PPP US\$ OF GDP	KT	% OF WORLD EMISSIONS	TONNES PER CAPITA
Indonesia	IDN	263991.38	3.51	1015539.02	1.25	3846.86	4.88	5.03	5.07	0.17	464176.19	1.28	1.82
Korea, Republic of	KOR	51466.20	0.68	1530750.92	1.89	29742.84	2.79	2.93	3.06	0.34	587156.37	1.62	11.57
Kyrgyzstan	KGZ	6201.50	0.08	7564.74	0.01	1219.82	3.88	4.34	4.58	0.49	9607.54	0.03	1.65
Mali	MLI	18541.98	0.25	15334.34	0.02	827.01	5.96	5.80	5.40	0.04	1411.80	0.00	0.08
Mauritius	MUS	1264.61	0.02	13266.43	0.02	10490.50	3.55	3.84	3.82	0.17	4228.05	0.01	3.35
Montenegro	MNE	622.47	0.01	4844.59	0.01	7782.84	3.40	2.90	4.70	0.23	2211.20	0.01	3.56
Philippines	PHL	104918.09	1.39	313595.21	0.39	2988.95	6.07	6.88	6.68	0.15	105653.60	0.29	1.06
Senegal	SEN	15850.57	0.21	21070.23	0.03	1329.30	6.37	6.23	7.15	0.20	8855.81	0.02	0.61
South Africa	ZAF	56717.16	0.75	348871.65	0.43	6151.08	1.28	0.57	1.32	0.69	489771.85	1.36	8.98
Spain	ESP	46572.03	0.62	1311320.02	1.62	28156.82	3.43	3.27	3.05	0.15	233976.60	0.65	5.03
Tajikistan	TJK	8921.34	0.12	7146.45	0.01	801.05	6.01	6.87	7.62	0.23	5188.81	0.01	0.62
Thailand	THA	69037.51	0.92	455302.68	0.56	6595.00	3.02	3.28	3.91	0.30	316212.74	0.88	4.62
Uganda	UGA	42862.96	0.57	25995.03	0.03	606.47	5.19	4.78	3.86	0.08	5229.14	0.01	0.13
United Arab Emirates	ARE	9400.15	0.12	382575.09	3.24	40698.85	5.06	2.99	0.79	0.35	211369.55	0.58	23.30
United Kingdom	GBR	66022.27	0.88	2622433.96	0.47	39720.44	2.35	1.94	1.79	0.16	419820.16	1.16	6.50
United States	USA	325719.18	4.33	19390604.00	23.96	59531.66	2.86	1.49	2.27	0.30	5254279.29	14.54	16.49
Zimbabwe	ZWE	16529.90	0.22	22040.90	0.03	1333.40	1.78	0.76	4.70	0.34	12020.43	0.03	0.78
Total (32 countries)		4537219.63	60.25	52938427.19	65.41								

Source: World Bank Databank: <http://databank.worldbank.org>.

Table A3.2 Employment and selected indices

COUNTRY NAME	COUNTRY CODE	INFORMAL EMPLOYMENT, AS % OF TOTAL EMPLOYMENT, 2017 OR LATEST YEAR AVAILABLE	LABOUR FORCE PARTICIPATION RATE, TOTAL, %, 2017	UNEMPLOYMENT RATE, TOTAL, %, 2017	EMPLOYMENT, 000s, 2017	% OF WORLD EMPLOYMENT, 2017	HUMAN DEVELOPMENT INDEX (HDI), 2017	ENVIRONMENTAL PERFORMANCE INDEX (EPI), 2018	GREEN ECONOMY PROGRESS (GEP) INDEX, 2017	GLOBAL COMPETITIVENESS INDEX (GCI), 2018
Australia	AUS	n.a.	65.20	5.60	12177	0.37	0.94	74.12	-0.05	78.85
Bangladesh	BGD	94.70	58.30	4.40	66219	2.02	0.61	29.56	0.21	52.08
Barbados	BRB	n.a.	n.a.	n.a.	138	0.00	0.80	55.76	n.a.	n.a.
Brazil	BRA	45.00 ¹	62.40	12.80	91514	2.80	0.76	60.70	-0.01	59.51
Burkina Faso	BFA	n.a.	n.a.	n.a.	6603	0.20	0.42	42.83	n.a.	43.90
China	CHN	n.a.	n.a.	3.90	767735	23.48	0.75	50.74	-0.17	72.61
Costa Rica	CRI	38.20	58.20	8.10	2119	0.06	0.79	67.85	-0.15	62.14
Denmark	DNK	n.a.	62.30	5.70	2799	0.09	0.93	81.60	0.07	80.62
Egypt	EGY	63.80	45.00	11.70	27490	0.84	0.70	61.21	0.11	53.59
Estonia	EST	n.a.	63.70	5.80	657	0.02	0.87	64.31	0.09	70.75
France	FRA	n.a.	55.80	9.40	27418	0.84	0.90	83.95	0.18	78.01
Germany	DEU	n.a.	61.20	3.80	41675	1.27	0.94	78.37	0.18	82.84
Ghana	GHA	88.80 ¹	n.a.	n.a.	11176	0.34	0.59	49.66	0.04	51.33
Guyana	GUY	56.10	56.00	12.00	278	0.01	0.65	47.93	n.a.	n.a.
India	IND	n.a.	n.a.	n.a.	490490	15.00	0.64	30.57	0.01	62.02
Indonesia	IDN	84.20	67.00	4.20	123416	3.77	0.69	46.92	-0.05	64.94
Korea, Republic of	KOR	n.a.	63.00	3.70	26737	0.82	0.90	62.30	0.12	78.84
Kyrgyzstan	KGZ	n.a.	60.10	6.90	2365	0.07	0.67	54.86	0.12	53.02

COUNTRY NAME	COUNTRY CODE	INFORMAL EMPLOYMENT, AS % OF TOTAL EMPLOYMENT, 2017 OR LATEST YEAR AVAILABLE	LABOUR FORCE PARTICIPATION RATE, TOTAL, %, 2017	UNEMPLOYMENT RATE, TOTAL, %, 2017	EMPLOYMENT, 000s, 2017	% OF WORLD EMPLOYMENT, 2017	HUMAN DEVELOPMENT INDEX (HDI), 2017	ENVIRONMENTAL PERFORMANCE INDEX (EPI), 2018	GREEN ECONOMY PROGRESS (GEP) INDEX, 2017	GLOBAL COMPETITIVENESS INDEX (GCI), 2018
Mali	MLI	94.90 ²	n.a.		6235	0.19	0.43	43.71	0.08	43.63
Mauritius	MUS	52.20	59.40	6.80	562	0.02	0.79	56.63	n.a.	63.74
Montenegro	MNE	n.a.	54.70	16.10	220	0.01	0.81	61.33	n.a.	59.62
Philippines	PHL	n.a.	59.10	2.60	41706	1.28	0.70	57.65	0.21	62.13
Senegal	SEN	n.a.	n.a.	n.a.	3929	0.12	0.51	49.52	0.13	49.03
South Africa	ZAF	34.60	55.40	27.10	16272	0.50	0.70	44.73	-0.19	60.76
Spain	ESP	n.a.	58.10	17.20	18882	0.58	0.89	78.39	0.20	74.20
Tajikistan	TJK	n.a.	n.a.	n.a.	2247	0.07	0.65	47.85	0.15	52.18
Thailand	THA	n.a.	n.a.	n.a.	38453	1.18	0.76	49.88	0.21	67.53
Uganda	UGA	n.a.	53.00	9.40	15630	0.48	0.52	44.28	0.52	46.80
United Arab Emirates	ARE	n.a.	80.80	2.50	32463	0.99	0.86	58.90	n.a.	73.37
United Kingdom	GBR	n.a.	62.90	4.30	6580	0.20	0.92	79.89	0.18	81.99
United States	USA	n.a.	62.90	4.40	156751	4.79	0.92	71.19	0.07	85.64
Zimbabwe	ZWE	n.a.	n.a.	n.a.	7706	0.24	0.54	43.41	0.06	42.61
Total (32 countries)					2 048 642	62.64				

¹ 2015. ² 2016. n.a. = not available.

Sources: Data for informal employment, labour force participation rate and unemployment rate extracted from ILOSTAT <https://www.ilo.org/ilostat/>. Employment figures: ILO estimates. HDI: United Nations Development Program (UNDP), <http://hdr.undp.org/en/content/human-development-index-hdi>. EPI: Environmental Performance Index developed by Yale Center for Environmental Law and Policy and the Earth Institute, Columbia University, in collaboration with the World Economic Forum: <https://epi.envirocenter.yale.edu/>. GEP: UN Partnership for Action on Green Economy (PAGE); information available at: <https://www.un-page.org/home>; data download at: http://www.un-page.org/files/public/raw_data_files.zip. GCI: World Economic Forum, Global Competitiveness Index 4.0: <http://reports.weforum.org/global-competitiveness-report-2018/>.

Table A3.3 Human Development Index (HDI), labour force participation and unemployment, by gender

COUNTRY NAME	COUNTRY CODE	HDI, 2017		LABOUR FORCE PARTICIPATION RATE, %, 2017		UNEMPLOYMENT RATE, %, 2017	
		MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
Australia	AUS	0.95	0.93	70.70	59.80	5.50	5.70
Bangladesh	BGD	0.64	0.57	80.70	36.40	3.30	6.70
Barbados	BRB	0.79	0.81	n.a.	n.a.	n.a.	n.a.
Brazil	BRA	0.76	0.76	72.90	52.80	11.30	14.70
Burkina Faso	BFA	0.45	0.39	n.a.	n.a.	n.a.	n.a.
China	CHN	0.77	0.74	n.a.	n.a.	n.a.	n.a.
Costa Rica	CRI	0.80	0.78	72.40	43.90	6.80	10.30
Denmark	DNK	0.94	0.92	66.40	58.20	5.60	5.90
Egypt	EGY	0.73	0.64	66.90	22.00	8.20	23.00
Estonia	EST	0.86	0.88	71.40	57.10	6.20	5.30
France	FRA	0.91	0.89	60.50	51.40	9.50	9.30
Germany	DEU	0.95	0.92	66.70	55.90	4.10	3.30
Ghana	GHA	0.62	0.56	n.a.	n.a.	n.a.	n.a.
Guyana	GUY	0.67	0.63	68.90	43.60	9.90	15.30
India	IND	0.68	0.58	n.a.	n.a.	n.a.	n.a.
Indonesia	IDN	0.72	0.67	81.80	52.20	4.40	3.90
Korea, Republic of	KOR	0.93	0.87	73.90	52.60	3.80	3.60
Kyrgyzstan	KGZ	0.68	0.65	75.00	45.90	5.60	8.90
Mali	MLI	0.47	0.38	n.a.	n.a.	n.a.	n.a.
Mauritius	MUS	0.80	0.77	74.20	45.40	4.60	10.00
Montenegro	MNE	0.83	0.79	62.20	47.50	15.40	16.90
Philippines	PHL	0.70	0.70	73.30	44.90	2.50	2.70
Senegal	SEN	0.53	0.48	n.a.	n.a.	n.a.	n.a.
South Africa	ZAF	0.70	0.69	62.70	48.60	25.20	29.30
Spain	ESP	0.90	0.88	63.90	52.60	15.70	19.00
Tajikistan	TJK	0.67	0.62	n.a.	n.a.	n.a.	n.a.
Thailand	THA	0.76	0.75	n.a.	n.a.	n.a.	n.a.
Uganda	UGA	0.55	0.48	61.80	45.00	8.10	11.10
United Arab Emirates	ARE	0.86	0.83	92.80	52.60	1.40	6.80
United Kingdom	GBR	0.94	0.90	68.20	57.80	4.40	4.20
United States	USA	0.93	0.92	69.10	57.00	4.40	4.30
Zimbabwe	ZWE	0.56	0.51			n.a.	n.a.

n.a. = not available.

Sources: HDI: United Nations Development Program (UNDP), <http://hdr.undp.org/en/content/human-development-index-hdi>. Labour force participation rate and unemployment: ILOSTAT <https://www.ilo.org/ilostat/>.

ANNEX 4.

REFERENCES TO INTERNATIONAL ENVIRONMENTAL AGREEMENTS IN COUNTRY REPORTS

Table A4.1 References to international environmental agreements in country reports

COUNTRY GROUP BY INCOME	NO. OF MENTIONS WITHIN REPORTS			NOT MENTIONED
	SDGS/MDGS	UNFCCC/PARIS AGREEMENT/COP21	NDC	
LICs	BFA, MLI, SEN TJK	BFA, SEN	MLI, SEN, TJK, ZWE	UGA
LMICs	BGD, EGY, IND, IDN, KGZ	BGD, IND, IDN, PHL	GHA, IDN, IDN, KGZ	
UMICs	CRI, GUY, MNE, ZAF	CRI, GUY, MNE, MUS, THA	BRA, GUY, MNE, THA, ZAF	CHN
HICs	DEU, FRA	FRA, ESP, ARE		AUS, BRB, DNK, EST, KOR, GBR, USA

Note: For country codes, see Annexes 2–3 above.

Source: Authors' analysis based on *Skills for green jobs* country reports (ILO, 2018).

ANNEX 5.

METHODOLOGY OF THE QUANTITATIVE MODEL

The analyses presented in Chapter 6 of this report follow the methods outlined in Strietska-Illina et al., 2011, to identify the skills needs that will arise in the transition to a low-carbon and resource-efficient economy. The analyses presented take the number of jobs projected to be created, through direct, indirect or induced effects, at the industry level from ILO, 2018, and draw conclusions for the employment implications of a transition to energy sustainability and the circular economy in respect of occupations and skills.

In its *World Employment and Social Outlook 2018: Greening with jobs*, the ILO (2018) estimates the total number of jobs created or destroyed under sustainable energy and circular economy scenarios in each of 163 industries. It draws on EXIOBASE v3, a multi-regional input-output model that projects economic transactions across countries, regions and industries to estimate the employment impact of each scenario in each of the 163 industries covered. For more details on how baseline employment is estimated in each of these 163 industries, see Stadler et al. (2018). For more details on the scenarios used to estimate the number of jobs created and destroyed, see Montt, Wiebe et al., 2018; ILO, 2018a, Appendix 2.1; and Wiebe et al., forthcoming.

Several steps were involved in drawing estimates at the occupational level from industry-level results. First, we estimated the occupational structure of each industry, identified by its two-digit classification in the International Standard Industrial Classification of All Economic Activities, Revision 4 (ISIC Rev.4).¹ This means estimating the share that each ISCO-08 two-digit occupation occupies in each ISIC Rev.4 two-digit industry. For this purpose we used the 38 ILO harmonized labour force surveys (LFS) available in the ILOStat Microdata Repository which detail workers' occupations and industries at the respective two-digit levels.² (The ILOStat Microdata Repository harmonizes the LFS of 104 countries; countries not included in this analysis do not have data at the two-digit level for either occupation or industry.) For countries with annual LFS, we used the corresponding year's survey. For countries with quarterly LFS, we used the third quarter's LFS.³ For countries with monthly LFS, we used the September LFS. We estimated, for each industry, the share of workers in each occupation. We only used LFS from 2014 (or the closest available year if 2014 was unavailable), for consistency with the baseline year used to model the scenarios (see ILO, 2018a).

1. See https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf [24 Oct. 2019].

2. <https://www.ilo.org/surveydata/index.php/home> [24 Oct. 2019.]

3. Owing to data availability issues, Guatemala's second-quarter LFS was used.

Table A5.1 National labour force surveys used in the estimation of industry-specific occupational structures

COUNTRY	YEAR	PERIOD	SAMPLE SIZE
Bosnia and Herzegovina	2014	Annual	26 630
Brunei Darussalam	2014	Annual	17 199
Cambodia	2012	Annual	48 290
Ecuador	2014	Quarterly (Q3)	59 312
Eswatini	2016	Annual	13 623
Ethiopia	2013	Annual	240 660
Fiji	2016	Annual	23 258
Ghana	2015	Annual	9 604
Greece	2014	Quarterly (Q3)	58 630
Guatemala	2014	Quarterly (Q2)	18 028
Guyana	2017	Annual	15 112
Lao People's Democratic Republic	2017	Annual	52 167
Liberia	2010	Annual	31 809
Madagascar	2015	Annual	15 641
Mauritius	2014	Annual	39 010
Mexico	2014	Quarterly (Q3)	398 047
Mongolia	2014	Annual	43 664
Myanmar	2015	Annual	101 278
Nepal	2017	Annual	78 496
Pakistan	2014	Annual	258 490
Panama	2014	Annual	43 719
Peru	2014	Monthly (Sep.)	12 668
Rwanda	2017	Annual	77 761
Samoa	2012	Annual	16 004
Serbia	2014	Quarterly (Q3)	23 471
Seychelles	2014	Annual	12 594
Sierra Leone	2014	Annual	25 641
Sri Lanka	2014	Annual	81 376
Switzerland	2014	Annual	68 892
Thailand	2014	Quarterly (Q3)	232 710
Timor-Leste	2013	Annual	33 136
Turkey	2015	Annual	389 035
Uganda	2012	Annual	31 779
United Arab Emirates	2017	Annual	71 400
United Kingdom	2014	Quarterly (Q3)	95 950
United States	2014	Monthly (Sep.)	152 485
Uruguay	2014	Annual	131 857
Zimbabwe	2011	Annual	39 798

Note: The ILOstat Microdata Repository harmonizes labour force surveys for 104 countries. We used only that subset of surveys which provide workers' occupation at the ISCO-08 two-digit level and industry at the ISIC Rev.4 two-digit level.

Source: ILO calculations based on the ILOstat Microdata Repository.

In order to have sufficient cases in each cell of the industry–occupation matrix, we pooled all the data, weighted to give each country equal representation. The 38 countries in our sample represent a diverse set of countries covering five regions of the world and different levels of development (for the list of surveys and sample sizes used to compute the industry-specific occupational structure, see. We weighted each LFS to assume that each country is a unit and to ensure that larger countries or countries with larger sample sizes did not bias the general occupational structure of each industry. The resulting occupational structure thus reflects the occupational structure in each industry as observed in the average country. We also estimated occupational structures by gender to obtain gender-specific trends associated with the transition to energy sustainability and the circular economy.

Second, we matched EXIOBASE's 163-industry classification to the ISIC Rev.4 two-digit classification. In many cases there was a direct, one-to-one match between the two classifications. In other cases, EXIOBASE industries were matched with the ISIC classification through aggregation (e.g. EXIOBASE's "cultivation of paddy rice", "cultivation of wheat", "cultivation of cereal grains n.e.c.", "cultivation of vegetables, fruit, nuts", "cultivation of oil seeds", "cultivation of sugar cane, sugar beet", "cultivation of plant-based fibres", "cultivation of crops n.e.c.", "cattle farming", "pig farming", "poultry farming", "meat animals n.e.c.", "animal products n.e.c.", "raw milk" and "wool, silk-worm cocoons" industries together correspond directly with ISIC's 01, "Crop and animal production, hunting and related service activities"). In this case, we assume that the industrial structure and definitions are identical. Where an EXIOBASE industry corresponds to more than one ISIC industry (e.g. EXIOBASE's "extraction of crude petroleum and services related to crude oil extraction, excluding surveying" corresponds to ISIC 06, "extraction of crude petroleum and natural gas", and ISIC 09, "mining support service activities"), we take the average of the occupational structure of the matched ISIC industries. The matching resulted in 88 ISIC Rev.4 two-digit industries.

Third, we matched the occupational structures obtained from the LFS to the matched ISIC Rev.4 two-digit industries and multiplied each occupational share by the estimated employment creation and destruction at the national and regional level in each scenario. We sum the results for each occupation to obtain occupational-level results. By comparing the estimated creation and destruction of jobs in each occupation at the industry and country level, we could estimate the total numbers of jobs created that could be filled by reallocation of workers whose jobs had been destroyed, jobs that would need to be filled through entirely new skills development, and jobs that would be destroyed with no possibility of reallocation, as follows:

$$New\ Jobs_{reallocation} = \begin{cases} Jobs_{destroyed}, & Jobs_{destroyed} < Jobs_{created} \\ Jobs_{created}, & Jobs_{destroyed} \geq Jobs_{created} \end{cases} \quad (1)$$

$$New\ Jobs_{net} = Jobs_{created} - Jobs_{destroyed}, \quad Jobs_{destroyed} < Jobs_{created} \quad (2)$$

$$Jobs\ Lost_{reallocation} = New\ Jobs_{reallocation} \quad (3)$$

$$Jobs\ Lost_{net} = Jobs_{destroyed} - Jobs_{created}, \quad Jobs_{destroyed} \geq Jobs_{created} \quad (4)$$

The methodological strategy adopted to translate industry-level impacts to the occupational level carries with it an important assumption: that the occupational structure observed in 2014 (or surrounding years) is an accurate representation of each industry's occupational structure both as it was in 2014 and as it will be 2030.

The results presented here assume, then, that occupational structure remains constant up to 2030. Any changes to the occupational structure – and the gender composition therein – of each industry will affect the results presented here and, in so far as they have implications at the skill or gender levels, will affect those results as well.

An analysis of change in occupational shares by industry shows that the assumption of a constant occupational structure is a tenable one. For countries whose LFS present employment data at the ISIC two-digit industry level and the ISCO-08 two-digit occupational level, and have comparable classification systems over at least three years in the period up to 2017, we estimated the employment share of each occupation in each industry ($emp_share_{o,i,t}$). For robustness purposes we selected only those occupation–industry pairs for which there were at least 30 observations in a survey.⁴ For each occupation–industry pair (o,i), we estimated a linear regression with robust standard errors:

$$emp_share_{o,i,t} = \beta_0 + \beta_1 year_t + \varepsilon_{o,i,t}$$

where β_1 is the average yearly change of occupation o 's share in industry i 's employment over the period measured. If β_1 is statistically significant, there is a linear occupational change over time. If it is not, the share of that occupation in that particular industry's employment has remained stable over the period observed.⁵

Table A5.2 shows the number of industry–occupation pairs and the period analysed in each country, identifying the share of coefficients which are and which are not statistically significant. In the 12 countries analysed, the majority of occupations do not change their share within a particular industry. In Mauritius, Seychelles and Sri Lanka, over 90 per cent of the industry–occupation pairs do not experience statistically significant change over the period analysed: the share of each occupation in an industry has remained constant. The same is true for 80 per cent or more of the occupations analysed in Ecuador (85 per cent), Mexico (86), Mongolia (88), Peru (83), Switzerland (80) and Uruguay (84). Only in the United States is the proportion of occupations experiencing no change in their industry share less than 70 per cent, and even here it remains a majority of the observations. Table A5.2 also shows that the longer the period analysed, the lower the proportion of occupations that maintain a constant share within the industry. The correlation between the length of the period analysed and the proportion of occupations with no statistically significant change over the period is -0.87 . Notwithstanding this relationship, both Greece and the United States, both countries with observed series of over 15 years, show a 71 and 59 per cent of occupations that retain their share within industries. These results lend support to the hypothesis that occupational structures observed in 2014 will remain relatively constant over a five-, ten- or 15-year period and up to 2030.

Similarly, the analysis in Chapter 6 assumes that the gender composition in each occupation remains relatively stable over time. For countries that have employment data in their LFS at both the ISIC two-digit industry level and the ISCO-08 two-digit occupational level, and have comparable classification systems over at least

4. The results shown below are robust to limiting the analysis to those occupations that have 25 or 20 observations in each occupation–industry pair.

5. If anything, this specification may overestimate the number of occupations experiencing a change in their share within the industry, as neither the sampling variance underlying a year's estimate nor the possible autocorrelation of errors is considered. Alternative models that account for sampling variance (e.g. multinomial logistic regression models) or autocorrelation (e.g. time series regression models) require longer trends and/or larger sample sizes within each industry and within each industry–occupation pair than are available in LFS.

Table A5.2 Occupations experiencing changing employment shares within each industry

COUNTRY	PERIOD	INDUSTRY– OCCUPATION- PAIRS	OCCUPATIONS GAINING SHARE WITHIN THE INDUSTRY		OCCUPATIONS LOSING SHARE WITHIN THE INDUSTRY		OCCUPATIONS WITH NO CHANGE WITHIN THE INDUSTRY	
			NO.	%	NO.	%	NO.	%
Ecuador	2013–17	367	18	5	37	10	312	85
Greece	1998–2017	874	148	17	107	12	619	71
Mauritius	2011–17	136	5	4	8	6	123	90
Mexico	2012–18	517	29	6	42	8	446	86
Mongolia	2008–17	121	5	4	10	8	106	88
Peru	2010–17	205	18	9	16	8	171	83
Seychelles	2014–17	74	2	3	1	1	71	96
Sri Lanka	2013–16	146	5	3	6	4	135	92
Switzerland	2009–17	323	29	9	37	11	257	80
United Kingdom	2009–17	1240	169	14	88	7	983	79
United States	2000–17	2039	413	20	418	21	1208	59
Uruguay	2011–17	328	33	10	18	5	277	84

Note: Only occupations with at least 30 observations within an industry are used in the estimation.

Source: ILO calculations based on national LFS in the ILOStat Microdata Repository.

three years in the period up to 2017, we estimated the female employment share of each occupation in each industry ($fem_share_{o,i,t}$). For robustness purposes we selected only those occupations for which there were at least 30 observations in a survey. For each occupation–industry pair (o,i), we estimated a linear regression with robust standard errors:

$$fem_share_{o,i,t} = \gamma_0 + \gamma_1 year_t + \varepsilon_{o,i,t}$$

where γ_1 is the average yearly change of women's share of employment in occupation o in industry i over the period measured. If γ_1 is statistically significant, there is a linear gender composition change over time. If it is not, the gender share in that occupation has remained stable over the period observed in the particular industry.⁶

Table A5.3 shows the number of industry–occupation pairs and the period analysed in each country, identifying the share of coefficients which are and which are not statistically significant. For all occupations in Sri Lanka and for over 90 per cent of

6. As noted in the preceding footnote, this specification may overestimate the number of occupations experiencing a change in their share within the industry, as it takes into account neither the sampling variance underlying a year's estimate nor the possible autocorrelation of the errors. Alternative models that account for sampling variance (e.g. multinomial logistic regression models) or autocorrelation (e.g. time series regression models) require longer trends and/or larger sample sizes within each industry and within each industry–occupation pair than those available in LFS.

the industry–occupation pairs analysed in the Seychelles and Uruguay, there is no statistically significant change in the share of women employed. Nor is there any such change in over 80 per cent of the occupations analysed in Ecuador (87 per cent), Mauritius (89), Mexico (89), Mongolia (89), Peru (86) or the United Kingdom (83). Only in the United States is the share of occupations experiencing no change lower than 70 per cent, at 67 per cent. Also shows that the longer the period analysed, the lower the proportion of occupations within the industry that maintain a constant share of female employment. The correlation between the length of the period analysed and the share of occupations with no statistically significant change over the period is -0.85 . Notwithstanding this relationship, Greece and the United States, both countries with observed series of over 15 years, show respectively 76 per cent and 67 per cent of occupations retain their shares within industries. These results lend support to the hypothesis that occupational structures observed in 2014 will remain relatively constant over a five-, ten- or 15-year period and up to 2030.

Table A5.3 Occupations experiencing changing female employment shares within each industry

COUNTRY	PERIOD	INDUSTRY– OCCUPATION- PAIRS	OCCUPATIONS GAINING SHARE WITHIN THE INDUSTRY		OCCUPATIONS LOSING SHARE WITHIN THE INDUSTRY		OCCUPATIONS WITH NO CHANGE WITHIN THE INDUSTRY	
			NO.	%	NO.	%	NO.	%
Ecuador	2013–17	367	21	6	26	7	320	87
Greece	1998–2017	874	93	11	113	13	668	76
Mauritius	2011–17	136	10	7	5	4	121	89
Mexico	2012–18	517	28	5	29	6	460	89
Mongolia	2008–17	121	5	4	8	7	108	89
Peru	2010–17	205	19	9	10	5	176	86
Seychelles	2014–17	74	3	4	2	3	69	93
Sri Lanka	2013–16	146	0	0	0	0	146	100
Switzerland	2009–17	323	32	10	35	11	256	79
United Kingdom	2009–17	1240	143	12	73	6	1024	83
United States	2000–17	2039	305	15	360	18	1374	67
Uruguay	2011–17	328	18	5	16	5	294	90

Note: Only occupations with at least 30 observations within an industry are used in the estimation.

Source: ILO calculations based on national labour force surveys in the ILOStat Microdata Repository.

ANNEX 6.

DETAILED OCCUPATIONAL-LEVEL RESULTS

Table A6.1 Detailed occupational-level results, energy scenario (000s)

ISCO-08 TWO- DIGIT CODE	ISCO-08 OCCUPATION	SKILL LEVEL ^a	NEW JOBS		JOBS LOST	
			ABSORBING LAID-OFF WORKERS	NET	NET	RE- ALLOCATED
11	Chief executives, senior officials and legislators	H	44	108	-5	-44
12	Administrative and commercial managers	H	132	128	-54	-132
13	Production and specialized services managers	H	136	323	-36	-136
14	Hospitality, retail and other services managers	H	33	136	-7	-33
19	Other managers	H	<0.5	<0.5	-8	<0.5
21	Science and engineering professionals	H	500	263	-253	-500
22	Health professionals	H	21	21	-16	-21
23	Teaching professionals	H	23	15	-18	-23
24	Business and administration professionals	H	218	147	-75	-218
25	Information and communications technology professionals	H	65	49	-40	-65
26	Legal, social and cultural professionals	H	45	66	-20	-45
29	Other professionals	H	<0.5	1	<0.5	<0.5
31	Science and engineering associate professionals	H	748	528	-206	-748
32	Health associate professionals	H	16	14	-10	-16
33	Business and administration associate professionals	H	181	389	-43	-181
34	Legal, social, cultural and related associate professionals	H	9	43	-5	-9

ISCO-08 TWO- DIGIT CODE	ISCO-08 OCCUPATION	SKILL LEVEL ^a	NEW JOBS		JOBS LOST	
			ABSORBING LAID-OFF WORKERS	NET	NET	RE- ALLOCATED
35	Information and communications technicians	H	23	20	-12	-23
39	Other technicians and associate professionals	H	3	34	-1	-3
41	General and keyboard clerks	M	175	300	-26	-175
42	Customer services clerks	M	51	274	-27	-51
43	Numerical and material recording clerks	M	127	278	-21	-127
44	Other clerical support workers	M	46	105	-9	-46
49	Other clerical support workers	M	1	22	-6	-1
51	Personal service workers	M	151	299	-21	-151
52	Sales workers	M	160	978	-77	-160
53	Personal care workers	M	5	5	-32	-5
54	Protective services workers	M	141	179	-27	-141
59	Other service and sales workers	M	2	27	-3	-2
61	Market-oriented skilled agricultural workers	M	98	1327	-98	-98
62	Market-oriented skilled forestry, fishery and hunting workers	M	61	91	-56	-61
63	Subsistence farmers, fishers, hunters and gatherers	M	42	644	-47	-42
69	Other skilled agricultural, forestry and fishery workers	M	<0.5	4	<0.5	<0.5
71	Building and related trades workers, excluding electricians	M	102	3733	<0.5	-102
72	Metal, machinery and related trades workers	M	279	1195	-29	-279
73	Handicraft and printing workers	M	27	310	<0.5	-27
74	Electrical and electronic trades workers	M	328	860	-2	-328
75	Food-processing, wood-working, garment and other craft and related trades workers	M	48	316	<0.5	-48
79	Other craft and related trades workers	M	3	70	<0.5	-3
81	Stationary plant and machine operators	M	339	712	-34	-339
82	Assemblers	M	15	565	<0.5	-15
83	Drivers and mobile plant operators	M	329	810	-33	-329

ISCO-08 TWO- DIGIT CODE	ISCO-08 OCCUPATION	SKILL LEVEL ^a	NEW JOBS		JOBS LOST	
			ABSORBING LAID-OFF WORKERS	NET	NET	RE- ALLOCATED
89	Other plant and machine operators and assemblers	M	2	118	-2	-2
91	Cleaners and helpers	L	184	147	-201	-184
92	Agricultural, forestry and fishery labourers	L	56	601	-38	-56
93	Labourers in mining, construction, manufacturing and transport	L	246	2943	<0.5	-246
94	Food preparation assistants	L	24	26	-23	-24
95	Street and related sales and service workers	L	12	44	-3	-12
96	Refuse workers and other elementary workers	L	153	305	-17	-153
99	Other elementary occupations	L	2	100	<0.5	-2

Notes: ^a H = high; M = medium; L = low. Occupations measured at the ISCO-08 two-digit level. New jobs absorbing laid-off workers are jobs that can be filled by reallocation of workers from similar jobs lost in other industries in the same country or region. New net jobs are jobs created that cannot be filled by workers who have lost jobs in similar occupations in other industries in the same country or region. Lost net jobs are jobs that will not be matched by similar vacancies in other industries within the same country or region. See Annex 5 for methodological details.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

Table A6.2 Detailed occupational-level results, circular economy scenario (000s)

ISCO-08 TWO- DIGIT CODE	ISCO-08 OCCUPATION	SKILL LEVEL ^a	NEW JOBS		JOBS LOST	
			ABSORBING LAID-OFF WORKERS	NET	NET	RE- ALLOCATED
11	Chief executives, senior officials and legislators	H	244	375	-43	-244
12	Administrative and commercial managers	H	596	797	-32	-596
13	Production and specialized services managers	H	1095	143	-1110	-1095
14	Hospitality, retail and other services managers	H	121	1035	-4	-121
19	Other managers	H	<0.5	1	-1	<0.5
21	Science and engineering professionals	H	1379	1274	-397	-1379
22	Health professionals	H	222	173	-77	-222
23	Teaching professionals	H	125	166	-58	-125
24	Business and administration professionals	H	823	837	-53	-823

ISCO-08 TWO- DIGIT CODE	ISCO-08 OCCUPATION	SKILL LEVEL ^a	NEW JOBS		JOBS LOST	
			ABSORBING LAID-OFF WORKERS	NET	NET	RE- ALLOCATED
25	Information and communications technology professionals	H	187	296	-31	-187
26	Legal, social and cultural professionals	H	319	221	-190	-319
29	Other professionals	H	<0.5	<0.5	-4	<0.5
31	Science and engineering associate professionals	H	3042	1225	-965	-3042
32	Health associate professionals	H	90	206	<0.5	-90
33	Business and administration associate professionals	H	1102	1715	-1	-1102
34	Legal, social, cultural and related associate professionals	H	56	103	-5	-56
35	Information and communications technicians	H	73	98	-8	-73
39	Other technicians and associate professionals	H	35	81	-39	-35
41	General and keyboard clerks	M	834	1040	-98	-834
42	Customer services clerks	M	294	707	-18	-294
43	Numerical and material recording clerks	M	844	784	-147	-844
44	Other clerical support workers	M	123	417	<0.5	-123
49	Other clerical support workers	M	10	37	-51	-10
51	Personal service workers	M	728	298	-748	-728
52	Sales workers	M	942	14 695	-58	-942
53	Personal care workers	M	41	19	-47	-41
54	Protective services workers	M	744	579	-497	-744
59	Other service and sales workers	M	5	503	-2	-5
61	Market-oriented skilled agricultural workers	M	757	1024	-448	-757
62	Market-oriented skilled forestry, fishery and hunting workers	M	221	14	-349	-221
63	Subsistence farmers, fishers, hunters and gatherers	M	331	377	-281	-331
69	Other skilled agricultural, forestry and fishery workers	M	2	3	-1	-2

ISCO-08 TWO- DIGIT CODE	ISCO-08 OCCUPATION	SKILL LEVEL ^a	NEW JOBS		JOBS LOST	
			ABSORBING LAID-OFF WORKERS	NET	NET	RE- ALLOCATED
71	Building and related trades workers, excluding electricians	M	2579	150	-2172	-2579
72	Metal, machinery and related trades workers	M	8654	1795	-1605	-8654
73	Handicraft and printing workers	M	1331	35	-1057	-1331
74	Electrical and electronic trades workers	M	1408	1845	-304	-1408
75	Food-processing, wood-working, garment and other craft and related trades workers	M	1315	408	-440	-1315
79	Other craft and related trades workers	M	124	64	-54	-124
81	Stationary plant and machine operators	M	2913	<0.5	-5589	-2913
82	Assemblers	M	224	14	-367	-224
83	Drivers and mobile plant operators	M	2899	753	-2612	-2899
89	Other plant and machine operators and assemblers	M	92	62	-121	-92
91	Cleaners and helpers	L	803	442	-577	-803
92	Agricultural, forestry and fishery labourers	L	683	328	-325	-683
93	Labourers in mining, construction, manufacturing and transport	L	3058	144	-8593	-3058
94	Food preparation assistants	L	114	100	-105	-114
95	Street and related sales and service workers	L	59	749	-21	-59
96	Refuse workers and other elementary workers	L	860	1152	-111	-860
99	Other elementary occupations	L	65	38	-58	-65

Notes: ^a H = high; M = medium; L = low. Occupations measured at the ISCO-08 two-digit level. New jobs absorbing laid-off workers are jobs that can be filled by reallocation of workers from similar jobs lost in other industries in the same country or region. New net jobs are jobs created that cannot be filled by workers who have lost jobs in similar occupations in other industries in the same country or region. Lost net jobs are jobs that will not be matched by similar vacancies in other industries within the same country or region. See Annex 5 for methodological details.

Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.

ANNEX 7.

METHOD OF CALCULATING SIMILARITY SCORES

Jobs in the BGT data set are categorized according to standardized job codes and job titles from O*NET. The BGT data set on similarity scores is based on approximately 50 million job postings over a two-year period from 2016 to 2017, covering about 40,000 unique data sources in the United States.

- A.** The similarity scores assess the overlap between the skills requirements of a job pair as a proxy for the feasibility of transitioning between two jobs. Job pairs that have a similarity score of 1 can be said to have a perfect fit, while job pairs with a similarity score of 0 have the most remote and imperfect fit. High similarity scores are scores of 0.9 or higher, medium similarity scores are those between 0.85 and 0.9, and low similarity scores are those below 0.85.

The BGT methodology combines data from two sources: the BGT job postings database and the O*NET database of job-specific descriptors. The steps are as follows:

1. Similarity scores based on O*NET 's standardized job descriptors are calculated. Using cosine similarity, the similarity score is calculated for each of the following five groups: "skills", "knowledge", "abilities", "work activities" and "education, training and experience". Then a weighted average of the similarity scores of the groups is calculated.
 2. Similarity scores based on BGT's up-to-date job requirements calculated. The similarity score is calculated for different skills clusters (as defined by BGT, these include baseline, specialized and software skill clusters) as well as for "experience" and "education" measures. Then a weighted average of the similarity scores is calculated.
 3. A joint similarity score of O*NET and BGT is calculated by calculating a weighted average between the BGT and the O*NET similarity scores.
- B.** The wage continuity (or increase) condition takes into account the aim that the standard of living of the individual should not fall after the transition to the target job. Therefore, the next step was to compare wages between starting and target jobs to ascertain which job transition paths would lead to wage continuity (or increase).

Further details of the method can be found in WEF and BCG, 2019.

ANNEX 8.

PROGRESS MADE IN COUNTRIES WHERE GREEN POLICY AND REGULATION POORLY DEVELOPED BEFORE 2011: BANGLADESH, MALI AND UGANDA

Bangladesh

Bangladesh has introduced or updated/improved a raft of policies relating to the environment, but adequate consideration of green employment and skills policies is still lacking. New/revised policies include the following: revising and updating the 1992 National Environmental Policy with the aim of integrating environmental conservation and management in the mainstream of development and suggesting 271 action plans for 23 sectors; the Bangladesh Water Act 2013; modification in 2014 of the Bangladesh Climate Change Strategy and Action Plan; a National Plan for Disaster Management 2016–20; the Disaster Management Act 2012 and the Disaster Management Policy approved in 2015; the Ecologically Critical Area Management Act 2016; the Sustainable and Renewable Energy Development Authority Act 2012; and the Sixth Five-Year Plan (2011–15), which, unlike previous plans, included a firm commitment to pursue an environmentally sustainable development process. Of most relevance to the green economy is the new National Industrial Policy of 2016, which was adopted as a response to the challenges of industrial pollution in tandem with the launching of the country's Sustainable Development Goals: this stands in contrast to all Bangladesh's previous industrial policies by promulgating, as an indispensable precondition of sustainable development, environment-friendly industrialization.

Mali

In Mali some strategies and policies, including the national renewable energy strategy and the national energy policy, have not undergone any change or revision since 2009. However, there are some new policies, including a climate change policy and a law prohibiting the generation of non-biodegradable plastic waste, both of which take into account the greening of the economy. Furthermore, in 2011 the Ministry of Environment and Sanitation, with the support of the UNDP, developed a strategy for a green and climate-resilient economy. Moreover, the Strategic Framework for Economic Recovery and Sustainable Development (2016–18) seeks to promote inclusive and sustainable development conducive to the reduction of poverty and inequality in the context of the Sustainable Development Objectives. It includes a specific objective of promoting the green economy through sustainable management of natural resources and combating global warming.

Uganda

Since 2011, Uganda has introduced a National Strategy to Strengthen Human Resources and Skills to Advance Green, Low Emission and Climate Resilient Development (2013–22); a National Policy on Climate Change; a skills development strategy for clean technologies; a policy on integrating climate change learning in TVET; and a Green Jobs Programme, under the auspices of the Ministry of Gender, Labour and Social Development, approved in December 2016. A Green Growth Strategy is also forthcoming. However, effective implementation of policies remains to be achieved.



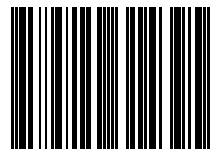
NO ONE SHOULD BE LEFT BEHIND IN CLIMATE ACTION

Skills and Employability Branch (SKILLS)
Employment Policy Department

International Labour Office
Route des Morillons 4
CH-1211 Geneva, Switzerland
empskills@ilo.org
www.ilo.org/skills



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