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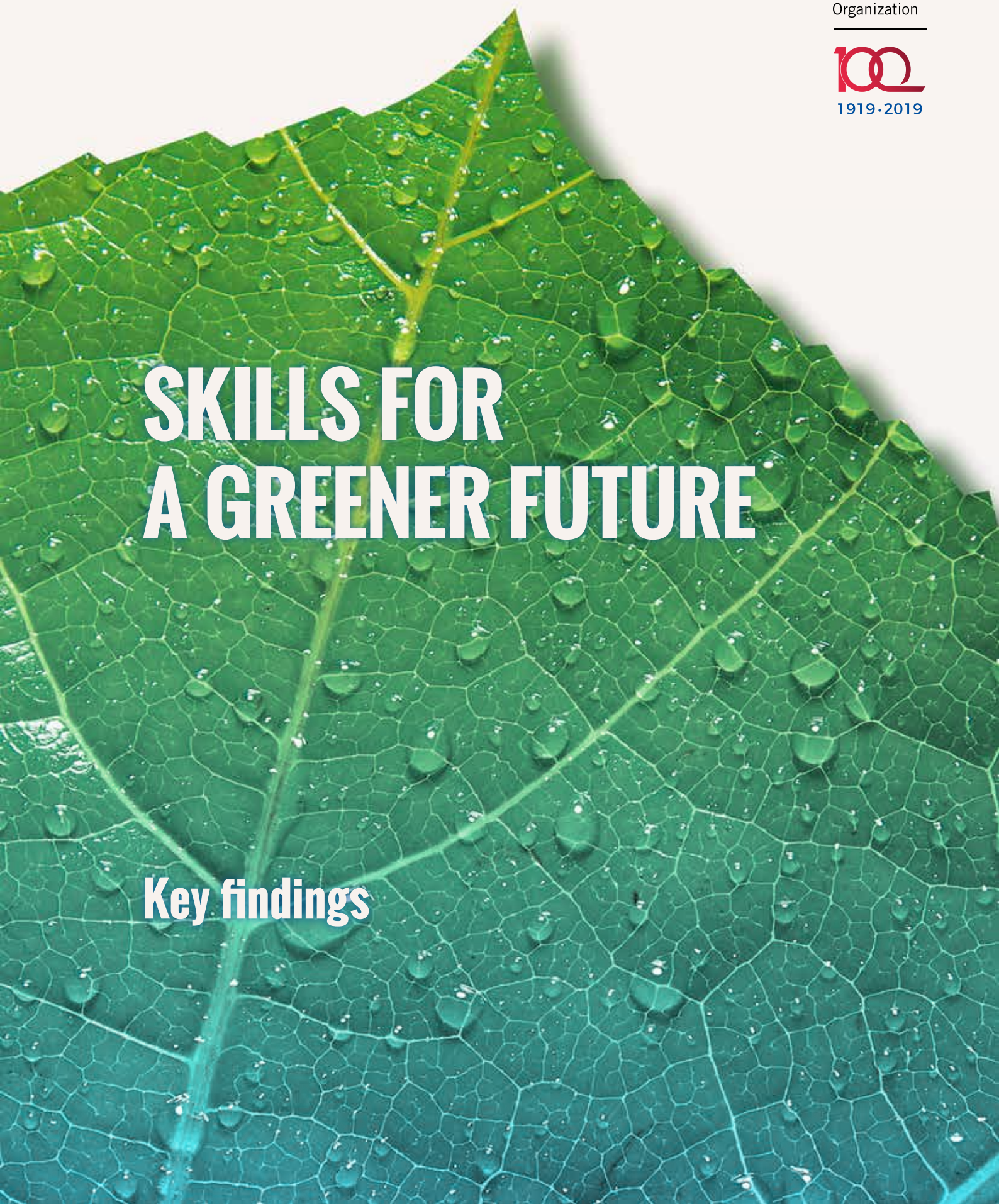

SKILLS FOR A GREENER FUTURE

Key findings

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KEY FINDINGS

INTERNATIONAL LABOUR OFFICE • GENEVA

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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 alike.

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 bold measures 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 Office 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 *World Economic and Social Outlook 2018: 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.

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KEY FINDINGS

It is time to take stock

The right skills[1] 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 ILO[3] and six European Union (EU) countries by Cedefop[4] (see figure 1). The full report is to be published shortly under the title *Skills for a greener future* (ILO, forthcoming). Together, these 32 countries account for 63 per cent of world employment, 65 per cent of global GDP and 63 per cent of CO_2 emissions.

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 a

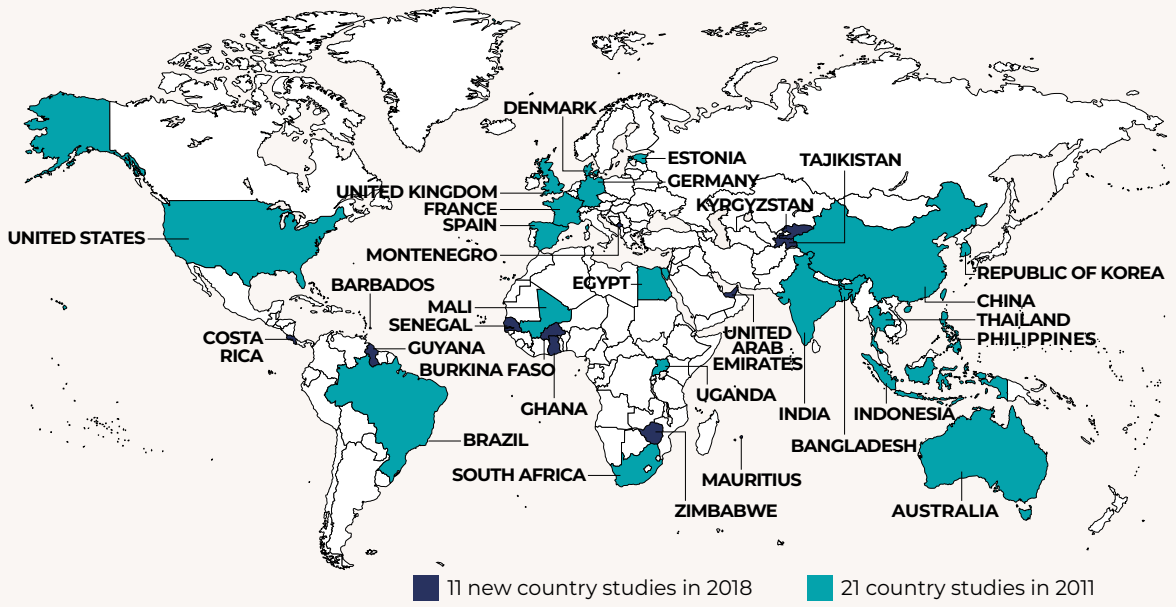
1. The term "skills" is used throughout this document to refer to the knowledge, competence and experience needed to perform a specific task or job. A "skill" is an ability to carry out a manual or mental activity, acquired through learning and practice (Strietska-Ilina et al., 2011).

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, 2016).

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.

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

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



circular 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, 2018), 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 disadvantaged groups in adjusting to change, and effective skills policy measures to increase productivity and support a just green 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.

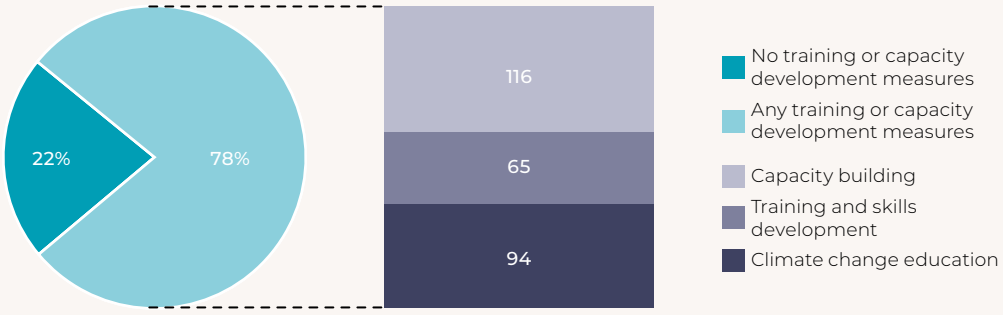
While the climate situation itself has been deteriorating, the climate of international talks about it has improved. A sense of urgency and heightened anxiety about the consequences of climate change and environmental degradation for economies and societies have resulted in major accords on climate change 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

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



Note: The sample consisted of 169 NDCs.

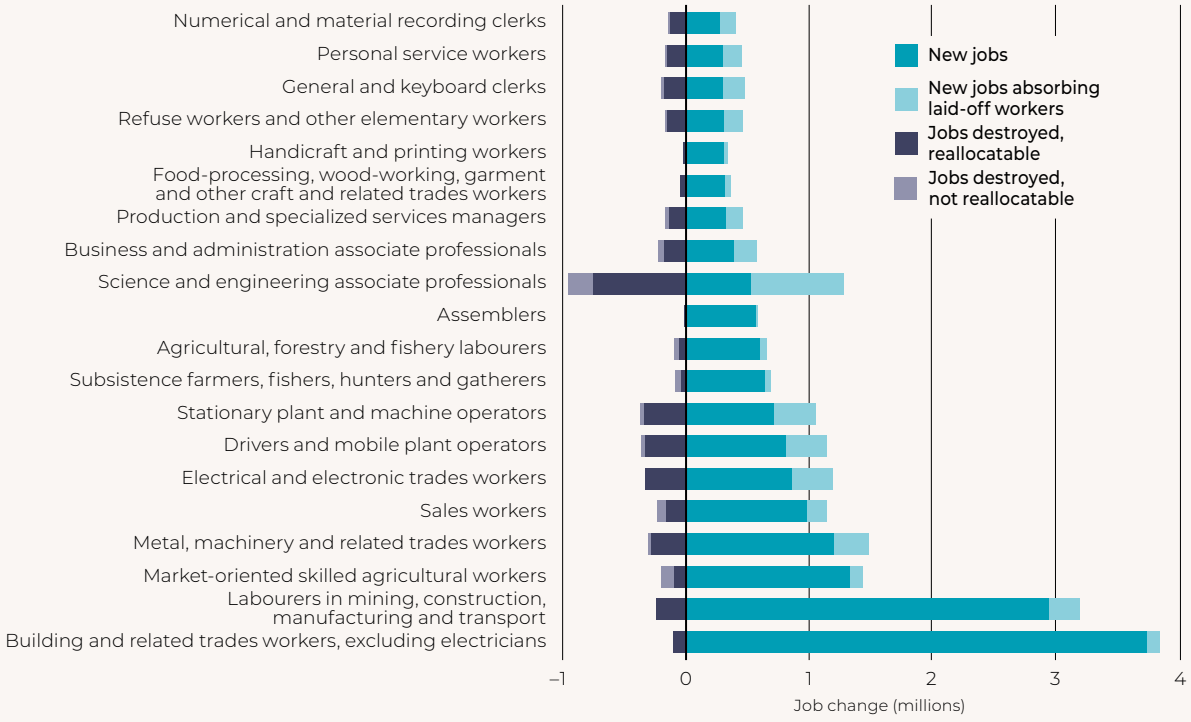
Source: Data computed from NDC Explorer, Jan. 2019. Available at: https://klimalog.die-gdi.de/ndc.

over 20 per cent do not plan any human capital related activities at all (figure 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, 2018). 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 3).

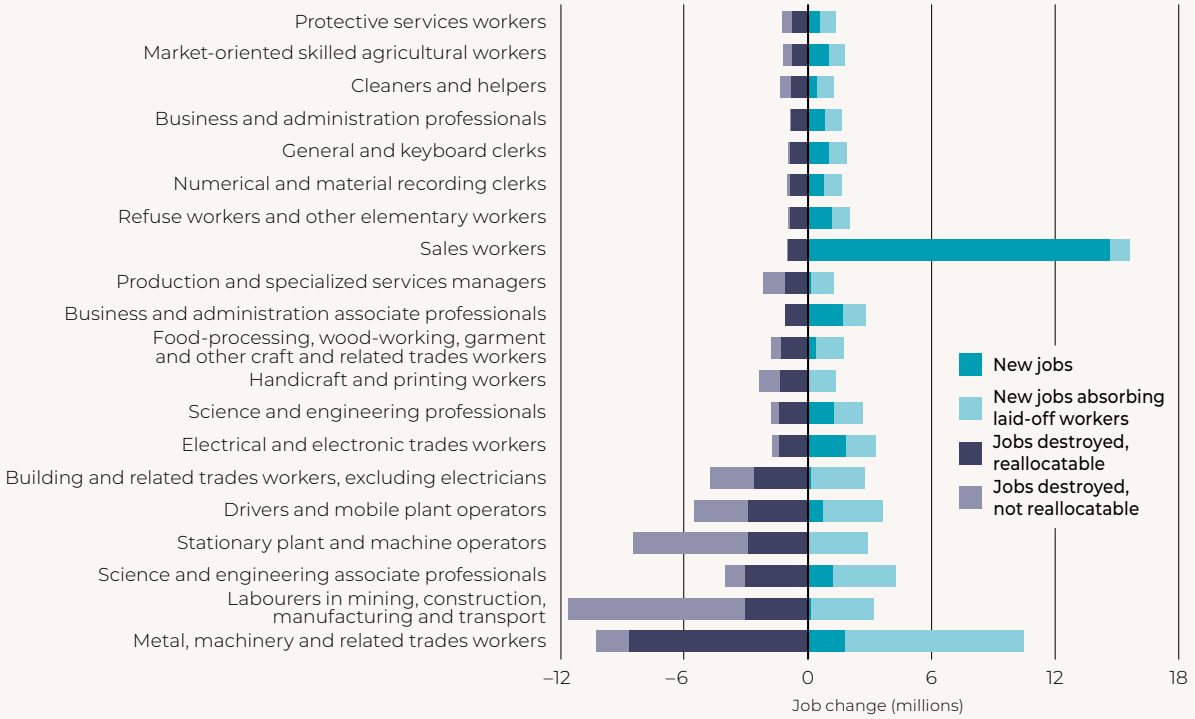
Figure 3. Occupations most in demand across industries in a global energy sustainability scenario, 2030



Note: Percentage 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, 2018). Detailed information on the methodology is described in ILO, 2018, pp. 39, 162–170.

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

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



Note: The figure shows percentage 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, 2018). For detailed information on the methodology, see ILO, 2018, pp. 39, 162–170.

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

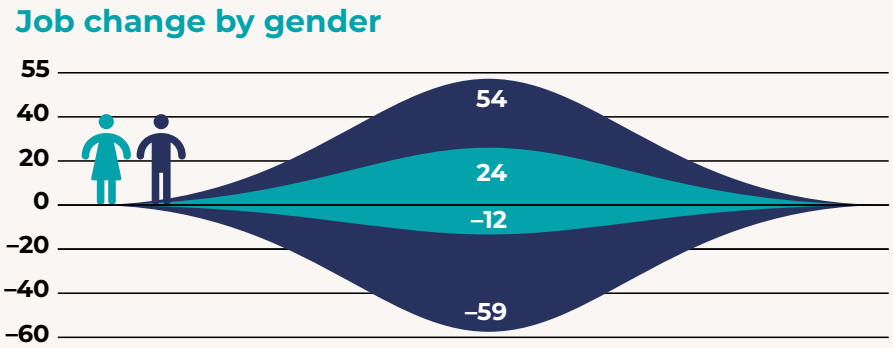
The ILO also estimates that in working towards a circular economy,[5] a net total of between 7 and 8 million new jobs will be created by 2030, as compared to a business-as-usual scenario (ibid.). The extension of these estimates shows that in the circular economy scenario, nearly 78 million jobs will 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 4 shows the 20 occupations that will figure most prominently in job destruction and reallocation in the circular economy scenario.

5. 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).

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, with the greatest impact on male-dominated occupations (figure 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 5. Jobs created and destroyed in a global circular economy scenario, by gender, 2030 (millions)



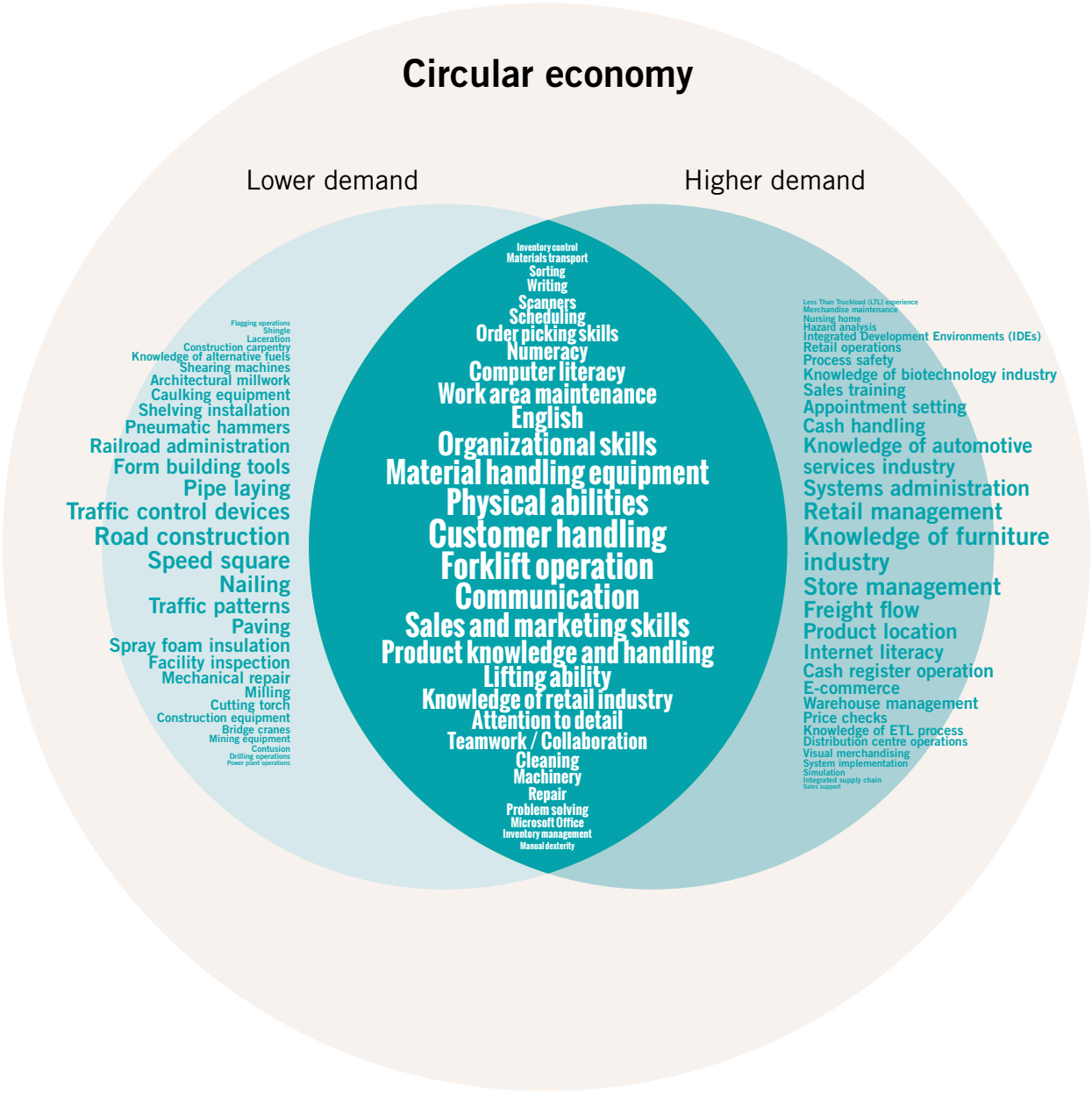
Source: ILO calculations based on EXIOBASE v3 and national labour force surveys.
For detailed information on the methodology, see ILO, 2018, pp. 39, 162–170.

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 6 and 7). Of particular importance will be core (or soft) skills, which can confer a comparative advantage as they can be transferred across occupations.

The creation of over 100 million jobs in either scenario, including both the successful reallocation of workers and the filling of new, additional jobs, is entirely dependent on workforce access to training and related policy measures.

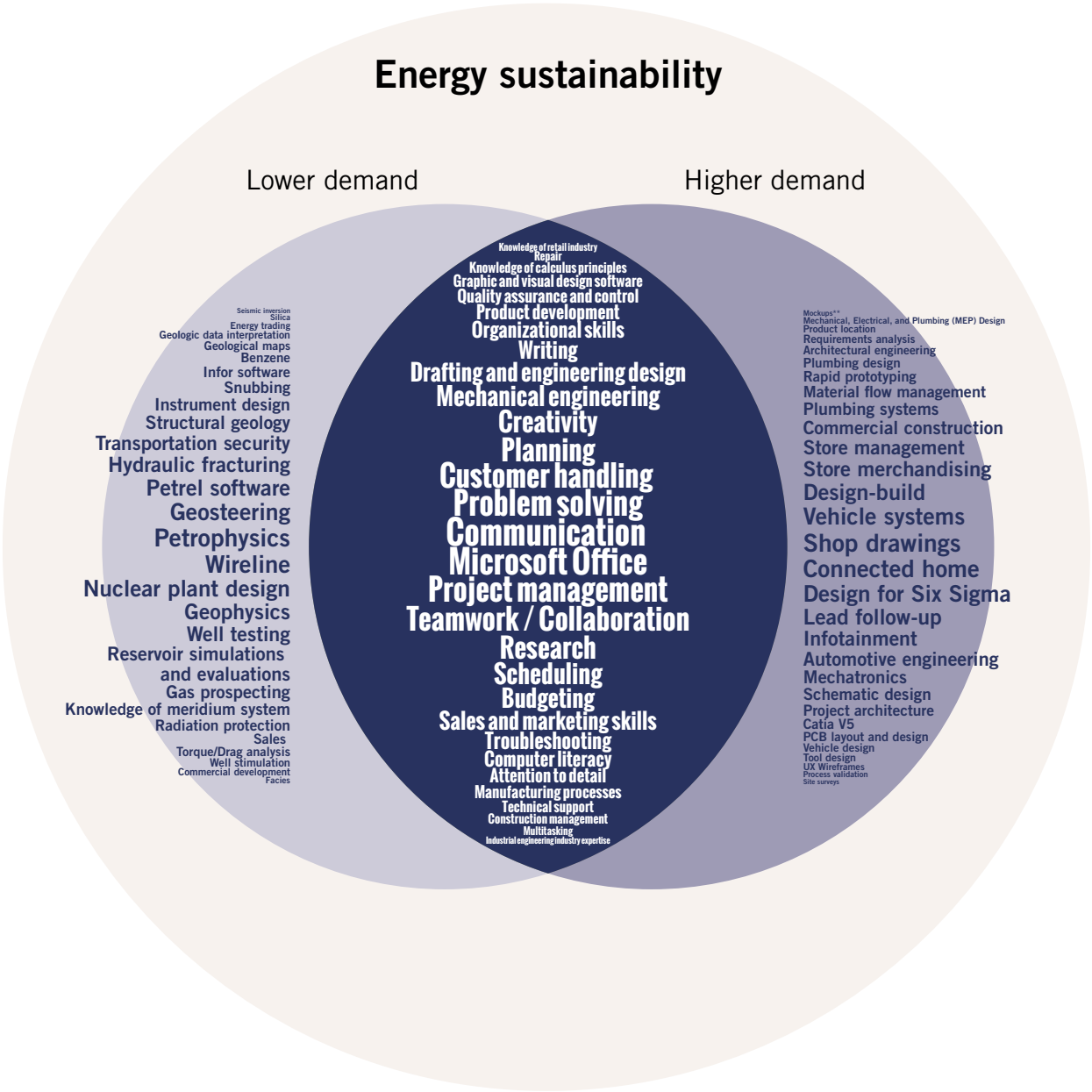
Figure 6. Overlap of core and technical skills for workers in mining, construction, manufacturing and transport, in declining and in growing industries (circular economy scenario)



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 Technology. US data (2017) are used as a proxy.

Figure 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.

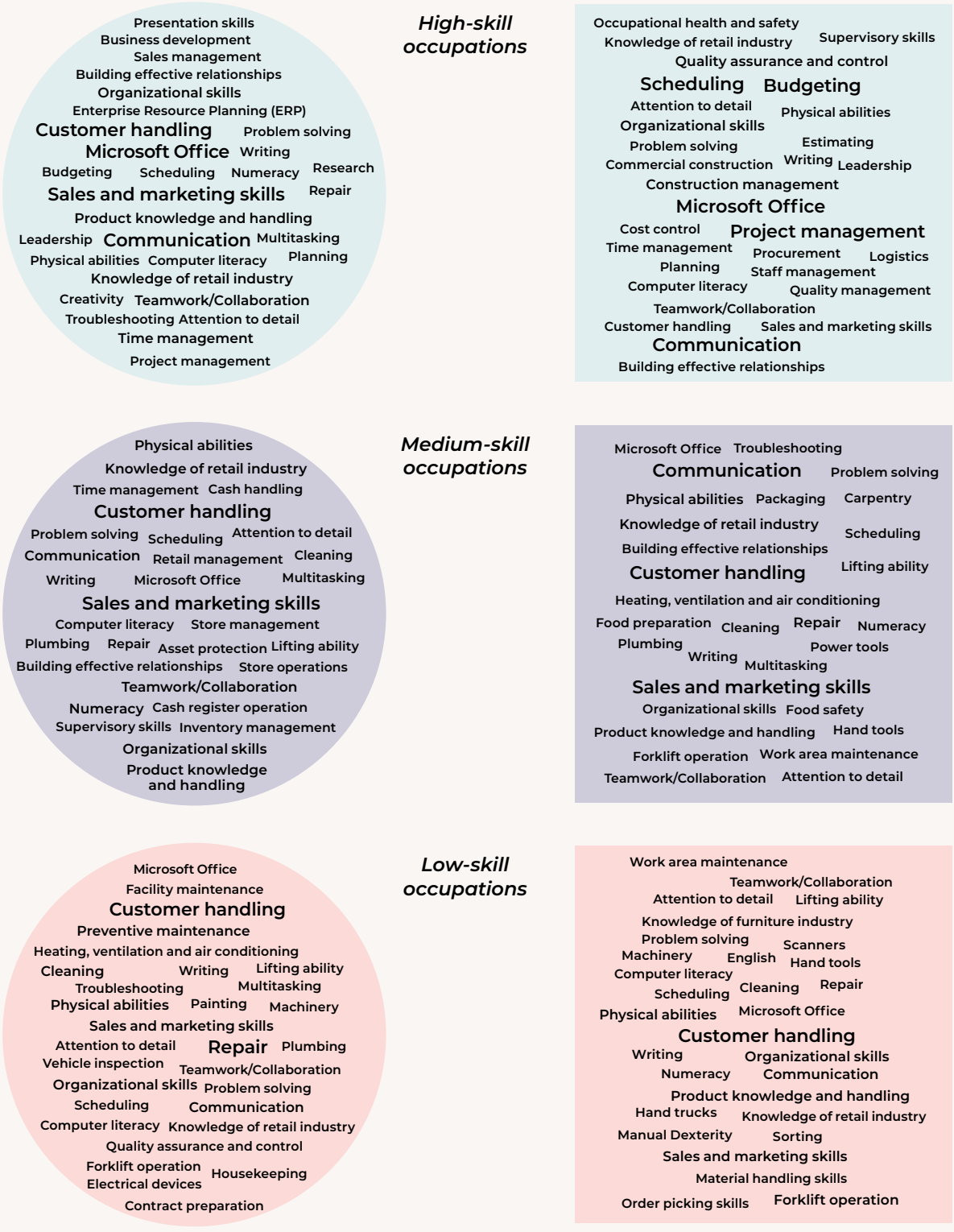
Source: Calculations based on real-time data on vacancies, Burning Glass Technology. US data (2017) are used as a proxy.

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 8a and 8b).

Figure 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



Source: Calculations based on real-time data on vacancies, Burning Glass Technology. 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, 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.

Country reports on the period since 2011 highlight 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 1).

Table 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	*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	University degree; longer upskilling programmes	*New occupations:* agricultural meteorologists, climate change scientists; energy auditors, energy consultants; carbon trading analysts *Changing occupations:* 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 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 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 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 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

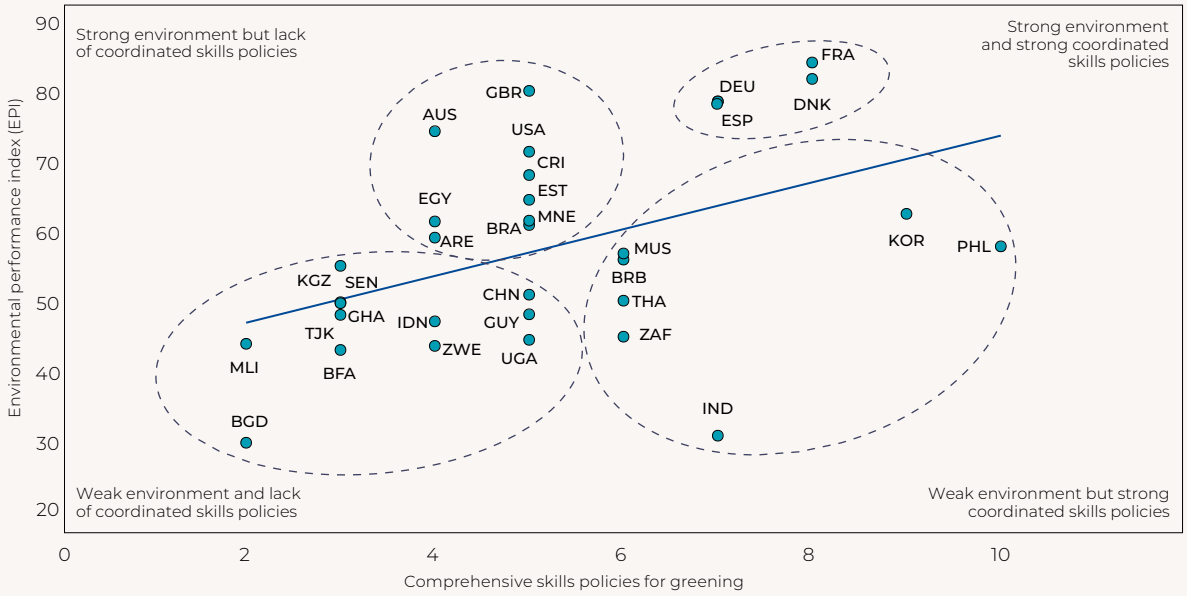
Note: **HSL:** higher skill level; **MSL:** medium skill level.

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 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 MICs, is strong in environmental policies but weak on the skills side. A third group of MICs 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 9. Countries grouped according to performance in environmental and skills policies

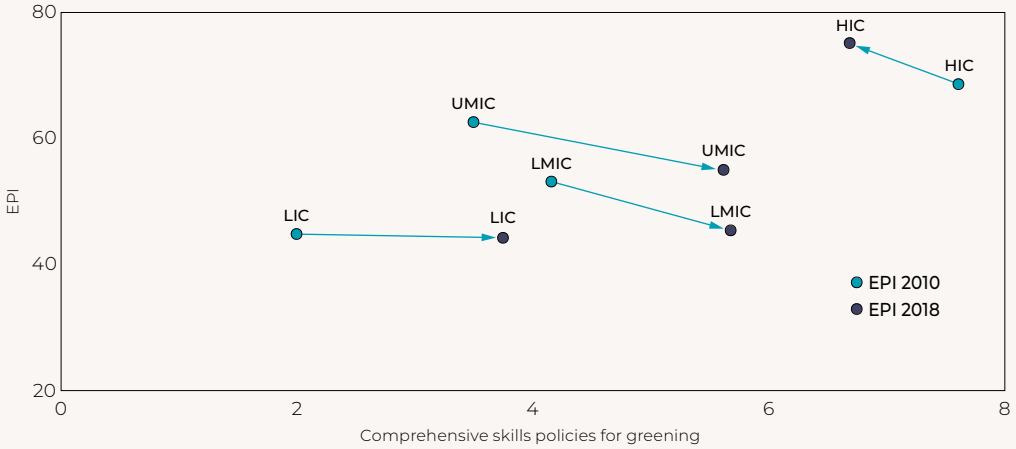


Note: Y axis: the EPI uses the distance-to-target technique for indicator construction, which situates each country relative to targets for worst and best performance corresponding to scores of 0 and 100 respectively. X axis: the presence of comprehensive skills policies for greening was calculated on 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), Philippines (PHL), Senegal (SEN), South Africa (ZAF), Spain (ESP), Tajikistan (TJK), Thailand (THA), Uganda (UGA), United Arab Emirates (ARE), United Kingdom (GBR), United States (USA); Zimbabwe (ZWE).

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

Figure 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: Wendling et al., 2018; Emerson et al., 2010; 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 10).

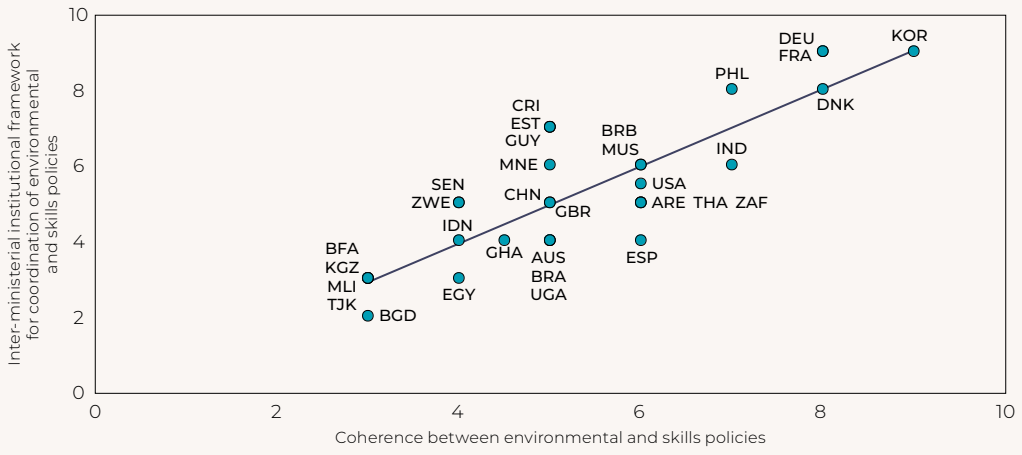
More generally, skills development for green jobs can be characterized as somewhat unsystematic, sometimes taking place as part of overall government policy but often carried out by other actors, including civil society groups as well as regional and local government authorities and social partners, 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 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.

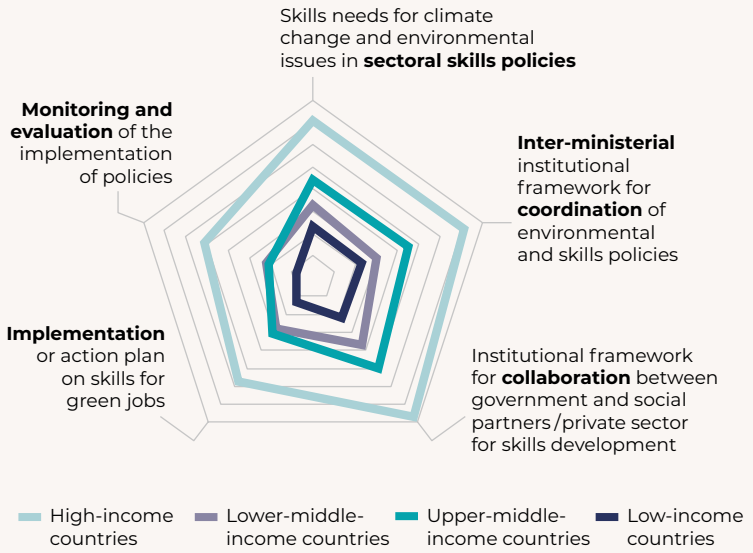
Figure 11. Inter-ministerial coordination and coherence between skills and environment policies



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 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.

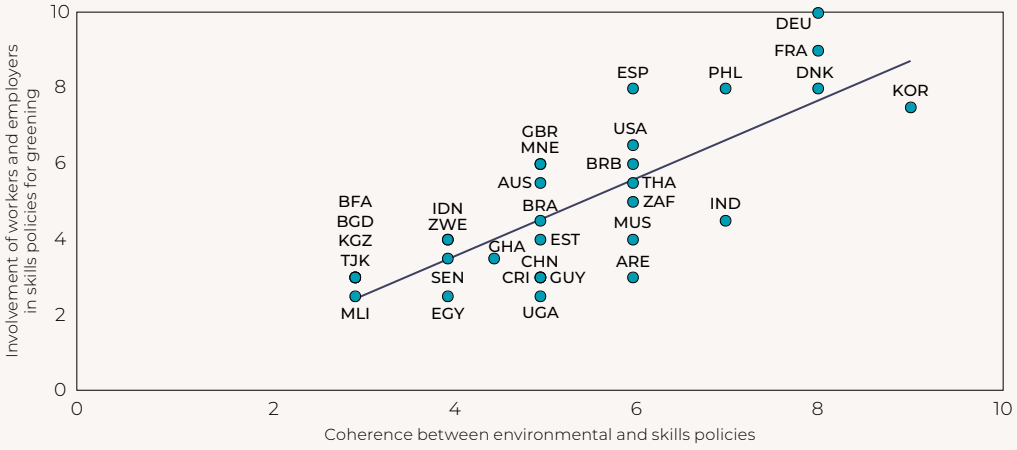
While in HICs coordination within government as well as with social partners is facilitated by the presence of institutional structures, such structures are rare in LICs and many MICs. The policy coordination gap that is such a common feature at national level of the skills for green jobs landscape is 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 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 13).

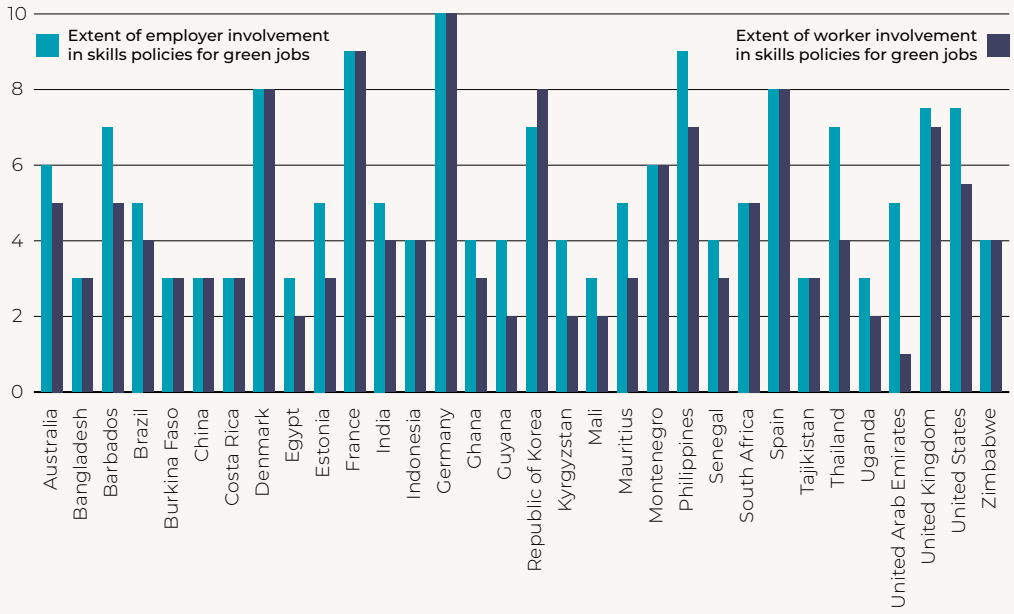
Figure 13. Involvement of employers and workers in skills policies, and coherence between environmental and skills policies



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 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 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 4.

To compensate for deficiencies in skills supply from TVET, the private sector 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 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. Adapting TVET regulations.	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.

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

Specific disadvantaged 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 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 re-training 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.

REFERENCES

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

Emerson, J.W.; Esty, D.C.; Levy, M.A.; Kim, C.H.; Mara, V.; de Sherbinin, A.; Srebotnjak, T. 2010. *2010 Environmental Performance Index* (New Haven, CT, Yale Center for Environmental Law & Policy).

Frey, C.B.; Osborne, M.A. 2013. "The future of employment: How susceptible are jobs to computerisation?", in *Technological Forecasting and Social Change*, Vol. 114, pp. 254–280.

IEA (International Energy Agency). 2019. *Global energy and CO_2 status report*, March (Paris).

ILO (International Labour Office/Organization). 2015. *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (Geneva).

—. 2016. *What is a green job?*, 13 Apr. Available at: https://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang--en/index.htm [30 Apr. 2019].

—. 2018. *World Employment and Social Outlook 2018: Greening with jobs* (Geneva).

—. 2019. *Work for a brighter future – Global Commission on the Future of Work* (Geneva).

—. Forthcoming. *Skills for a greener future: A global view*, based on 32 country studies (Geneva).

IPCC (Intergovernmental Panel on Climate Change). 2018. *Global warming of 1.5°C: An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (Geneva).

McKinsey Global Institute. 2017. *A future that works: Automation, employment and productivity. Executive summary* (New York).

Strietska-Ilina, O.; Hofmann, C.; Haro, D.; Jeon, S. 2011. *Skills for green jobs: A global view.* Synthesis report based on 21 country studies (Geneva, ILO).

Wendling, Z.A.; Emerson, J.W.; Esty, D.C.; Levy, M.A.; de Sherbinin, A.; et al. 2018. *2018 Environmental Performance Index* (New Haven, CT, Yale Center for Environmental Law & Policy).

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