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Greening with jobs

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Greening with jobs

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Preface

The world of work is intrinsically linked to the natural environment. Jobs in agriculture, fisheries, forestry, tourism and other industries including pharmaceuticals, textiles and food and beverage depend on a healthy environment. Temperature rises like those expected due to climate change will increase the number of days that are too hot to work, putting workers' health at risk and reducing productivity.

We may soon reach the point in which the jobs created or improved by economic development risk being destroyed or worsened by the resulting environmental degradation. The world of work needs environmental sustainability.

Social justice requires it, given the large inequalities in the impact of the negative effects of environmental degradation.

As I highlighted in my Report to the 106th Session of the International Labour Conference, there need be no tension or contradiction between economic growth and jobs on the one hand, and environmental sustainability on the other. This development path is embedded in the Paris Agreement, with its reference to the imperative of a just transition.

The present report shows that achieving environmental sustainability can create jobs. The green economy will be a major source of job growth in the future of work. Taking action in the energy sector to limit global warming to 2 degrees Celsius by the end of the century can create around 24 million jobs, largely offsetting any job losses. Embracing the circular economy to reduce material extraction and waste generation will also result in net job gains.

The job-creating potential of environmental sustainability is not a given: the right policies are needed to promote green industries while ensuring decent work within them. They are also needed to allow workers to transition to new sectors and to protect those who may lose out due to lower activity in industries that contribute to environmental degradation.

In 2013, the ILO launched the Green Initiative as one of the seven initiatives to mark the ILO's centenary in 2019. It aims to better equip the actors of the world of work to understand the challenges and opportunities of the transition and to take up the active role that they must play in managing this change. This report is one step towards this end, along with the *Guidelines for a just transition towards environmentally sustainable economies and societies for all* endorsed by the ILO Governing Body, and the ILO's Green Jobs Programme.

As this report shows, there is scope for policies in the world of work to advance environmental sustainability; and for environmental policies to ensure decent work. A coherent and integrated legal framework is a step in this direction. Labour regulations on occupational safety and health, for example, can contribute to the preservation of the environment. Advances have been made by including decent work issues in environmental regulations, such as climate action policies that take note of their skills implications. Providing workers with the right set of skills and recognizing workers' skills will help the transition to sectors with employment growth, and also to better jobs. Social protection systems can support workers' incomes against risks stemming from climate change and local environmental degradation. Social dialogue contributes to finding innovative ways to mitigate environmental impacts that are reducing or negatively affecting employment or working conditions.

It is too late for the world to grow now, and only clean up later. It is time to grow clean, to go green. The Sustainable Development Goals are clear in the desire to combine decent work for all with environmental sustainability. This report shows it is possible and allows us to plan, not just wish for, a sustainable future.

Guy Ryder
ILO Director-General

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Table of contents

Boxes

Figures

Tables

Executive summary

Action to limit global warming to 2°C will create jobs

The long-term goal of the 2015 Paris Agreement is to keep the increase in global average temperature to less than 2°C above pre-industrial levels. The Agreement aims to help countries meet this target and strengthen societies' capacities to address the wide-ranging impacts of climate change. The employment estimates in this report suggest that the net effect on job numbers will be positive. The transition to a green economy will inevitably cause job losses in certain sectors as carbon- and resource-intensive industries are scaled down, but they will be more than offset by new job opportunities. Measures taken in the production and use of energy, for example, will lead to job losses of around 6 million as well as the creation of some 24 million jobs. The net increase of approximately 18 million jobs across the world will be the result of the adoption of sustainable practices, including changes in the energy mix, the projected growth in the use of electric vehicles, and increases in energy efficiency in existing and future buildings. In order to ensure a just transition, efforts to promote the green economy must be accompanied by policies that facilitate the reallocation of workers, advance decent work, offer local solutions and support displaced workers.

A transition to agricultural sustainability and a circular economy will result in more and often better jobs

The adoption of more sustainable agricultural policies can create wage employment in medium and large organic farms, and allow smallholders to diversify their sources of income through a transition to conservation agriculture. With complementary policies to support workers, adopting conservation agriculture can help sustain a structural transformation in developing countries. In parallel, embracing a circular economy that emphasizes the reuse, recycling, remanufacture and repair of goods will create around 6 million new employment opportunities across the world as such actions replace the traditional model of "extract, make, use and dispose".

The transition is urgent, given the unsustainable pressure of current economic activity on the environment

Substantial progress was achieved during the period between 2000 and 2015 in the global economy and in the promotion of decent work, especially in the form of a reduction in working poverty and child labour. But wage growth has stagnated and, to a large extent, inequality has risen. Moreover, it is striking that in a context of scarce resources and limited ability to absorb waste, current patterns of economic growth rely largely on the extraction of resources, manufacturing, consumption and the generation of waste. In 2013, for example, humanity used 1.7 times the amount of resources and waste that the biosphere was able to regenerate and absorb. Indeed, human activity has already caused irreversible environmental change on a global scale.

Jobs rely heavily on a healthy and stable environment and the services it provides…

From a jobs perspective, environmental sustainability is critical. In fact, the increasing frequency and intensity of natural disasters associated with human activity have already lowered productivity. Annually, between 2000 and 2015, natural disasters caused or exacerbated by humanity resulted in a global loss of working-life years equivalent to 0.8 per cent of a year's work. Looking ahead, projected temperature increases will make heat stress more common, reducing the total number of working hours by 2.0 per cent globally by 2030 and affecting above all workers in agriculture and in developing countries. The damage associated with unmitigated climate change will therefore undermine GDP growth, productivity, and working conditions. Local air, water and soil pollution and other forms of environmental degradation negatively affect workers' health, income, food and fuel security, as well as their productivity. This negative impact can be reduced by the adoption of specific policy measures, including occupational safety and health measures, social protection policies and other actions designed to adapt to a changing environment.

… which highlights the critical nature of the transition to environmental sustainability for the world of work

Currently, 1.2 billion jobs rely directly on the effective management and sustainability of a healthy environment, in particular jobs in farming, fishing and forestry dependent on natural processes such as air and water purification, soil renewal and fertilization, pollination, pest control, the moderation of extreme temperatures, and protection against storms, floods and strong winds. Environmental degradation threatens these ecosystem services and the jobs that depend on them. The effects of environmental degradation on the world of work are particularly acute for the most vulnerable workers. Workers from lower-income countries and Small Island Developing States, rural workers, people in poverty, indigenous and tribal peoples and other disadvantaged groups are affected the most by the impact of climate change. The transition to a green economy is not only urgent for the sake of the planet but is also compatible with improvements in decent work. A key finding of this report is that some countries have succeeded in improving labour market outcomes while at the same time decoupling growth from carbon emissions.

Complementary policies can promote employment and mitigate the effects of climate change

Although climate change mitigation measures may result in short-term employment losses, their negative impact on GDP growth, employment and inequality can be reduced through appropriate policies. Climate change mitigation could bring down slightly the share of women in total employment unless action is taken to reduce occupational segregation, as employment gains associated with the 2°C scenario are likely to create jobs in currently male-dominated industries (renewables, manufacturing and construction). Coordination between the social partners can reduce inequality and promote efficiency gains, while coordination at the international level is necessary to achieve meaningful cuts in emissions. Certain mitigation policies (such as limiting the increase in temperature, for example by promoting renewable energy) may act as an incentive for enterprises to develop and adopt more efficient technology, thereby boosting employment in key occupations, as well as productivity. Adaptation policies (e.g. converting to climate-resilient agriculture practice) can also create jobs at the local level.

The legal framework can provide incentives for greening the economy, while ensuring decent work

Legal standards can promote progress towards decent work during and beyond the transition to environmental sustainability. By virtue of their broad acceptance and universal relevance for workers, workplaces and the various sectors, international labour standards provide a social pillar for the green economy and can help to ensure that emerging sectors offer decent working conditions. In addition, ILO standards on occupational safety and health contribute to the preservation of the environment. The Indigenous and Tribal Peoples Convention, 1989 (No. 169), which requires environmental impact assessments to be carried out in relation to development activities that may affect that population,

the Prevention of Major Industrial Accidents Convention, 1993 (No. 174), and the Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205), among others, address environmental issues directly.

Multilateral environmental agreements (MEAs), which are binding agreements between States dealing with environmental matters, increasingly include labour dimensions such as the importance of environmental rights at work, employment protection and promotion. They place particular emphasis on occupational safety and health standards. At the national level, environmental legislation and policies increasingly incorporate labour issues. In 19 of the 26 national legal frameworks reviewed for this report, climate change policies contain labour considerations, including complementary skills policies and job creation. Sector-specific environmental legislation also tends to cover employment and decent work issues. The strong links between environmental regulation and labour issues are also more and more evident in sub-Saharan Africa in the renewable energy and waste management sectors.

Social dialogue contributes to ensuring that the green transition is a just transition

Social dialogue has contributed to making environmental governance more labour-friendly by promoting frameworks, legislation and policies that include both labour and environmental concerns. This illustrates the priorities established by the UN Agenda for Sustainable Development and the principles embedded in international labour standards, including the importance of consultation and collective bargaining. At the international level, international framework agreements (IFAs) are voluntary agreements between multinational enterprises and global union federations. Of the 104 IFAs reviewed for this report, 61 include environmental provisions on such issues as respect for the environment as a corporate responsibility and waste management measures, particularly in the manufacturing, energy, mining and automotive industries. At the national and enterprise level, while the number of collective agreements containing green clauses is still limited, they are used by employers and workers to reconcile social and economic objectives with environmental concerns. Emerging examples indicate that workers and employers, through social dialogue, have identified areas where the environmental impact could be mitigated without reducing or negatively affecting employment or working conditions. In the longer term, the protection of environmental rights at work could also be strengthened in national policies and legislation.

Synergies between social protection and environmental policy can support both workers' incomes and the green transition

Social protection systems are the first line of protection against the negative effects on income of different risks, including those stemming from climate change and local environmental degradation. They support the economy by stabilizing household incomes. Four policy areas offer particular synergies between social protection and environmental sustainability: unemployment protection, cash transfer programmes, public employment programmes (PEPs) and payments for ecosystem services (PES).

Unemployment protection schemes and cash transfer programmes play a critical role in supporting workers facing job loss related either to the transition to environmental sustainability or to a natural disaster. They facilitate the transition to new jobs, particularly when combined with skills development and job placement or relocation measures. In addition, access to safe and regular labour migration opportunities can foster economic diversification and increase adaptive capacity through remittances and skills transfer. Cash transfer programmes contribute to preventing poverty and reducing the vulnerability of households and communities.

PEPs too can be powerful tools to address the impact of climate change on workers and their incomes, while also enhancing mitigation. Half of the 86 PEPs in 62 countries surveyed include an environmental component. They often provide health care, education and other benefits. Similarly, PES, although originally conceived with an environmental objective, can provide effective support for household incomes in specific circumstances.

A policy mix comprising cash transfers, stronger social insurance and limits on the use of fossil fuels could lead to faster economic growth, stronger employment creation and a fairer income distribution, as well as lower greenhouse gas emissions.

Although skills development programmes for enterprises and workers facilitate the transition to a green economy, they are yet to be mainstreamed in policy discussions

Skills development programmes are crucial to the achievement of a just transition. Of the 27 countries surveyed, about two-thirds have established platforms to anticipate skills needs and the provision of training in general, but they are not all used to discuss the skills implications of the green transition. The active participation of social partners is useful in identifying skills gaps, implementing training provisions, emphasizing that higher skills translate into higher pay, and recognizing the skills acquired on the job. However, social partners are not always involved in the relevant discussions; this is especially the case of workers. Where they exist, specific bodies to discuss skills for the green transition have led to positive changes in training for the sectors directly involved in the transition (such as renewable energy and waste management), but they have comparatively little influence on the greening of the economy as a whole.

National environmental legislation increasingly refers to skills development but the provisions are often limited to specific skills policy areas (such as the identification of skills needs), target groups (e.g. youth), sectors (especially energy) or regions. Consensus has not yet been reached in many countries on the definition of skills for the green transition and the capacity is lacking to collect relevant data for reliable skills identification. As a result, skills development policies for the green transition tend to adopt a short-term and fragmented approach. Greater awareness of environmental issues and their mainstreaming in skills policy discussions are required to ensure that identification of skills needs and implementation of training programmes respond to labour market needs.

Institutions, policy-making and effective implementation are key for a just transition

Social dialogue, the elimination of discrimination in employment and occupation, and good governance are the foundations of an effective and just transition. For example, the involvement of central and local governments, social partners and NGOs in debates on climate change at the national level has led to the integration of economic, social and environmental objectives. Tax reform can support the transition to a green economy, while at the same time facilitating employment creation.

Low-income and some middle-income countries need support to develop data collection, identify and adopt best practices, strengthen implementation and finance both mitigation and adaptation strategies in order to achieve a just transition to environmentally sustainable economies and societies for all. A just transition requires identifying and implementing policy solutions to some of the most pressing challenges to the future of work that also affect climate change, such as employment and working conditions in the rural economy, demographic shifts and globalization.

A just transition offers enhanced potential for decent job creation through the integration of labour and environmental issues

This ILO report quantifies job losses and job creation in the transition to a green economy, based on projections to 2030 founded on the agreed policy goal of limiting global warming to 2°C. More generally, it finds that the greening of economies can have a positive overall effect on growth and jobs. Positive employment outcomes will also probably apply in the 1.5°C scenario, as encouraged by the Paris Agreement.

The report shows that environmental laws, regulations and policies that include labour issues offer a powerful means of integrating elements of the Decent Work Agenda with environmental objectives. This is true for social protection programmes, skills development programmes, macroeconomic policy and the legal framework. Though some degree of integration is observed in all these domains, it is not yet systematic and not yet universal. For example, while environmental legal frameworks can be effective in combining some elements of the Decent Work Agenda with environmental objectives, the respective provisions often focus on particular groups of workers (such as additional support for local communities, training in areas that are key for the transition, and the protection of workers in specific sectors). The transition affects all workers, however; the universality of rights and protection therefore remains important to ensure that the transition delivers inclusive growth and decent work.

1 Environmental sustainability and decent work

KEY FINDINGS

Across the world between 1999 and 2015, GDP grew by almost 80 per cent, real wages improved by 42 per cent, child labour fell and female labour force participation increased. Under certain thresholds, working poverty also fell. Yet, despite this progress, inequality has risen.

Between 2000 and 2012, greenhouse gas (GHG) emissions, which cause climate change, increased by 33 per cent worldwide, and, between 2000 and 2013, material extraction increased by 62 per cent. This resource- and carbon-intensive model of economic activity has put pressure on the environment, with the result that economic activity today is unsustainable.

Some 23 countries have decoupled economic growth from GHG emissions as a result of the increased use of renewable energy, carbon pricing, green product subsidies and green jobs, among other policies. Environmental sustainability can be achieved alongside the advancement of decent work.

Some 1.2 billion jobs, or 40 per cent of total world employment, most of which are in Africa and Asia and the Pacific, depend directly on ecosystem services, and jobs everywhere are dependent on a stable environment. Every year, on average, natural disasters caused or exacerbated by humanity result in the loss of 23 million working-life years, or the equivalent of 0.8 per cent of a year's work. Even in a scenario of effective climate change mitigation, temperature increases resulting from climate change will lead to the loss of the equivalent of 72 million full-time jobs by 2030 due to heat stress. Developing countries and the most vulnerable population groups are most exposed to these impacts.

Global and local environmental degradation threaten jobs and worsen working conditions, especially in developing countries and among women and the world's most vulnerable people (including migrant workers, people in poverty and indigenous and tribal peoples), making environmental sustainability an issue of social justice.

Because many industries bring adverse spillover effects on ecosystem services, it is necessary to ask whether jobs that produce negative externalities and affect other workers can in fact be considered decent jobs.

Introduction

In recent decades, humanity has increased its pressure on the environment. Already by the 1970s, the world was using more resources than could be regenerated by nature and producing more waste and emitting more greenhouse gases (GHG) than could be absorbed by the ecosystem (Global Footprint Network, 2017). This trend has intensified. As a result of population growth and carbon- and resource-intensive economic activities, current development models and economic activity have led humanity towards environmental unsustainability. Humanity is using tomorrow's resources to satisfy today's production and consumption needs (UNEP, 2011).

This chapter shows how environmental degradation (e.g. GHG emissions and the resulting climate change, natural resource scarcity, air and water pollution, soil degradation, biodiversity loss, changes in biochemical flows and other environmental challenges) directly and negatively affects the world of work. Overall, the report demonstrates the urgency of achieving environmental sustainability and shows that the path towards sustainability is compatible with improvements in decent work, much like other drivers of the future of work, such as new technologies, alternative business models and globalization (ILO, 2017a). The chapter further argues that, from the perspective of the world of work, achieving environmental sustainability is a question of social justice as women and the most vulnerable people in the world – migrant workers, youth, persons with disabilities, people in poverty, indigenous and tribal peoples and other vulnerable population groups, depending on the country and region – are particularly exposed to the risks and damages associated with environmental degradation, despite contributing to it the least. It asks whether work that degrades the environment and harms other workers' rights and productivity can be considered decent work.

Economic activity and jobs rely on environmental resources, a stable environment and ecosystem services (e.g. water purification, climate regulation, pollination, etc.). Climate change and other forms of environmental degradation therefore place economic activity and jobs at risk and are a direct obstacle to achieving full employment that is both productive and decent. Importantly, progress towards decent work is compatible with progress towards environmental sustainability.

After outlining the current link between economic growth and emissions and resource use, this chapter shows that some countries have been able to "decouple", that is, to grow without putting additional pressure on the environment, and that advancing towards decent work does not limit progress towards environmental sustainability. In a third section, it demonstrates how jobs depend on a stable and sustainable environment, making the case that environmental sustainability is fundamental to the achievement of decent work. Overall, the chapter highlights the urgency of the transition to environmental sustainability from the perspective of the world of work. It sets the stage to examine how the transition to an environmentally sustainable economy impacts the economy and the world of work (Chapter 2) and review the policies to promote a just transition, which also promote social inclusion and decent work (Chapters 3, 4 and 5). A glossary is available after Chapter 5.

A. Economic growth, decent work and environmental degradation

Economic growth has taken place in conjunction with improvements in decent work

In the right policy and institutional context, economic growth can be a major driver for the attainment of decent work, or, in other words, work that is productive, delivers a fair income, offers security in the workplace and social protection for families, contributes to personal development and social integration, grants people the freedom to express their concerns, organize and participate in the decisions that affect their lives, and ensures equality of opportunity and treatment for all women and men.

The past decades have seen improvements in decent work. Between 1999 and 2015, global GDP (in purchasing power parity (PPP) and constant 2011 US$) grew by almost 80 per cent (World Bank, 2017a),[1] and real monthly wages increased by 42 per cent on average across the world (ILO, 2016a). In low-income countries, the share of people in employment living in extreme poverty (below US$1.90 PPP per day) fell from more than 64 per cent to 38 per cent. It fell from 41 to 15 per cent in lower middle-income countries and from 24 to 3.7 per cent in upper middle-income countries (ILO, 2015b). Although child labour remains common in certain regions, it fell from 16 to 11 per cent globally between 2000 and 2012 (ILO, 2013). Even though women remain under-represented in the labour force, employment and decent work, certain gender gaps have narrowed in developing and developed countries, particularly in terms of labour force participation (ILO, 2018b). But certain deficits remain and, in the past few years, progress towards decent work has not kept up with economic growth, as wage growth has stagnated and, by and large, inequality is rising (ILO, 2016a and 2018a).

Economic growth has increased pressures on the environment to an unsustainable level

As countries develop and populations grow, they tend to need more resources, given that development relies on the extraction of resources, manufacturing, consumption and the generation of waste (Global Footprint Network, 2017; Steinberger et al., 2012). This process accelerated sharply after the 1950s (Steffen, Broadgate et al., 2015), and takes place in a context of limited and scarce resources. There are limits to economic growth that is based on natural resource extraction and waste generation (Meadows et al., 1972), but, as this chapter shows, there is the possibility to decouple growth and human development from emissions and resource use.

In 2013, the latest year for which data are available, humanity used and produced 1.7 times as much resources and waste as the biosphere was able to regenerate and absorb. It now takes the Earth 18 months to regenerate what humanity uses in a year (Global Footprint Network, 2017). Seen from another perspective, nine planetary boundaries define the Earth system's ability to remain stable.[2] At least three of these boundaries have recently been crossed, which will produce irreversible and abrupt environmental change on a global scale: the addition of nitrogen and phosphorus into water and terrestrial systems, biodiversity loss and GHG emissions (Rockström et al., 2009; Steffen, Richardson et al., 2015).

Economic activity and development remain coupled to emissions and resource use

Economic activity, economic growth, consumption and development rely, to a larger or lesser extent, on finite natural resources and energy services, which are often linked to GHG emissions[3] and other forms of environmental degradation (Dorling, 2017; IPCC, 2013 and 2014a; Ocampo et al., 2009;

1. Over the same period, GDP per capita grew by 48 per cent and the population increased by 22 per cent.

2. The nine planetary boundaries are, in no particular order: (1) biosphere integrity (biodiversity loss and extinctions); (2) climate change; (3) chemical pollution and the release of novel entities (e.g. the release of synthetic organic pollutants, heavy metal compounds and radioactive material); (4) stratospheric ozone depletion; (5) atmospheric aerosol loading (air pollution); (6) ocean acidification; (7) biogeochemical flows (nitrogen and phosphorus flows to the biosphere and oceans); (8) freshwater use; and (9) land-system change (Rockström et al., 2009; Steffen, Broadgate et al., 2015).

3. Carbon-dioxide (CO_2) is the largest contributor to greenhouse gases (GHGs) which, in turn, are responsible for climate change. Other GHGs include methane, nitrous oxides and F-gases (HFCs, PFCs and SF6). For the purposes of simplicity, non-CO_2 GHGs are converted to a CO_2-equivalence based on their global warming potential (GWP). For example, nitrous oxide (N_2O), emitted during agricultural and industrial activities, has a GWP of 298 times that of CO_2. F-gases, commonly used as refrigerants or fire suppressants, and in various industrial processes, have a GWP ranging from 124 for some specific hydrofluorocarbons, to 22,800 for sulphur hexafluoride. This report uses the broad terms *carbon-based economy* and *carbon intensity* to refer to the reliance of economic activity on GHG emissions more generally.

Box 1.1

Consumption- and production-based emissions and resource use: The role of trade

A country's emissions and resource use can be described in two different ways: territorial emissions and resource or material use (production based), on the one hand, and its carbon, resource or material footprint, on the other (consumption based). Territorial emissions or resources used are those needed to produce goods and services within the economy. In contrast, the footprint includes all the emissions and resources embodied in consumption, including those associated with imported goods and services, as well as the goods and services produced and consumed in the country, but not those that are exported.

In a closed economy, territorial emissions and use and the footprint are identical. In an open economy, however, they differ, because carbon-, resource-intensive and hazardous production is moved away from where goods are consumed. From a footprint perspective, for example, GHG emissions have increased in some European countries, but their production-based emissions have declined (or grown more slowly) as a result of carbon-intensive production being relocated to Asia and the Pacific. For fossil fuel exporters, production-based emissions understate the extent to which development has been based on an unsustainable use of fossil fuels (Peters, Davis and Andrew, 2012; Steinberger et al., 2012; Tukker et al., 2014; Wiebe and Yamano, 2016).

The situation is similar for the material, water and land resources embodied in consumption, compared with those used for the production of goods and services: developing and emerging countries are usually net exporters of these resources, while developed countries are net importers (Tukker et al., 2014; Wiedmann et al., 2015). This is also true for biodiversity and hazardous production processes. Trade is responsible for at least one-third of biodiversity threats worldwide, with consumption in Europe, Japan and the United States driving human-induced deforestation, overhunting and climate change, which are threatening biodiversity in Africa, Latin America and South-East Asia, among others (Moran and Kanemoto, 2017).

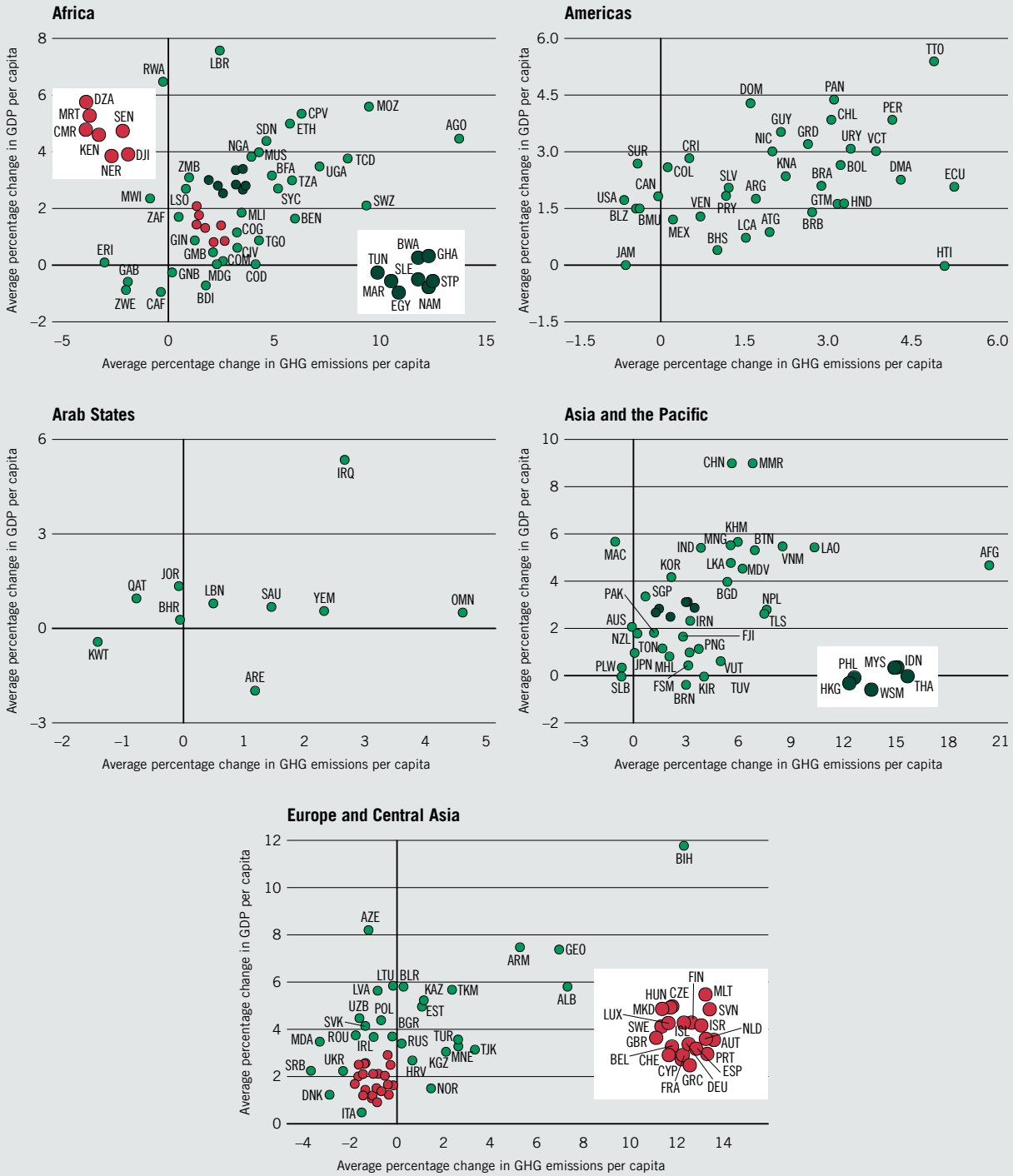
Steffen, Broadgate et al., 2015; Steffen, Richardson et al., 2015). GHG emissions are unevenly distributed across regions due to their relative size and their reliance on GHG emissions for economic production (an economy's carbon intensity). The bulk of emissions in 2012 came from China, the United States, European Union, India, Brazil and the Russian Federation, which together accounted for almost 60 per cent of worldwide GHG emissions (PBL, 2016). G20 countries alone account for over 70 per cent of global emissions (World Bank, 2017a). A quarter of GHGs are emitted by electricity and heat production. Another quarter can be traced to agriculture, forestry and other land use, with a strong contribution from forest conversion. Economic and population growth are currently the most important drivers of increases in GHGs, with the share attributable to economic growth increasing over the past decades (IPCC, 2014a).

As a result of trade, since goods are not necessarily consumed where they are produced (see box 1.1), consumption- and production-based emissions and resource use differ. This section focuses on territorial (production-based) emissions and use as they relate to the economic activity of specific countries and are associated with the jobs in an economy. International agreements, such as the Paris Agreement, and cap-and-trade schemes, such as the European Emissions Trading Scheme, are also based on territorial emissions.

Figure 1.1 compares the rise in GHG emissions with economic growth across regions between 1995 and 2014. Of the 180 countries for which data are available, 165 saw GDP per capita grow between 1995 and 2014. Of these, almost three-quarters (72 per cent) saw GHG emissions rise alongside GDP per capita (countries in the upper right quadrants). In most regions, and particularly in Africa, Asia and the Pacific and most countries in the Americas, economic growth remains coupled with GHG emissions (the same is also true, although not shown, for material extraction, water and land use).

Figure 1.1

GDP and GHG emissions growth, 1995–2014 or latest year available

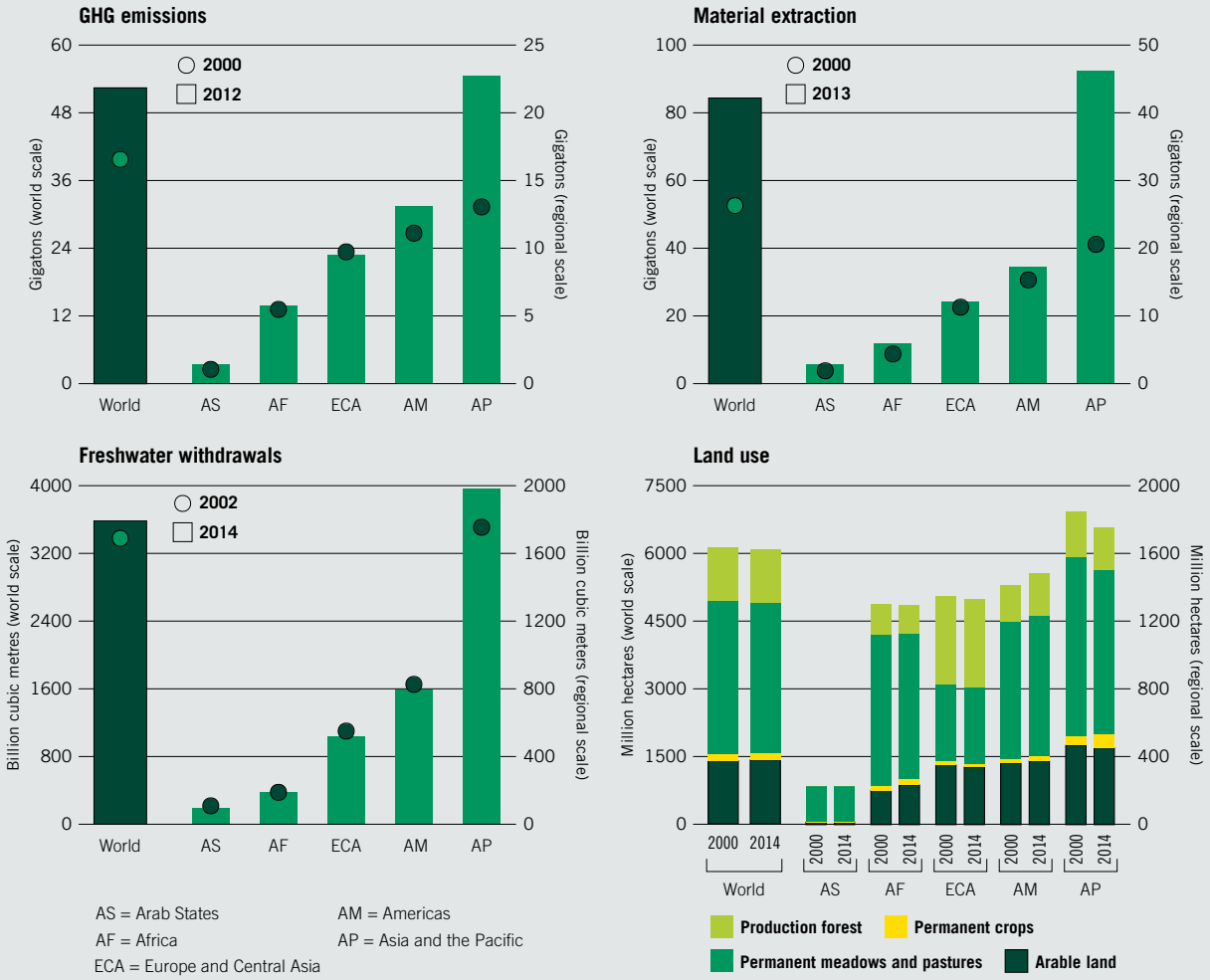


Notes: Data for 51 countries in Africa, 34 countries in the Americas, 10 countries in the Arab States, 35 countries in Asia and the Pacific and 50 countries in Europe and Central Asia. Data for the Central African Republic used in calculations but not shown due to its outlier status (yearly GHG emissions per capita growth at 55 per cent and yearly GDP per capita growth at 19 per cent). The further down and to the right a country is in the figure, the higher are its emissions associated with each percentage point of GDP growth (i.e. the more the growth is carbon dependent). Vertical scales differ by panel.

Source: ILO calculations based on World Development Indicators.

Figure 1.2

Total GHG emissions, materials and resource extraction and land use, 2000–14 or latest year available

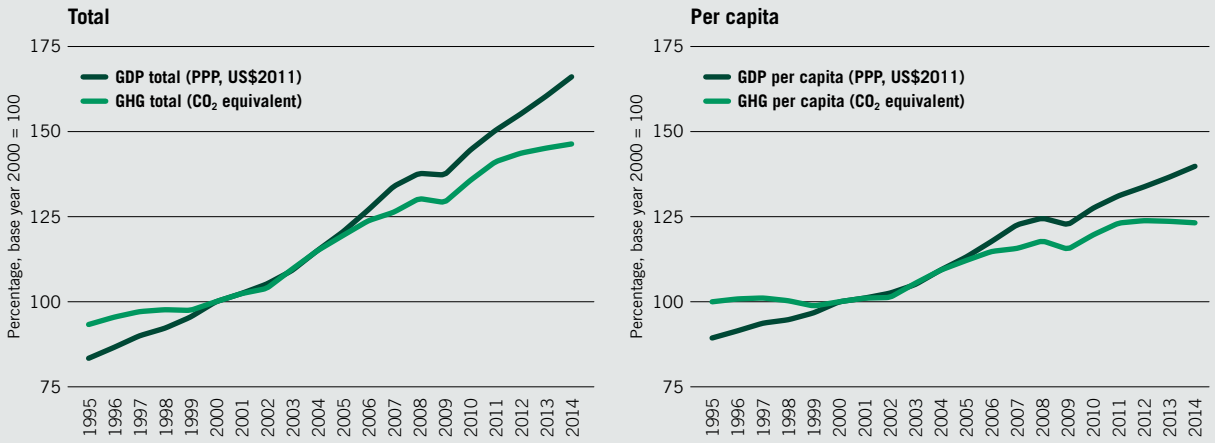


Source: ILO calculations based on World Development Indicators (GHG emissions and freshwater withdrawals), FAOStat (land use) and Material Flows Data (material extraction).

Although of key global importance due to their relationship with climate change, GHG emissions are not the only source of environmental degradation caused by a carbon- and resource-intensive development model and economic activity. In 2013, the world economy extracted 84.4 gigatons of materials, 62 per cent more than in 2000, with the highest volume of extraction in Asia and the Pacific (55 per cent of total world extraction in 2013) and the Americas (20 per cent) (see figure 1.2). As regards total water extraction, figure 1.2 shows that Asia and the Pacific uses more than 55 per cent of the world's freshwater resources and almost a third of the world's land. Both freshwater and land resources are used, to a great extent, by the agriculture sector. These resources are not infinite and economies that rely on them may soon face limits to growth as a result of resource depletion.

Figure 1.3

Global GDP and GHG emissions, 1995–2015



Note: Base year 2000 = 100.

Source: ILO calculations based on World Development Indicators.

Decoupling growth from emissions and resource use is possible

GHG emissions, and resource use in general, do not need to be linked to economic growth; or, in other words, economic growth can be decoupled from both emissions and material and resource use. There are two levels at which countries/regions can decouple: absolute and relative decoupling. While relative decoupling involves economies growing faster than their emissions or material/resource use, absolute decoupling allows for economies to grow without increasing environmental pressure, or even reducing it. An environmentally sustainable economy is absolutely decoupled at the global level. Relative or absolute decoupling at the national level may not guarantee progress towards global decoupling because they can be achieved by the relocation of production, as noted in box 1.1 (Ward et al., 2016).[4]

There is evidence of only relative decoupling at the global scale (figure 1.3). Between 1995 and 2015, the world became less dependent on emissions and resource use to generate each unit of GDP (i.e. the carbon intensity of world output has fallen, but total emissions continued to grow). This has been the result of growth in the service sector as well as gains in energy and resource efficiency.

There is also evidence of decoupling at the national level. Figure 1.4 shows the countries from figure 1.1 that experienced growth in per capita GDP with a reduction in territorial per capita GHG emissions between 1995 and 2014. Yet not all countries that reduced their territorial emissions can be said to have decoupled if, for example, they relocated carbon-intensive production to other countries. Of the 41 countries that experienced GDP growth and a reduction of their production-based emissions, 23 countries (marked in green) did so with a reduction in their carbon footprint. These countries achieved an absolute reduction in both production- and consumption-based emissions.[5] It can therefore be said that these countries decoupled their emissions from GDP.[6]

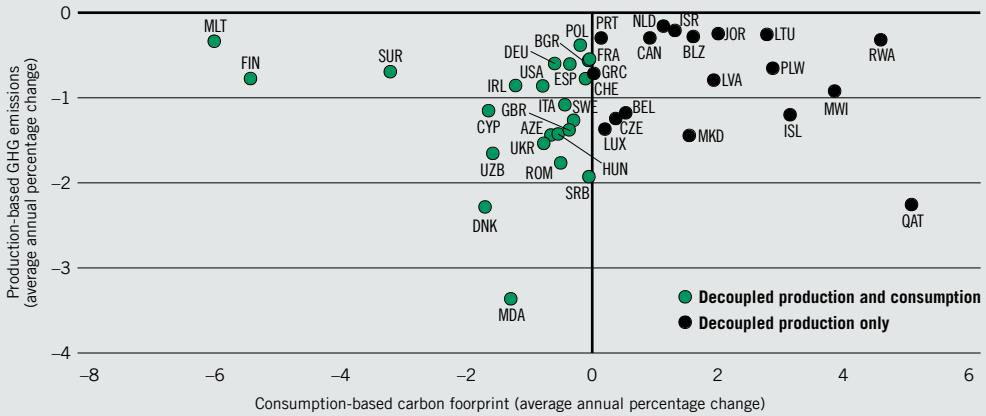
4. Ward et al. (2016) point out the difficulty of decoupling GDP growth from environmental impacts and question whether GDP growth should be a societal goal in itself, as it is a poor proxy for well-being. The objective should not therefore be to decouple GDP growth from material and resource use and emissions, but to decouple well-being. Decoupling well-being is a more apt and possible objective, as shown for example by the relationship between emissions and life expectancy (Steinberger et al., 2012), or between inequality and emissions (Dorling, 2017; Piketty and Chancel, 2015).

5. The countries that decoupled economic growth from both production-based and consumption-based emissions are Azerbaijan, Bulgaria, Cyprus, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Malta, Republic of Moldova, Poland, Romania, Serbia, Spain, Suriname, Sweden, Switzerland, Ukraine, the United Kingdom, the United States and Uzbekistan.

6. This analysis only focuses on decoupling GHG emissions from growth. It takes into account GHG emissions and the corresponding carbon footprint but does not necessarily include other sources of environmental degradation (such as unsustainable freshwater extraction, land use change or resource extraction).

Figure 1.4

Decoupling of production and consumption-based emissions, 1995–2013



Notes: Only the 41 countries from figure 1.1 that experienced GDP growth between 1995 and 2013 and a decline in per capita GHG emissions over that period are shown. Countries in green experienced growth in GDP per capita, a fall in per capita GHG emissions and a decline in their per capita carbon footprint. See Appendix 1.1 for methodological details.

Source: ILO calculations based on World Development Indicators (GDP, GHG emissions) and Global Footprint Network National Footprint Accounts (carbon footprint).

Denmark is a clear example of decoupling. It achieved average annual GDP growth of 0.94 per cent between 1995 and 2013, with an average annual GHG emissions and carbon footprint reduction of 3.0 and 2.8 per cent, respectively. This was largely due to the growth of renewables in its energy mix. By 2015, renewable energy sources accounted for 56 per cent of its domestic electricity supply (DEA, 2017). Germany also shows signs of decoupling, with average annual GDP growth of 1.3 per cent and a reduction of GHG emissions and the carbon footprint at an average annual rate of 0.9 and 0.7 per cent, respectively, over the same period. Decoupling in Germany has been driven by the substantial growth in environmental goods and services (i.e. green jobs) (OECD, 2012) and in the use of renewable energy, notably wind energy (WindEurope, 2017).

At the industry level, there are options for economies to decouple in absolute terms. For example, the production of electrical energy is carbon intensive in countries that rely on coal or natural gas as their source of energy, and less intensive in countries that rely on renewables or non-fossil fuel energy sources. Algeria, Bangladesh, Israel, South Africa, United Arab Emirates and many other countries rely on fossil fuels for over 95 per cent of electricity production. India is rapidly increasing its share of renewable energy sources but still relies on coal, oil and natural gas and the related carbon emissions for 80 per cent of its electricity. In 2013, more than 80 countries relied on fossil fuels for over 50 per cent of their electrical energy. Albania, Ethiopia and Paraguay, thanks to their hydroelectric capacity, and Iceland, thanks to its geothermal activity, rely on carbon emissions for less than 1 per cent of their electricity generation (IEA, 2016).

B. The relationship between progress towards environmental sustainability and progress towards decent work

Despite some evidence of decoupling, economic growth remains coupled to material resource extraction, water use and GHG emissions for the majority of countries. But this is not necessarily the case for human development and well-being. For example, improvements in life expectancy are related to higher emissions only to a certain extent (up to a GDP of around US$ 12,000), after which they decouple (Steinberger et al., 2012). Nor is it the case, as this section sets out to show, for improvements in decent work. Environmental sustainability can be compatible with decent work, especially when the institutional and policy tools adopted to promote decent work complement measures to advance a sustainable, low-carbon and resource-efficient economy.

Certain countries have been able to improve labour market outcomes while decoupling growth and emissions. Comparing the set of countries with GHG-coupled growth and those with GHG-decoupled growth, the data suggest that both sets improved certain labour market outcomes between 1995 and 2014 by similar proportions (figure 1.5). For instance, the group of countries that decoupled growth between 1995 and 2014 reduced working poverty[7] by an annual average of 4.6 per cent, while the group of countries in which growth was coupled with a rise in GHG emissions reduced working poverty by an average of 3.7 per cent annually. Similarly, increases in female labour participation and reductions in self-employment are observed irrespective of the degree to which their economic growth is coupled to GHG emissions. Mirroring the global trend, the labour share of income fell in all groups of countries, although it declined more slowly in countries that decoupled both production- and consumption-based emissions. Regression models in table 1.1 estimate the extent to which GHG emissions and labour market outcomes are driven by economic growth and evaluate the statistical significance of the relationships.

Figure 1.5

Changes in labour market outcomes for coupled and decoupled countries, 1995–2014

Notes: Calculations include only countries that experienced GDP growth over 1995–2014 (157 countries out of a total of 182 countries for which data are available) and countries for which data are available for the respective indicator (working poverty: 109; labour share of income: 117; female labour force participation: 157; employment-to-population ratio: 157; self-employment: 157). Results for the change in working poverty in countries that decoupled production and consumption-based emissions are not shown because working poverty data are available for only six countries in this group.

Source: ILO calculations based on World Development Indicators, Global Footprint Network 2017 National Footprint Accounts, Penn World Tables and ILOStat.

7. Working poverty measures the share of workers living in extreme or moderate poverty, that is, on less than US$3.10 PPP a day.

Table 1.1

Labour market outcomes and GHG emissions

Labour market outcome	Marginal	Conditional	Possible explanation
Working poverty	–0.703***	–0.185***	A large part of the negative relationship observed between working poverty and GHG emissions is explained by GDP growth and energy intensity
Labour share of income	–0.302***	–0.036	Any negative relationship observed between labour share of income and GHG emissions is explained by GDP growth and energy intensity
Female labour participation rate	–2.072***	–0.724***	Growth in the female labour participation rate is associated with a reduction in GHG emissions, possibly due to the fact that female participation is usually associated with growth in less GHG-intensive sectors
Employment-to-population ratio	–1.798***	–0.174	Growth in employment, net of GDP growth and energy intensity, is not associated with GHG emissions
Self-employment	–1.601***	0.094	Any negative relationship observed between self-employment and GHG emissions is explained by GDP, population and energy intensity

*Notes: A marginal and conditional time series (1995–2014) regression is estimated for each decent work indicator. All regression models consider yearly log-GHG emissions per capita as the dependent variable and the labour market outcome as the independent variable. All models include country and year fixed effects. The marginal model only includes the relationship between each decent work indicator and log-GHG emissions per capita. The conditional model adds controls for log-GDP per capita, log-population, log-energy intensity and the share of the urban population. Appendix 1.2 provides methodological details and full regression results. * p<0.05, ** p<0.01, *** p<0.001.*

Source: ILO calculations based on World Development Indicators, Global Footprint Network 2017 National Footprint Accounts, Penn World Tables and ILOStat.

Table 1.1 summarizes the results of regression models that estimate the relationship between GHG emissions and these labour market outcomes, controlling for GDP growth, energy intensity and urbanization, as it is not clear from figure 1.5 whether labour market outcomes are driven by GDP growth, explaining the change in GHG emissions and labour market outcomes independently. The models estimate, first, the direct relationship between labour market outcomes and GHG emissions (the marginal model), and, second, the relationship after accounting for GDP, energy intensity and other relevant indicators (the conditional model).

Improvements in working poverty are associated with higher GHG emissions (marginal model), but this is mainly due to the fact that GDP growth helps to reduce working poverty and, independently, is usually coupled with GHG emissions (conditional model). In other words, improving working poverty only has a weak relationship with higher GHG emissions. The same is true for self-employment. After controlling for GDP and population growth and energy intensity, reductions in self-employment are not related to higher GHG emissions. Countries in which female labour participation rates improved and the labour share increased between 1995 and 2014 tended to see reductions in GHG emissions. This remains the case after controlling for GDP growth, energy intensity and urban population, but is unlikely to be a direct effect. Growth in female labour participation and labour share is usually associated with sectors with low emissions or less productive sectors (e.g. certain service sub-sectors). Similarly, growth in the employment-to-population ratio is not related to higher GHG emissions. This is because when GDP growth is driven by growth in services or agriculture, it is associated with lower emissions when compared to GDP employment growth driven by the manufacturing sector. Indeed, as examined further in Chapter 2, employment creation can be achieved independently of GHG emissions, or as a result of specific efforts to reduce GHG emissions vis-à-vis the business-as-usual scenario.

In summary, table 1.1 shows that the promotion of positive labour market outcomes and certain aspects of decent work is to a large extent conditional on economic growth. When growth is decoupled from emissions it can promote employment in low-emission sectors, promoting labour market outcomes and decent work. The promotion of decent work is compatible with environmental sustainability, particularly when economic growth and the specific sectors that promote decent work, are decoupled from environmental degradation. This requires growth in specific sectors, but also adequate labour market and environmental regulation and institutions, including full compliance with trade union rights (Chapters 3, 4 and 5).

C. The tight link between jobs and the environment

The previous section described how economic activity relies to a large extent on resources and GHG emissions. It showed that progress towards decent work does not limit progress towards environmental sustainability. Yet the relationship between work and the environment is more fundamental and can be thought about in terms of five different channels.

First, jobs in many sectors (e.g. agriculture, mining and fossil fuel-based energy) rely on natural resources and GHG emissions directly, while other sectors, by virtue of economic linkages, rely on them indirectly. These jobs are thus coupled to resource use and GHG emissions. They are threatened by the increasing scarcity of natural resources and by the limits of the Earth's capacity to absorb the related waste and emissions. Second, directly and indirectly, jobs rely on the services that ecosystems provide free of charge (ecosystem services), e.g. jobs in agriculture, fisheries, forestry and tourism. Third, jobs and the quality of work also rely on the absence of environmental hazards (such as storms and air pollution) and the maintenance of environmental stability (e.g. temperatures within a particular range and predictable precipitation patterns). Fourth, to a certain extent, decent work deficits can create conditions that contribute to environmental degradation (for example, overgrazing and overexploitation could compensate for food, energy or income insecurity). Finally, the risks and hazards associated with environmental degradation tend to affect women and vulnerable workers the most, including migrant workers, people in poverty, indigenous and tribal peoples and other disadvantaged groups, depending on the country or region, thereby generating and perpetuating inequality.

This section describes these channels and ends by asking whether jobs that contribute to environmental degradation undermine social justice.

Through general economic activity, jobs rely on environmental resources and the capacity of the environment to absorb waste

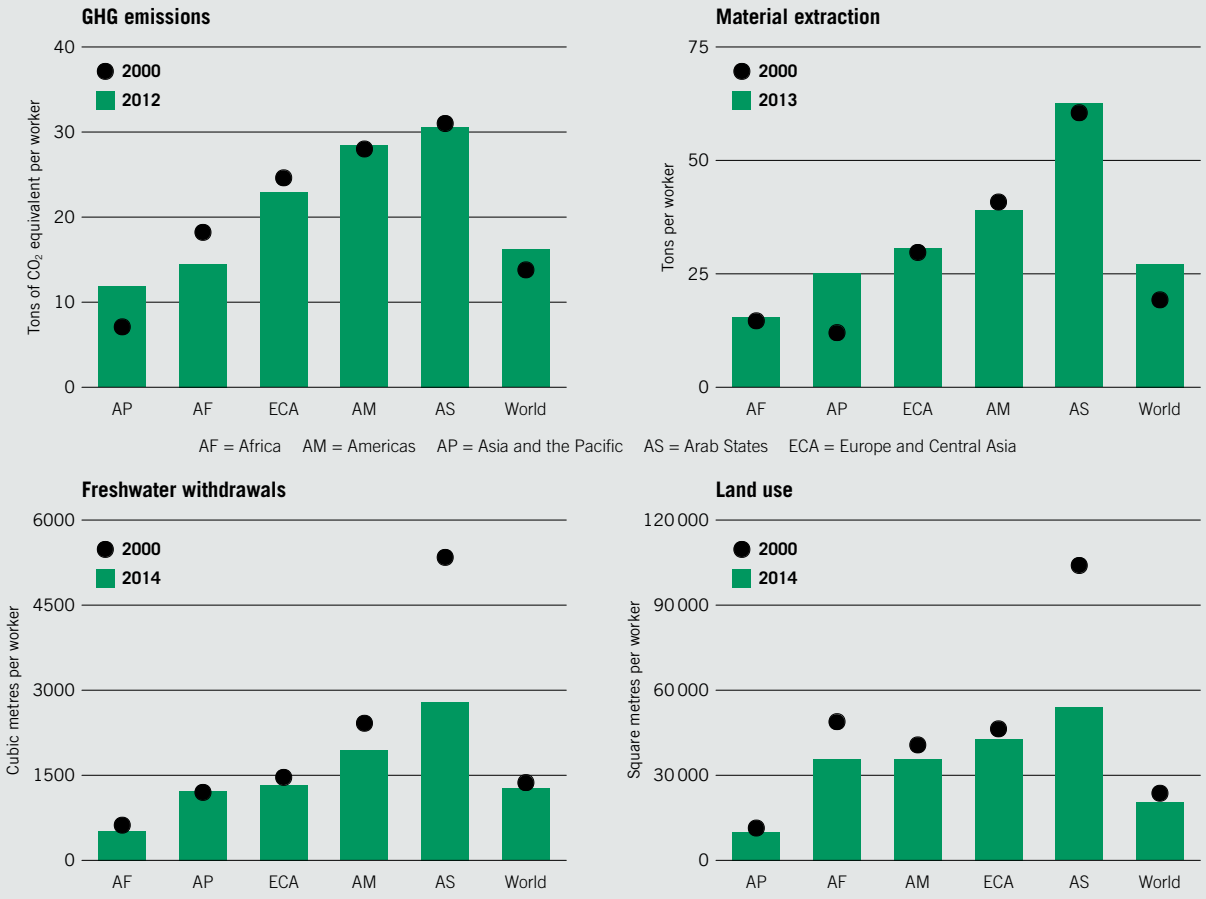
The relationship between economic activity and emissions and resource use can be extended to employment. Across the world, at the aggregate level, employment remains coupled to GHG emissions and material extraction, as the decoupling of employment and resources has been achieved in only a minority of countries and has not yet been realized at the global level. The carbon and resource intensity of employment demonstrate the extent to which jobs in a particular country or region are reliant on GHG emissions, material and water extraction and land use.

Figure 1.6 shows how regions sustain jobs with different levels of GHG emissions, material extraction, and water and land use. In the Americas, jobs are more dependent on GHG emissions and resource use than in Asia and the Pacific and Africa, to a large extent mirroring the higher labour productivity in the Americas and the size of the subsistence sector in Asia and the Pacific and Africa. In the Arab States, jobs are more dependent on GHG emissions because of the importance of the oil industry.

Importantly, the global economy relied more heavily on GHG emissions and material extraction to sustain jobs in 2014 than in 2000, a trend driven mainly by Asia and the Pacific which increased its level of GHG emissions between 2000 (black dot) and 2012 (green bar). Aggregate figures are economy-wide, but the employment implications differ by economic sector. The analysis in Chapter 2 goes further and explores the relationship between employment and environmentally sustainable activity, showing how environmentally sustainable growth may in practice create more jobs, though with a reallocation across industries.

Figure 1.6

Carbon and resource intensity of employment, 2000–14 or latest year available



Note: See Appendix 1.3 for methodological details.

Source: ILO calculations based on ILOStat (employment), World Development Indicators (GHG emissions and freshwater withdrawals), FAOStat (land use) and Material Flows Data (material extraction).

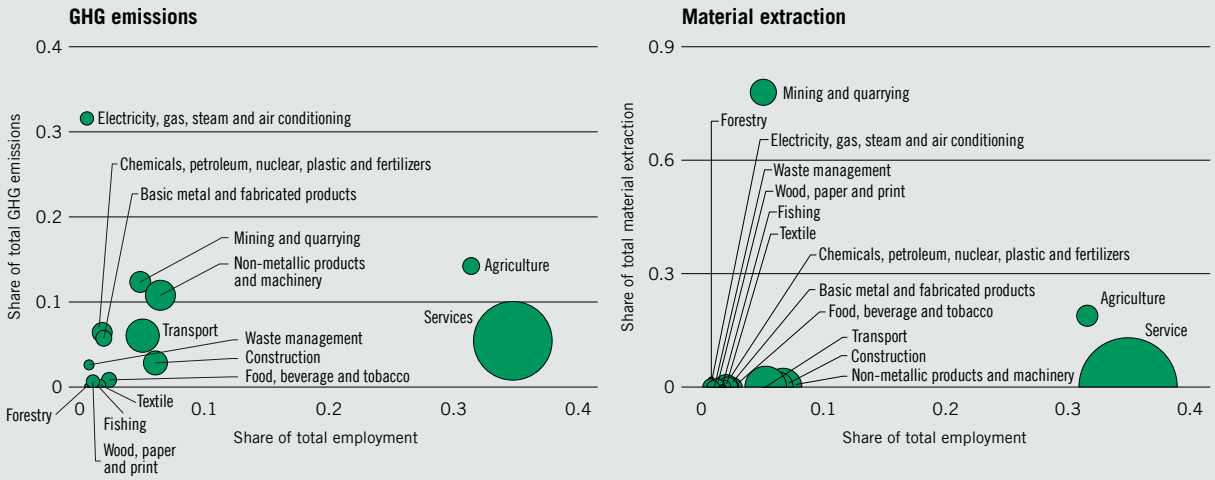
Employment in energy, agriculture, manufacturing and mining is more reliant on greenhouse gas emissions and resource extraction

The path towards environmental sustainability puts pressure on current modes of production. Sectors that emit more GHGs or extract more materials will need to transform to lead the transition to a green economy. Sectors that rely on carbon-intensive and material-intensive inputs as well as on a large number of workers can also lead the transformation to achieve decent work for all.

In line with an earlier ILO study (ILO, 2012), figure 1.7 shows that mining and quarrying, and to a lesser extent transport and resource-intensive manufacturing, have a high level of emissions and resource use, but employ a relatively small share of workers. The transition in these sectors will affect a comparatively lower share of workers, who will still require support in case of displacement. In agriculture, the average emissions per person employed are relatively small in view of the high numbers working in the sector. Agriculture employs around 1 billion workers, often without decent conditions of work (ILO, 2016d). Aggregating the environmental impact per worker to the whole sector means that agriculture is an important contributor to both GHG emissions and materials extraction. A transition to sustainability in agriculture will impact the work of many workers, requiring close attention to the evolution of decent work in the sector during the transition. The service sector is a weak contributor of emissions per person employed, but it is a relevant contributor to GHG emissions given its large size. Other sectors that employ large numbers of workers, as discussed in Chapter 2, seem under-represented in figure 1.7

Figure 1.7

Employment, GHG emissions and material extraction by sector, 2014



Note: Bubble size shows sector's contribution to GDP.

Source: ILO calculations based on Exiobase v3. For more information on Exiobase, see Appendix 2.1 and Stadler et al., 2018.

because the figure shows direct GHG emissions and resource extraction, but does not consider their indirect reliance on material resources (e.g. construction), indirect impact on employment (e.g. energy), or because they rely more heavily on land (e.g. forestry and agriculture) and water (e.g. agriculture and fisheries).

Some 1.2 billion jobs depend directly on ecosystem services

A second channel by which jobs relate to the environment is through ecosystem services. Ecosystems provide services to economies, societies and individuals through natural processes.[8] For example, dry-land farming relies on rain for irrigation and farmers rely on forests to prevent floods; farmers also rely on the capacity of the soil to maintain and renew its nutrients. Coastal fishing relies on the biodiversity of the ocean and its capacity to renew fish stocks, as well as on tidal marshes, mangroves and/or coral reefs for storm protection. These ecosystem services also include, among others, the purification of air and water, the pollination of crops, the control of agricultural pests, the moderation of temperature extremes, protection against storms, floods and wind, and support for diverse human cultures and aesthetic beauty (Daily, 1997).[9]

Ecosystem services provide important, although unrecorded, economic value (Costanza et al., 2014). They are typically not monetized nor subject to market exchange. Their value and contribution to human well-being and economic activity are not captured by GDP or market exchanges. In Costa Rica, for example, the forestry sector contributes 0.1 per cent of GDP, as usually calculated from monetary transactions, but its contribution rises to 2.0 per cent when the associated ecosystem services are taken into account. This is due to forests' contribution to agriculture and hydroelectric production (through water flow regulation), tourism (through aesthetic and cultural values) and the pharmaceutical sector (through biodiversity preservation) (WAVES, 2015). Similarly to any other, the United Kingdom's

8. The concept of ecosystem services was popularized by the Millennium Ecosystem Assessment (MEA, 2005) and the Economics of Ecosystems and Biodiversity (TEEB) (Kumar, 2010). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services suggests moving beyond the notion of ecosystem services to that of Nature's Contributions to People (NCP), considering both the beneficial and detrimental contributions of nature and that many NCP may be perceived as benefits or detriments depending on the cultural, socioeconomic, temporal or special context (Diaz et al., 2018).

9. The MEA and TEEB identify four classes of ecosystem services: provisioning services (e.g. food, water, wood for timber and fuel); regulating services (e.g. water purification, climate regulation); supporting services (e.g. soil formation and nutrient cycling); and cultural services (e.g. spiritual, cultural and aesthetic uses).

Box 1.2

Ecosystem services are essential for people in poverty and for indigenous and tribal peoples, who are key actors in conservation

Ecosystem services are particularly relevant for the world's poor and for poverty alleviation. People in poverty rely more directly on the provision of ecosystem services for their livelihoods and well-being. Direct consumption of natural resources sustains livelihoods and prevents households from falling further into poverty (Suich, Howe and Mace, 2015). For people in poverty, especially those in rural areas, the environment provides food and energy. Over 60 per cent of working women in South Asia and sub-Saharan Africa remain in agriculture, which is often rain fed (ILO, 2016c). Their livelihoods depend directly on a stable environment. Conserving the environment to ensure the provision of ecosystem services helps prevent these households from falling into extreme poverty or, particularly in drylands and water-scarce areas, facing the prospect of displacement. Environmental conservation and sustainability are therefore a matter of economic efficiency and social justice.

Ecosystem services are particularly beneficial for indigenous and tribal peoples, who are vulnerable to environmental shocks, as their income, livelihoods and culture depend on forests and biodiversity. Of the estimated 370 million people belonging to the world's indigenous and tribal peoples, 70 million depend on forests to meet their livelihood needs. Although they account for only 5 per cent of the world's population, indigenous peoples care for and protect 22 per cent of the Earth's surface and 80 per cent of its biodiversity (ILO, 2017b).

Indigenous and tribal peoples can lead environmental conservation. Their economy, based on the principles of sustainability, and their unique knowledge and skills enable them to make a distinct contribution to climate action and environmental protection. Innovation based on traditional knowledge and practices is already enhancing sustainability in the agriculture and forestry sectors (ibid.). For example, the deforestation rate in the Brazilian Amazon between 2000 and 2012 was 0.6 per cent on indigenous lands, compared to 7.0 per cent outside them (Stevens et al., 2014). In the context of climate change action, the Local Communities and Indigenous Peoples Platform of the Subsidiary Body for Scientific and Technological Advice of the United Nations Framework Convention on Climate Change (UNFCCC) recognizes and further enables the active role of indigenous and tribal peoples (UNFCCC, 2017a). In Australia, indigenous Bininj knowledge is at the core of the West Arnhem Land Fire Abatement Project which, among other positive outcomes, has increased the level of technical skills in the community by sharing both traditional ecological knowledge and Western scientific knowledge (Huon et al., forthcoming).

economy also benefits from a variety of ecosystem services; White et al. (2017) estimate that their loss could have important effects in terms of jobs lost and GDP. Estimates measuring the contribution of all ecosystem services across the globe in 2011 suggest a value of US$ 124.8 trillion (global GDP in 2011 was estimated at US$ 75.2 trillion) (Costanza et al., 2014). These services are essential for the economy, and particularly for people in poverty and for indigenous and tribal peoples (see box 1.2).

Around 1.2 billion jobs in 2014 were sustained by industries that depend directly or heavily on ecosystem services (table 1.2). They account for 40 per cent of total world employment. Workers in these industries depend on ecosystem services to sustain their livelihoods.

The share of employment that relies on ecosystem services varies widely across regions, with Africa and Asia and the Pacific having the highest share, at 58 and 49 per cent, respectively. In Europe and the Americas, 17 per cent of total employment relies directly on ecosystem services, and the figure is 15 per cent in the Arab States. Most of these jobs are in agriculture (80 per cent), forestry and fishing (5 per cent), food, drink and tobacco (6 per cent), and the wood and paper, renewable energy, water, textile, chemical and environment-related tourism sectors (9 per cent).

Table 1.2

Jobs relying on ecosystem services, 2014 (thousands)

Sectors	Examples of ecosystem services	Africa	Americas	Asia and the Pacific	Europe	Middle East	World
Most activity in the sector is related to biodiversity and ecosystem services							
Agriculture	Genetic resources and stock availability, freshwater, pollination, seed dispersal	217263	42600	670476	42108	4248	976694
Forestry		1634	1103	11866	2061	36	16700
Fishing		5118	2264	36491	603	252	44728
Food, drink and tobacco	Food, fibre and freshwater	3267	10470	46141	11083	510	71471
Wood and paper	Fibre, water purification and waste control	487	3605	7789	3694	126	15701
Renewable energy	Fibre for biofuels	123	292	1842	737	107	3101
Water	Freshwater supply, recycling, regulation, purification and natural hazard regulation	23	136	414	320	57	950
Most activity in the sector relies on biodiversity and ecosystem services, but they do not determine the nature of the sector							
Textile	Fibre, water purification and waste control	595	5409	39423	4263	165	49855
Chemicals	Genetic resources, biochemical diversity, freshwater	247	2254	10938	1388	<0.5	14827
Environment-related tourism	Food, freshwater, air quality, education, aesthetic and cultural value	2 282	7110	23081	4828	357	37657
Total by region		231039	75244	848461	71084	5856	1231684
Share of total regional employment		59%	17%	47%	16%	15%	40%

Note: Only industries in which the activity has a "significant and substantial" link to the environment are shown. The identification of these linkages is taken from GHK, 2007. The environment-related tourism sector, following the same source, is estimated as a 0.3 share of the total hotel and restaurant sector.

Sources: ILO calculations based on Exiobase v3; ILO, 2015b; GHK, 2007; and Rademaekers et al., 2012.

These estimates consider only employment that is directly dependent on the provision of ecosystem services. Ecosystem services also support jobs indirectly through other industries that depend on or provide inputs for these activities (for example, farmers, but not salespeople selling seeds or truckers transporting produce).

Environmental degradation limits the ability of ecosystems to provide these services, damaging health and well-being (WHO, 2005) and economic activity (Kumar, 2010) and also putting jobs at risk (GHK, 2007; Rademaekers et al., 2012). For example, climate change affects rain patterns and the economic activity of farmers; deforestation increases the risk of floods; and intensive, repeated tillage and mono-cultivation of high-value crops reduce soil health and future yields, requiring more fertilizer use, which may lead to run-off and changing chemical balances in water bodies (eutrophication). Ocean acidification brought about by climate change affects ecosystems and limits their ability to renew fish stocks. Changing ocean currents, also due to climate change, modify fishery cycles, making stocks less predictable. Box 1.3 showcases the overexploitation of fisheries as an example of how environmental degradation destroys ecosystem services and, by extension communities and jobs throughout the economy.

Box 1.3

Overexploitation of fish stocks could destroy 85.7 million jobs

According to the FAO (2016), 31 per cent of fish stocks are overfished and 58 per cent are fully fished. For the majority of collapsed fisheries, recovery is elusive, even after 15 years, leading to long-term economic losses (Hutchings, 2000). The percentage of stocks fished at unsustainable levels has increased since the 1970s, putting the livelihoods of many fishers at risk in the short or medium term.[1] The livelihoods of some 45.6 million workers depend on fish capture and aquaculture (table 1.2).[2] Two-thirds of these workers are fishers who depend on wild catch (not aquaculture) (FAO, 2016). Due to the linkages of the fishing industry with other sectors (fishers need fuel and other inputs and, once caught, wild fish are processed, distributed and sold to retailers and the food and hotels and restaurant sectors, for example), around 2.8 additional jobs in other industries depend on each fishing sector job (Pauly and Zeller, 2016). ILO estimates suggest that if the wild catch fishing sector (not aquaculture) were to collapse, for example due to overfishing, 85.7 million jobs would be destroyed in total (30.6 million in wild catch fisheries and 55.1 million in other industries). Overexploitation of fisheries can also have wider implications for the well-being of migrant fishers and the economies that rely on their remittances, such as those in the ASEAN region (ILO, 2014).

The sardine fishery in the Atlantic is facing an imminent collapse (ICES, 2017). A similar situation was experienced for the Peruvian anchoveta fishery in the 1970s and for North Atlantic cod in the 1990s (Pauly et al., 2002). In Newfoundland and Labrador, Canada, 40,000 fishers were left out of work, and the province lost 10 per cent of its population following the collapse of the fishery. Expensive relief packages failed to provide adequate support for these fishers and cod stocks have failed to recover 25 years after the moratorium went into effect.

The World Bank (2017b) shows how overfishing led to US$83 billion in losses in 2012, due to lower productivity in the sector. A reduction in fishing can help restore fisheries, leading to an increase in fish biomass in the ocean, higher annual harvests, higher prices and lower costs, resulting in an overall increase in annual net benefits in the sector. Measures to restore fisheries are particularly urgent in Asia.

Overexploitation is only one of the many sources of environmental degradation that threaten productivity in the fishing sector. These include water flows into dams, which reduce the nutritional intake of fish in river basins (Ziv et al., 2012), changing ocean currents as a result of climate change, the accumulation of plastic in oceans, the increase in nitrogen and potassium run-off from agriculture into rivers and lakes and, potentially, ocean acidification (Steffen, Richardson et al., 2015), all of which will continue to affect the distribution and will reduce the body size of fish (Cheung et al., 2013).

[1] Other estimates argue that capture statistics are usually biased downwards and that total catch may actually be higher than officially reported to governments, due to illegal catch, under- or non-reporting. Estimates that take this bias into account put total catch at 30–50 per cent higher than the officially recognized figures in developed countries and over 100 per cent higher in developing countries (Pauly and Zeller, 2016).

[2] Estimates that attempt to correct for the lack of detailed official data on fisheries and which include indirect employment suggest much larger figures. Teh and Sumaila (2011) suggest that around 203 million full-time equivalent jobs are sustained by global fisheries. Roughly 11 per cent are small-scale fishers.

Jobs are vulnerable to local environmental risks

Jobs are also vulnerable to the projected increase in environmental risks[10] which have the potential to destroy ecosystems and communities, leaving little chance of recovery. This is the third channel by which jobs and the environment are related. Environmental risks lead to, among others, displacement, migration and increased inequalities (IPCC, 2014b; McLeman, 2011; UNISDR, 2015). Risks can stem from slow-onset events (as is the case of droughts, erosion, soil degradation or sea level rise) or rapid-onset events (as is the case of extreme weather events), and can be local or global. Environmental risks can result from human activity (e.g. water pollution from non-compliant industrial activity) or natural hazards (e.g. water pollution following a volcanic eruption). Human activity can also increase

10. An environmental risk is the probability and consequences of an event transmitted through the air, water, soil or biological food chains.

the occurrence and intensity of natural hazards (e.g. increasing the intensity and frequency of extreme weather events as a result of human-induced climate change), and their consequences (for example, mangrove deforestation increases the consequences of storms on shores) (Whyte and Burton, 1980).

Risks become disasters when they overwhelm local capacity. They destroy jobs, oblige people to move and slow down economic activity through the destruction of capital stock, delivery and transport systems and other infrastructure. Although rebuilding capital stock following a disaster may stimulate GDP, the short- and long-term economic consequences of disasters are negative, particularly for developing and smaller economies (Felbermayr and Gröschl, 2014; Noy, 2009).

At the local level, for example, human-caused air, water, food chain and soil pollution, biodiversity loss and natural resource depletion have a direct negative effect on the health of workers and the population, productivity and economic activity, and an indirect one in related sectors or geographical areas.

Soil, air and water pollution alone led to 9 million deaths in 2015, or over 15 times the deaths related to armed conflict and violence and three times the number of deaths attributed to AIDS, tuberculosis and malaria combined. Outdoor and household air pollution from industrial activity and fossil-fuel based transport and power generation, led to 6.5 million premature deaths in 2015 (Landrigan et al., 2018). The detrimental effect of air pollution reduces productivity and working hours through the deterioration of the health of workers themselves, and of women in their role as caregivers for dependent children. Air pollution thus increases gender inequality in the labour market (Montt, 2018). The health effects of intense air pollution persist in the long term, even ten years after exposure (Kim, Manley and Radoias, 2017). Taking into account only premature deaths, air pollution costs the world economy about US$225 billion in lost labour income and US$5 trillion in welfare losses. The losses are greatest in East Asia and the Pacific, where they amount to 7.5 per cent of GDP, and South Asia, at 7.4 per cent of GDP (World Bank and Institute for Health Metrics and Evaluation, 2016). These economic costs are an underestimate as they do not take into account the changes in crop yields caused by high concentrations of pollutants in the air (OECD, 2016) or lost productivity due to absenteeism.

There are similarly significant economic, social and welfare costs as a result of soil and water pollution and soil degradation, desertification and poor land management, which can threaten agricultural activity, workers' health and food security (Kneese, 2015; Lu et al., 2015; Utuk and Daniel, 2015); wildfires, which affect economic activity and workers' health (Richardson, Champ and Loomis, 2012); floods, which affect property, safety and the economic well-being of communities (Brody et al., 2007); and food chain pollution, which affects workers' health and incomes (Bachev and Ito, 2014). To a great extent, these environmental risks become disasters due to the design and structure of communities and the resulting interactions with the environment (Mileti, 1999).

Human-induced climate change will increase the impact of natural hazards on the world of work, leading to job and productivity losses

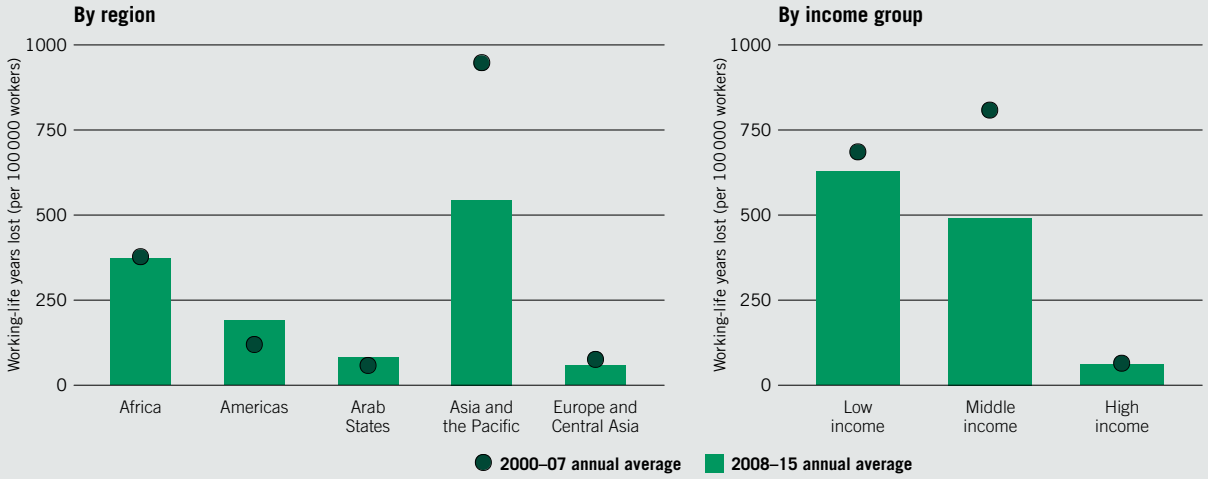
As a result of climate change and other forms of environmental degradation, projections point towards an increase in the frequency and intensity of extreme weather events and disasters (IPCC, 2014b). With each disaster, jobs and productivity are lost. Figure 1.8 shows that between 2000 and 2015, 23 million working-life years were lost annually as a result of different environmentally related hazards caused or exacerbated by human activity.[11] Beyond accounts of untold human suffering, this is equivalent to 0.8 per cent of a years work, considering that 2.8 billion people aged 15 to 64 are in employment in any given year. Across all regions, Asia and the Pacific and Africa suffered the greatest loss of working-life years due to human-induced or climate change related disasters between 2008 and 2015, with an annual average loss of, respectively, 536 and 376 working-life years per 100,000 people of working age. The effects of environment-related hazards increased in the Americas and the Arab States between the periods 2000–07 and 2008–15.[12]

11. The estimate of working-life years follows Noy's (2014) estimates for total life years lost due to disasters. Noy's methodology is adapted to take into account retirement and the population in employment in each country, as described in Appendix 1.4.

12. The large drop in working-life years lost in Asia and the Pacific during 2008–15 in comparison with 2000–07 is due to the fact that out of the five biggest disasters in terms of working-life years lost during the entire 2000–15 period, four occurred between 2000 and 2007: the 2002 drought in India and the 2002, 2003 and 2007 floods in China.

Figure 1.8

Working-life years lost due to disasters, 2000–15



Note: The estimates take into consideration casualties, people affected and damages resulting from meteorological (storms, fog, extreme temperature), hydrological (floods, landslides, wave action), climatological (drought, glacial lake outburst, wildfires), biological (insect infestation) and certain technological (industrial or miscellaneous accidents) hazards. Estimates do not include casualties, people affected or damages resulting from geophysical (earthquake, mass movement, volcanic activity), biological (viral, bacterial, parasitic, fungal or prion disease epidemics, animal accidents), extraterrestial (impact, space weather) or certain technological (transport accidents) hazards. The methods used follow Noy's (2014) approach, with adjustments for retirement age and national employment-to-population ratios. Appendix 1.4 provides more details on the methodology applied.

Source: ILO calculations based on Noy, 2014, EM-DAT Disaster Database, Global Health Observatory, United Nations population statistics, World Development Indicators, World Economic Outlook Database and ILOStat.

Changing weather patterns threaten agricultural incomes and rural jobs

Average temperature rises of over 2°C above late twentieth century levels will, without adaptation, negatively impact maize, wheat, rice, cocoa, coffee and tea yields in tropical and temperate regions, all of which support the livelihoods of millions of farmers (Bhagat, Deb Baruah and Safique, 2010; Bongase, 2017; Bunn et al., 2015; ILO, 2012; IPCC, 2014b; Renteria, 2016; Schroth et al., 2016; Wildenberg and Sommeregger, 2016).[13] An average temperature rise of over 4°C will pose serious risks for food security (IPCC, 2014b). Rainfall is predicted to increase in the tropics and higher latitudes, but to decline in the already dry semi-arid to arid mid-latitudes and in the interior of large continents. Population growth will also increase the demand for water by at least 40 per cent for a constant volume of production, exacerbating scarcities expected through climate change. By 2030 nearly half of the world's population will live in areas of high water stress; water scarcity will force the displacement of hundreds of millions of people (ibid.). Agriculture relying on run-off from glaciers and snow melt is also expected to be negatively affected by climate change (FAO, 2011). Areas suitable for growing crops will move geographically, but farmers may not be able to act on these changes by migrating or adopting alternative or drought-resistant crops, many of which require decades of investment before yields become profitable. These challenges are in addition to those related to overexploitation, chemical run-off and soil degradation following the injudicious use of the technologies that instigated the productivity gains in agriculture between the 1960s and 1980s (Pingali, 2012).

The greatest implications will be in rain-fed agriculture, which currently provides around 60 per cent of the world's agricultural production and covers 96 per cent of cultivated land in sub-Saharan Africa, 87 per cent in South America and 61 per cent in Asia (FAO, 2011), with significant effects on economic growth and development (Brown et al., 2011). A large number of agricultural wage workers are also migrant workers from poorer countries who provide an important safety net for their communities back home (ILO, 2016b). Without aggressive adaptation measures (irrigation infrastructure, access to improved seed varieties, skills development and access to regular migration opportunities), farmers practising rain-fed agriculture in vulnerable regions could be displaced or have little choice but to

13. Projections suggest a higher likelihood of positive effects on crop yields in northern latitudes (IPCC, 2014b).

migrate. Some may be forced to migrate to urban areas, while others may be compelled to cross borders.[14] In the absence of safe and regular migration pathways, urban and cross-border movements can increase the risk of exploitation and abuse.

Climate change acts as a multiplier of the risk of social conflict. For example, the displacement, food insecurity and resource depletion brought about by climate change have been associated with the humanitarian crisis in the Lake Chad region (Nett and Rüttinger, 2016). The 2007–10 drought in the Syrian Arab Republic, the worst on record in the country, caused massive crop failures in the national agricultural heartland. Its severity and the higher probability of other such droughts in the region are the consequence of human-induced GHG emissions and the resulting climate change. Some 75 per cent of agriculture-dependent households experienced total crop failure from the start of the drought. With the loss of income from crops, and the resulting need to sell livestock at depressed prices, between 2 and 3 million people fell into extreme poverty and some 1.5 million were forced from rural into urban areas, making the drought a contributing factor to the ongoing conflict (Kelley et al., 2015).

In addition to the changes resulting from climate change, agriculture is sensitive to other forms of environmental degradation, such as oil spills (e.g. in Nigeria) or water scarcity caused by overexploitation of freshwater resources (e.g. in the Colorado River basin in the United States, or in Jordan). As with the effects of climate change, these effects are disproportionately distributed and have negative repercussions on rural agricultural workers in terms of employment, productivity and shifts in food and non-food crops.

Women and the working poor, as well as the population of low-income countries and Small Island Developing States are overly exposed to current and future risks

People who are socially, economically, culturally, politically, institutionally, or otherwise marginalized are especially vulnerable to the effects of climate change and other forms of environmental degradation. Environmental degradation thus increases inequality, signalling a fourth channel by which jobs and the environment are related. Groups at risk include populations not covered by national social protection systems such as migrant workers and workers in the informal economy (IPCC, 2014a). People in poverty are generally more exposed to hazards and disasters (Hallegatte et al., 2016). Exposure and vulnerability to environmental risks are not evenly distributed across countries; indeed, 80 per cent of the total life years lost to disasters are spread across low- and middle-income countries (UNISDR, 2015). Poor and low-income countries are at higher risk in view of their lower capacity to mitigate the damage and mobilize resources for reconstruction (Noy, 2009; Schumacher and Strobl, 2011). For example, climate change is a direct threat to poverty eradication as a result of changes in ecosystems, which affect food prices and security, more extreme and more frequent natural hazards and the magnification of health threats, a key source of chronic poverty (Hallegatte et al., 2016). Gender differences in social and economic roles and responsibilities exacerbate the vulnerability of women, who have lower access than men to resources to adapt to climate change, including land, credit, agricultural inputs, decision-making bodies, technology, social insurance and training. For the majority of women working in the informal economy and in small enterprises, it is particularly difficult to recover from the effects of environmental disasters (ILO, 2009; IPCC, 2014b).

Recognizing the gendered effects of climate change, a gender action plan was adopted at the 23rd Conference of the Parties (COP23) of the United Nations Framework Convention on Climate Change (UNFCCC). Mindful of the imperative of a just transition, the plan will promote gender-responsive climate policy by integrating gender considerations into all activities concerning adaptation, mitigation and related means of implementation (finance, technology development and transfer, and capacity-building), as well as decision-making in the implementation of climate policies (UNFCCC, 2017b).

Disasters damage lower-income countries the most. Although middle-income countries, in view of their population size, accounted for the vast majority (88 per cent) of working-life years lost to disasters between 2008 and 2015, low-income countries experienced the greatest per capita effects. Between 2008 and 2015, an average of 629 working-life years were lost per 100,000 people in low-income

14. Climate- and environment-induced migration may, to a certain extent, provide sending regions with opportunities associated with migration, including remittances, which could be used to finance adaptation measures and labour mobility, which can in turn lead to the acquisition of skills relevant for adaptation and mitigation.

countries, compared with 61 in high-income countries (Noy, 2014, and ILO estimates based on Noy's interactive data set). Natural hazards can also cause large-scale disasters in countries with limited financial buffers against severe, but infrequent disasters (e.g. Algeria, Chile, Indonesia, Islamic Republic of Iran, Madagascar, Pakistan and Peru) (UNISDR, 2015).

Small Island Developing States (SIDS) are particularly vulnerable to environmental shocks. They have a narrow resource base, comparatively remote markets and a limited ability to benefit from economies of scale. Storm surges and sea-level rise will degrade fresh groundwater resources and salinize agricultural land. The fragile land and marine ecosystems of SIDS, and the related economic activities, are sensitive to invasive alien species, globally emitted contaminants and overexploitation, among other human-induced risks (IPCC, 2014b; UNEP, 2014). Many of the environmental risks that threaten SIDS originate outside their borders and directly affect key industries (such as agriculture, fisheries and tourism) and the substantial number of jobs and livelihoods that depend on them (ILO and ADB, 2017). Over 85 per cent of the land of the Cook Islands, Kiribati, Maldives and Marshall Islands, and 26 per cent of all the land of SIDS lies less than 5 metres above sea level, probably forcing displacement (ADB, 2012). In the Caribbean Community, around 30 per cent of major resort properties would be partially or fully inundated by a 1-metre rise in the sea level, affecting a key industry (UN-OHRLLS, 2015).

The annual impact of natural disasters in SIDS represents over 17 per cent of their GDP, compared to 6 per cent in lower middle-income countries and 3 per cent in high-income countries (OECD and World Bank, 2016). By way of illustration, Cyclone Pam hit the islands of Vanuatu in 2015, levelling the housing and transport infrastructure and destroying crops, and the storm surge salinized farming land. The medium-term impacts on tourism and agriculture undermined economic activity, jobs and incomes in the islands for several years (ADB, 2015).[15]

Rising temperatures will have a significant impact on productivity and occupational safety and health

Rising temperatures increase the incidence of heat stress and health risks, and the proportion of working hours during which a worker needs to rest and cool down the body to maintain the core body temperature below 38°C and avoid heat stroke. During the course of the century, and as a result of human-induced climate change, many of the more than 4 billion people who live in hot areas will experience negative health and safety effects and reduced work capacity (Kjellström et al., 2016). Heat stress is an occupational safety and health (OSH) hazard (ISO, 1989, 2017), as indicated in manuals produced by OSH agencies around the world, and should be considered a hazard by workers, employers and governments,[16] in accordance with the Occupational Safety and Health Convention, 1981 (No. 155), and the accompanying Recommendation No. 164. Likewise, workers affected by heat stress are entitled to remedy benefits as prescribed under the Employment Injury Benefits Convention, 1964 (No. 121).

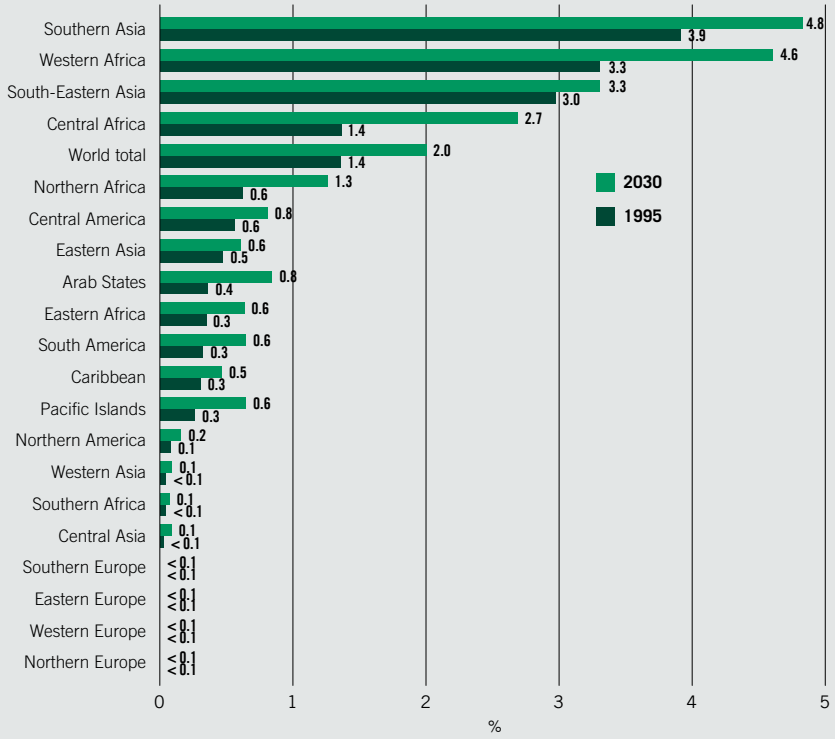
The growing prevalence of heat stress will reduce worker performance, partly because slowing down is a natural adaptation to heat exposure. Heat stress will continue to reduce productivity and lead to negative occupational health effects and workplace injuries, particularly in the countries most exposed to extreme heat, in sectors that rely on outside and daytime work (e.g. agriculture, construction) and in areas with weaker adaptation (such as factories without effective cooling systems) (Kovats and Hajat, 2008). In developing countries, the majority of workers suffering from heat stress are not covered by employment injury insurance. Worldwide, only 34 per cent of persons of working age are covered in case of an injury at work (ILO, 2017c). Productivity losses are expected in developing and emerging economies (e.g. Bangladesh and Thailand), as well as some advanced economies (e.g. Australia and the United States) (Kjellström et al., 2016). Urban areas often experience higher heat levels. Estimates

15. The high vulnerability of SIDS to risks produced elsewhere means that adaptation is a core component of their long-term economic and social sustainability as, with their small relative size, they can do little to mitigate their occurrence. Several funding mechanisms exist to build resilience in SIDS. These include the International Development Association, the Adaptation Fund, the Green Climate Fund, the Global Environment Fund, the Least Developed Countries Fund and the Special Climate Change Fund. Most of these funds are available to World Bank or IMF members only, excluding the Cook Islands and Cuba from most of these mechanisms (they also exclude Montserrat and Niue, non-ILO member States) (OECD and World Bank, 2016).

16. See, for example, the heat stress information brochures produced by the Ontario Ministry of Labour (https://www.labour.gov.on.ca/english/hs/pubs/gl_heat.php), the United Kingdom Health and Safety Executive (http://www.hse.gov.uk/pubns/indg451.htm) and the United States Occupational Safety and Health Administration (https://www.osha.gov/SLTC/heatstress/).

Figure 1.9

Working hours lost to heat stress under a 1.5°C scenario, 1995–2030



Note: Appendix 1.5 provides more details on the methodology applied.

Source: ILO calculations based on ILOStat and HadGEM2-ES and GFDL-ESM2M climate models.

for urban economies suggest that a warm year can result in losses in gross value added between –0.4 per cent (London, United Kingdom) and –9.5 per cent (Bilbao, Spain) (Costa et al., 2016), with even greater estimated losses for urban economies in emerging countries.

Globally, an estimated 1.4 per cent of total hours worked were lost in 1995 due to high heat levels (figure 1.9), representing around 35 million full-time jobs worldwide. Estimates combining a global temperature rise of 1.5°C by the end of the twenty-first century and labour force trends suggest that, by 2030, the percentage of total hours of work lost will rise to 2.0 per cent, a productivity loss equivalent to 72 million full-time jobs. This is most likely an underestimate as it assumes a 1.5°C increase in global mean temperature and assumes that agricultural work is carried out in the shade.

The negative impact of rising temperatures is unevenly distributed across sub-regions. Southern Asia and Western Africa will be most affected, with productivity losses equivalent to 4.8 per cent and 4.6 per cent, corresponding to around 40 and 9 million full-time jobs, respectively. In contrast, European subregions are expected to experience a smaller impact. Agricultural workers will be the worst affected; they will account for 66 per cent of global hours lost due to heat stress in 2030, in view of the physical nature of their work, which it is undertaken outside, and the fact that a large number of workers are engaged in agriculture in the areas most affected by future heat stress. Even greater temperature rises, as predicted under a business-as-usual scenario, will make some of these areas unproductive, displacing a large number of workers.[17]

17. These results are in line with those of the IMF (2017), which suggest that for a median low-income country, with an average temperature of 25°C, the effect of a 1°C increase in temperature will reduce annual GDP growth by 1.2 percentage points. Appendix 1.5 provides more details on the methodology used to estimate and project heat stress.

Decent work deficits can contribute to environmental degradation

As indicated above, environmental degradation limits the possibility of achieving full and productive employment and decent work. Though the largest part of environmental degradation is the result of industrial activity, decent work deficits can also contribute to environmental degradation to some extent, especially at the local level, marking the fifth way in which the world of work is related to the natural environment. Decent work deficits reflect institutional failures, economies in development paths characterized by low diversification, low levels of innovation and high levels of employment in low-productivity activities as well as market failures, and are a major driver of poverty; all of these interact and can lead to environmental degradation (Duraiappah, 1998; ILO, 2016d; Nunan, 2015). Viewed in simple terms, decent work deficits – through lack of employment, income security and training opportunities and awareness – contribute to environmental degradation since, when faced with food and energy insecurity, farmers are tempted to overgraze, overuse land and cut down forests (World Commission on Environment and Development, 1987). For example, the households of the rural working poor often lack access to social protection and may have to resort to unsustainable forms of resource extraction for immediate income generation. In the Apac district in Uganda, rural households frequently cut down trees to produce charcoal to generate off-farm income. The resulting deforestation reduces the humidity levels of the soil and agricultural production. As a result, in dry years, farmers expand their agricultural activities to wetlands, making it more difficult to preserve the local ecosystem and the related services (Ulrichs and Slater, 2016). Chapter 4 explores how policies that protect workers and households, as is the case of social protection policies, can break this cycle.

In some instances, well-governed labour migration opportunities can provide an alternative source of income insulated from environmental risk, while reducing population pressure and allowing stressed land to regenerate. However, in the absence of safe and regular migration pathways, populations may be compelled to move internally to locations where they perceive greater decent work opportunities. This often means overcrowded urban centres, already struggling under large volumes of waste, scant resources and polluted water.

Jobs that contribute to environmental degradation violate the principle of equal opportunity

The above sections highlight the negative effects of environmental degradation on jobs. Yet many jobs and economic activities contribute to environmental degradation when the associated resource extraction and emissions are unsustainable. Given that jobs in specific industries are likely to generate negative externalities (such as jobs in mining, which can pollute water), it is necessary to trace the indirect impact on jobs in affected industries (such as fishing and farming), to test whether jobs that generate negative externalities comply with the principles of equality of opportunity and decent work.[18] At the global level, climate change caused by industrialized countries, and increasingly by emerging economies, is placing jobs at risk in less developed countries. At the local level, the externality of one type of job may compromise the ability to pursue decent work in other jobs (figure 1.10).

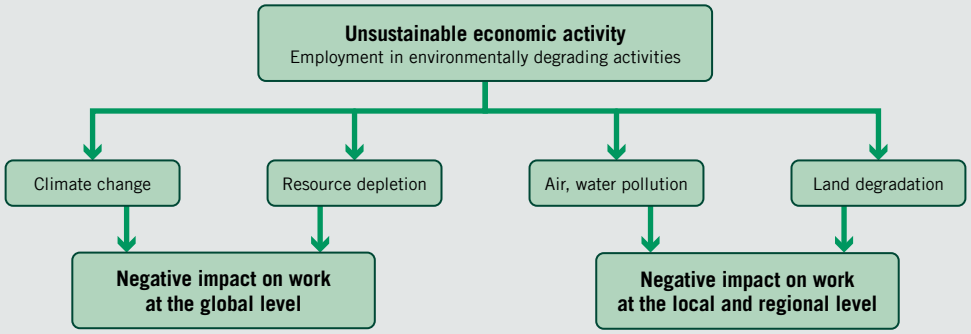
In this context, *can jobs which produce negative externalities affecting other workers be considered decent jobs, and do they threaten equality of opportunity?* These questions are not so much about who has the right to the job (following the previous example, the miner or the fisher), but how to ensure equal opportunity for all.

To a certain extent, this principle is beginning to be acknowledged for workers who have experienced the negative consequences of environmental degradation. For example, the possibility of allowing vulnerable workers from developing regions to access foreign labour markets as a means of reparation is being considered in the UNFCCC Warsaw International Mechanisms Task Force on Displacement, as an issue related to "loss and damage" stemming from climate change. An environmentally sustainable economy guarantees that negative environmental externalities are limited, suggesting that environmental sustainability is an issue of social justice. Also, a just transition, as outlined by the *Guidelines to a just transition to environmentally sustainable economies and societies for all* (ILO, 2015a), guarantees protection to workers who may be damaged by environmental degradation and by phasing-out or adaptation of certain industries.

18. The Declaration concerning the aims and purposes of the International Labour Organisation (Declaration of Philadelphia), adopted in 1944, states that "all human beings, irrespective of race, creed or sex, have the right to pursue both their material well-being and their spiritual development in conditions of freedom and dignity, of economic security and equal opportunity".

Figure 1.10

Jobs in unsustainable economic activities undermine equal opportunity



Source: ILO.

Conclusions

Economic development, social protection policies and labour market institutions have brought improvements in decent work in many parts of the world. Current development models and economic activity, however, threaten environmental stability through climate change, soil degradation, biodiversity loss, air and water pollution, eutrophication and other forms of environmental degradation. This chapter has shown the intricate relationship between the environment and the world of work, highlighting how environmental degradation increases risks from natural hazards and the loss of ecosystem services, both of which directly affect the number and quality of jobs. Fundamentally, environmental degradation threatens the achievement of decent work for all.

Some 1.2 billion workers depend on ecosystem services. Workers in agriculture (the majority of whom are poor) have already begun to suffer from changing rain patterns, natural hazards and higher temperatures resulting from climate change, and lower productivity as a result of poor land management, overexploitation and desertification. Millions of hours of work have been lost to natural disasters, and millions will be lost to higher temperatures. Mitigation (to avert future damage) and adaptation (to prevent degradation from causing damage) are urgent.

From the perspective of the world of work, environmental sustainability is also an issue of social justice. Environmental degradation, in its many forms, limits the right of workers to work. It widens inequalities, as women and the most vulnerable workers (particularly migrants, people in poverty, and indigenous and tribal peoples) are most affected by environmental degradation. Importantly, this chapter shows that progress towards decent work is compatible with environmental sustainability.

Building on this analysis, Chapter 2 examines the meaning of a transition for economic activity, employment and some aspects of job quality in the medium term. It explores the role that green enterprises and green jobs play in such a transition. The remaining chapters analyse policies that can help ensure that the transition to an environmentally sustainable economy is just, examining how the regulatory framework (Chapter 3), income support policies (Chapter 4) and skills development (Chapter 5) can lead to more and better jobs. Acknowledging the inequalities associated with environmental degradation and the opportunities to remedy them, Chapters 4 and 5 also analyse how social protection and skills policies take gender into account in policy development.

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2 Employment and the role of workers and employers in a green economy

KEY FINDINGS

To a large extent, advancing towards a green economy creates employment at the global level. It entails a reallocation of employment across industries, requiring policies to ensure the transition is just for all.

Compared to the business-as-usual scenario, changes in energy production and use to achieve the 2°C goal can create around 18 million jobs throughout the world economy. These changes include a shift towards renewable energy sources and greater efficiency, the projected adoption of electric vehicles and construction work to achieve greater energy efficiency in buildings. This net job growth results from the creation of some 24 million new jobs and the loss of around 6 million jobs by 2030.

Promoting sustainability in agriculture will change rural economies: a shift to conservation agriculture may shed jobs in the sector but improve the quality of employment therein, while a shift to organic agriculture may create jobs, though at the expense of increased land use pressure. The transition in agriculture requires complementary policies to ensure that it is an opportunity for workers and economies.

The circular economy is a model for sustainability in resource use and consumption. Almost 6 million jobs can be created by moving away from an extract-manufacture-use-discard model and embracing the recycling, reuse, remanufacture, rental and longer durability of goods. Notably, it means a reallocation from the mining and manufacturing sectors to waste management (recycling) and services (repair, rent).

Workers and employers have made significant contributions to greening the economy through green jobs and sustainable business practices. However, despite the sound business case for sustainability, firms' commitment should be enhanced to achieve environmental sustainability at the global level.

Introduction

Development in a context of environmental sustainability means transitioning towards a green economy, that is, an economy in which the capacity to satisfy tomorrow's needs is not limited by today's resource use, emissions and waste. A green economy is one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011, p. 2). It is low-carbon, resource-efficient and socially inclusive. It entails environmental sustainability and decent work. A green economy embodies the Sustainable Development Goals (SDGs) by, among other means, advancing climate action, protecting life on land and below water, providing affordable and clean energy and promoting decent work and economic growth.

As indicated in Chapter 1, today's economic reliance on freshwater and materials extraction, land use, waste and GHG emissions has reached unsustainable levels. In view of the reliance on natural resources and emissions, the transition to a green economy is akin to an industrial revolution (Bowen, Duffy and Fankhauser, 2016; Bowen and Kuralbayeva, 2015), offering opportunities and challenges for labour markets (Esposito et al., 2017). The costs of not supporting the transition can be higher than the costs of the transition itself, as illustrated by the energy transition (Caldecott, Sartor and Spencer, 2017). The transition to a green economy must be complemented with adequate labour market policies to ensure a smooth and just transition (ILO, 2015).

As the ILO (2012) points out, a green economy means a more effective use of resources and more friendly methods of production in the agricultural sector that rely on fewer GHG emissions and do not bring about deforestation, topsoil degradation or pollution and geochemical imbalances from pesticide and fertilizer run-off. It means sustainable management of forests and fisheries to increase their production capacity while avoiding overexploitation and biodiversity loss, the promotion of reliance on less carbon-intensive and more renewable energy sources, the increased energy efficiency of buildings and transport, and lower reliance on materials extraction for production. As shown in this chapter, a low-carbon, resource-efficient economy employs more people, is more labour intensive, and is at least as productive as an economy with a production model based on high carbon, resource and material intensity.[1]

This chapter demonstrates that achieving the 2°C goal (i.e. limiting global warming to 2°C above pre-industrial times over the long term) can create more employment than predicted by the business-as-usual scenario. Positive results can also be expected from the adoption of certain principles of the circular economy and the promotion of sustainability in agriculture if the path towards sustainability is accompanied by policies to support the transition of agriculture workers into other, more productive sectors. The chapter concludes by highlighting the important role that enterprises and workers play in guiding and leading the transition.[2]

1. As described in Chapter 1, this is due to a shift in value added from resource-based capital gains to workers' compensation and services, higher technology utilization and longer value chains.

2. Chapter 3 describes in more detail how social dialogue and other instruments can enhance the role of workers and enterprises in advancing a just transition.

A. Job creation and job destruction in the transition to a green economy

The transition to a low-carbon and resource-efficient economy involves changing methods of production across several sectors. In particular, changes are required in the energy, agriculture and waste management sectors to increase their resource efficiency and reduce their reliance on GHG emissions (ILO, 2012; IPCC, 2014). As shown in Chapter 1, these are the sectors that account for a high share of GHG emissions, use a high level of resources and, especially in the case of agriculture, employ large numbers of people. The required measures will change these industries, as well as the industries that supply their inputs and depend on their outputs. The resulting changes will cross borders. This section assesses the impact of the transition to a green economy on the number and types of jobs, taking into account the economic linkages across industries. It looks at the jobs created both directly and indirectly and at those destroyed by the transition. Focusing on key sectors of the transition to a green economy, it first examines transition in the energy sector, followed by an assessment in the agriculture sector, and concludes with the adoption of some principles of the circular economy. Box 2.1 provides a brief description of the data and methodology used in the scenarios, suggesting caution in the interpretation of the results. Appendix 2.1 provides further methodological details. Appendix 2.2 discusses models typically used to assess the long-term economic impact of climate change on economic growth and employment.

Box 2.1

Estimating green economy employment scenarios using Exiobase

The scenarios explored in this section rely on Exiobase v3, a multiregional input-output table (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 driving the results. Exiobase v3 offers greater precision than other MRIOs, as it details the transactions between 163 industries across 44 countries and five regions. The scenarios estimate and localize at the regional and industry level the expected number of direct and indirect jobs created and destroyed under various scenarios. Appendix 2.1 provides methodological details about the data set and the estimates.

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 International Monetary Fund (IMF) and the International Energy Agency (IEA) and population growth projections by the United Nations. 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 (box 2.2 examines the investment needed to achieve climate-compatible development). Importantly, as is common in analyses based on MRIOs, relative prices and the world trade structure are assumed to remain constant. In doing so, 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 labour requirements could diminish, reducing the employment benefits of this technological adoption. Adjustment changes are not modelled in this exercise and could affect the estimates presented here. Other adjustment costs not considered relate to the ability of labour to adjust to scenarios: owing to skills mismatch, for example, and other rigidities in the labour market, it may take longer to adjust to changing demand for goods and services, reducing the employment creation potential of the technologies investigated. Moreover, each scenario estimates the impact of a change in technology or 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 remains unchanged. Also, to verify the specific impact of these scenarios, estimates do not account for 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.

Box 2.2

Investment for environmental sustainability

The OECD (2017) estimates that between 2016 and 2030 an annual investment of US$6.3 trillion will be needed in infrastructure to meet global development needs. With only an additional US$0.6 trillion, this investment would be climate compatible. As highlighted by the IMF (2017), this extra investment is worth it: climate change adaptation and mitigation offer strong medium- and long-term benefits in terms of employment, productivity, economic activity and well-being. The two organizations also point out that, in view of the long time horizon, the social returns and the non-monetized costs associated with climate-related investment, a mix of public and private sources of investment are required (OECD, 2017; IMF, 2017). Development banks and finance institutions will have an important role to play at every level, and should value and incorporate climate-related risks alongside the elimination of fossil fuel subsidies and the implementation of carbon pricing systems. Policy coherence, as explored in further detail in Chapter 3, is critical to ensure that the regulatory framework, policies and investment offer adequate incentives.

Achieving sustainability necessarily involves the energy sector…

The energy sector is key for a successful transition to a low-carbon economy. Together, electricity and heat production, transport[3] and buildings account for almost half of global GHG emissions (IPCC, 2014). Replacing fossil fuel-based energy sources with renewables, such as solar or wind, together with efforts to improve energy efficiency, can reduce GHG emissions and contribute to the mitigation of climate change, while maintaining or increasing energy supply.

As noted in Chapter 1, progress has been made in reducing fossil fuel dependency to meet energy demand and, through the 2015 Paris Agreement, national commitments (i.e. nationally determined contributions) have been established to reduce GHG emissions. To some extent, a transition is already occurring, as the renewables sector has been growing rapidly, from 1.5 per cent of global electricity generation in 2000 to 5.5 per cent in 2013, favouring employment in the sector (Montt, Maitre and Amo Agyei, 2018). However, this progress and formal national commitments are not sufficient to achieve the international goal of limiting global warming to 2°C, or the more desirable goal of 1.5°C.

… with economic and employment effects that will spread to all economic sectors

The International Energy Agency (IEA) has developed country-specific scenarios that decouple the energy sector from fossil fuels, which would limit global warming to 2°C (IEA, 2017a and 2017b).[4] The 2°C scenario can be achieved by progressive decarbonization in the electricity, transport and construction sectors, thereby achieving progress towards SDGs 7 (clean energy) and 13 (climate action). (Box 2.3 explores these effects for the 1.5°C goal as encouraged by the Paris Agreement.) Although employment in these sectors may be small, as noted in Chapter 1, they are closely linked to other economic sectors and have strong multiplier effects. Changes in the energy sector, through changes in

3. Road transport is also a major contributor to air pollution, accounting for about 50 per cent of the total health costs of outdoor air pollution in OECD countries (OECD, 2014).

4. In *Energy Technology Perspectives 2017*, the IEA explores several scenarios. The 2°C scenario requires a pathway towards rapid decarbonization to meet international policy goals. The Reference Technology Scenario takes into account national energy- and climate-related commitments, which fall short of international policy goals. The 6°C scenario is largely a continuation of current trends, a business-as-usual scenario, under which CO_2 emissions would rise by about 60 per cent between 2013 and 2050 (IEA, 2017b). The scenarios used in this report take into account each country's potential energy sources, while meeting projected energy demand up to 2030.

Box 2.3

Employment and decent work under the 1.5°C goal

The 2015 Paris Agreement calls for the increase in the global average temperature to be held at well below 2°C above pre-industrial levels. It encourages countries to pursue efforts to limit the temperature rise to 1.5°C, in recognition that this increase would significantly reduce the risks and impacts of climate change. The scenario in this chapter is based on the IEA's country- and region-specific blueprints for achieving the 2°C goal. No such blueprint exists for the 1.5°C goal which could be used to estimate its employment outcome. However, the 2°C scenario offers insight into the employment implications of the path to limit warming to 1.5°C. Achieving the 1.5°C goal would entail a more aggressive decarbonization of the energy sector. It would imply a more rapid replacement of fossil fuel-based energy production by renewables, and a more aggressive reduction in energy use through greater efficiency. Judging from the results associated with the direct and indirect effects of achieving the 2°C goal highlighted in this chapter, and the employment implications of investing in energy efficiency (Garrett-Peltier, 2017), achieving the 1.5°C goal would magnify the results shown in figure 2.1. Achieving the 1.5°C goal could prompt action in other sectors, such as agriculture which, as indicated below, could create employment or facilitate structural transformation. Achieving the 1.5°C goal may also require the development of carbon sinks through reforestation or carbon capture and sequestration technology, which could also create employment and growth opportunities.

electricity generation, transport and construction, will necessarily affect other sectors. For example, in the automotive sector, electric vehicles entail very different value chains compared to internal combustion engine vehicles. This will therefore result in changes in forward- and backward-linked industries, as well as in demand for oil products, and will thus modify consumer spending patterns (for this and other examples, see Cassar, 2015; Garret-Peltier, 2017; OECD, 2009; Government of Scotland, 2016a; Stehrer and Ward, 2012; UBS Research, 2017; WEF and IHS CERA, 2012; Wild, 2014). The wide-ranging impact of a transition to a low-carbon energy economy therefore requires consideration for the needs and active participation of employers and workers in multiple sectors.

Limiting global warming to 2°C through the energy sector means reducing fossil fuel reliance in electricity and transport and improving energy efficiency in buildings and construction…

The IEA identifies the changes that are possible and required to limit global warming to 2°C over the course of the century (2017b). This section draws on this scenario, painting a change in the energy mix towards greater reliance on renewable energy sources for electricity and heat generation and industry, and complements it with the projected rise in the share of electric vehicles and building improvements to achieve greater energy efficiency.

In terms of electricity, the scenario implies an increased share of renewables for electricity generation (including a 59 per cent increase in electricity produced from solar photovoltaic panels in 2030, compared to 2012), a decrease in the use of fossil fuels (a 50 per cent reduction in coal-based electricity production), and a drop in overall demand as a result of greater efficiency. Similarly, under this scenario, energy demand by industry would fall by 20 per cent by 2030 as a result of greater efficiency, and the remaining energy needs would be met through greater reliance on biomass and waste, rather than fossil fuel-based energy sources.

Energy is also crucial in transport. Harmful exhaust emissions are largely avoided in the case of electric and battery-based vehicles, especially if the power to charge electric batteries comes from renewable

sources.[5] Forecasts point to around 14 per cent of new car sales globally being electric vehicles in 2025, with higher sales projected in Europe (30.6 per cent) and China (15.5 per cent) than in the United States (5.1 per cent) and the rest of the world (5.2 per cent) (UBS Research, 2017).[6]

Finally, the energy demands of buildings and construction are also expected to fall in this scenario, as a result of construction that pays more attention to resource efficiency and retrofitting to improve the efficiency of existing buildings. Under this scenario, all savings from energy efficiency in the IEA 2°C and 6°C scenarios in the construction sector are invested in retrofitting buildings to achieve efficiency gains. The scenario also takes into account the changes in energy needs in agriculture and fisheries.

… and will result in net job creation in almost all regions and sectors

The analyses presented here show an overall positive employment impact from the action taken in the energy, transport and construction sectors to limit global warming to 2°C over the course of the century. As a result, climate action brings about net job creation.[7] Indeed, progress towards sustainability in the energy sector will create around 18 million more jobs globally by 2030 when compared to the business-as-usual path, which is equivalent to a 0.3 per cent difference between the two scenarios. Employment creation is driven by the higher labour demand of renewable energy sources in comparison with electricity produced from fossil fuel sources, and the employment demand of the entire value chain associated with renewable energy and electric vehicles and construction.

This overall net jobs benefit comes with a 41 per cent reduction in GHG emissions by 2030, which is in line with global policy goals. However, these overall changes conceal sectoral and regional differences, as summarized in figure 2.1. Chapter 5 examines in greater depth the types of skills development programmes required to support this change.

In the renewables sector (hydro, biomass, solar thermal, solar photovoltaic (PV), tide and wave, and geothermal), job creation is expected to be higher by around 11 per cent in the 2°C scenario compared to the business-as-usual scenario. Net job growth is also expected in manufacturing (0.5 per cent) and construction (1.7 per cent). This growth is equivalent to around 4 million jobs in manufacturing and 9 million in renewables and construction combined. In addition, due to the economic linkages between sectors, employment in services, waste management and agriculture will also grow. For example, over 2 million jobs will be created in the manufacture of the electrical machinery required for the production of electric vehicles and the generation of electricity from renewables.

At the regional level, there will be net job creation in the Americas, Asia and the Pacific and Europe (0.45, 0.32 and 0.27 per cent, respectively, representing around 3, 14 and 2 million jobs). In contrast, there will be net job losses in the Middle East (–0.48 per cent, or over 300,000 jobs) and Africa (–0.04 per cent, or around 350,000 jobs) if the economic structure of these regions does not divert from the historical trend.[8] Under this scenario, policy changes could allay the anticipated job losses or their negative impact (see Chapters 3, 4 and 5).

Reallocation is most evident in the electricity production sector, with employment gains in renewable-based electricity (net creation of some 2.5 million jobs), offsetting employment losses in fossil fuel-based electricity generation (net losses of around 400,000 jobs) (table 2.1).

This scenario also entails reallocation in other sectors, and particularly mining. Any loss of employment in the sector due to a reduction in the mining and extraction of coal, petroleum and natural gas

5. The negative environmental effects of the transport sector are due to exhaust emissions from fossil fuel-based internal combustion engines. Negative effects also stem from brakes, tyre wear, the disposal of vehicles and other uses which come in addition to the emissions of potentially harmful particles and gases. The negative effects of transport that are not due to exhaust of GHGs are not modelled in the scenarios.

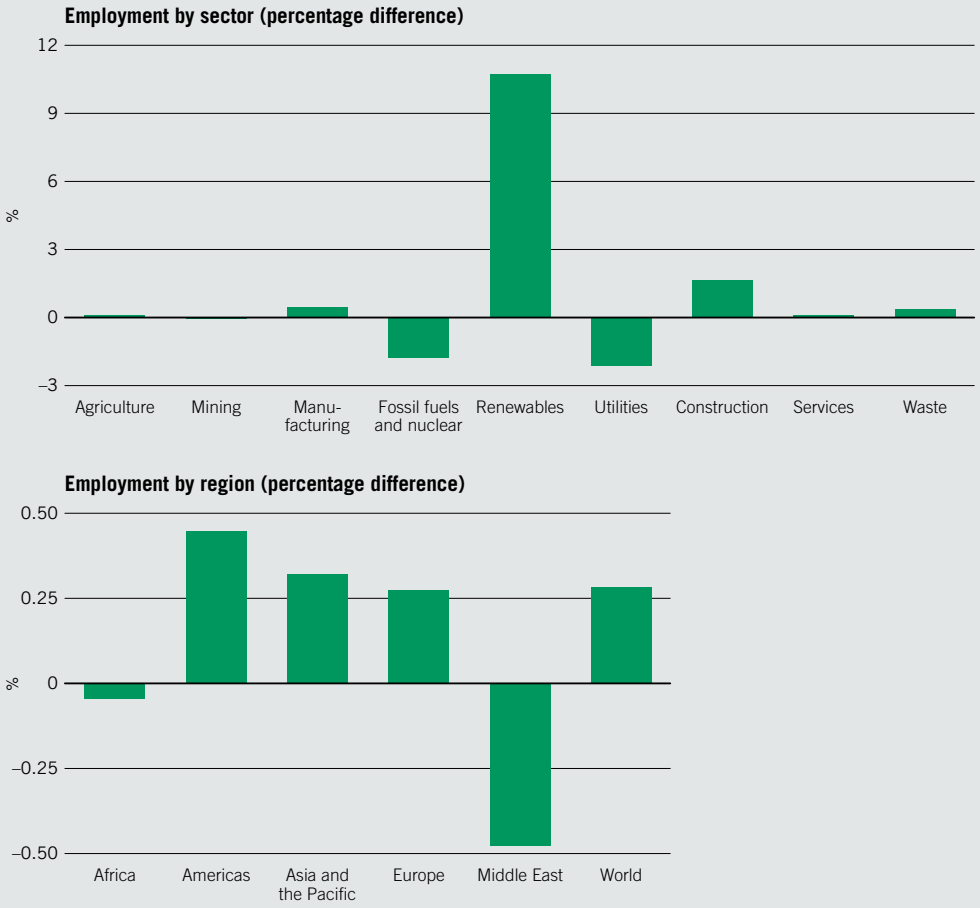
6. This scenario explores only one dimension of sustainability in the transport sector, namely a shift away from the internal combustion engine and towards electric vehicles for people transport. It ignores other initiatives to promote sustainability in the sector, including in public transport, maritime and air transport, and freight transport.

7. Net job creation refers to the overall impact on job numbers. It considers the direct and indirect jobs created and lost. Net jobs are created if, on balance, more jobs are created than are lost.

8. Africa's net job loss is led by a total of around 650,000 jobs lost, mainly in fossil fuel-related sectors (e.g. petroleum refinery, extraction of petroleum and mining of coal, electricity production by coal) and job gains of around 300,000, mainly in the construction, mining of copper ores and manufacture of electrical machinery sectors.

Figure 2.1

Energy sustainability and employment in 2030



Notes: Percentage difference in employment between the sustainable energy scenario and the IEA 6°C (business-as-usual) scenario by 2030. Appendix 2.1 provides further methodological details on the data and methods used. Vertical scales differ by panel.

Source: ILO calculations based on Exiobase v3.

(around 2 million job losses), would be partially compensated by the growing demand for inputs for electric vehicles and electrical machinery (some 2 million additional jobs in the mining of copper, nickel, iron and other non-ferrous and metal ores).

In addition, employment losses are expected in sectors with close linkages to the fossil fuel-based automotive industry. Some job losses are expected in the manufacture of motor vehicles as electric engines have fewer moving parts and fewer workers are required for each car produced. Also, the life cycle of electric vehicles is longer than that of vehicles with internal combustion engines (UBS Research, 2017), and some jobs are expected to be lost in the retail sale of automotive fuel.

In total, as noted above, job creation throughout the economy and in specific sectors more than offsets job destruction. The net job creation of 18 million projected to 2030 is the result of around 24 million jobs created and around 6 million jobs lost. Of the 163 economic sectors analysed, only 14 show employment losses of more than 10,000 jobs worldwide, and only two (petroleum refinery and extraction of crude petroleum) show losses of 1 million or more jobs (table 2.1).

Table 2.1

Sectors most affected by the transition to sustainability in the energy sector

Industries set to experience the highest job demand growth (absolute)		Industries set to experience the strongest job demand decline (absolute)	
Sector	**Jobs (millions)**	**Sector**	**Jobs (millions)**
Construction	6.5	Petroleum refinery	–1.6
Manufacture of electrical machinery and apparatus	2.5	Extraction of crude petroleum and services related to crude oil extraction, 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 photovoltaics	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
Industries set to experience the highest job demand growth (percentage)		**Industries set to experience the strongest job demand decline (percentage)**	
Sector	**Jobs (percentage)**	**Sector**	**Jobs (percentage)**
Production of electricity by solar thermal energy	3.0	Production of electricity by coal	–0.19
Production of electricity by geothermal energy	0.4	Extraction of crude petroleum and services related to crude oil extraction, excluding surveying	–0.11
Production of electricity by wind	0.4	Extraction, liquefaction, and regasification of other petroleum and gaseous materials	–0.11
Production of electricity by nuclear energy	0.3	Petroleum refinery	–0.08
Production of electricity by biomass and waste	0.3	Manufacture of gas, distribution of gaseous fuels through mains	–0.05
Production of electricity by solar photovoltaics	0.3	Mining of coal and lignite, peat extraction	–0.03
Production of electricity by hydropower	0.2	Extraction of natural gas and services related to natural gas extraction, excluding surveying	–0.03

Notes: Percentage difference in employment between the sustainable energy and the IEA 6°C (business-as-usual) scenario by 2030. Appendix 2.1 provides further details on the data and methods used.

Source: ILO calculations based on Exiobase v3.

As a result of the sectoral redistribution of employment, the transition will result in a slightly lower female labour share in employment, if current female labour shares by economic sub-sector remain constant. This is because the sectors currently associated with green technology (such as electrical machinery) employ a relatively lower share of women. Reallocation is also likely to benefit sectors that employ fewer highly skilled workers,[9] which means that employment opportunities will favour low- and medium-skilled workers.[10] The scenario will also probably result in a modest reduction in the numbers of own-account and contributing family workers.

Although, in overall terms, the scenario is expected to lead to net aggregate benefits in terms of greater employment opportunities, certain groups, regions and sectors will face disruption. Transition to an environmentally sustainable economy requires consideration for these workers. In this context, the ILO has adopted and is piloting the *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (ILO, 2015) to ensure that no workers are left behind. Chapters 4 and 5 examine social protection and skills development policies to support these workers and sectors.

9. As indicated in Appendix 2.1, highly skilled workers are defined by the share of workers in ISCO major groups 1, 2 and 3 (managers, professional and technicians and associate professionals).

10. These results contrast with the findings by Cambridge Econometrics, GHK and the Warwick Institute for Employment Research (2011) which highlight the demand for higher level skills in a scenario of a low-carbon economy. Besides the different methodological approaches, the different modelling strategies assume different scenarios, which lead to different industry-to-industry changes and, ultimately, different labour market outcomes.

The agricultural sector needs to reduce environmental degradation and ensure food security

A transition is also required in agriculture. Since the 1970s, agricultural output has increased three-fold.[11] This remarkable achievement has outpaced population growth and resulted in only a 30 per cent increase in the use of cultivated land worldwide (Pingali, 2012). Yet challenges for the agricultural sector remain. It is necessary to continue improving productivity to secure future food demand, while becoming environmentally sustainable and overcoming the decent work deficits still faced by the sector (Alexandratos and Bruinsma, 2012; Godfray et al., 2010; ILO, 2016; Swaminathan and Kesavan, 2017).

However, productivity growth has slowed (FAO, 2017). Food security remains a priority, particularly in view of the world's rapidly growing population and the expected dietary changes that follow economic growth. Agriculture has become a major contributor to GHG emissions (through land use change, livestock and fertilizer use), soil degradation (the loss of organic matter as a result of overexploitation and mismanagement), desertification and freshwater scarcity (through inadequate land and crop management), biodiversity loss, pest resistance and water pollution (resulting from change in land use, eutrophication, run-off and improper nutrient management) (FAO, 2011). Mostly as a result of intensive farming, about a third of the world's soil has already been degraded and, if current rates continue, all of the world's topsoil could be degraded in 60 years (FAO, 2015a). These environmental challenges contribute to environmental degradation at the global and local levels. Agriculture is itself vulnerable to environmental degradation (through natural hazards and the loss of ecosystem services, as noted in Chapter 1), which jeopardizes the livelihoods of farmers and food security around the world.

Future food security (SDG 2) can only be sustainable if it is coupled with environmental sustainability, climate action (SDGs 13, 14 and 15) and adaptation to climate change. It requires the adoption of different agricultural practices and adaptation to climate change, water scarcity and land degradation (ELD Initiative and UNEP, 2015; FAO, 2016a and 2016b; Pagiola, 1999). It also requires investment in infrastructure to enhance productive potential and resilience to climate change (e.g. irrigation, roads and transport, storage, as well as extension services and research, development and access to improved seed varieties) (Headey and Jayne, 2014; Jayne, Chamberlin and Heady, 2014; OECD, 2017).

Transforming agriculture also offers an opportunity to transform the world of work and reduce the many decent work deficits in the sector. It should bring workers in the sector out of poverty. Over 1 billion people work in the agricultural sector, the majority on smallholder and family farms (Lowder, Shoet and Raney, 2016). Most of the working poor are employed in agriculture (ILO, 2016). In developed and emerging economies, migrant workers from poorer regions make up to 70 per cent of the sector's wage workers (BLS, 2017). In the case of developing countries, allowing employment to transit out of agriculture is key to supporting national structural transformation (ILO, 2005 and 2016).

Although there is agreement that sustainable agriculture must simultaneously ensure food security, while reducing its impact on the environment and promoting decent work, there is less agreement on the specific techniques required to achieve these aims (Zahm et al., 2015). Among others, conservation agriculture and organic agriculture have been proposed to overcome some of the environmental challenges. Both conservation and organic agriculture imply a change in inputs and modes of production, affecting the world of work (boxes 2.4 and 2.5 describe them in further detail).[12] Table 2.2 summarizes the main implications for smallholder and large farms, with emphasis on the environment, food security and the world of work.

11. The productivity increase in agriculture following the Green Revolution is the result of investment in crop research, infrastructure, market development and policy support between 1965 and 1985. After this period, scientific advances in crop genetics were adapted to developing countries, propagating productivity growth in the developing world (Pingali, 2012). Some negative impacts have accompanied the Green Revolution, including environmental degradation, increased income inequality, inequitable asset distribution and higher levels of absolute poverty (Hazell, 2003).

12. Zahm et al. (2015) note that Biodynamic Agriculture, Humus Farming and Alternative Agriculture were developed prior to the 1990s with a multidimensional approach to sustainability at their core. As with any agricultural technique, there is no one-size-fits-all approach to sustainable agriculture. No specific system can achieve sustainability in every situation, which is why this section focuses on the broader approaches encompassed by conservation agriculture and sustainable organic farming. The System of Crop Intensification (SCI), developed from the System of Rice Intensification (SRI), shows how crop, land and resource management techniques that take advantage of the interactions, dependencies and interdepencies between the crops and microorganisms can greatly improve yields and reduce the ecological impact of agriculture (Abraham et al., 2014; Uphoff, 2012).

Box 2.4

Conservation agriculture minimizes soil disruption and increases yields

Conservation agriculture (CA) is an agro-ecosystem management system characterized by: (i) continuous minimum mechanical soil disturbance (minimum or no tillage); (ii) permanent soil cover; and (iii) the diversification of crops grown in sequence or association (FAO, 2015b). Minimum or no tillage limits the harmful effects of regular tillage that are common in conventional agriculture, allowing the maintenance of organic matter in the soil and increased soil quality through higher water holding capacity, lower susceptibility to erosion and a greater capacity of the soil to release nutrients in synchrony with crop demand. Reducing tillage limits the possibility of creating a hardpan at the bottom of the cultivated layer and reduces evaporation from the soil surface, which exposes seedlings to water stress (Johansen et al., 2012). CA reduces agricultural GHG emissions because it requires less fuel for machinery and increases the carbon sequestration potential of the soil (Dendooven et al., 2012).

CA is currently practised on over 125 million hectares, or around 9 per cent of arable land worldwide. It is practised on over 70 per cent of arable land in Argentina, Brazil, Paraguay and Uruguay. CA is becoming increasingly widespread, owing to its applicability and observed benefits across different climates, soil types, crops and farm characteristics. It is applicable in various contexts: from the Arctic Circle to the tropics and the southern extremes; at sea level and at 3,000 metres of altitude; in extremely rainy and extremely dry areas (Friedrich, Derpsch and Kassam, 2017).

At the level of individual farms, one of the main drivers for the adoption of CA is higher profits, resulting from lower labour costs and higher productivity (Knowler and Bradshaw, 2007). These benefits accrue for large-scale farms (Friedrich, Derpsch and Kassam, 2017; Pannell, Llewellyn and Corbeels, 2014), and there is emerging evidence that they can also benefit smallholder and family farms (Johansen et al., 2012; Lalani, Dorward and Holloway, 2017; Pannell, Llewellyn and Corbeels, 2014).

Importantly for the world of work, CA farming requires around 50–60 per cent fewer work hours at the beginning of the growing season, due to the lower demand for labour for land preparation. For large mechanized farms, savings exist, but are small, as labour costs amount to less than 10 per cent of total costs per acre (FAO, 2001). For labour-intensive farms the savings can be important, but at the expense of employment opportunities in rural economies with cross-border implications when migrant workers are implied, as is common in developed and emerging economies. For smallholders and family farms supplying their own labour, lower labour requirements may free family workers from farm duties, allowing them to diversify their income.

By minimizing or eliminating tilling, CA removes one of the primary short-term benefits of conventional tillage, namely weed control. To control weeds, CA requires more frequent application of herbicides (Johansen et al., 2012). Although they are less toxic than insecticides, inappropriate and unsafe exposure to herbicides can pose serious health risks for workers and communities (Donham, 2016; Frank et al., 2004).[1] As a result of the need for integrated nutrient management, increased fertilizer and herbicide use and crop rotation and/or association, CA requires greater management skills. It also requires different machinery, which may create an entry barrier. These factors may hinder the adoption or optimal implementation of CA by smallholders and family farmers with low skills (Knowler and Bradshaw, 2007).

[1] *The Safety and Health in Agriculture Convention, 2001 (No. 184), ratified by 16 countries, requires the sound management of chemicals (Articles 12 and 13). It also requires employers to carry out risk assessments, to provide appropriate training when chemicals are used and to stop any operation where there is an imminent and serious danger to safety and health (Article 7). Workers have the right to be informed on safety and health matters, participate in the application and review of safety and health measures and remove themselves from danger, and they have the duty to comply with safety and health measures (Article 8).*

Box 2.5

Organic agriculture relies on ecological processes, biodiversity and natural cycles

Organic agriculture is "a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects" (IFOAM, 2008). In 2015, around 51 million hectares were organic farmland or under conversion, representing almost 3.7 per cent of total agricultural land. In some ten countries, including Austria, Czech Republic, Italy, Sao Tome and Principe, Sweden and Switzerland, over 10 per cent of agricultural land is organic (Willer and Lernoud, 2017). For over two decades, the adoption of organic agriculture has been seen as a means of improving livelihoods in Uganda, which is the largest organic producer in Africa, with over 200,000 internationally certified farmers and 2 per cent of agricultural land (Poschen, 2015; Rukundo, 2014).[1]

Organic agriculture emphasizes environmental protection through the entire farm-to-consumer chain. It excludes the use of artificial products, such as genetically modified organisms, synthetic pesticides, veterinary drugs, additives and mineral fertilizers (Morgera, Bullón Caro and Marín Durán, 2012). Organic agriculture, compared to conventional agriculture, promotes soil quality and biodiversity, reduces nutrient leaching and requires less energy (Mondelaers, Aertsens and van Huylenbroeck, 2009; Tuomisto et al., 2012). Studies have also found benefits of organic agriculture in terms of water retention and use, reduced erosion (Nemes, 2009) and the maintenance of ecosystem services (Merfield et al., 2017). Under situations of bio-physical stress (e.g. drought), organic yields are higher than conventional yields.

The average yield of organic farms is generally lower than conventional farms for a wide range of crops throughout the world. In developing countries, yields in organic agriculture average 84 per cent of those of conventional agriculture, while the figure is 79 per cent in developed countries (de Ponti, Rijk and van Ittersum, 2012). To a large extent, these averages mask differences in the specific conditions of each farm.[2] With good management practices, organic systems can nearly match conventional yields (Seufert, Ramankutty and Foley, 2012). When compared to subsistence farming, the adoption of organic farming increases yields, although they might have increased further if subsistence farming had adopted conventional intensive farming techniques (Auerbach, Rundgren and Scialabba, 2013). Organic farms may contaminate less, but they need more land to produce the same quantity of output (Tuomisto et al., 2012), unless reductions in food waste, food-competing feed from arable land and the production and consumption of animal products complement the large-scale adoption of organic farming (Muller et al., 2017).

For farmers, the higher market prices and growing demand for organic produce and lower production costs offset any reduction in yield (Nemes, 2009). However, higher prices may make it difficult for poor and developing countries to achieve food security.

As with conservation agriculture, the conversion to organic agriculture entails considerable changes in labour use. Organic agriculture is more labour intensive than conventional agriculture, as noted by studies in Europe (EC, 2013), India (Charyulu, Kumara and Biswas, 2010) and Ghana (Kleemann, 2016), but the work may not necessarily be decent. The exclusion of synthetic pesticides may reduce exposure to harmful chemicals and reduce occupational health and safety risks, potentially improving working conditions.

[1] Swaminathan and Kesavan (2017) note that green agriculture considers the linkages between farm processes and the broader ecosystem and conditions, but allows the use of chemical inputs within integrated pest and nutrient management schedules. They also note that organic agriculture encompasses several approaches, including Effective Microorganisms Agriculture, One-Straw Revolution (natural farming with no ploughing, chemical fertilizers, weeding or chemical pesticides and herbicides) and White Agriculture (substantial use of micro-organisms, and particularly fungi). They highlight the Evergreen Revolution as an ecosystem-integrated farm system that exploits synergies between crop and animal associations, both within the farm and with the surrounding ecosystem although, as with other sustainable farming systems, it requires a substantial knowledge base. Chapter 5 further examines the skills development programmes in place to support the transition towards environmentally sustainable agriculture.

[2] Seufert, Ramankutty and Foley (2012) note that the yields of organic farms are only 5 per cent lower in the case of rain-fed legumes and perennials in weak-acidic or weak-alkaline soils, but can be 25 per cent lower for cereal crops such as maize and wheat, and vegetables such as broccoli.

Table 2.2

Environmental and work-related impacts of conservation and organic agriculture

	Conservation agriculture	Sustainable organic farming
Environment and food security	Increases soil water retention	Increases soil water retention
	Increases soil organic matter	Increases soil organic matter
	Reduces GHG emissions	Reduces GHG emissions
	Reduces soil erosion	Reduces soil erosion
	Increases use of pest control and, initially, fertilizers	Reduces use of synthetic pesticides and mineral fertilizers
	Higher yield limits can promote productivity growth without pressure on land resources	Lower yields may increase pressure on land resources
	Similar prices to conventional agriculture can promote food security in developing countries	Higher prices than conventional agriculture may reduce access to crops and food security for poor and developing countries
Work on smallholder farms	Higher yields and lower costs lead to higher income for farmers	Higher income due to lower costs and higher prices (lower yields than conventional farming, higher yields than subsistence farming)
	Lower labour needs increase the ability of farmers to diversify their income	Higher labour needs reduce the ability of family farmers to diversify their income
	High up-front costs in terms of machinery, tools, management skills, and lower yields during the conversion phase	High up-front costs due to lower yields during the conversion phase
	Higher exposure to potentially harmful chemicals	Lower exposure to potentially harmful chemicals
	Crop residues no longer used for feed or construction materials	Crop residues can be used for feed or construction materials
Work on large farms	Higher yields and lower costs lead to higher income for farmers	Higher prices and lower costs offset lower yields and increase farmers' income
	Lower labour needs may reduce the demand for paid workers in rural areas	Higher labour needs increase demand for (potentially non-decent) work in rural areas
	Higher worker exposure to potentially harmful chemicals	Lower exposure to potentially harmful chemicals

Notes: Impacts of conservation and organic agriculture in comparison with conventional agriculture. Light-coloured cells indicate positive effects, darker ones indicate negative effects.

Unless sound crop, nutrient and waste management techniques are adopted, organic and conservation agriculture may not be sustainable and may not eliminate environmental degradation, and will instead lead to the degradation of the organic content of the soil, the pollution of water sources and eutrophication as a result of run-off. Furthermore, unless they are accompanied by investments in infrastructure, access to finance, social protection, governance reform, research and development and outreach, among others, organic and conservation agriculture by themselves will not ensure adaptability to environmental degradation, food security and environmental sustainability.

Importantly, conservation and organic agriculture are not mutually exclusive. For example, the FAO Save and Grow (2011) approach extracts the environmental benefits of both, but highlights their important implications for rural economies due to their lower labour intensity. The FAO Sustainability Assessment of Food and Agriculture systems (2014) offers clear guidelines on how food systems can achieve sustainability through good governance, environmental integrity, economic resilience and social well-being.

Conservation and organic agriculture can bring sustainability to agriculture, though with different implications for wage employment and smallholder farms

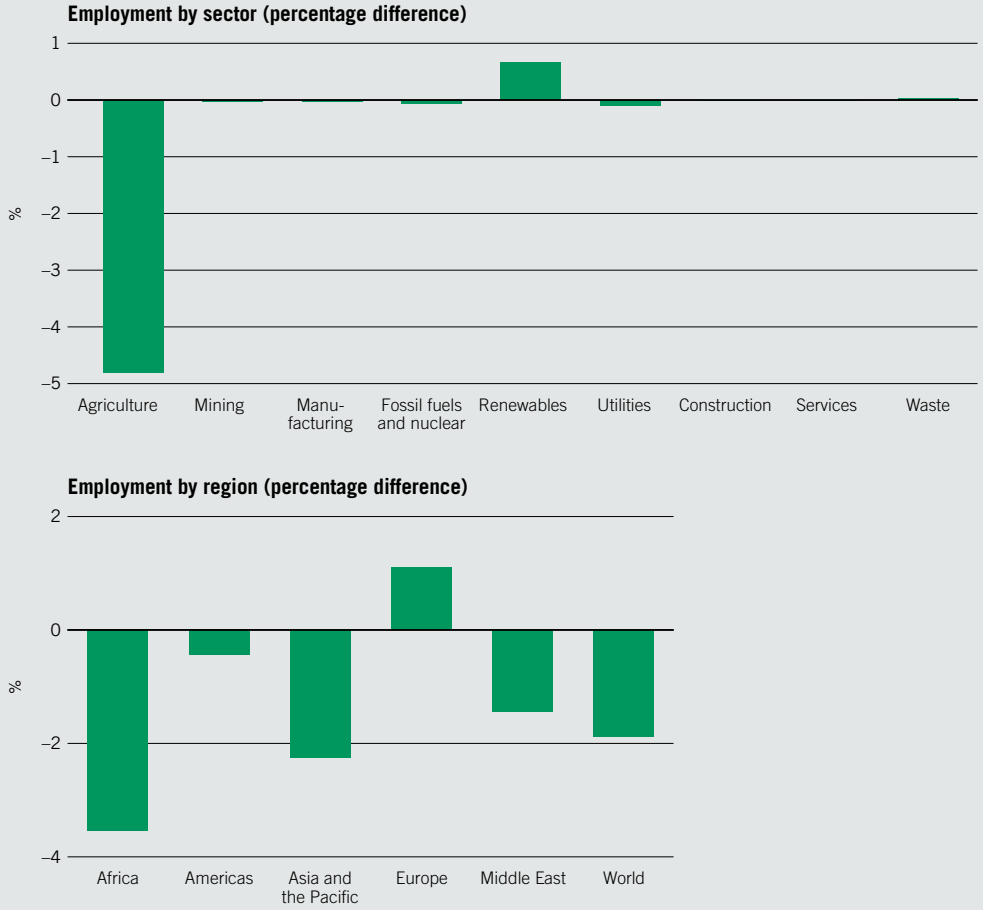
Conservation agriculture and organic agriculture can be sustainable if adequate crop, soil, pest, nutrient and waste management techniques are adopted alongside investments in infrastructure, access to finance, outreach, social protection and other policies. This section explores a scenario in which conservation agriculture is adopted in developing countries and organic agriculture in developed countries. Under this scenario, output from these sustainable forms of agriculture grows to reach 30 per cent of each country's total output by 2030.[13] Due to data constraints, the scenario does not explore the impact of other changes required in agriculture to achieve sustainability, as noted above.[14]

13. In view of the price differential between output from conventional and conservation and organic agriculture, large-scale conversion to organic agriculture may limit progress towards achieving food security. Much of the produce of organic agriculture in developing countries is exported to developed countries and is not destined for local consumption.

14. Appendix 2.1 provides a summary of the conservation- and organic-to-conventional input ratios used in the analysis.

Figure 2.2

Sustainability in agriculture and employment in 2030



Notes: Sustainability in agriculture is defined as adoption of conservation agriculture in developing and emerging countries, and adoption of organic agriculture in developed economies. The percentage differences in employment by 2030 are between (i) a scenario in which 30 per cent of agricultural production is organic in developed countries and 30 per cent of agricultural production results from conservation agriculture in developing and emerging countries, and (ii) the IEA 6°C (business-as-usual) scenario. Appendix 2.1 provides further methodological details on the data and methods used. Vertical scales differ by panel.

Source: ILO calculations based on Exiobase v3.

Figure 2.2 shows how a transition in agriculture that means adopting conservation agriculture in developing countries and organic agriculture in developed countries will result in reduced employment in all regions except Europe. This is largely driven by the lower labour requirements of conservation agriculture, when implemented in regions that have a high share of workers in the sector. Under this mixed scenario, around 120 million fewer jobs will be required than under the business-as-usual scenario (a –1.9 per cent difference in employment between the two scenarios). This means around 4.8 per cent fewer jobs in agriculture, with losses concentrated in Africa (–3.5 per cent, or over 20 million fewer jobs) and Asia and the Pacific (–2.2 per cent, or 100 million fewer jobs). This could result in reductions in wage employment, but could also offer opportunities for smallholder and family farms by allowing workers to seek other opportunities and to diversify their household incomes. Fewer jobs in agriculture in Africa and in Asia and the Pacific may free labour to sustain policies that promote structural transformation if complemented by adequate industrial and skills policy (see, for example, Chapters 3, 4 and 5; ILO, 2005; Salazar-Xirinachs, Nübler and Kozul-Wright, 2014). The adoption of organic agriculture in developed countries, by contrast, will attract more labour to the sector, leading to a 1.1 per cent growth in employment in agriculture in Europe. Table 2.3 lists the sectors most affected by the adoption of conservation and organic agriculture.

Table 2.3

Sectors most affected by the transition to sustainability in agriculture

Industries set to experience the highest job demand growth (absolute)		Industries set to experience the strongest job demand decline (absolute)	
Sector	**Jobs (millions)**	**Sector**	**Jobs (millions)**
Poultry farming	0.6	Cultivation of vegetables, fruit, nuts	–83.1
Pig farming	0.5	Cultivation of paddy rice	–8.3
Cattle farming	0.5	Cultivation of crops n.e.c.	–7.8
Research and development	0.2	Cultivation of cereal grains n.e.c.	–6.2
Production of electricity by solar photovoltaics	0.2	Cultivation of wheat	–5.5
Meat animals	0.1	Cultivation of oil seeds	–4.4
Composting of food waste, incl. land application	0.0	Cultivation of plant-based fibers	–4.1
Industries set to experience the highest job demand growth (percentage)		**Industries set to experience the strongest job demand decline (percentage)**	
Sector	**Jobs (percentage)**	**Sector**	**Jobs (percentage)**
Composting of paper and wood, incl. land application	0.12	Cultivation of sugar cane, sugar beet	–0.08
Production of electricity by solar photovoltaics	0.06	Cultivation of plant-based fibers	–0.08
Composting of food waste, incl. land application	0.05	Cultivation of crops n.e.c.	–0.08
Cattle farming	0.01	Cultivation of paddy rice	–0.07
Production of electricity n.e.c.	0.01	Cultivation of vegetables, fruit, nuts	–0.07
Research and development	0.01	Cultivation of cereal grains n.e.c.	–0.07
Poultry farming	0.00	Cultivation of wheat	–0.06

Notes: Sustainability in agriculture is defined as adoption of conservation agriculture in developing and emerging countries, and adoption of organic agriculture in developed economies. Percentage differences in employment by 2030 are between the scenarios in which 30 per cent of agricultural production is organic in developed countries and 30 per cent of agricultural production is conservation agriculture in developing countries and the IEA 6°C (business-as-usual) scenario. Appendix 2.1 provides further methodological details about the data and methods used.

Source: ILO calculations based on Exiobase v3.

In view of the linkages between conservation and organic agriculture and other economic sectors (such as mining, fertilizer manufacture, pest control and machinery, in the case of conservation agriculture, and organic fertilizers and pest control systems for organic agriculture), the promotion of sustainability in agriculture will create jobs in industries associated with the production, distribution and sale of specific inputs for these agricultural systems. For example, the promotion of sustainability in agriculture will promote employment in waste management, construction, renewable energy and services.

Both conservation agriculture and organic agriculture can promote environmental sustainability, for example by reducing GHG emissions in the agricultural sector. However, in view of its lower yields, there are concerns about the extent to which organic agriculture will increase pressure on land resources, particularly when considering the 50 per cent increase in food, feed and biofuel demand by 2050 (FAO, 2017). Concerns regarding yields can be offset by reductions in food waste, which in many cases require improvements in infrastructure for the transport and storage of agricultural products. Whatever the path adopted in agriculture, it can only be sustainable when accompanied by proper nutrient, crop and waste management.

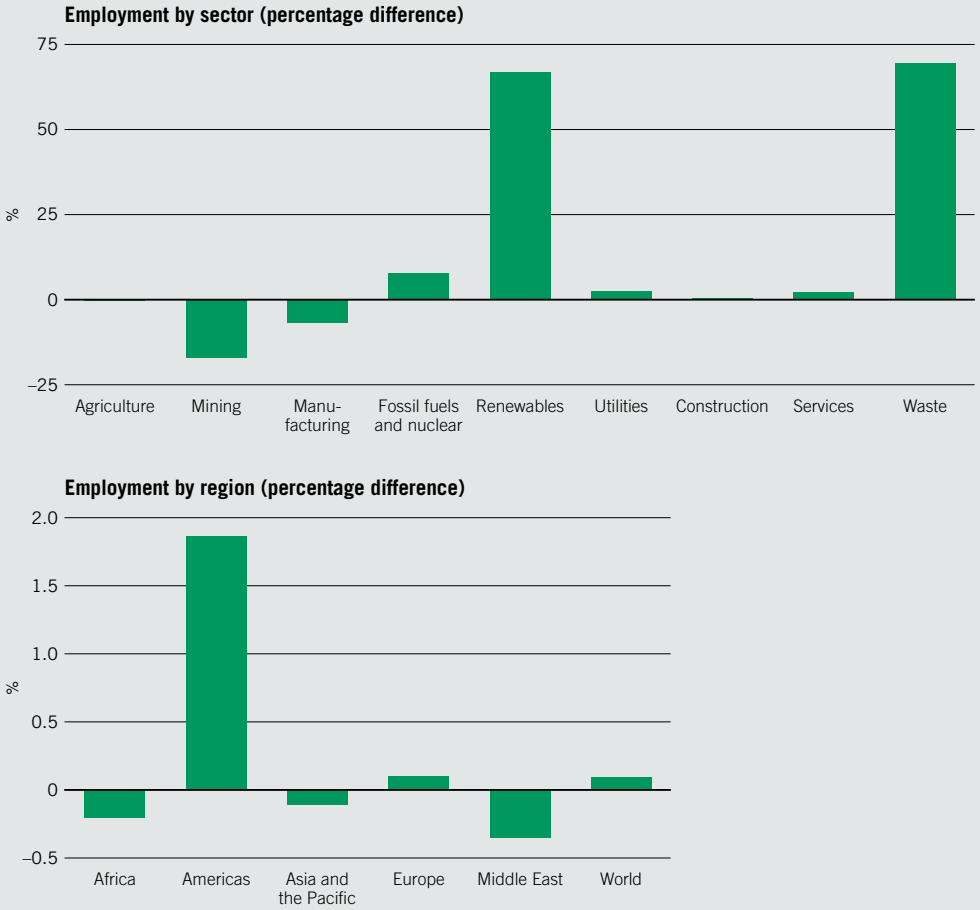
Moreover, the promotion of sustainability can lead to important changes in the rural economy, requiring close attention and complementary policies, as those outlined by the ILO's 2015 *Guidelines for a just transition to environmentally sustainable economies and societies for all,* to ensure that the transition is just and that it creates decent work.

Advancing towards a circular economy will also create jobs

In addition to energy and agriculture, Chapter 1 noted how resource-intensive sectors such as mining and manufacturing will also undergo substantial changes on the path towards sustainability. Current models could be typified as linear: extract, manufacture, use and discard. The circular economy, as an alternative, is based on the principle of produce-use-service-reuse. One of its tenets is to reduce the extraction of raw materials and to rely instead on reuse, repair and recycling. In a circular economy, products are designed to have longer lives and to be repaired, reused or recycled. Through changes to the incentive structure for enterprises to produce 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 (Ellen MacArthur Foundation, 2013). In view of the interlinkages in the manufacturing sector and the fact that inputs are recycled, employment changes are warranted in extractive and waste management industries. A circular economy also results in changes in the services sector, as repair and rental services gain in importance over the replacement and ownership of goods (Wijkman and Skånberg, 2016).

Figure 2.3

The circular economy and employment in 2030



Notes: Percentage difference in employment between the circular economy scenario and the IEA 6°C (business-as-usual) scenario by 2030. Appendix 2.1 provides further methodological details on the data and methods used. Vertical scales differ by panel.

Source: ILO calculations based on Exiobase v3.

Table 2.4

Sectors most affected by the transition to a circular economy

Industries set to experience the highest job demand growth (absolute)		Industries set to experience the strongest job demand decline (absolute)	
Sector	**Jobs (millions)**	**Sector**	**Jobs (millions)**
Reprocessing of secondary steel into new steel	30.8	Manufacture of basic iron and steel and of ferro-alloys and first products thereof	–28.2
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	21.5	Mining of copper ores and concentrates	–20.8
Production of electricity by solar photovoltaics	14.7	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	–10.2
Wholesale trade and commission trade, except of motor vehicles and motorcycles	12.2	Mining of iron ores	–8.0
Reprocessing of secondary wood material into new wood material	5.0	Manufacture of glass and glass products	–7.6
Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts and accessories	4.7	Mining of coal and lignite; peat extraction	–4.9
Research and development	3.5	Mining of nickel ores and concentrates	–4.3
Industries set to experience the highest job demand growth (percentage)		**Industries set to experience the strongest job demand decline (percentage)**	
Sector	**Jobs (percentage)**	**Sector**	**Jobs (percentage)**
Reprocessing of secondary lead into new lead, zinc and tin	15.0	Production of electricity by coal	–0.9
Reprocessing of secondary precious metals into new precious metals	11.2	Extraction of crude petroleum and services related to crude oil extraction, excluding surveying	–0.9
Production of electricity by solar photovoltaics	4.9	Extraction, liquefaction, and regasification of other petroleum and gaseous materials	–0.9
Reprocessing of secondary copper into new copper	4.3	Petroleum refinery	–0.8
Reprocessing of secondary wood material into new wood material	4.2	Manufacture of gas; distribution of gaseous fuels through mains	–0.8
Reprocessing of secondary steel into new steel	3.1	Mining of coal and lignite; peat extraction	–0.8
Reprocessing of secondary aluminium into new aluminium	2.7	Extraction of natural gas and services related to natural gas extraction, excluding surveying	–0.8

Notes: Percentage difference in employment between the circular economy scenario and the IEA 6°C (business-as-usual) scenario by 2030. Appendix 2.1 provides further methodological details on the data and methods used.

Source: ILO calculations based on Exiobase v3.

This scenario, summarized in figure 2.3, explores the employment impact of a sustained 5 per cent annual increase in recycling rates for plastics, glass, wood pulp, metals and minerals, replacing the direct extraction of the primary resources for these products. This scenario also models growth in the service economy, which, through rental and repair services, reduces ownership and replacement of goods at an annual rate of 1 per cent.[15]

Under the circular economy scenario, worldwide employment would grow by 0.1 per cent by 2030 in comparison with a business-as-usual scenario. This is equivalent to around 6 million more jobs in an economy that adopts certain tenets of the circular economy, such as recycling and the service economy. Employment growth is led by growth in services and waste management, with some 50 and 45 million jobs, respectively.

15. In view of the limits to the recyclability of materials, recycling rates are capped at 65 per cent and remain stable thereafter. A 65 per cent recycling rate coincides with the European Union Circular Economy Package (EC, 2015). As indicated by the Ellen MacArthur Foundation (2013), this scenario only develops two dimensions of a circular economy and, for example, ignores the potential effects of changes to product design that enhances the durability, remanufacture, reusability and repair of goods.

These employment gains, driven for example by recycling services, offset employment losses in mining and manufacturing (where losses are expected to be around 50 and 60 million jobs, respectively). This is largely due to the replacement of the extraction of primary resources and the production of metals, plastics, glass and pulp by the recycling and reprocessing of secondary metals, plastics, glass and pulp. Table 2.4 shows the sectors most affected by the adoption of the circular economy.

This sectoral reallocation leads to different effects in the various regions, with employment growth driven mostly by increases in Latin America and the Caribbean (over 10 million jobs) and Europe (around 0.5 million jobs). In contrast, net employment losses are expected in Asia and the Pacific (around 5 million jobs), Africa (around 1 million jobs) and the Middle East (around 200,000 jobs) if no action is taken to promote economic diversification. By benefiting jobs in services, and if the gender distribution across sectors remains similar, the circular economy will rise the female share of employment and highly skilled jobs. However, it will also result in a small increase in the numbers of own-account and contributing family workers, highlighting the importance of decent work policies to complement policies to promote the circular economy.

B. Green jobs

As noted above, the transition to low-carbon, resource-efficient economies will lead to changes in the occupational structure of the economy, with some jobs being destroyed and others created during the transition. Jobs are also likely to be transformed, requiring a skills transformation, as further examined in Chapter 5. When seen in this light, it may seem that jobs are passively moulded by the transition. But in practice jobs, and particularly green jobs, can act as a catalyst for the transition to a green economy, and can be considered a policy objective in themselves (ILO, 2013a). This section describes in more detail what green jobs are, highlighting how they can be active agents in the transition.

Green jobs are defined as follows: they reduce the consumption of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems and enable enterprises and communities to adapt to climate change. In addition, green jobs have to be decent (UNEP, 2008). They can be found in any economic sector and any enterprise, including the environmental goods and services sector (box 2.6). The rural sector offers many opportunities for the creation of green jobs, and particularly green jobs that further the traditional practices of indigenous and tribal peoples, which can advance sustainability (see box 1.2). Importantly, green jobs can enhance the transition to a green economy (ITC-ILO, 2016).

Measurements of the number of green jobs throughout the world are scarce. Some efforts have been made in the European Union (Eurostat, 2017), the United States (Elliott and Lindley, 2017) and the United Kingdom (ONS, 2017), but they are based on different definitions and may not be comparable. They usually focus only on environmental goods and services, and therefore do not capture all types of green jobs, for example failing to count jobs that improve the environmental impact of production processes in enterprises in any industry.[16] Some national definitions of green jobs also tend to exclude the decent work component; ignoring a key component of green jobs makes comparisons across estimates difficult (see, for example, BLS, 2010).

In 2013, the 19th International Conference of Labour Statisticians adopted statistical guidelines on *Employment in the environmental sector and green jobs* that overcome these limitations (ILO, 2013b). The ILO subsequently developed survey instruments and led work for the implementation of the guidelines in practice. Data from pilot surveys conducted in Albania (ILO, 2014) and Mongolia (NSO, 2017) offer the first insights into the extent of employment in the environmental goods and services sector and in green jobs, and their characteristics.

16. The United States Bureau of Labor Statistics defines green jobs as those pertaining to both the production of environmental goods and services and the promotion of environmentally friendly production processes within enterprises (BLS, 2010). Only jobs in the environmental goods and services sector have been measured in the United States. Efforts to continue the measurement of green jobs have been dropped (BLS, 2013).

Box 2.6

Jobs in the environmental goods and services sector

Environmental goods and services are those that directly benefit the environment or conserve natural resources. They can be specific environmental services (such as waste and wastewater management and treatment, energy and water-saving activities, conservation and protection), environmental sole-purpose goods, which have no use except for environmental protection or resource management (e.g., catalytic converters, septic tanks, installation of renewable energy production technologies), or adapted goods that have been modified to be cleaner or more resource efficient (such as buses with lower emissions).

Estimates of the number of jobs in the environmental goods and services sector can differ, as not all definitions are completely consistent. Nonetheless, estimates suggest that the sector accounted for 2.0 per cent of employment in the European Union (EU-28) in 2013, employing 4.1 million people. In the United States, the sector employed 3.4 million people in 2011, or 2.6 per cent of overall employment (Elliott and Lindley, 2017; Eurostat, 2017; ILO, 2013b and 2014; NSO, 2017).

For example, in Mongolia in 2016, employment in the environmental sector was estimated at 374,100 workers, of whom 233,500 are employed in the production of environmental outputs and 341,500 in environmental processes (some workers can work simultaneously in environmental output and environmental processes). Of the 374,100 jobs in the environmental sector, 112,300 (30 per cent of employment in the environmental sector, or 9.9 per cent of total employment) are green jobs because they are also decent, being covered by social security schemes. From the perspective of wages, 196,800 jobs in the environmental sector (53 per cent of jobs in the environmental sector, or 17.4 per cent of total employment) would be considered green as they pay decent wages (that is, they pay more than two-thirds of median earnings).

The ILO supports governments, employers and workers in the promotion of a just transition towards environmentally sustainable economies and societies for all. Following the Tripartite Meeting of Experts on Sustainable Development, Decent Work and Green Jobs, held in 2015, the ILO's Governing Body endorsed the *Guidelines for a just transition towards environmentally sustainable economies and societies for all* at its 325th Session in 2015. The ILO has begun using the *Guidelines* in its activities in Uruguay and the Philippines (box 2.7), as well as Ghana. The *Guidelines* propose a set of balanced policy measures to be developed within each country, based on social dialogue, to facilitate the transition towards environmentally sustainable economies and societies by setting the right incentives for enterprises and protecting workers. The ILO has also collaborated with the UK Department for International Development (DfID), UN Environment, UN-Habitat and the county governments in the Maasai pastoralist communities of Narok and Kajiado in Kenya to reduce vulnerabilities to climate risks and improve livelihoods and living standards. The project benefited pastoralist women through the creation of green jobs in the building industry, while contributing to community resilience and poverty reduction.[17] The ILO is also involved in the Euro-Mediterranean Green Jobs (EGREJOB) project which brings together bodies and associations from Italy, Lebanon, Spain and Tunisia for the development of the green economy.

17. Project information can be found at: http://www.ilo.org/global/about-the-ilo/newsroom/features/WCMS_554979/lang--en/index.htm

Box 2.7

Implementing the *Guidelines for a just transition* in Uruguay and the Philippines

Uruguay has been increasingly focusing on implementing the SDGs and action on climate change. It is actively promoting a just transition to a green economy. Accordingly, Uruguay's Decent Work Country Programme (DWCP), adopted in 2015, emphasizes the importance of productive development to encourage business development and job creation. A first ILO Green Jobs Assessment made an estimate of the green jobs already existing in the country and their contribution to GDP as a baseline for action to promote the creation of green jobs. It also recognized the opportunities and weaknesses at the national level for creating green jobs. National studies show the relevance of green jobs in promoting environmental protection, securing improvements in competitiveness and the transition towards a greener economy.

The Philippines is highly vulnerable to extreme weather events and other, long-term, climate risks. Climate change will have an almost certain and long-term impact on its economy, sustainable development, social equity and national security. In April 2016, the Philippine Government adopted the Green Jobs Act, with the aim of leveraging the process of structural change towards a sustainable, low-carbon, climate-resilient economy that creates decent jobs on a significant scale.

The pilot implementation of the *Guidelines* in Uruguay started in 2016 and has two main objectives. First, to create employment, while simultaneously protecting natural resources and ensuring decent work and social well-being. Second, to develop a model of intervention to be followed by other countries and stakeholders for the implementation of the *Guidelines* and the adoption of green jobs strategies. Consultations with tripartite stakeholders, studies on renewable energy sectors and capacity-building through training activities will contribute to the implementation of the *Guidelines*.

In the Philippines, the implementation of the *Guidelines* follows a dual approach. First, a Green Jobs Assessment, analytical research, capacity-building and advocacy will develop ways to enable the creation of sustainable enterprises and decent work opportunities and to ensure social well-being. Second, a technical working group and tripartite cooperation have developed an intervention model at the industry, enterprise and local levels with capacity-building activities for all stakeholders to showcase measures associated with the just transition. These activities have resulted in measurements of green jobs, modelling and policy, which have been presented to and validated by all the relevant stakeholders as a basis for developing a framework and specific policies. These evidence-based activities have raised the awareness of stakeholders and the general public. Finally, the intervention model for just transition has been developed and tested at the industry, sectoral and local levels.

With funding from the Swedish International Development Cooperation Agency and other ILO sources of funding, the pilot implementations of the *Guidelines* in Uruguay and the Philippines have so far resulted in the establishment of a tripartite project steering committee and national dialogues to define priorities, project strategy and expected outcomes, based on the contribution of green jobs to society.

In Uruguay, it has also resulted in: (1) sectoral research focusing on (a) the impact of a national renewable energy strategy on employment; and (b) a study on green jobs in the citrus sector to understand the expected changes, challenges and opportunities; (2) capacity-building activities to provide stakeholders with guidance on the implementation of the project, and knowledge and understanding of green jobs and possible strategies and policies to promote their creation; and (3) collaboration with other actors through partnership with United Nations Environment and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), among others, as well as regional cooperation through workshops.

In the Philippines, it has also resulted in: (1) strengthening social partners' and other stakeholders'understanding of the need for the transition to a green economy through sustainable development, decent work and green jobs; (2) the integration of a Just Transition Framework in the implementing rules and regulations of the Green Jobs Act, together with the development of the Green Jobs Human Resource Development Plan to ensure an inclusive and equitable shift towards a sustainable economy; and (3) the integration of just transition issues and the promotion of green jobs in national frameworks and policies.

C. Green enterprises: Key actors in the transition

Enterprises can lead the way to the green economy

Enterprises are the principal source of economic growth and employment (ILO, 2017). They are key actors in guiding and sustaining the transition to a low-carbon and resource-efficient economy as they are sources of innovation, adoption of new technologies, financing, strategic outlooks, contracts throughout the value chain and know-how to address environmental challenges (ILO, 2013a; ITC-ILO, 2016). This role has been acknowledged by the international community, for example through the Sustainable Stock Exchange Initiative (SSE, 2016) and the ILO's Green Jobs and Sustainable Enterprises programmes (ILO, 2013a; ITC-ILO, 2016); and businesses themselves, for example through the World Business Council for Sustainable Development (WBCSD, 2010) and certification schemes like B-corps (Chen and Kelly, 2015).

This section highlights how enterprises benefit from a stable natural environment and face risks arising out of environmental degradation. It shows what it means for enterprises to become green and how sustainability makes business sense, with implications for the entire value chain and specific challenges for micro-, small and medium-sized enterprises (MSMEs). However, although the voluntary action taken by enterprises so far is welcome, it is not enough to ensure environmental sustainability, which suggests that governments need to provide overall direction, targets, guidance, incentives, norms, monitoring and enforcement (Gunningham and Holley, 2016). As discussed in Chapter 3, social dialogue and collective agreements can help enterprises embrace sustainability.

Enterprises benefit from a stable natural environment

Enterprises benefit from a predictable and sustainable natural environment and from being sustainable enterprises themselves (ILO, 2007). As noted in Chapter 1, environmental degradation can lead to the loss of the ecosystem services that sustain economic activity. Ecosystem services are in practice enterprise inputs, many of which are not priced. Moreover, human-induced climate change increases the occurrence and strength of natural hazards, which create uncertainty for businesses and drive up direct costs through the disruption of operations and supply chains. These costs are in addition to those borne by enterprises in relation to land conversion, land degradation, water availability, biodiversity loss, chemical exposure and waste.

For example, and only in terms of environmental issues related to water, over half of the companies surveyed by the Carbon Disclosure Project (CDP) in 2016 experienced higher operating costs due to an increase in energy and water costs associated with droughts, or received fines and penalties associated with the non-sustainable use of water (CDP, 2016a).[18] In deforestation-related activities, four out of five companies surveyed had experienced impacts related to forest-risk commodities, which affected operations, revenue or expenditure over the past five years. Deforestation has also become a key concern for companies engaging directly or indirectly in the production and trade of soy, palm oil, timber and cattle. Their reliance on deforestation to expand production can contribute to habitat loss, GHG emissions and social conflict, exposing suppliers and customers to negative perceptions (CDP, 2016b). In view of their concerns at the effects of an unstable environment on their business, large multinational companies from the technology, food, oil, chemical, pharmaceutical, retail, consumer goods, electricity and mining sectors have voiced support for the Paris Agreement (C2ES, 2017).[19]

18. The Carbon Disclosure Project (CDP) water programme surveyed 1,252 of the largest companies to gather information on their efforts to manage and govern freshwater resources. The companies were selected from the MSCI All Country World Index. Around half of the targeted companies (607) responded to the questionnaire (CDP, 2016a). The CDP forest programme surveyed 821 global companies to gather information on how they manage and mitigate risks associated with the sourcing or production of four commodities responsible for deforestation (timber products, palm oil, soy and cattle products). Roughly a quarter of the companies (201) replied to the questionnaire (CDP, 2016b).

19. On 26 April 2017, Apple, BHP Billiton, BP, DuPont, General Mills, Google, Intel, Microsoft, National Grid, Novartis Corporation, PG&E, Rio Tinto, Schneider Electric, Shell, Unilever and Walmart addressed an open letter to the President of the United States urging the country to remain a party to the Paris Agreement. The companies recognize the costs of climate change and the economic and employment opportunities of a green economy. They argue that the Paris Agreement offers a stable and practical framework that allows them to compete and plan future investment and reduce future climate impacts (C2ES, 2017).

Environmental degradation brings increased risk for enterprises

Table 2.5 draws on UNEP (2013) to outline the implications of current environmental trends for business. Although some market opportunities arise from environmental degradation (for example, for enterprises engaged in the restoration of degraded land), the majority of impacts run counter to the interests of most enterprises.

Enterprises recognize these risks to their operations, revenues or expenditures. They also identify opportunities to embrace the transition to low-carbon and resource-efficient economies. CDP data relating to climate change suggest that in 2016 practically all enterprises recognize the risks and opportunities arising out of climate change regulation, climate change physical parameters or other climate-related developments. This was not necessarily the case in 2010, when only around 80 per cent of the enterprises recognized the risks and opportunities (figure 2.4).

Table 2.5

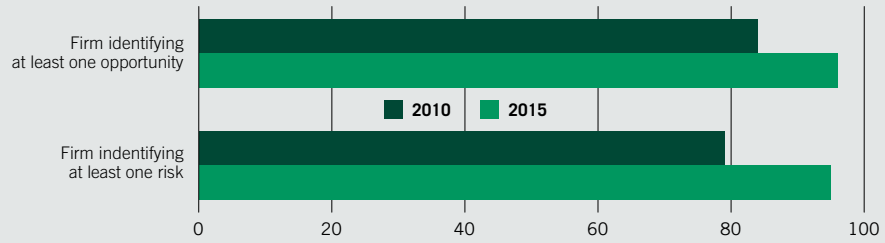
The business implications of environmental degradation

Environmental trend	Implications for business
Increase in greenhouse gas emissions and climate change	Market shifts favouring lower-carbon products; operational and supply chain disruptions; higher cost of energy, food and other commodities; shifting production and transport patterns to adapt to local conditions
Increased occurrence of severe weather events	Operational and supply chain disruptions; increased cost of operations and materials; damage to shared public infrastructure; increased demand for reconstruction services
Land conversion	New and growing markets arising out of urban expansion; restricted access to land-based resources; loss of ecosystem services; competition for arable land; increasing pressure to protect critical natural resources
Reduced water availability	New markets for water-efficient products; constraints on growth due to water scarcity; operational and supply chain disruptions; conflicts with other stakeholders over limited supply of water; increasing cost of water
Increased water pollution	Increased demand for pollution control devices and systems; increased cost of water treatment; stricter water quality regulations; increased demand for health-care services to treat health impacts
Biodiversity loss	Increased market, reputational and regulatory pressure to reduce biodiversity impacts; increased cost and reduced availability of scarce resources; reduced opportunity for new product breakthroughs; limitations on access to land
Increased chemical exposure	Market shift towards environmentally sustainable products; product use restrictions; regulatory, customer and public pressure for greater transparency
Increased waste	Growing market opportunities to recover/reuse e-waste and other forms of waste; increasing regulatory and customer pressure to reduce/manage waste; reputational damage resulting from uncontrolled waste
Increased work accidents and diseases	Higher cost of employment injury benefits and contributions due to workers' compensation

Source: ITC-ILO, 2016, based on UNEP, 2013.

Figure 2.4

Firms identifying at least one opportunity or risk from climate change, 2010–15 (percentages)



Notes: Results based on 760 enterprises with information in FactSet reporting to CDP in 2010 and 2015. Appendix 2.3 provides more information about the firms in the sample. Enterprises were asked about the existence of climate change-related risks and opportunities arising out of: (i) physical climate parameters; (ii) regulatory changes; and (iii) other climate-related developments. These include, for example: (i) changes in natural resource availability and rain and temperature patterns; (ii) carbon taxes, energy taxes, emission trading schemes, emissions regulations and international agreements; and (iii) changing consumer behaviour and fluctuating socio-economic conditions.

Source: ILO calculations based on CDP 2015 data.

Figure 2.5

Firms that decoupled GHG emissions from sales growth, 2010–15

Notes: Firms that have coupled sales growth are those which increased sales and GHG emissions. Firms that had decoupled sales growth are those that increased sales while reducing GHG emissions. Firms that had coupled sales decline experienced a decline in sales and GHG emissions. Firms that had a decoupled sales decline experienced a decline in sales with an increase in GHG emissions. Results based on 760 enterprises with information in FactSet reporting to CDP in 2010 and 2015. Appendix 2.3 provides more information about the firms in the sample.

Source: ILO calculations based on CDP 2015 and FactSet.

For firms, going green implies adopting green products, green services and/or green processes and technologies

To grasp the opportunities associated with the transition to a green economy, enterprises need to adopt sustainable business models, which in turn requires consideration of a triple-bottom-line approach in which social and environmental outcomes complement a profit-only strategy (Bocken et al., 2014). Enterprises that consider the three outcomes jointly are oriented towards the production of goods and services that actively promote environmental sustainability (green goods and services) and/or the adoption of environmentally sustainable processes (green processes) (ILO, 2013a; ITC-ILO, 2016). Environmental management systems, such as ISO 14000 and the European Union Eco-Management and Audit Scheme (EMAS), can guide enterprises in the adoption of green processes (ITC-ILO, 2016). Moreover, the adoption of blockchain technology can sustain trust, ensure traceability and advance enterprises and production towards sustainability in certain sectors like mining, forestry, fishing and forestry (Chapron, 2017).

Enterprises have begun to decouple their growth from GHG emissions. In the same way as for countries (see Chapter 1), growth in the economic activity of enterprises does not need to be associated with more emissions. As further elaborated below, this is because sustainability makes business sense. Some 760 enterprises disclosed their emissions to the CDP in 2010 and 2015, and their sales and employment information is available in FactSet.[20] Of these 760 firms, 22 per cent have decoupled and have achieved sales growth and a reduction in their GHG emissions (figure 2.5). However, the economic activity of a large number of enterprises remains coupled to emissions. For 31 per cent of these enterprises, sales growth was accompanied by an increase in GHG emissions, while 28 per cent experienced a decline in sales alongside a reduction in emissions.[21]

Embracing environmental sustainability makes business sense

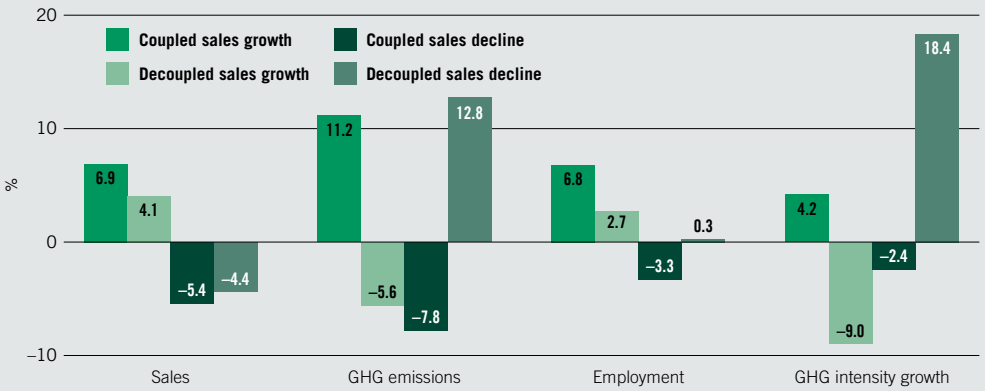
A key debate concerns the extent to which a shift to environmental sustainability can be complementary with current models of enterprise profitability or requires alternative business models. For some, all the efforts made, although welcome, will ultimately fail if they do not reflect positively on the bottom line and promote profits (Unruh et al., 2016). Indeed, enterprises need the appropriate price signals, regulations and mandates to embrace sustainability (Strand and Toman, 2010). Today, going green makes

20. Appendix 2.3 provides more information on the CDP, FactSet and the types of enterprises covered by the two surveys by sector, size and region.

21. The fact that some companies experienced a reduction in sales growth with an increase in GHG emissions could be driven by capital-intensive firms, as their energy demands may be less dependent on sales.

Figure 2.6

Change in sales, GHG emissions and employment for coupled and decoupled firms, 2010–15



Notes: Firms that have coupled sales growth are those which increased sales and GHG emissions. Firms that had decoupled sales growth are those that increased sales while reducing GHG emissions. Firms that had coupled sales decline experienced a decline in sales and GHG emissions. Firms that had a decoupled sales decline experienced a decline in sales with an increase in GHG emissions. Results based on 760 enterprises with information in FactSet reporting to CDP in 2010 and 2015. Appendix 2.3 provides more information about the firms in the sample.

Source: ILO calculations based on CDP 2015 and FactSet data.

business sense (Unruh et al., 2016), particularly as sales of consumer goods from brands committed to sustainability are growing faster than those of other brands, and an increasing share of consumers are willing to pay more for sustainable products (Nielsen, 2015).

Decoupling growth from GHG emissions does not limit the ability of enterprises to grow. Between 2010 and 2015, companies that decoupled sales growth from GHG emissions achieved an annual rate of sales growth of 4.1 per cent and an annual rate of employment growth of 2.7 per cent. However, companies that coupled sales growth with GHG emissions over that period grew faster in terms of sales and employment, at around 7 per cent (figure 2.6).[22] Nevertheless, it is likely that, over the long term, coupled firms will experience slower growth as a result of more volatile energy prices, as can be seen from the benefits that enterprises derive from embracing sustainability and the fact that coupled firms which saw sales decline experienced a strong decline in both sales and employment (figure 2.6).

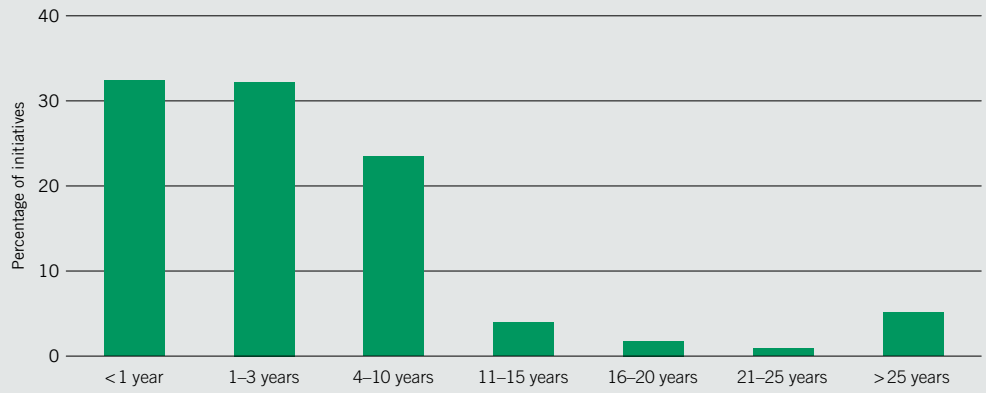
In the long term, sustainability reduces risks, lowers the cost of capital and improves revenue performance and operational efficiency (ITC-ILO, 2016). The Ellen MacArthur Foundation (2013) shows how embracing a circular mode of production provides short-term cost benefits, new profit tools and long-term strategic opportunities. Enterprises that adopt a circular model of production should expect reduced material bills and warranty risks, improved customer interaction and loyalty, less product complexity and more manageable product life cycles. Major enterprises have adopted the circular economy. For example, 36 per cent of the total mass of a new car produced by a major French auto manufacturer is made from recycled materials and 85 per cent of such a new vehicle is recyclable when it reaches the end of its life (Ellen MacArthur Foundation, 2017). The Government of Scotland (2016b), in collaboration with stakeholders, has outlined a framework to promote waste prevention and design for longer product lifetimes, reuse, repair and recycling.

The available technology and infrastructure means that investing in clean processes is now cost effective (Ellen MacArthur Foundation, 2013). For example, investing in green products and services and green processes makes business sense in the context of GHG emissions reductions. Of the enterprises reporting to the CDP in 2015, 1,839 were implementing 5,929 initiatives to reduce GHG emissions, involving an overall investment of current US$ 103.9 billion. Initiatives include, but are not

22. The results in figure 2.6 remain largely unchanged after taking into account the industry, region, age and size of enterprises through regression models.

Figure 2.7

Payback period for initiatives to reduce GHG emissions



Note: Percentages calculated on the basis of 5,929 initiatives listed in the CDP 2015 database by 1,839 firms.

Source: ILO calculations based on CDP 2015 data.

restricted to, measures to increase the energy efficiency of manufacturing processes, transportation or buildings, or installing low-carbon energy sources. For more than 60 per cent of the enterprises, the investment is paid back in less than three years, and for 80 per cent of them the payback period is less than ten years. Payback is a result of both savings and the sales growth associated with the investment (figure 2.7).

The potential to reap greater business benefits is high and applies to the entire value chain

Investors are increasingly recognizing the business case for going green. They also see sustainability as an indicator of effective management. Three-quarters of investors consider sustainability to be materially important when making business decisions (Unruh et al., 2016).

The business case for going green goes beyond specific enterprises and comprises the whole supply chain. Businesses engaging in environmentally sustainable practices should consider their dual role as producers and consumers (ITC-ILO, 2016). Golicic and Smith (2013) find that enterprises that require environmentally sound practices from their suppliers achieve better performance.

Although the business case for adopting environmentally sustainable practices is clear for the majority of enterprises and is valued by investors, enterprises tend to believe that investors are not very interested in sustainability performance (Unruh et al., 2016). Even though the great majority (90 per cent) of the enterprises surveyed believe that adopting a sustainability strategy is important to remain competitive, only 60 per cent have adopted such a strategy in practice, and only a quarter explicitly point out the business case of adopting sustainability. A perceived lack of consumer demand for such action, the difficulty of quantifying the intangible effects of sustainability in cost–benefit analyses, short-term thinking in planning and budgeting cycles and insufficient resources all limit the capacity of enterprises to address sustainability issues more robustly (ibid.). Public policy, through price incentives and regulation, can help to ensure that all enterprises embrace sustainability.

This mismatch between attitudes and practice regarding sustainability is also seen in relation to environmental risks, which may be perceived as individual risks, and not part of an enterprise's comprehensive risk management strategy (CDP, 2016b). Chapter 3 examines how engagement with trade unions, social dialogue and collective agreements can promote the adoption of sustainability strategies by enterprises.

When public efforts to support the transition have lagged behind (the top-down approach), enterprises can take the lead in supporting the transition (the bottom-up approach). For example, despite the steps taken to decarbonize the Australian economy in the early 2000s, public efforts have recently weakened. In this context, some corporations have themselves taken the initiative of moving away from coal-based energy. Illustrations include a utility company in Australia and its plan to decarbonize electricity generation by 2050, the efforts made by an Australian solar power manufacturer to reconvert the coal-producing Latrobe Valley into a hub for the manufacture and recycling of batteries, and an Australian company, which offers homeowners a business case to install solar panels and sell the electricity to tenants (Huon et al., forthcoming).

Micro-, small and medium-sized enterprises face specific challenges in embracing sustainability

Most research, attention and initiatives focus on large corporations. Indeed, targeting large corporations is effective for now, as action by a few enterprises can go a long way in reducing emissions and environmental degradation, particularly if the action involves their entire value chain. The 1,839 firms reporting to CDP in 2015 account for around 11 per cent of global emissions.

However, micro-, small and medium-sized enterprises (MSMEs) account for over 90 per cent of enterprises throughout the world and, although their individual energy consumption may be small (and, by extension, their individual emissions and environmental impact), their collective impact is considerable. Together, MSMEs consume over 13 per cent of total global energy production (IEA, 2015). MSMEs tend to be slower to embrace environmentally sustainable processes or to shift to the production of green goods and services. The IEA (2015) emphasizes that energy efficiency may be the most effective way for MSMEs to reduce their GHG emissions with relatively little or no investment. MSMEs are particularly relevant to advance environmental sustainability and promote formal employment in rural economies.

The engagement of MSMEs with environmental sustainability is limited by the additional costs, lower awareness, voluntary practices that do not result in direct business benefit and the perception that customers are not interested in their environmental impact (Aykol and Leonidou, 2015; Hillary, 2000). Indeed, even if sustainable management tools exist for MSMEs, they are rarely taken up (Johnson and Schaltegger, 2016). The lower access to finance of MSMEs compared with larger firms usually limits their ability to grow and to adopt environmental practices (Hoogendoorn, Guerra and van der Zwan, 2015). Informality can be another limitation for MSMEs, for example by excluding them from public incentives (such as subsidies to adopt energy efficiency) and their workers from training and skills development programmes, as well as by precluding social dialogue. As further examined in Chapters 3 and 5, social dialogue and skills development are key elements in facilitating a just transition to environmentally sustainable societies. The Transition from the Informal to the Formal Economy Recommendation, 2015 (No. 204), contains guidance that can help countries to adopt policies to facilitate this step.

The cooperative business model is well positioned to play a role in addressing some of the challenges in the renewable energy industry, particularly through community-driven initiatives supporting access to affordable and clean energy sources for all. Cooperatives have a number of competitive advantages in the production, provision and distribution of energy, including democratic control by the communities over energy production and use, the capacity to create local employment and promote local development, and reasonable pricing (ILO, 2013c). Energy cooperatives responding to the demands for democratizing energy production and distribution are prevalent in countries across the world, ranging from rural electricity cooperatives in Costa Rica and Bangladesh and biomass production plants in Brazil and Finland to photovoltaic cooperatives in Denmark and Argentina.

The positive momentum needs to be strengthened

Large enterprises have adopted several tools to drive action to reduce their GHG emissions. These include voluntary internal carbon pricing mechanisms, participation in emissions trading schemes and broader investment strategies to reduce emissions. These efforts are generally set against self-determined emissions reduction targets. But these targets, even if they are met, only constitute one-quarter

of the emissions reductions needed from these firms to achieve the 2°C goal set by the international community, also falling short of the 1.5°C goal. Self-determined targets only amount to one-tenth of potential emissions reductions by the private sector as a whole (CDP, 2016c). Macroeconomic policies (ILO, 2015) and infrastructure investment (OECD, 2017) can provide the necessary price signals, incentives, regulation and business environment to improve the measures taken and to achieve the 1.5°C or the 2°C goal.

Policies are needed if enterprise action is to bear fruit. During the 1990s, reliance on information disclosure, social licences and price signals to guide profit-seeking activity and other voluntary schemes offered only limited incentives for enterprises to adopt environmental practices. Smart regulation can enhance the motivation of current businesses to achieve sustainability, and stimulate the necessary motivation in other cases (Gunningham and Holley, 2016). In the United States, a US$40 tax per CO_2eq ton emitted, coupled with border tax adjustments, could help to meet the Paris Agreement target, reduce the burden of emissions regulation and improve the well-being of most citizens (Bailey and Bookbinder, 2017; Baker et al., 2017). As further examined in Chapters 3, 4 and 5, pricing externalities and ecosystem services, environmental regulation, social protection, skills and access to finance can pave the way for firms, and the economy as a whole, to go green.

Conclusions

Chapter 1 showed that, from the perspective of the world of work, the transition towards a low-carbon and resource-efficient economy is urgent. This chapter shows that achieving environmental sustainability can lead to an economy that offers more jobs. Though there is sectoral reallocation, achieving sustainability does not destroy jobs at the level of the whole economy. Net job creation is expected if sustainability is embraced in the energy sector and by adopting some tenets of the circular economy. It shows that there is a sound business case for enterprises to adopt sustainability. Like Chapter 1, this chapter also demonstrates that the SDGs that promote environmental sustainability can be compatible with food security (SDG 2), clean energy (SDG7) and decent work for all (SDG 8).

Indeed, around 18 million jobs are expected to be created if, by 2030, there has been a transition in energy use towards greater efficiency and energy is sourced from renewables, as opposed to fossil fuels, in line with the IEA scenarios, if electric vehicle sales meet projections and any savings in energy efficiency are used to invest in building's energy efficiency. This net job creation masks an important restructuring of the economy, with employment losses expected in the fossil fuel sectors and related industries, and in regions that are heavily dependent thereon.

A similar transformation will affect the entire economy if agriculture embraces sustainability, with the effects depending on the sustainability path adopted. For some regions, particularly in developed countries, a transition may involve embracing organic agriculture. For others, particularly in developing countries, a decent work friendly and food security friendly sustainability path may mean adopting conservation agriculture. In either case, complementary policies will be needed to ensure that these changes enhance decent work in the agriculture sector and that any employment losses can be used as an opportunity to guide the structural transformation in developing countries.

Moreover, the redistribution of economic activity and jobs will affect different sectors, as sustainability in one sector affects the chain of inputs. While this is true for all forms of sustainability, this is clearly seen in the employment changes associated with the adoption of a circular economy. By replacing the extraction of resources and the manufacture of goods for ownership by the reuse, repair, recycling and renting of goods, employment will move away from extraction and manufacturing into reprocessing, waste management and services. Overall, these findings suggest that the achievement of a green economy can enhance employment opportunities. They also emphasize that the transition requires support for workers, industries and regions from which employment opportunities are displaced. This support needs to be accompanied by incentives to ensure that they too put their weight behind the transition.

The transition requires global collaboration across countries, enterprises and workers. The interconnectedness of global supply chains means that consumption and production in one country embed the emissions and materials used in others (Tukker et al., 2014), resulting in regions being affected differently. Also, as indicated in Appendix 2.2, many environmental challenges are global, including climate change, even though their causes may be limited to a few countries and sectors, and their effects will mostly be felt over the medium to long term, with little incentive to act in the present. The transition requires the re-thinking of production and consumption patterns and, to a certain extent, social organization and solidarity (Maxton and Randers, 2016). Indeed, workers and enterprises have a key role to play in the transition, through green jobs, innovation, the adoption of new technologies and modes of production, investment and standard-setting. Progress in this area is already visible, but is yet not sufficient, which signals the need for an integrated policy framework to accelerate the transition by workers and enterprises alike. Chapters 3, 4 and 5 examine in greater depth the legal framework, social protection tools and skills policies required to achieve this global transformation.

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3 Regulatory frameworks: Integration, partnerships and dialogue

KEY FINDINGS

International labour standards (ILS) provide a regulatory framework for the social pillar of the green economy and help ensure decent work practices in sectors affected by the green transition. In addition, ILS protect the environment. On the one hand, they do so indirectly through the protection of workers and the working environment, as is the case of standards on occupational safety and health (OSH), for example. On the other hand, certain ILS address environmental issues directly. These include the Indigenous and Tribal Peoples Convention, 1989 (No. 169), which requires environmental impact assessments, the Prevention of Major Industrial Accidents Convention, 1993 (No. 174), and the Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205).

Labour dimensions such as environmental rights at work, employment protection and promotion, and in particular occupational safety and health are being increasingly integrated into multilateral environmental agreements (MEAs).

National environmental legislation and policies have begun to include labour issues. For example, a review of climate change policies in 26 countries shows that in 19 of them these policies include labour issues. In particular, climate change policies include the promotion of skills and training, as well as setting job creation as a formal objective or as an outcome of climate change adaptation and mitigation measures. Sectoral legislation also includes employment and decent work concerns. Indeed, out of 40 countries whose energy legislation was analysed, in different regions and at different levels of development, 27 include labour issues such as skills development and training.

Both developed and emerging countries have enacted legislation and policies to foster the "greening" of jobs, but this has also been done in developing countries. A recent analysis of 16 countries in sub-Saharan Africa shows that legislation linking labour and environmental issues has been adopted increasingly since the early 2000s, particularly in relation to renewable energy and waste management.

Social dialogue is a valuable tool for advancing towards a just transition. At the international level, green issues, together with labour standards, have become the subject of social dialogue between multinational enterprises and global union federations in International Framework Agreements. At the national level, social dialogue has contributed to making environmental governance more labour-friendly, for instance through collective agreements.

There is emerging consensus on the regulatory and policy framework needed to facilitate the interaction between the environmental and the decent work agenda, but it is too early to pinpoint obstacles to further progress.

Introduction

It is undeniable that, to be just, a transition to a low-carbon economy needs to take into account decent work and social justice. This premise has been reinforced by the UN 2030 Agenda for Sustainable Development, as well as the Paris Agreement. In the preamble to the latter, the Parties recognize the "imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities".

There is currently no distinct area of law dealing with green jobs. While legal researchers have recently started exploring the possibility of a "just transition law" in the framework of environmental sustainability, they have also acknowledged that its emergence is still distant (Doorey, 2017).[1] Rather, what exists is two separate branches of standards and policies within the fields of labour and the environment.

Chapters 1 and 2 have examined the rationale behind the need for a transition to environmentally sustainable economies and provided evidence of its job creation potential. This chapter focuses on analysing existing international rules and instruments which form part of the policy options available for the process of a "just transition".

The chapter first looks at international instruments on labour and environmental matters. It reviews international labour standards (ILS), based on their broad acceptance and universal relevance, as a means of promoting and ensuring decent working conditions in sectors most affected by the transition.[2] Multilateral environmental agreements (MEAs) are also examined with a view to identifying the labour issues that they incorporate, principally occupational safety and health (OSH) (section A). The chapter then analyses how the process of the integration of labour and environmental laws has taken place at the national level. It reviews and compares the links between environmental legislation and policies with labour considerations in 52 countries (section B). Finally, it discusses the role of social dialogue as a means to a just transition towards environmentally sustainable economies and societies for all and examines the different ways in which the social partners have contributed to the process of greening (section C).

1. Nevertheless, a "just transition law" would "provide a framework for organizing a coherent body of law", including aspects of other legal fields, including labour and environmental law (Doorey, 2017).

2. ILS are legal instruments developed by governments and the representatives of employers and workers, the ILO's constituents, which establish basic principles and rights at work. They mainly take the form of Conventions, Protocols and Recommendations (ILO, 2014).

A. Integration of environmental protection and labour issues at the international level

This section examines the role of international labour standards (ILS) in a just transition. Analysis of the structure of ILS identifies that the entire body of standards found in ILO Conventions and Recommendations is relevant to the green transition. In addition, at least 11 ILO instruments contain express references to environmental concerns. As the section demonstrates, ILS can also contribute to implementing principles of sustainable development, and therefore contribute to dealing with the environmental impact of the world of work and framing responses to environmental challenges.

INTERNATIONAL LABOUR STANDARDS RELEVANT TO THE PROCESS OF GREENING WITH JOBS

International labour standards ensure a just transition to a green economy

As yet there is no specific international labour standard on a just transition.[3] However, the tripartite *Guidelines for a just transition towards environmentally sustainable economies and societies for all,* endorsed by the ILO Governing Body at its 325th Session in 2015, set out the roles of the ILO's constituents and provide a non-exhaustive list of ILO instruments relevant to the just transition framework and covered in this chapter.[4] As the *Guidelines* point out, international labour standards offer a framework for addressing most of the issues associated with the greening of the economy and, more broadly, with the transition towards sustainable development. In view of their universality and flexibility, ILS are relevant to all workers, sectors and workplaces, including emerging green sectors.[5] ILS therefore contribute to the regulatory framework of the green economy's social pillar and can promote decent working conditions in green sectors. Additionally, ILS deal with issues that have environmental ramifications, such as lack of employment and adequate standards of living, and also provide a legal framework for skills relevant for the green transition, as further analysed in Chapter 6.

Certain specific ILS, and particularly the fundamental and governance Conventions,[6] make an overall contribution to the regulation of the labour market. They also act as a tool for the social partners to address the challenges posed for the workplace and employment in general by the process of greening (Olsen, 2009). For example, the Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87), and the Right to Organise and Collective Bargaining Convention, 1949 (No. 98), provide guidelines on how to ensure participation in decision-making related to environmental and climate change policies affecting the world of work.

Impacts of climate change on livelihoods and labour markets have increasingly drawn attention (and sometimes alarm) to the prospects of cross-border human displacement (Kagan et al., 2017). Recognizing the importance of protecting the rights of migrant workers as essential to social justice in the world of work,[7] the ILO has adopted a number of standards on, or affecting, migrant workers (Rodgers et al., 2009). These standards include the Migration for Employment Convention, 1949

3. A proposal was made to include an item on the agenda of the International Labour Conference with a view to the adoption of a standard on a just transition. It was argued that such an instrument would provide the *Guideline*s with "force and authoritative guidance" and that it would be a means for the International Labour Conference and the Governing Body "to monitor the implementation of social and labour issues in relation to environmental change and related policies". So far there is no consensus on this question among the ILO's tripartite constituency. Irrespective of the adoption of an instrument on this issue, the *Guidelines* are starting to be implemented, as seen in Chapter 2.

4. ILO, 2017a, Appendix I.A, indicates that the governance structures of the climate change regime are not sufficient to address the needs and realities of the world of work, and that the International Labour Conference is the body that is best placed to "complement the global policy framework on environmental matters".

5. On *universality* and *flexibility,* see e.g. Valticos (1979); Von Potobsky and de la Cruz (1990); ILO (2014); Servais (2017).

6. The eight fundamental Conventions are: the Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87); the Right to Organise and Collective Bargaining Convention, 1949 (No. 98); the Forced Labour Convention, 1930 (No. 29); the Abolition of Forced Labour Convention, 1957 (No. 105); the Minimum Age Convention, 1973 (No. 138); the Worst Forms of Child Labour Convention, 1999 (No. 182); the Equal Remuneration Convention, 1951 (No. 100); and the Discrimination (Employment and Occupation) Convention, 1958 (No. 111). The four governance Conventions are: the Labour Inspection Convention, 1947 (No. 81); the Employment Policy Convention, 1964 (No. 122); the Labour Inspection (Agriculture) Convention, 1969 (No. 129); and the Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144).

7. Constitution of the International Labour Organisation, as modified by the Instrument of Amendment of 1972 (entry into force: 1 November 1974).

Table 3.1

International labour standards relevant to climate adaptation and mitigation policies

Adaptation policies	Mitigation policies
Climate change induced stress at work: • **Hazardous air quality**: C148 (Working Environment); • **Measures to cope with heat and other stress at work**: C110 (Plantations), R116 (Reduction of Hours); • **Occupational safety and health**: C155 &P155 (OSH), C187 (Promotional Framework for Occupational Safety and Health), C171 (Occupational Health Services).	**Enhancement of adaptive capacity:** • **Poverty reduction**: various ILS, including on fundamental rights at work, employment, social security, OSH; • **Improving education/knowledge and skills**: C140 (Paid Educational Leave), C142 (Human Resources Development); C155 & P155 (OSH); • **Promoting rights of groups vulnerable to the climate change**: C111 (Discrimination), C159 & R168 (Vocational Rehabilitation and Employment (Disabled Persons)), C183 (Maternity Protection), C169 (Indigenous and Tribal Peoples).
Compensation and protection of workers in affected sectors: • **Unemployment**: C102 (Social Security (Minimum Standards)), C168 (Protection against Unemployment); • **Compensation for the victims of pollution/environmental damage**: R181 (Prevention of Major Industrial Accidents); • **Compensation for removal from traditional lands**: C169 (Indigenous and Tribal Peoples); • **Minimum levels of benefits to workers facing an accident or illness related to work**: C121 & R121 (Employment Injury Benefits), C202 (Social Protection Floors).	**Prevention of damage to the environment:** • **Prevention and protection measures**: C162 & R172 (Asbestos); C176 (Safety and Health in Mines); R192 (Safety and Health in Agriculture); • **Environmentally sound management of pollution and waste disposal**: C162 & R172 (Asbestos); C170 & R177 (Chemicals); C184 & R192 (Safety and Health in Agriculture); • **Environmental impact assessment**: C169 (Indigenous and Tribal Peoples).
Climate-induced displacement (migration): • **Labour migration specific standards**: C97 (Migration for Employment); C143 (Migrant Workers); R100 (Protection of Migrant Workers); R151 (Migrant Workers).	**Reduction of greenhouse gas emissions:** • **Agriculture:** C184 & R192 (Safety and Health in Agriculture); • **Mining**: C176 & R183 (Safety and Health in Mines).
Measures to address disasters: • **Preparedness and response to industrial disasters**: C174 (Prevention of Major Industrial Accidents); • **Preparedness and response to natural disasters and other situations of crisis**: R205 (Peace and Resilience).	**Sectoral policy measures:** • **Agriculture**: C184 & R192 (Safety and Health in Agriculture); • **Chemicals**: C170 & R177 (Chemicals); • **Waste management**: C170 & R177 (Chemicals); C184 & R192 (Safety and Health in Agriculture).
Diversification of economies and redress of inequality: • **Employment policy**: C122 (Employment Policy), R189 (Job Creation in Small and Medium-Sized Enterprises), R198 (Employment Relationship), R205 (Peace and Resilience); • **Skills:** C140 (Paid Educational Leave), C142 (Human Resources Development).	**Sustainable patterns of production and consumption:** • **Elimination/reduction of production processes that may damage the environment, respect for ecological thresholds, waste minimization:** C148 (Working Environment); C162 (Asbestos); C169 (Indigenous and Tribal Peoples); C170 (Chemicals); C174 (Prevention of Major Industrial Accidents); C176 (Safety and Health in Mines); C184 (Safety and Health in Agriculture).

Note: C = Convention; R = Recommendation.

Source: ILO compilation.

(No. 97), and the Migrant Workers (Supplementary Provisions) Convention, 1974 (No. 143), and apply to workers who are forced from their homes and across borders as a result of climate change and natural disasters.

More recently, the ILO adopted the Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205), which contains measures specifically related to recovery and building resilience in response to crisis arising from environmental and climate-related disasters. The need for a just transition towards an environmentally sustainable economy is one of the guiding principles and proposed strategic approaches of this Recommendation. Although Recommendation No. 205 consolidates the main principles related to building resilience to climate-induced disasters, it is important to note that a much wider range of ILS are relevant to climate adaptation and mitigation policies (table 3.1).

ILO instruments are also relevant to the structural transformation of the economy and the protection of workers through social dialogue

As noted above, the fundamental and governance Conventions are particularly important in fostering a just transition. In particular, the Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87), the Right to Organise and Collective Bargaining Convention, 1949 (No. 98), and the Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144), through the promotion of social dialogue, play an important role in ensuring public participation and consultation, which are crucial to sustainable development. Without these, societies cannot be inclusive, equitable or democratic (Olsen, 2009 and 2010).

Other instruments that contain provisions giving a voice to the parties involved in the greening process include the Rural Workers' Organisations Convention, 1975 (No. 141) and Recommendation (No. 149), which seek the organization of rural and agricultural workers, and indirectly benefit migrant workers, who are highly involved in agriculture.[8] Section C further discusses the role of the social partners and social dialogue, and specific jointly agreed instruments, in facilitating the greening of the economy.

THE CONTRIBUTION OF ILS TO ENVIRONMENTAL PROTECTION AND THE IMPLEMENTATION OF THE PRINCIPLES OF SUSTAINABLE DEVELOPMENT

The role of ILS is not limited to the social dimension of the transition to a low-carbon society. Alongside social and developmental aspects, outlined above, they also support and reinforce the environmental pillar of the green economy and, more broadly, sustainable development.

Environmental issues are addressed in ILS in different ways. Some ILO instruments are more closely linked, either directly or indirectly, to the protection and preservation of the environment (figure 3.1).[9] The Indigenous and Tribal Peoples Convention, 1989 (No. 169), is directly protective of the environment. It strengthens the role of indigenous and tribal peoples in environmental management and sets out a legal framework for environmental impact assessments.[10] It also provides that measures should be taken to "protect and preserve the environment of the territories inhabited by indigenous peoples". Another instrument directly protective of the environment is the Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205). It should be noted that the Prevention of Major Industrial Accidents Convention, 1993 (No. 174), puts protection of the environment on an equal footing with that of workers and the public.

In contrast, ILO instruments on occupational safety and health (OSH) address environmental challenges indirectly through the protection of workers. Some ILS on the control of hazards and accident prevention also pursue both environmental and worker protection. Underlying this approach is the idea that the deterioration of conditions in the working environment is among the main causes of environmental pollution and the degradation of the human environment. This idea is reflected in the *Resolution concerning the contribution of the International Labour Organisation to the protection and enhancement of the environment related to work*, adopted by the ILC in 1972.[11] The role of ILS in this respect was seen as setting legal standards to prevent harm to the environment stemming from the workplace. Standards, particularly on OSH, can contribute to the design of policy solutions in situations of environmental degradation and to mainstreaming environmental concerns into the world of work. As the following section demonstrates, OSH standards provide a significant body of rules aimed at the protection of the environment.

8. Some governments have provided support services to agricultural workers for environmental activities. For example, in Austria, alternative energy and energy conservation have been included in such support services (ILO, 2015b).

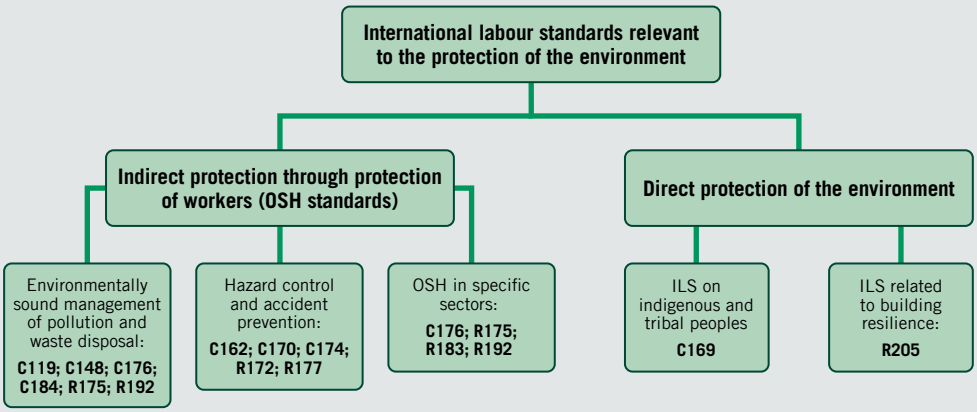
9. Olsen (2009) explores a different classification of ILS that are directly and indirectly related to the climate change agenda.

10. Article 7(3) of the Convention provides that "[g]overnments shall ensure that, whenever appropriate, studies are carried out, in co-operation with the peoples concerned, to assess the social, spiritual, cultural and environmental impact on them of planned development activities. The results of these studies shall be considered as fundamental criteria for the implementation of these activities."

11. For a study of the ILO's involvement in environmental matters, see Olsen and Kempter (2013).

Figure 3.1

The structure of ILS from an environmental protection perspective



Source: ILO compilation.

Occupational safety and health: From worker protection to environmental protection

Although environmental concerns were initially addressed through the prism of worker protection, the protection of the environment has steadily become an objective of its own in these standards (box 3.1). For example, the preparatory work, preamble, scheme and structure of the Chemicals Convention, 1990 (No. 170), and the Prevention of Major Industrial Accidents Convention, 1993 (No. 174), make it clear that the objective of protecting the environment is pursued equally alongside worker protection.[12] OSH standards can promote the protection of the environment through rules on: (a) environmentally sound management of pollution and waste disposal; (b) hazard control and accident prevention; and (c) the protection of the environment in specific sectors.

Box 3.1

The relationship between the working environment and the general environment

Environmental concerns were first introduced into ILS in the context of, and in relation to, the working environment. The Working Environment (Air Pollution, Noise and Vibration) Recommendation, 1977 (No. 156), is the first ILO standard to make an explicit link between the protection of the working environment and of the general environment, which should be taken into account by the competent authorities (Paragraph 15).

As the working environment is not a closed system isolated from the general environment, factors that give rise to a deterioration in the working environment are also among the main causes of the deterioration in the human environment (ILO, 1987, para. 344). The workplace, as a source of risk generation, is a place where primary control should be exercised and where measures should be taken to coordinate environmental and labour protection (ibid., para. 345).

ILO instruments on hazard control and accident prevention in relation to the use of hazardous substances and processes in industry focus on potential risks emanating from the working environment. They therefore provide a framework for further developing the principle of the inter-relationship between the protection of the working environment and the general environment (ibid., para. 347).

12. The inclusion of considerations of environmental protection in ILS has not always been widely welcomed by some ILO constituents. See, for example, ILO (1995) on safety and health in mines.

(a) Environmentally sound management of pollution and waste disposal

The management of pollution and waste disposal is addressed by the Asbestos Convention, 1986 (No. 162) and Recommendation (No. 172), the Chemicals Convention, 1990 (No. 170) and Recommendation (No. 177), and the Safety and Health in Agriculture Convention, 2001 (No. 184) and Recommendation (No. 192). These instruments contain provisions that address unsustainable patterns of production. Prevention, precaution and respect for ecological thresholds are important aspects of all these instruments.

Thus, Article 19(2) of Convention No. 162 requires that appropriate measures be taken by the competent authority and by employers to prevent pollution of the general environment by asbestos dust released from the workplace.[13] Recommendation No. 172 further specifies measures to be taken and encourages opting for environmentally friendly technologies and processes which reduce or eliminate the formation of asbestos dust and its release (Paragraphs 17(c) and 28(2)).

Convention No. 170 addresses environmentally friendly handling and disposal of hazardous chemicals (Article 14).[14] Similarly, Convention No. 184 and Recommendation No. 192 contain provisions on the sound management of chemicals in agriculture. Convention No. 184, in particular, requires measures to ensure there is a suitable system for the safe collection, recycling and disposal of chemical waste and to eliminate or minimize risks to the environment. Environmentally sound management of waste disposal in construction and mining operations is governed by Article 5(4)(d) of Convention No. 176 and Paragraph 41(3) of Recommendation No. 175, respectively.

(b) Hazard control and accident prevention

In addition to the potential human and material losses, and injuries inside or outside the workplace, an industrial disaster has an impact on the environment. The Prevention of Major Industrial Accidents Convention, 1993 (No. 174), requires member States to formulate, implement and periodically review a coherent national policy concerning the protection of workers, the public and the environment against the risk of major accidents, in consultation with the most representative organizations of employers and workers, and with other interested parties who may be affected (Article 4(1)).[15] Additionally, the Convention requires employers to establish and maintain a documented system of major hazard control, including emergency plans and procedures, for each major hazard installation (Article 9(d)(ii)). Article 15, on the responsibilities of the competent authorities, requires them to "ensure that emergency plans and procedures containing provisions for the protection of … the environment outside the site of each major hazard installation are established, updated at appropriate intervals and coordinated with the relevant authorities and bodies" (see box 3.2).

(c) OSH in specific sectors

Environmental protection is also integrated into several ILO standards on OSH in specific sectors, including some of those most relevant for the transition towards sustainable economies, namely mining, agriculture and construction. The Safety and Health in Mines Convention, 1995 (No. 176), recognizes that it is desirable to prevent any damage to the environment arising from mining operations. This principle is further developed in its accompanying Recommendation No. 183, which states that emergency response plans developed by employers (in accordance with Article 8 of the Convention) could include adequate protection of the environment (Paragraph 19(d)). The Recommendation adds that due regard should be given to the possible impact of mining on the surrounding environment (Paragraph 33).[16]

13. The Committee of Experts on the Application of Conventions and Recommendations (CEACR) has requested information on the measures taken in law and practice in relation to work on land and on ships to give effect to the requirement to prevent pollution of the general environment by asbestos released from workplaces. See, for example, Denmark – CEACR, Convention No. 162, direct request, published in 2012.

14. Recommendation No. 177 adds two parameters: first, that chemical safety data sheets for hazardous chemicals should also contain ecological information (Paragraph 10(1)), and, second, that the "criteria for the use of chemicals at work … should be as consistent as possible with the protection of the general public and the environment and any criteria established for that purpose" (Paragraph 17).

15. The drafters of the instrument saw Convention No. 174 as being designed to protect equally the public and the environment as, in the view of some States, workers are protected by OSH standards (ILO, 1992).

16. Some measures of due diligence include the control of subsidence, vibration, flyrock, harmful contaminants in water, air or soil, the safe and effective management of waste tips, and the rehabilitation of mine sites (ibid.).

Box 3.2

Implementation of the Prevention of Major Industrial Accidents Convention, 1993 (No. 174): Recent CEACR comments

The comments of the Committee of Experts on the Application of Conventions and Recommendations (CEACR) on the implementation of Convention No. 174 have highlighted the equal importance accorded to the protection of the environment and to the rights of workers and the public. For example, when reviewing the application of Article 4, the CEACR has recalled that the focus of the Convention "is not only on the management of accidents in such installations, nor on environmental law, but on the management of major industrial accidents to which not only workers, but also the environment and the public are exposed".[1] It has also indicated that a national OSH policy is not sufficient to address the objective and focus of the Convention,[2] as "neither labour legislation, nor environmental legislation, is sufficient to give effect to this Convention" and, in line with Article 4(1), there has to be a coherent national policy concerning the protection of workers, the public and the environment against the risks of major accidents,[3] rather than fragmented or separate labour or environmental regulation.[4] The CEACR has therefore emphasized the objective of the Convention to protect "workers, the public and the environment".

Through its direct requests, the CEACR has raised a number of issues, including requesting information on the manner in which risks to workers, the environment or the public are taken into account in the application of Article 6 in relation to the protection of confidential information;[5] and information on the effect given to Article 15 on the establishment and regular updating of off-site plans and procedures to protect the environment outside the sites of hazardous installations,[6] and the consultations held for this purpose.[7]

[1] Colombia – CEACR, Convention No. 174, observation, published in 2014. [2] See also, for example, Brazil – CEACR, Convention No. 174, direct request, published in 2012. [3] Colombia, 2014, op. cit. [4] Brazil, 2012, op. cit.; Colombia – CEACR, Convention No. 174, direct request, published in 2012. [5] Saudi Arabia – CEACR, Convention No. 174, direct request, published in 2015; Colombia, 2014, op. cit. [6] Armenia – CEACR, Convention No. 174, direct request, published in 2014. [7] Zimbabwe – CEACR, Convention No. 174, direct request, published in 2015.

The Safety and Health in Agriculture Recommendation, 2001 (No. 192), indicates that when implementing the national policy on this issue, the measures adopted for the prevention and control of occupational hazards should take into account the need to protect the general environment from the impact of agricultural activities (Paragraph 3).[17] Similarly, the Safety and Health in Construction Recommendation, 1998 (No. 175), calls for the preservation of the environment to be safeguarded, as prescribed by national laws and regulations, when materials are used that contain hazardous substances and in the removal and disposal of waste (Paragraph 41(3)).

The environment and the Indigenous and Tribal Peoples Convention, 1989 (No. 169)

Convention No. 169 is one of the two ILO instruments dealing with the environment directly. One of its objectives is to reflect the special relationship that indigenous peoples have with their land and environment. As a general principle, the Convention stipulates that indigenous peoples have the right "to the natural resources pertaining to their lands", including the right "to participate in the use, management and conservation of these resources". It sets out the general obligations of ratifying States, including the adoption of measures, in cooperation with indigenous peoples, to protect and preserve the environment of the territories that indigenous and tribal peoples inhabit (Articles 4 and 7).

17. These measures should also protect the general environment from risks which may arise from agricultural activities (such as agrochemical waste, livestock waste, soil and water contamination, soil depletion and topographic changes).

The Convention also requires that environmental assessments be carried out on the possible impact of planned development projects on the peoples concerned. The environment is considered to be an inseparable component of the right of indigenous peoples to land, the use of natural resources and their traditional life. Article 7 thus emphasizes the right of indigenous peoples to participate in the formulation, implementation and evaluation of development plans which may affect them directly, and specifies that the results of environmental assessments should be considered as fundamental criteria for the implementation of development activities.

ILS contribute to the implementation of sustainable development principles

As the *Guidelines for a just transition* make clear, sustainable development provides the framework for the transition at the global level (ILO, 2015a). Understanding the contribution of ILS to the principles of sustainable development is helpful in that respect. The main points of convergence and contribution of ILS to the implementation of sustainable development principles are set out in table 3.2.

This equation of international labour standards with sustainable development leads to two substantive conclusions. First, ILS contribute to the implementation of a broad range of sustainable development principles. Olsen (2009) notes some of the linkages between sustainable development principles and labour standards, such as the fact that OSH standards are based on the precautionary principle. As table 3.2 indicates, ILS contribute to the implementation of sustainable development principles in matters such as control of hazardous activities and substances, environmental impact assessments, integration of environmental, social and economic concerns, notification and assistance during emergencies, prevention of environmental pollution, public participation in environmental matters, participation of ITPs in environmental management, reduction of GHG emissions, and sustainable patterns of production and consumption.

Second, ILO instruments are also capable of broadening the scope of environmental protection, particularly in unregulated or insufficiently regulated areas. In relation to hazardous substances, for example, ILO instruments such as the Chemicals Convention, 1990 (No. 170), and its accompanying Recommendation (No. 177), focus on waste disposal at the *source* of their production. This is in contrast to the Rio Declaration, which only addresses the transfer or relocation of substances that cause severe environmental degradation, while other multilateral environmental agreements, analysed in the next section,[18] regulate mainly the *transboundary movement* and *trade* in waste and other hazardous substances (Mbengue, 2015).[19]

Similarly, a series of ILO standards on OSH issues in specific sectors (such as mining, agriculture and construction) include provisions on environmental protection. For instance, the Safety and Health in Agriculture Convention, 2001 (No. 184), requires environmentally sound collection, recycling and disposal of chemical waste, obsolete chemicals and empty containers of chemicals in agriculture. This is a normative contribution by ILS to environmental protection, as many industrial and other activities, such as transport, mining, and energy generation, which may pose significant long-term environmental threats, "are not subject to significant specific international environmental regulation" (Sands and Peel, 2012, p. 516).

18. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989) and the Stockholm Convention on Persistent Organic Pollutants (2001), which goes further in addressing the international movement of hazardous waste by directly limiting/regulating the production and use of hazardous chemicals known as persistent organic pollutants; and the Minamata Convention on Mercury (2013), which provides for the phase-out of mercury mining.

19. For example, Article 4(2) of the Basel Convention requires States parties to take "appropriate measures" to reduce the generation of hazardous wastes to a minimum and to ensure the availability of adequate disposal facilities for their environmentally sound management.

Table 3.2

Contribution of international labour standards to the sustainable development normative framework[1]

Sustainable development legal principles and policy guidelines	International labour standards	Methods set out in international labour standards
Capacity building and knowledge	Human Resources Development Convention, 1975 (No. 142); Occupational Safety and Health Convention, 1981 (No. 155); Protocol of 2002 to the Occupational Safety and Health Convention, 1981; Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187) and Recommendation, 2006 (No. 197)	• Skills necessary to meet changing methods of production • New skills to ensure safety in environmental jobs
Compensation for the victims of pollution/other environmental damage	Prevention of Major Industrial Accidents Recommendation, 1993 (No. 181)	• Establishment of a system to compensate workers following major accidents and adequately address their effects on the environment
Hazardous activities and substances	Chemicals Convention, 1990 (No. 170) and Recommendation, 1990 (No. 177)	• Chemical data sheets to include information on environmental impact[2] • Ensuring the use of chemicals is consistent with protection
	Prevention of Major Industrial Accidents Convention, 1993 (No. 174)	• National policies that protect the environment against the risk of major accidents (for workers and the general public)
Environmental impact assessments	Indigenous and Tribal Peoples Convention, 1989 (No. 169)	• Studies carried out, and followed up, in cooperation with indigenous and tribal peoples to evaluate the environmental impact of development activities
Integration of environmental, economic and social dimensions	Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148) and Recommendation, 1977 (No. 156) Safety and Health in Agriculture Convention, 2001 (No. 184) Transition from the Informal to the Formal Economy Recommendation, 2015 (No. 204) Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205)	• Control of the workplace as a source of risk for the environment • Coordination of measures to protect the environment, both within and outside the workplace • OSH mechanisms in agriculture that also take into account the protection of the environment • Strategies for sustainable development, poverty eradication and inclusive growth • Support the public sector and promoting socially, economically and environmentally responsible public–private partnerships
Notification and assistance (natural disasters or other emergencies)	Prevention of Major Industrial Accidents Convention, 1993 (No. 174)	• Obligation of the employer to maintain emergency plans and procedures[3]
	Safety and Health in Mines Recommendation, 1995 (No. 183)	• Emergency response plans in mining operations that include adequate protection of the environment
Prevention of environmental pollution/degradation	Asbestos Convention, 1986 (No. 162) and Recommendation, 1986 (No. 172) Safety and Health in Agriculture Convention, 2001 (No. 184) and Recommendation, 2001 (No. 192) Safety and Health in Mines Convention, 1995 (No. 176) and Recommendation, 1995 (No. 183)	• Elimination and minimization of the release of asbestos dust • Reduction of greenhouse gas emissions through the control of hazards in agriculture and due diligence measures in related to agricultural and mining activities
	Safety and Health in Mines Convention, 1995 (No. 176); Chemicals Convention, 1990 (No. 170) and Recommendation, 1990 (No. 177); Safety and Health in Agriculture Convention, 2001 (No. 184); Occupational Health Services Recommendation, 1985 (No. 171)	• Need to prevent damage to the environment arising out of mining operations • Development of an adequate system for the handling and disposal of chemicals to prevent their use for other purposes and to eliminate/minimize risks to the environment • Participation of occupational health services in measures to prevent an undertaking's activities from having an adverse effect on the general environment
	Safety and Health in Agriculture Recommendation, 2001 (No. 192); Safety and Health in Construction Recommendation, 1988 (No. 175); Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205)	• Measures to protect from risks due to agrochemical waste, livestock waste. Measures to protect soil and water contamination, soil depletion and topographic changes in agricultural activities • Preservation of the environment in the use of hazardous substances, the removal and disposal of waste in the construction sector • In response to crisis, identifying and monitoring negative and unintended consequences to avoid harmful spillover effects on the environment

Table 3.2 (cont'd)

Contribution of international labour standards to the sustainable development normative framework[1]

Sustainable development legal principles and policy guidelines	International labour standards	Methods set out in international labour standards
Participation of indigenous and tribal peoples in environmental management	Indigenous and Tribal Peoples Convention, 1989 (No. 169)	• Requirement for governments to facilitate contacts and cooperation between indigenous and tribal peoples across borders, including activities in the environmental field
Right to information	Occupational Safety and Health Convention, 1981 (No. 155); Safety and Health in Construction Convention, 1988 (No. 167); Safety and Health in Agriculture Convention, 2001 (No. 184)	• Obligation of the relevant parties to provide information on: hazards relating to machinery and equipment; dangerous properties of substances, biological agents or products; and instructions on how to avoid known hazards • Workers' right (enterprise level) to know and be informed of workplace hazards that may affect their safety or health, to have access to information on the OSH measures taken by the employer as well as risks from new technologies
Sustainable patterns of production and consumption	Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148); Indigenous and Tribal Peoples Convention, 1989 (No. 169); Chemicals Convention, 1990 (No. 170); Safety and Health in Mines Convention, 1995 (No. 176) and Recommendation, 1995 (No. 183); Safety and Health in Agriculture Convention, 2001 (No. 184) and Recommendation, 2001 (No. 192)	• Elimination or reduction of production processes that may damage the environment, in accordance with ecological thresholds, and waste minimization

[1] *The legal principles and guidelines on sustainable development stem from the 1992 Rio Declaration on Environment and Development (the Rio Declaration), which underpins the international community's approach to the environment.* [2] *A chemical data sheet is a document containing information on the properties of hazardous chemicals.* [3] *The ILO* Code of practice on prevention of major industrial accidents *(1991) indicates that the objective of emergency plans is to minimize the harmful effects of an emergency on people, property and the environment.*

Source: ILO compilation.

THE EMPLOYMENT AND DECENT WORK DIMENSIONS OF MULTILATERAL ENVIRONMENTAL AGREEMENTS

Multilateral environmental agreements (MEAs), which are international treaties between States on environmental issues,[20] entail legal and policy consequences for labour law and practice. A concern that is frequently expressed is that MEAs and their incorporation into national legislation may displace jobs or that, although they foster job creation, the resulting jobs may lack decent work components. A review of MEAs helps to identify their labour dimensions and ways of effectively voicing labour concerns in environmental policy-making.

MEAs that include labour concerns

Over the past several decades, the number of MEAs has increased, particularly since the United Nations Conference on the Human Environment in 1972 (the "Stockholm Conference"). The first generation of MEAs were aimed at protecting specific species or ecosystems. However, during the 1990s, environmental regulations, frameworks and mechanisms increasingly integrated social and economic considerations, including employment and decent work. Indeed, 18 of the 20 MEAs that include labour issues have been adopted since 1992.[21] As shown in table 3.3, MEAs containing labour provisions cover various fields of ILO standard-setting action such as decent work, employment promotion and protection, just transition, OSH, issues pertaining to the resolution of conflicts of law regarding workers' compensation and, to a lesser extent, the protection of certain environmental rights at work (for an example, see table 3.3).

20. For a review of the features of MEAs and their historical evolution, see Brunnée (2011).

21. The Vienna Convention on Civil Liability for Nuclear Damage of 1963 is the earliest recorded agreement that contains a reference to "labour". It provides that, where national provisions related to workmen's compensation or occupational disease compensation systems include compensation for nuclear damage, rights of beneficiaries of such systems to obtain compensation and rights of recourse shall be determined by the applicable national law.

Table 3.3

Labour issues in multilateral environmental agreements

Policy area	MEA
Decent work	• United Nations Convention on the Law of the Sea (1982) • Convention on the Protection of the Marine Environment of the Baltic Sea area (1992) • International Tropical Timber Agreement (2006) • Paris Agreement under the United Nations Framework Convention on Climate Change (2015)
Employment promotion and protection	• United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa (1994) • Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995) • International Tropical Timber Agreement (2006)
Environmental rights at work	• Kiev Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (2003)
Just transition	• Paris Agreement under the United Nations Framework Convention on Climate Change (2015)
OSH	• Convention on Nuclear Safety (1994) • Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997) • Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Heavy Metals (1998) • Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998) • Stockholm Convention on Persistent Organic Pollutants (2001) • International Convention on the Control of Harmful Anti-Fouling Systems on Ships (2001) • Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (2009) • Minamata Convention on Mercury (2013)
Rules on the resolution of conflicts of law regarding the compensation of workers	• Vienna Convention on Civil Liability for Nuclear Damage (1963) • International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (1996) • Convention on Supplementary Compensation for Nuclear Damage (1997)

Note: See Appendix 3 for a full analysis of employment and decent work parameters in MEAs.

Source: ILO compilation.

OSH is an area regulated by both MEAs and ILS. A number of MEAs on the environmental impact of hazardous substances and activities refer to OSH standards. Examples include the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997), the Minamata Convention on Mercury (2013), Annex II to the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Heavy Metals (1998), and the Regulations concerning the International Carriage of Dangerous Goods by Rail (2015). These agreements include specific references to the safety and health of workers engaged in radioactive waste management and the training of workers on occupational exposure to mercury, radiation and dust from pyrometallurgical production. Box 3.3 presents an example of a synergistic interface between labour and the environment in the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (2009).

Some MEAs seek to support vulnerable groups through the enhancement of income generation and employment opportunities.[22] Others, such as the Kiev Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (2003), include elements of environmental rights at work, namely the protection of workers who report a violation of the national laws implementing the Protocol.

Finally, other MEAs, although they do not refer explicitly to specific labour issues, such as OSH or social dialogue, have indirect implications for the activity of certain sectors and the working conditions therein. This is the case, for example, of the Montreal Protocol on Substances that Deplete the Ozone Layer (in force since 1989), which was amended in 2016 during the 28th Meeting of the Parties in Kigali. In the amendment the parties agreed to reduce the production and usage of hydrofluorocarbons in phases, contributing to climate change mitigation as they are powerful GHGs. By altering the methods of production of particular industries, these agreements can bring about direct and indirect effects (for more details on economy-wide effects of achieving sustainability, see Chapter 2).

22. The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa, 1994, and the International Tropical Timber Agreement, 2006.

Box 3.3

Integrated environmental and labour regulation: The case of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (2009)

The shipping industry has been effective at recycling and reusing materials, through the adoption of practices related to sustainability and a "life-cycle approach". However, ship dismantling has been associated with processes that are dangerous to human safety and health and cause environmental pollution, in particular in emerging and developing economies, where the ship recycling industry offers new economic opportunities. Since the maritime legal framework does not apply to the latter cycle of a vessel's life, there were no standards relating to ship decommissioning and disposal until recently (Andersen, 2001).

A normative response to some of these issues in the ship scrapping industry is the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (2009) (the "Hong Kong Convention"). The Convention challenges older models of production that neglect life-cycle safety and environmental impact in the design of ships. It also pursues the objectives of the protection of the environment and of human health, and particularly of workers involved in ship recycling. While certain ILO Conventions provide a legal framework for OSH in shipyards and the ILO has developed guidelines on shipbreaking (ILO, 2004), the Hong Kong Convention is an instrument that integrates both environmental and labour concerns in a single regulation.

The Hong Kong Convention incorporates the labour dimensions of shipbreaking by including important aspects of ILS, including the fundamental labour standards and those on OSH, social dialogue, guidance and training.[1] For example, the Convention includes a framework for the development of a programme to provide appropriate information, training and equipment to workers for safe and environmentally sound operations and the management of hazardous materials (Regulations 18 and 20); information and training on emergency preparedness and response for all workers in the ship recycling facility (Regulation 21); worker safety (including the use of personal protective equipment) and training covering all workers, including contractor personnel and employees (Regulation 22).

[1] *These standards are included in the Annex to the Convention (Regulations for Safe and Environmentally Sound Recycling of Ships) which, in accordance with Article 1, forms an integral part of the Convention.*

The promotion of ILS can be broadened through MEAs

Another approach to integration is the manner in which MEAs make direct reference to ILS. For example, the United Nations Convention on the Law of the Sea (1982), the International Tropical Timber Agreement (2006) and the Hong Kong Convention (2009) consider ILO instruments as relevant legal frameworks for the implementation of their measures.

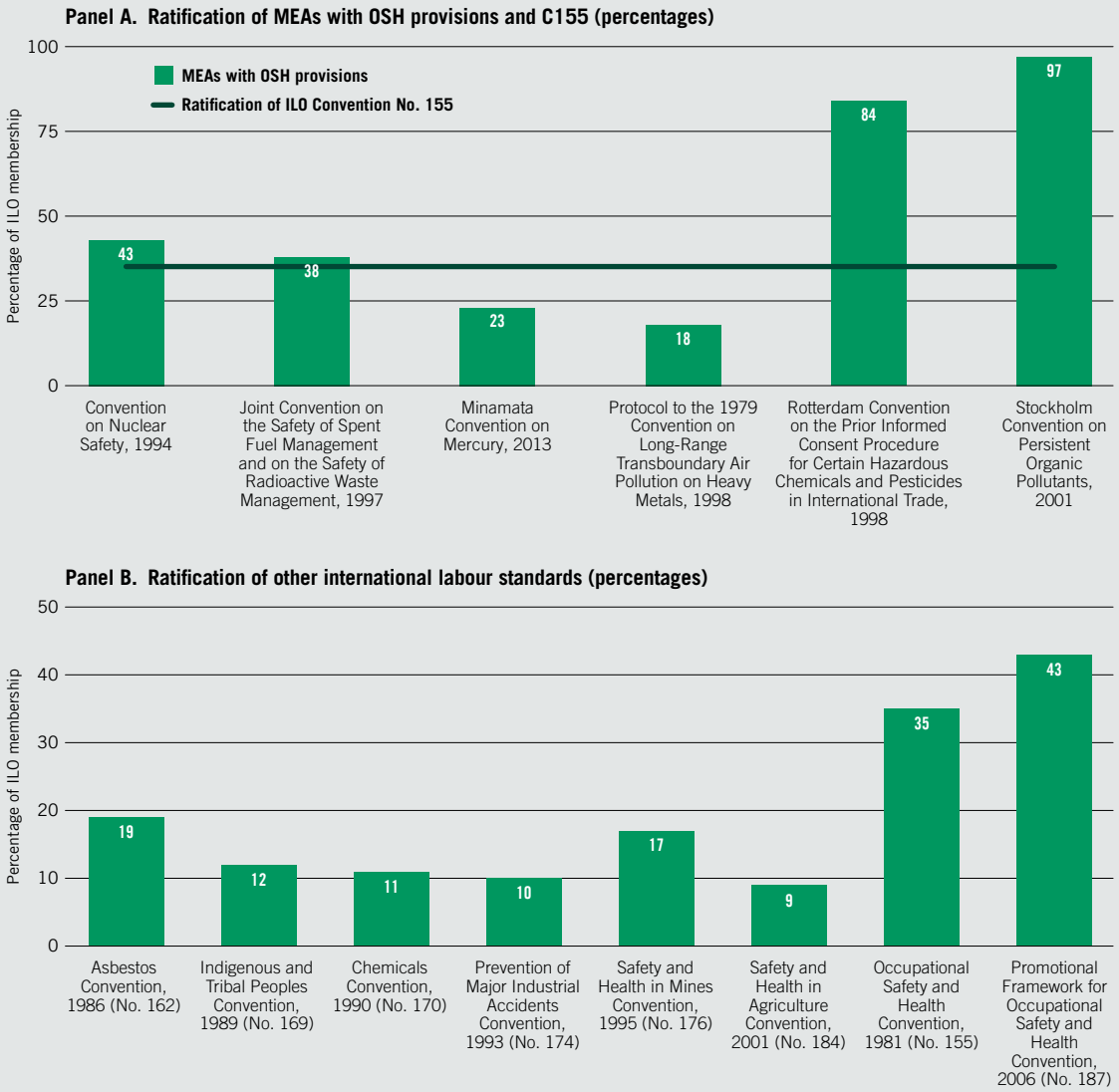
The United Nations Convention on the Law of the Sea (1982) refers to the applicable international regulations, which include ILS, to ensure health and safety at sea with regard to labour conditions (Article 94). Comparable legal linkages with labour and decent work are also present in the Minamata Convention on Mercury (2013), which provides for institutional cooperation between States parties to the Convention and the ILO on health and safety issues (Article 16). Such references may be regarded as evidence of the impact of the ILS on treaty-making processes as well as open routes for the broad incorporation of ILS in the implementation of international environmental treaties.

In some cases, MEAs with OSH provisions have received higher endorsement than ILO Conventions on OSH, as shown in figure 3.2. For example, the Stockholm Convention on Persistent Organic Pollutants (2001) has been ratified by 97 per cent of ILO member States, while the figure for the Occupational Safety and Health Convention, 1981 (No. 155), is only 35 per cent (Panel A). Panel B shows the percentage of ILO member States which have ratified OSH and other related Conventions.

However, ILO Conventions, regardless of ratification, may be reflected in national legislation, policies and practices. For example, 21 countries that had not ratified Convention No. 155 reported to the ILO that the Convention had been or was being taken into consideration in efforts to improve domestic OSH law and practice, in some cases with a view to future ratification (ILO, 2009). Obstacles to ratification of OSH Conventions include difficulties in reaching agreements with the full support of the social partners,

Figure 3.2

Ratification by ILO member States of MEAs with OSH provisions vis-à-vis the Occupational Safety and Health Convention, 1981 (No. 155), and ratification of certain other ILS



Source: ILO compilation.

the need to strengthen coordination between government authorities working on various OSH issues, lack of capacity, and lack of conformity between the Convention and existing national legislation.[23] When parties to an MEA with a labour reference implement such reference, they could also seek guidance in the content of ILS. For instance, the Stockholm Convention on Persistent Organic Pollutants (2001) sets out that appropriate techniques to prevent or reduce releases of certain chemicals must take into consideration the need to ensure OSH at workplaces. To comply, States may refer to ILS on OSH. MEAs with labour dimensions could therefore help to improve the impact of ILS by broadening their substantive scope and outreach.

23. See Chapter IV of ILO (2009) on impact, obstacles and prospects for further ratifications of ILO standards on occupational safety and health.

B. Mainstreaming decent work in laws and policies at the national level

At the national level, rules and policies to make the environment more sustainable are scattered among regulations governing specific issues or areas (such as climate change) and specific sectors, including energy, land use and agriculture, forestry, waste management and transport. Accordingly, although an increasing number of legal and policy frameworks have been adopted on the "green economy" or "green growth", this is not yet a widespread practice in all countries and regions. Environmental legislation and policies have emerged in various forms and reflect country-specific contexts. This section focuses on national laws and regulatory instruments in countries at different levels of development. It identifies certain trends and documents legal developments in sectors and focus areas relevant to the green economy (e.g. climate change). It also shows how employment and decent work parameters have been integrated into national regulation and provides a basis for discussion of emerging regulatory approaches to the employment in transition.[24]

NATIONAL LEGISLATION AND POLICIES GOVERNING THE TRANSITION TO A GREEN ECONOMY

Labour dimensions are found in various types of green policies and national legislation

Legislation and policies aimed at greening jobs can be varied and adopted in various contexts.[25] This section has identified four in particular. First, they can be adopted as part of a specific legal or policy framework on employment in transition, addressing most issues related to them. Some countries have adopted or discussed green jobs acts that deal with green jobs across all or sectors of interest (e.g. Bill for a Green Jobs Act introduced in 2016 in New Brunswick, Canada).[26]

Second, countries can integrate employment in transition issues into wider development and green growth legislation, policies and plans. For example, in the Republic of Korea, the Framework Act on Low Carbon, Green Growth (2010) includes several provisions on employment. The definition of "green growth"[27] includes the creation of new job opportunities and employment is identified as one of the basic principles for the promotion of low-carbon growth. Moreover, the Government is required to provide technical support, and to create and expand jobs for green technology and green industries, so that every citizen can benefit from green growth and learn about new technologies (Article 35).

Third, countries can incorporate labour considerations into laws and policies on specific sectors or particular focus areas, such as climate change adaptation/mitigation, renewable energy, environmental protection, land use and forestry, and waste management. For example, the legislation in Algeria on energy efficiency and the promotion of renewable energy supports the creation of conducive environment that may lead to creation of energy services enterprises, and thus to the generation of employment opportunities.[28]

Fourth, a mixed approach can be adopted combining specific legislation on green jobs and integrating labour issues into sectoral laws and policies. For example, the Philippines has adopted the Green Jobs Act of 2016 and has incorporated employment-related provisions into sectoral laws, such as the Renewable Energy Act of 2008 and the People's Survival Fund Act of 2011.

24. Chapter 2 explores the impact of environmental legislation on the level and composition of employment, with a particular focus on greenhouse gas (GHG) emissions.

25. A number of countries have embarked on green growth and green policies as a result of the 2008 financial crisis. A concept that rose to popularity in this context was the "Green New Deal", culminating in the endorsement of the concept of green economy at the Rio+20 Conference in 2012.

26. The purpose of the Bill is job creation and strengthening the province's local economy, while at the same time reducing dependence on fossil fuels. At the time of drafting the present report, the Act was not yet adopted.

27. Article 2 on definitions provides:"The term 'green growth' means growth achieved by saving and using energy and resources efficiently to reduce climate change and damage to the environment, securing new growth engines through research and development of green technology, creating new job opportunities, and achieving harmony between the economy and environment".

28. Law on Energy Management, Law no. 99-09, 28 July 1999, see particularly Article 33.

Box 3.4

Greening jobs in sub-Saharan Africa

Sub-Saharan Africa is one of the fastest-developing regions in the world. However, due to such factors as widespread poverty, recurrent droughts and over-dependence on rain-fed agriculture, it is considered to be more vulnerable to the impacts of environmental degradation. This intensifies the vulnerability of the region's economies, which are dependent on natural resources (German Federal Ministry for Economic Cooperation Development, 2015).

In this regard, the Constitutions of 12 of the 16 countries analysed defend the right to work and live in a clean and healthy environment, and most of the countries promote environmental impact assessments. Moreover, sectoral laws emphasize the role of workers in respecting and protecting the environment. This is the case of the Mining Codes in Benin (2006) and Burkina Faso (2003), the Forest Code in the Central African Republic (2008), the Oil Code in the Comoros (2012) and agriculture laws in the Democratic Republic of the Congo (2011).

Legislative and policy measures also try to combine the goal of job creation with the preservation of the environment, including training for workers and the introduction of environmental concerns into educational programmes. Examples of development plans or national strategies on climate change that include labour issues exist in Chad, Burkina Faso, Burundi, Mali, Niger and Senegal. In the case of Niger, the National Policy on Climate Change (2012) promotes the creation of "green jobs" and the adoption of tax incentives for employers that create them. [1]

In the case of sectoral laws, legislation targeting renewable energy and waste management acknowledges the need for new knowledge area and employment opportunities. In order to remedy electricity shortages, legal texts encourage the production, consumption, sale and import of renewable energy. There are tax incentives to support this sector in countries such as Benin, Burkina Faso, Burundi, Djibouti and Mali. Legislation also promotes waste management, taking into account population growth. The public authorities are responsible for ensuring the provision of adequate waste management services, and the private sector is encouraged to supplement government efforts to preserve public health.

Finally, some countries have adopted green jobs programmes. For instance, in Senegal, a joint programme with the United Nations Development Programme seeks to promote and develop new sectors with green jobs, to build the capacities of certain groups (including women) and to provide training on the creation of green jobs. At least 1,000 green jobs have been created in Senegal since 2015, and 10,000 more are expected within the next five years (UNDP, 2015). [2]

[1] The Policy defines green jobs as follows: "Green jobs are jobs that help reduce the environmental impact of economic sectors to keep it at an acceptable level, so as to ensure development on a sustainable basis preserving the interest of present and future generations" (unofficial translation). [2] While the programme does not provide a definition of green jobs, it does indicate as an objective the creation of "decent green jobs". The UNDP has acknowledged that the ILO definition of green jobs is one of the most widely accepted (see, for example, UNDP, 2013).

Environmental legislation has been adopted not only in developed economies, but also in developing and emerging economies in various regions. A review of 16 countries in sub-Saharan Africa[29] found that environmental issues are linked to employment and work-related matters in the legislation adopted since the early 2000s. Box 3.4 presents an overview of legal developments and examples of green jobs legislation covering specific sectors or focus areas in sub-Saharan Africa.

29. The countries analysed are: Benin, Burkina Faso, Burundi, Central African Republic, Chad, the Comoros, Democratic Republic of the Congo, Djibouti, Guinea, Madagascar, Mali, Mauritania, Niger, Rwanda, Senegal and Togo.

Different approaches in defining "green jobs" exist in national legislation and policies

A qualitative analysis of national legislation shows that existing regulatory frameworks across countries have not yet established a set of common criteria to define green jobs, green employment, greening with jobs or what a just transition to a green economy will imply. What exists is rather a variety of approaches. Table 3.4 provides examples of various national laws and policies aimed at promoting a just transition to a green economy.

Table 3.4

Examples of labour dimensions in national legislation on green growth

Labour dimension	Country	National law	Content of provision
Decent work	Côte d'Ivoire	Act No. 2015-537 on agricultural policy, 2015	Pursues environmental and decent work objectives in an integrated manner. It aims to develop an "optimized" agricultural sector that preserves and restores biodiversity while contributing to poverty alleviation and job creation, and combating forced labour and the worst forms of child labour. It reaffirms the obligation of the State to protect young persons and to ensure the safety and health of agricultural workers.
Green jobs	Philippines	Green Jobs Act of 2016	Promotes the creation of green jobs, granting incentives and appropriating funds. It also provides a comprehensive definition of "green", which incorporates decent work dimensions (i.e. productive jobs creation, respect for the rights of workers, delivery of a fair income, provision of security in the workplace and social protection for families, and the promotion of social dialogue).
Greening the workplace	Mexico	General Act on climate change, 2012	Identifies a number of measures to reduce emissions in the transport sector by changing consumption behaviour at the workplace. Agencies and entities of the federal public administration, federal entities and municipalities, acting within their competence, have to promote the design and development of policies and mitigation actions. The law encourages the establishment of programmes to reduce displacement of workers (e.g. telework or providing collective transport).
Job creation	Brazil	Act No. 12.305 establishing the National Policy on Solid Waste, 2010	Recognizes reusable and recyclable solid waste as an economic good of social value, a generator of work and income and promoter of citizenship. It also requires any municipal solid waste management plan to include, among other measures, mechanisms for the creation of sources of business, employment and income through the valuation of solid waste.

Source: ILO compilation.

This analysis also reveals a range of components that make up a broader concept of green jobs, in which various elements central to the concept of greening with jobs emerge: the importance of decent work and fundamental rights at work, the participation of the social partners as well as environmental action and rights at work. The addition of environmental rights at work to the notion of greening with jobs is significant (box 3.5), as any workplace can contribute to the reduction of environmental impact and to green growth. This is consistent with the idea that the reduction of GHG emissions cannot be limited to polluting industries. A broad-based approach is necessary to encourage behavioural adjustments and changes in consumption and production patterns throughout the economy.

National legislation and policies also have specific implications for the forecasting of skills needed for the green transitions, skills surveys and the provision of skills programmes (such as the 2015 Act on the energy transition for green growth in France). Chapter 5 reviews how skills development policies have taken into account the requirements implied by environmental legislation.

Box 3.5

Environmental rights at work: The French Labour Code

The Labour Code in France includes environmental elements in the rights and duties of employers and workers. Section L.4133 establishes the right of alert *(droit d'alerte)*, or early warning. This right has its origins in the constitutional obligation to protect the environment, and in Act No. 2013-316 of 16 April 2013 which empowers natural or legal persons to make public information which, if not available to the public, may pose a serious risk to the environment. Workers may exercise the right of alert in the presence of three cumulative conditions: the existence of a risk to the environment; the seriousness of the risk; and its relation to the product or manufacturing processes used by the enterprise. A notification can be submitted by the staff representative to the health, safety and working conditions committee. The alert should be recorded in writing and the employer is required to inform the notifying worker of the action taken as a result. The employer decides on the action to be taken. However, it could be argued that recorded communications provide an in-built tracking system and that the employer should be required to justify due diligence and the adequacy of the measures taken in the event of a civil or criminal procedure. The right of alert appears to be a positive development, as it contributes to a better integration of the world of work and the environment. Importantly, this early-warning mechanism can help an enterprise to take action in the event of an imminent threat of environmental damage.

LABOUR DIMENSION IN LEGISLATION AND POLICIES OF STRATEGIC IMPORTANCE FOR ENVIRONMENTAL PROTECTION

Climate change policies that also address employment and decent work issues

In view of the role assigned to climate change policy frameworks, including nationally determined contributions (NDCs), in the current context of the transition to a low-carbon economy, the inclusion of provisions related to employment and decent work is important. One question in this respect is whether coherence is being sought in current climate change policies (as part of green policies) between economic, environmental and social objectives.

A review of climate change policies in 26 countries (including adaptation and mitigation action) found that 19 of the policies include labour dimensions.[30] Of these, ten make reference to skills, training and capacity building for adaptation, eight refer to job creation as an objective or outcome of climate policies, and seven consider job creation as a component of sectoral action. Other labour-related aspects range from the integration of climate change into training for various professions and the development of capacity-building for adaptation strategies (awareness of the phenomenon and its technical and organizational implications) to the re-skilling of specific groups of professions. Figure 3.3 provides a breakdown of the labour dimensions identified in climate change policies.

Few climate change frameworks (three out of 26 countries studied) include explicit references to a just transition. Similarly, several include references to decent work and quality employment. In contrast, the climate policy in France specifies detailed transition measures, such as: inclusiveness (everyone affected directly or indirectly is taken into account); the development of plans to consider converting plants that face closure; and the involvement of the social partners in designing solutions for sectors affected by the transition.[31] Table 3.5 includes further examples of the design and content of climate change and green growth policies that include labour issues. Furthermore, Small Island Developing States have taken steps to develop national policy frameworks that address climate-induced displacements through pre-emptive labour migration opportunities abroad.[32]

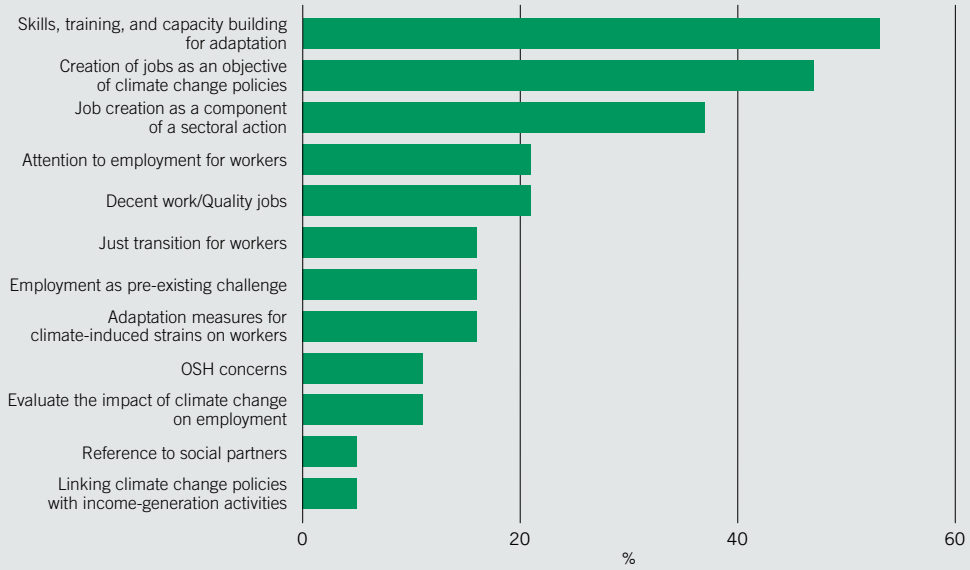
30. The policies examined do not include NDCs. A separate review of NDCs for G20 countries has shown that integration of employment and decent work has been rather limited.

31. Climate Plan *(Plan Climat)*, 1 July 2017.

32. International Labour Organization Office for Pacific Island Countries: *Compendium of Legislation and Institutional Arrangements for Labour Migration in Pacific Island Countries* (2014). Suva, Fiji. Available at: http://www.unescap.org/sites/default/files/Compendium-of-Legislation-and-Institutional-Arrangements-for-Labour-Migration-in-Pacific-Island-Countries.pdf

Figure 3.3

Breakdown of labour dimensions in general climate change policies



Note: Based on data from 26 countries (Algeria, Argentina, Australia, Bangladesh, Belgium, Brazil, Burkina Faso, Canada, China, Chile, Colombia, France, Germany, India, Kazakhstan, Kenya, Mexico, Namibia, Nepal, Russian Federation, Senegal, Singapore, South Africa, Switzerland, Thailand, United Kingdom). Extensive desk studies, analysis and review of climate change laws and policies of these countries were undertaken with a view to identifying labour-related content.

Source: ILO calculations.

Table 3.5

Examples of green policies that include labour issues

Country	National policy	Content of policy
Cambodia	National Policy on Green Growth, 2013	Focuses on strategic human resources development in the framework of green growth. Measures include: mainstreaming the principle of green growth, including jobs in the green economy (i.e. employment in such sectors as green investment, telecommunications, transport, energy and tourism); and integrating green growth into the curricula of vocational training schools.
Canada	Pan-Canadian Framework on Clean Growth and Climate Change, 2016	While also improving environmental performance, clean technologies could enhance the productivity and competitiveness of businesses and foster job creation. In terms of skills, Canada should be able to access talented workers from around the world and provide training for national workers.
Fiji	Green Growth Framework for Fiji, 2014	Seeks to address unemployment and underemployment issues through the enhancement of job skills for sustainable development focusing on youth by 2020. This includes apprenticeship schemes, trade skills, incentives for micro-, small and medium-sized enterprises, and vocational training programmes.
France	Climate Plan, 2017	Provides for the creation of "ecological transition contracts" for workers whose jobs are threatened. Stakeholders, including the social partners, contribute to discussions on changes to jobs in such sectors as energy as a result of current and future transitions.
Mongolia	Green Development Policy, 2014	Identifies green employment[1] as a strategic objective and a key indicator to measure progress in the transition to a green economy. Provides for measures such as: securing income through decent employment for at least 80 per cent of working-age population; involving citizens in vocational training programmes; creating job placement services; providing sufficient compensation to women for childcare; and increasing resilience to the negative impacts of climate change.

[1] *The policy defines a "green job" as any job that contributes to the reduced consumption of energy, raw materials and water and to limiting greenhouse gas emissions, waste and pollution, ecosystem preservation and restoration, and is aimed at environmental protection and the improvement of environmental quality through climate change adaptation.*

Source: ILO compilation.

Litigation on climate change as a useful tool, but currently of limited relevance to labour issues

It should also be noted that litigation on climate change issues has become a tool in some countries to address climate challenges.[33] A recent report finds that, outside the United States, there have been over 250 court cases in which climate change has been a subject of litigation, although mostly not the core claim (Nachmany et al., 2017). Most of the lawsuits focus on obtaining more information and disclosure from governments or sources considered as emitters. Others relate to the implementation of laws and policies, even if they are adopted at the international level, such as the Kyoto Protocol and the Paris Agreement, while others relate to claims for protection or losses and damages to personal property arising out of events linked to climate change. However, labour issues do not appear to be central in loss and damage cases, with the exception of cases in which specific types of workers have been affected, such as farmers. The same study finds that most of the cases are filed against governments (46 per cent), followed by corporations (13 per cent), and that they are brought by corporations (102), followed by governments (51), individuals (56), non-governmental organizations (33), or a combination of plaintiffs (11). Although these lawsuits have enhanced the impact of legislation, more research is required on their overall impact.

Employment and decent work issues in sectoral legislation and policies

In addition to general climate change laws and policies, sectoral environmental and green growth laws and policies that address labour issues have also been adopted. The key sectors relevant to the greening of the economy and subject to regulation worldwide include agriculture, forests, biodiversity, fisheries, marine issues, water regulation, tourism, energy, transport, building and construction, manufacturing, mining, waste disposal and waste minimization.

Energy legislation is a case in point. Some countries have adopted laws, policies and programmes to promote: environmentally sound energy generation and reduced emissions; low-carbon energy production (including wind, solar, geothermal, hydro and nuclear power); energy efficiency; and the use of renewable energy in the renovation and reconstruction of buildings. Labour issues, including skills development and training, are also taken into account in legislation governing the energy sector. Of the 40 countries for which the energy legislation was analysed, 27 include labour issues, and particularly skills and training. Table 3.6 shows the distribution of labour issues by country income group.

Table 3.6

Labour considerations in energy legislation by country income group (analysis of 40 countries)[1]

Income group (number of countries considered)	General reference to labour	Job creation	Skills/ training	Social dialogue	Total number of references
High income (15)	8	5	9	1	23
Upper-middle income (13)	7	5	10	0	22
Lower-middle income (8)	2	2	5	0	9
Low income (4)	1	1	1	0	3
Total number of references	**18**	**13**	**25**	**1**	**57**

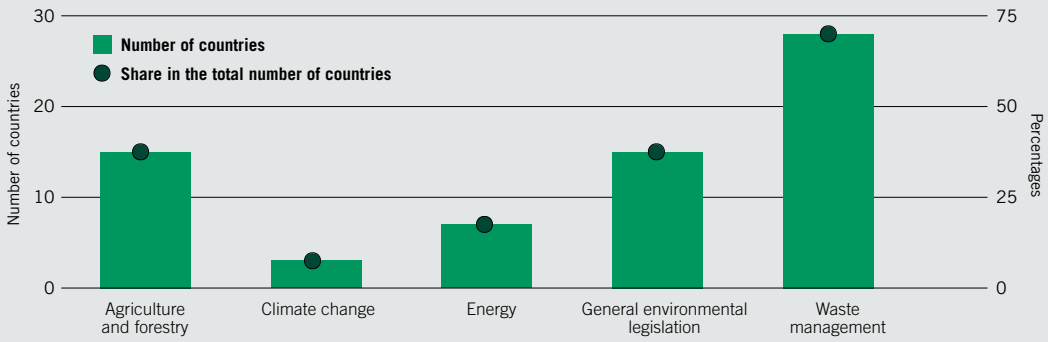
[1] *Algeria, Argentina, Australia, Bangladesh, Belgium, Brazil, Burkina Faso, Cambodia, Canada, Chile, China, Colombia, Costa Rica, Egypt, Fiji, France, Germany, India, Indonesia, Italy, Kenya, Kyrgyzstan, Luxembourg, Maldives, Mexico, Mongolia, Namibia, Nepal, Nigeria, Norway, Saudi Arabia, Senegal, Singapore, South Africa, Switzerland, United Republic of Tanzania, Thailand, Trinidad and Tobago, Turkey, United Kingdom.*

Source: ILO compilation.

33. See e.g. *Urgenda Foundation v. the State of the Netherlands (Ministry of Infrastructure and the Environment)*, C/09/456689 / HA ZA 13-1396, 24 June 2015.

Figure 3.4

OSH issues in legislation relevant to green transition (analysis of 40 countries by sector and focus area)[1]



[1] *Algeria, Argentina, Australia, Bangladesh, Belgium, Brazil, Burkina Faso, Cambodia, Canada, Chile, China, Colombia, Costa Rica, Egypt, Fiji, France, Germany, India, Indonesia, Italy, Kenya, Kyrgyzstan, Luxembourg, Maldives, Mexico, Mongolia, Namibia, Nepal, Nigeria, Norway, Saudi Arabia, Senegal, Singapore, South Africa, Switzerland, United Republic of Tanzania, Thailand, Trinidad and Tobago, Turkey, United Kingdom.*

Source: ILO calculations.

Although environmental and green growth laws and policies may seek to create new employment opportunities, the jobs created are not automatically safe and decent. This is partly because OSH policy and practice can sometimes be reactive, rather than seeking to prevent new risks (EASHW, 2013). Workers in the new industries or occupations may face hazards, including new and emerging risks, often associated with new technologies (ILO, 2017b). Figure 3.4 presents the results of a review of legislation and policies in specific sectors and focus areas in the same 40 countries at different levels of development in the various regions. The review shows that 37.5 per cent of countries include OSH dimensions in laws and policies focusing on agriculture and forestry, 17.5 per cent in energy and 70 per cent in waste management. Moreover, 37.5 per cent of countries include OSH issues in general environmental legislation and 7.5 per cent in climate change legislation. It is therefore important not only to strengthen the role and place of OSH standards in laws and policies related to the greening of the economy, but also to incorporate these aspects as a fundamental element of training (UNFCCC, 2016).

C. Greening the workplace through social dialogue

SOCIAL DIALOGUE: INCLUSION OF ALL CLIMATE ACTORS

Enterprises are often recognized as "climate actors", meaning agents capable of contributing to the green transformation of the economy. Hence, employers' organizations are important agents of change who are able to develop new ways of working that safeguard the environment. Chapter 2 has also noted the various voluntary initiatives adopted, particularly by large enterprises, to improve environmental sustainability (e.g. the inclusion of environmental provisions in codes of conduct for suppliers, which may be enforced when introduced in contracts).[34] Although these efforts should be recognized, not all firms are able to adopt voluntary practices for the reasons discussed in Chapter 2 (including additional costs for micro-, small and medium-sized enterprises, or the perceived lack of benefits).

Trade unions also play a role in responding to the occupational impact of environmental policies and in identifying challenges and opportunities for workers in the transition to the green economy.[35] Indeed, much of the work carried out on the implications of climate change for employment, such as policy articulation to address the trade-off between employment and climate action, and advancing workplace action on the environment, has been undertaken by trade unions.[36] However, the impact achieved by trade unions acting alone may be rather limited (Glynn, Cadman and Maraseni, 2017).

The role of the governments in supporting an enabling environment and the participation of all social actors, including the social partners, is of paramount importance, as recognized in the *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (ILO, 2015a). Although the number of policies and institutional initiatives at the international level that combine decent work and environmental concerns in a fully integrated manner is limited,[37] the participation of workers' and employers' organizations must be integrated in mitigation and adaptation policies.[38] They are the ones who are best placed for their implementation, for taking action at the workplace and reducing the environmental impact of production activities.

For example, collaboration between workers and employers can help to: (a) prevent and reduce the environmental impact of enterprises; (b) put into action environmental policies, plans and actions within an enterprise; (c) improve working conditions, as appropriate environmental regulations and practices also help to prevent and minimize risks to worker health; (d) preserve the quality of jobs and promote the quality of new "green jobs"; and (e) enhance public participation and voice in environmental decisions and decision-making processes.

As observed in section A, ILS support consultation mechanisms at the workplace are a tool for workers to exercise their right to participate in decisions affecting their lives. Although the rights of the public to information, participation and access to justice are set out in the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (1998), also known as the "Aarhus Convention", the right of the social partners to participate in environmental matters is not specified. The Aarhus Convention concerns participation at a broader policy level, rather than strictly in the workplace.

The review of legislation in this section has shown that environmental rights at work are rarely addressed comprehensively or explicitly by national legislation. Agreements negotiated by the social partners (including collective agreements) have thus become, at least in the short term, an important instrument of social dialogue to promote environmental commitments within enterprises at the national and global levels.

34. See, for example, Beckers (2016); Mitkidis (2014).

35. For a thorough analysis, see Hampton (2015).

36. Some major statements and reports include: ITUC: *Trade unions and climate change: Equity, justice & solidarity in the fight against climate change*, Trade Union Statement to the 15th Conference of the Parties, United Nations Framework Convention on Climate Change (UNFCCC), Copenhagen (7–18 December 2009); ITUC: *Growing green and decent jobs*, 2012. See also TUC: *The Union Effect: Greening the workplace*, 2014.

37. Despite the progress achieved, the 2015 Paris Agreement, the single most important roadmap to tackle climate change, refers to the concept of a just transition for workers only in its preamble.

38. This point is developed in ETUC (2004).

NATIONAL PRACTICES RELATING TO THE INCLUSION OF ENVIRONMENTAL CLAUSES IN COLLECTIVE AGREEMENTS

Social dialogue on environmental rights has been progressing slowly in certain countries, and has permeated into policies adopted at the national level. For example, the Green Skills Agreement in Australia (between the Federal Government and state and territory governments) is the result of negotiations that included participation by the social partners, however limited (Chapter 5).

Laws do not currently grant trade union representatives who deal with environmental issues at the workplace the right to time off, training or facilities to extend the scope of union activities to cover environmental issues. This role is usually performed under agreements negotiated with employers. At the enterprise level, employers and trade unions have worked together to identify areas, including GHG emissions, where a reduction in environmental impact could be achieved without losses in jobs, pay and working conditions. In Italy, for example, enterprise-level collective bargaining agreements recognize commitments for sustainable development, such as strengthening OSH, promoting sustainable mobility (e.g. car sharing), protection of vulnerable groups, elimination of waste, and adopting initiatives aimed at enhancing the well-being of workers and families, among others.[39] Other agreements have included in the calculation of the workers' productivity premium an indicator linked to resources consumption (such as water or energy), where lowering consumption could lead to a higher premium.[40]

Green provisions in collective agreements, particularly those containing concrete and appropriate actions oriented on greening workplaces, are part of a new direction taken recently at the national level. Moving towards the transformation of global production and consumption, as well as the impact of environmental laws and policies, the trend is for the environment to become a key aspect of social dialogue. Indeed, there is a growing understanding that environmental policies are essential to ensure decent and sustainable employment in the long term. Table 3.7 shows some examples of green provisions that have been negotiated in collective agreements in Canada.

In comparison with the global level, national collective bargaining agreements tend to be more inward-looking. Green clauses in these agreements are often mainly focused on the specific action that workers and enterprises can take to contribute to the greening of workplaces, and ultimately to the improvement of the general environment.

In Belgium, the National Collective Agreement 98 (CCT 98), negotiated by employers and workers with government approval, provides for a benefit known as "eco-cheques" *(éco-chèques)*, intended to help workers access and acquire ecological services and products. The agreement includes an annex listing the products and services that can be purchased with the cheques; these include energy-saving appliances, vehicles providing environmentally friendly mobility, ecotourism, sustainable gardening and second-hand and recycled products.

A model agreement[41] on the environment and climate change in the United Kingdom includes provisions on energy use (eco-efficient energy use and energy-saving measures), recycling and resource use (eco-purchasing, energy-saving equipment, minimizing the use of non-recyclable materials, opting for re-used or re-usable supplies, low-cost water-saving measures), food (locally sourced, not over-packaged or over-processed, and avoiding food in disposable packages), transport (working to design a travel plan that uses sustainable modes of transport, encouraging tele-conferencing) and other miscellaneous provisions (such as considering the use of plants to improve CO_2 absorption).

39. See e.g. Agreement between Luxottica and the Luxottica Union Coordination (30 October 2015).
40. See e.g. Agreement between Marposs S.p.A and R.S.U. and OO.SS. (1 September 2017).
41. Broadly speaking, a model agreement is a sample collective bargaining agreement to be used as a basis for a negotiation.

Table 3.7

Green provisions in a national context: Examples of Canadian collective bargaining practice[1]

Areas of action	Good practice/green provisions
Green procurement	**International Association of Machinists and Aerospace Workers (2010):** the green provision negotiated sets out the employer's commitment to undertake reasonable efforts to provide environmentally friendly products and services for employees to use, such as paper, ink, soap and cleaning supplies. Where the employer provides products, to the greatest extent possible they will be: locally grown and produced; pesticide free; non-genetically modified; and products produced in an ethical and fair-trade manner. The **Canadian Union of Public Employees (CUPE, 2012),** the **British Columbia Community Social Services Bargaining Association of Unions (CSSBA, 2014)** and the **British Columbia Government and Service Employees' Union (BCGEU, 2012):** in the provision the employers commit to investigate the use of or to use, whenever possible, environmentally friendly products. **Canadian Union of Public Employees (CUPE, 2008**): The clause includes the establishment of a Joint Review Committee (employer–worker) with a mandate to identify alternatives to any potentially hazardous chemicals/equipment and to seek to promote environmentally friendly products in facilities.
Green travel	The **British Columbia Government and Service Employees' Union (BCGEU, 2012):** the agreement provides that the employer shall actively participate in environmentally sustainable employee transit programmes. The **Public Service Alliance of Canada (2013)** negotiated an agreement under which employees and their family members are encouraged to use public transit, with the employer reimbursing 50 per cent of the cost of a pass on the city-operated public transit system. Similar arrangements have been negotiated by the **Manitoba Government and General Employees' Union (2014)** and other trade unions. The **International Association of Machinists and Aerospace Workers (2010):** the agreement provides for a transport incentive of an amount equal to 85 per cent of the cost of a transport pass each month, when employees use public transport or alternative means. Employees driving to work (including by carpool) more than four days a month are ineligible. A collective agreement (**2014**) negotiated between the **Canadian Union of Public Employees (CUPE)** and the **Simon Fraser University** provides that regular shifts are to be scheduled according to certain public transport schedules. The **Camosun College Faculty Association** and **Camosun College** agreed (**2014**) to implement an Alternative Transportation Dividend Program to reduce the percentage of single occupancy vehicles parking on campus. Employees who decline parking privileges receive a dividend payment.
Cutting waste, saving resources	An agreement negotiated in 2012 between the **British Columbia Government and Service Employees' Union (BCGEU, 2012)** and the **Government of the Province of British Columbia** includes a clause allowing the review of ways in which the employer can reduce workplace consumption of non-renewable and renewable resources, increase the amount of material that is reused in the workplace, and implement recycling programmes. The **National Automobile, Aerospace, Transportation and General Workers Union of Canada (2011)** negotiated green provisions that provide, among other measures, that the employer will endeavour to: use substances in work processes that eliminate or minimize impact on the environment; evaluate all substances used or produced with a view to substituting them with less hazardous substances; and, where substances cannot be substituted, evaluate and handle as follows: (i) reuse; (ii) recycle; (iii) dispose of them in a manner that eliminates or minimizes harm to the environment; or (iv) store them in an environmentally sound manner. The **Public Service Alliance of Canada (2011)** negotiated an agreement providing for a set of guidelines for energy conservation, insulation, summer savings, appropriate heating use and turning off lights when they are no longer required.
The right to refuse to work	According to the terms negotiated by the **International Union of Operating Engineers (2010)**, employees may refuse to perform work that would be an offence under provincial environmental legislation. In the agreement reached between the **National Automobile, Aerospace, Transportation and General Workers Union of Canada (2011)** and **Canadian Pacific Railway Co.**, the employer commits to informing employees that they have the right to refuse hazardous work which may harm the environment, and to posting signs in the workplace advising them of this right. Under the agreement, no employee may be penalized for exercising this right. Similar provisions were also integrated into the agreement negotiated by **Unifor** in 2013.
Whistle-blower protection	The **National Automobile, Aerospace, Transportation and General Workers Union of Canada, UNIFOR,** and the **Canadian Union of Public Employees (CUPE)** negotiated a clause in their collective agreements recognizing the responsibility of employees to notify authorities of the violation of environmental regulations or of a release of hazardous substances to the air, earth or water systems. No employee may be disciplined for such notification, providing that the company and the health, safety and environment committee have been notified first.

[1] *Based on Adapting Canadian Work and Workplaces to Respond to Climate Change (ACW), Green Collective Agreements Database, available at: https://www.zotero.org/green_agreements.*

GREEN PROVISIONS IN GLOBAL SOCIAL DIALOGUE

Environmental provisions ("green clauses") have increasingly become a subject of social dialogue between global union federations (GUFs) and multinational enterprises (MNEs), resulting in the inclusion of environmental issues in international framework agreements (IFAs), alongside labour rights and principles (box 3.6).

IFAs include a wide range of provisions that can make a useful contribution to the debate on the green transition and greening workplaces and can inform further negotiations by providing specific content (including language) on environmental issues. The inclusion of green clauses in IFAs is the result of negotiations in which joint commitments are adopted, which in some cases reflect the environmental policies of MNEs that are already in existence or the negotiation agenda of the GUFs (ETUC, Syndex and Sustainlabour, 2010). Despite some positive outcomes, it is necessary to recognize the limitations of IFAs. In comparison with nationally negotiated collective agreements, questions arise about their implementation and enforcement, and about compliance along the supply chain (Hadwiger, 2015).

Box 3.6

International framework agreements

International framework agreements (IFAs), also known as global framework agreements, are agreements between multinational enterprises (MNEs) and global union federations (GUFs). They are voluntary instruments concluded through cross-border social dialogue which promote minimum labour standards, sometimes referring to ILS, in MNEs and throughout their global supply chains (Papadakis, 2008 and 2011). The emergence of IFAs is partially a response to the absence of a comprehensive body of binding international standards governing the conduct of MNEs, and the relative inefficiency of national regulation in ensuring respect for labour rights in certain situations (Drouin, 2015).

IFAs are important instruments of cross-border social dialogue for a number of reasons. The vast majority include references to rights and principles contained in the 1998 ILO Declaration on Fundamental Principles and Rights at Work, ILO Conventions and the ILO Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy (revised in March 2017). They also provide a set of labour standards for a company's establishments worldwide that may be recommended to its suppliers. In some cases, strong implementation and monitoring mechanisms are also negotiated. It has been suggested that IFAs are the building blocks of an emerging cross-border industrial relations framework (ETUC, Syndex and Sustainlabour, 2010; Papadakis, 2008).

IFAs contain "green" provisions

A review of 104 IFAs sheds light on examples of practice relating to the inclusion or promotion of green provisions.[42] The majority of IFAs are signed by MNEs with headquarters in Europe. However, more recently – starting from mid-2000s – some Asian, African and North and Latin American companies have also signed IFAs. In all, some 20 IFAs have been negotiated by non-European MNEs.

The analysis of the IFAs reveals a number of trends. First, 59 per cent of them (61 agreements) include green provisions in the preamble to the agreement, in a declaration of common understanding or as a specific commitment in the operative part of the agreement. Some 6 per cent of IFAs have been concluded with non-European based MNEs. IFAs concluded by these MNEs also contain green provisions.

42. The number of IFAs is based on publicly available agreements accessed on the website of Global Unions (21 IFAs are signed by BWI, 46 IFAs by IndustiALL Global Union, 30 IFAs by UNI Global Union, 8 IFAs by IUF, and 3 IFAs by PSI).

Second, the IFAs reviewed covering the period between 1995 and 2017 show an evolution in the nature and content of their environmental provisions. Initial generic references to sustainable development and the environment have developed into more detailed and complex clauses, including provisions on their enforcement and monitoring, transparency and support for a just transition. The trend is for IFAs signed in recent years to be more specific and precise in their content and scope of application.[43]

Green provisions in IFAs often contain generic commitments undertaken by the MNE and/or union to pursue protection of the environment, but without setting out specific objectives, rights or action by workers and their representatives. Some IFAs do set out specific environmental objectives, for example in relation to water, waste disposal and the preservation of natural resources, which are formulated in greater detail and allow for a better implementation framework, monitoring and review.

Third, while OSH and the environment were frequently addressed together in early IFAs, most recent IFAs include a dedicated provision on environmental issues. This trend can be attributed to: (a) the increasing importance placed on climate change and environmental policies; (b) the greater involvement of workers in elaborating and monitoring environmental issues at the workplace (ETUC, Syndex and Sustainlabour, 2010); and (c) the realization that environmental clauses are important to ensure decent and sustainable jobs.

Fourth, some agreements explicitly acknowledge the environment as a theme of social dialogue. In one IFA, for example, the MNE commits "to conduct a constructive social dialogue with the employee representatives in determining its health, safety, environment and quality policy".[44] Another provides that "[g]lobal social dialogue will continue based on this agreement [leading to] … subsequent agreements in specific areas, for example, in such areas as … sustainable development/climate change".[45] As decisions about production are progressively more influenced by environmental policies, the role of the environment will become more prominent in cross-border social dialogue and in the national context.

The issues covered by green provisions

One of the most frequent "green" commitments in IFAs is related to sustainable development. More precisely, this commitment is formulated in a general statement by the MNEs parties to IFAs that "sustainable development is part of doing business". This statement is present in about 10 per cent of the 216 green commitments[46] identified in IFAs.[47] This is followed in importance by a commitment to respect and/or promote the environment as a corporate objective and social responsibility (about 9 per cent of all green provisions).

Other key commitments endorsed widely in the agreements reviewed include: (a) MNEs being aware of the environmental impact of their activities; (b) a commitment to respect international agreements, standards and principles, as well as national environmental legislation; (c) the reduction or management of the environmental impact of enterprise activity; and (d) due regard (or due diligence) for the environment as an overall policy, and specifically in conducting enterprise activities.

Table 3.8 lists the most widely endorsed green commitments in IFAs. Most of these commitments are outward-looking, in the sense that they address the environmental impact of enterprise activities, rather than environmental action at the workplace. Although general in nature, they may serve as an entry point for the "recognition of workers' responsibilities and rights on environmental issues".[48]

Other green provisions are more specific and target action at the workplace, including encouraging employees to adopt ecological behaviour, such as energy efficiency at the workplace and green

43. See, for example, IFAs concluded with multinationals such as AEON (2014), Lukoil (2014), Total (2015), Tchibo (2016), PSA Peugeot Citroen (2017).

44. IFA with Total.

45. IFA with GDF Suez.

46. The number of commitments that served as the basis of analysis does not correspond to the number of green provisions found in an IFA. This is because one green clause may in effect include two or more commitments of a different nature.

47. For a critical commentary on the integration of sustainable development issues in IFAs, see ETUC, Syndex and Sustainlabour (2010), p. 35.

48. Ibid., p. 41.

Table 3.8

List of main green commitments in IFAs

Type of green provisions in IFAs	Number of IFAs
Sustainable development as part of "doing business"	22
Respect for, or promotion of, the environment as a corporate objective/social responsibility	19
Awareness by the enterprise of the environmental impact of its activities	17
Respect for international agreements, principles and standards, and national environmental laws	15
Commitment to reduce or manage the environmental impact of company operations	14
Due regard for the environment in general and in carrying out enterprise activities	10
Make efforts and/or achieve improvement in environmental performance	9
A general commitment to adopt a preventive and precautionary approach to the environment when conducting operations	9
Promotion and development of environmentally friendly technologies, or a statement of intent to introduce such technologies	8
Respect for, or preservation of, the environment and/or natural resources and the protection/preservation of biodiversity	8
Commitment to take measures to reduce or control greenhouse gases	7
Ensuring that products and production processes display environmental friendliness or compliance with environmental standards	7
Sustainable use of natural resources (water, mineral resources, agricultural commodities, fossil fuel, etc.) and awareness thereof	7
Raising employees' awareness of applicable environmental standards	6
Waste management and recycling	6

Source: ILO compilation.

Table 3.9

List of innovative but less common green commitments

Innovative green commitments in IFAs	Number of IFAs
Energy eco-efficiency (including use and development of alternative energy sources)	4
Encouraging employees to adopt ecological behaviour	4
Termination of relations with contractor or supplier in the event of non-compliance with environmental regulations	3
Workers' rights as an element of sustainable development	2
Transparency, dialogue on the company's environmental activities, publicizing environmental assessment reports or damage caused	2
Review of the implementation of environmental commitments	2
Support for a "just transition"	1
Social dialogue in determining environmental policy	1
Development of employees' skills in respect of environmental challenges	1
Adaptation measures adopted in a way that ensures workers' rights and interests	1

Source: ILO compilation.

travel (rationalizing work-related travel and commuting). However, compared with the overall number of green provisions, the number of innovative provisions entailing workplace-related action is still modest (table 3.9).

It is crucial to address environmental issues as they relate to workplaces, which burn energy, consume resources, generate waste and travel, to help make jobs more sustainable. Only one green IFA provision makes reference to a "just transition" and measures of workforce adjustment. It provides as follows: "Signatory Global Union Federations support reduction of carbon emissions and will co-operate with [MNE] to ensure that any necessary adaptation takes place in a way that protects the rights and interests of workers and that the impact of any such changes are (sic) designed and implemented in an agreed, fair manner; [MNE] actively supports 'Just Transition' principles."[49]

49. IFA with GDF Suez.

A sector-specific analysis of IFAs reveals that sectors with a high environmental impact may include more environmental commitments. The oil and gas, energy, chemicals, pulp and paper (which includes stationery and printing), mining and manufacturing sectors are known to be the largest GHG emitters, and the total number of IFAs in these sectors (including aerospace and defence) amounts to 37 IFAs with green provisions.

The analysis shows that green commitments are increasingly included in IFAs.[50] Further research in this regard should be conducted to assess the impact of such commitments. Additionally, as noted earlier, some companies have pursued environmental policies through other voluntary initiatives and in a decentralized manner at the country level.

The examples provided, both at national and international levels, show that social dialogue could make a substantive contribution to reducing the environmental impact of the workplace and to combating climate change. However, in parallel with the steady emergence of environmental unionism, and with enterprises on board, there is a call to gradually continue incorporating social dialogue into the environmental debate to go further and to challenge the status quo of global production and consumption patterns (Barry, 2012). For environmental improvements to occur, social dialogue could focus more on supporting a qualitative improvement in living standards, rather than maintaining a prevalent framework of "continuous productive growth" on a planet with limited resources (María-Tomé Gil, 2013).

Conclusions

This chapter has examined whether and to what extent existing legal and policy frameworks consider labour and the environment as allies that are mutually dependent in order to produce the material resources necessary for socially, economically and environmentally sustainable development. The chapter starts by acknowledging that a "just transition law" does not exist, but that it is crucial to take advantage of the principles embedded in labour law to better utilize the benefits of environmental law, including the priority placed on promoting collective action and dialogue. Moreover, it is difficult to calculate costs and benefits related to a green transition since climatic disasters can be rare events, and such risks might be better covered by protective investments rather than insurance-type of coverage. Hence the theory of justice underlying labour law may serve as a tool to ensure these investments are distributed in an equitable way (Doorey, 2017).

ILO Conventions, Recommendations and Protocols offer policies, tools, measures and frameworks, and promote behavioural changes that can improve the normative framework of sustainable development. ILS adopt a dual approach to reconciling social and economic goals with environmental policy. First, they deal with issues that may cause environmental tensions, such as lack of employment and inadequate standards of living. Second, ILS can also contribute to the design of policy solutions in situations of environmental degradation. Over time, ILS, and particularly those on OSH, have evolved from focusing purely on the protection of workers to include the protection and preservation of the environment. The universality of ILS is therefore key to the greening of the economy.

The chapter also notes that there are ILS that integrate the environment, however there is yet no single international labour standard that deals specifically with issues related to a just transition. Nevertheless, other ILO means of action can also be used to promote a transition that is just, including capacity building and cooperation with other international and regional organizations (Olsen and Kemter, 2013).

Some ILS offer tools for the protection of the environment in areas that remain unregulated or insufficiently regulated by multilateral environmental agreements (MEAs). For example, Conventions Nos 170 and 184 contain standards dealing with waste disposal at source, an issue that has not been fully resolved by international environmental agreements. Similarly, although there is no other significant specific international environmental regulation covering agriculture, ILO standards, and particularly Convention No. 184, provide for agricultural processes to be conducted in an environmentally sound

50. For specific case studies on the impact of global framework agreements on global supply chains, see Hadwiger, 2015.

manner. Admittedly, ILS do not fulfil the direct function of protecting the environment, as envisaged by environmental law, but they reflect the reality that the working environment has a close relationship with the general environment.

National regulation is increasingly contributing to a better understanding of how legislation and policies can foster the transition to greening with jobs. In terms of the integration of social goals, the major focus of climate change policies (both adaptation and mitigation) in relation to labour is on skills (53 per cent) and re-training and job creation (42 per cent). There is still a need to improve our understanding and knowledge base about the impact of different laws, policies and institutional designs and the changes that they have achieved on the ground as regards employment and decent work. As implementation of climate policies is beginning to involve courts in some countries, further research is required to investigate how climate litigation includes just transition dimension. Other issues of crucial importance must not be neglected, for instance, social dialogue.

Laws and regulations are part of an enabling environment. A well-designed and effective regulatory framework can promote and encourage a streamlined and systematic approach to the national structural change required for the transition to green growth. Effective and well-enforced legal frameworks are also crucial to securing domestic and international investment.

Finally, social dialogue has a key role to play. As decisions about production are increasingly shaped by environmental policies, the environment will become more prominent in cross-border and national social dialogue. Social dialogue can act as a useful tool to promote the institutionalization of environmental action at the workplace. Workplace action can help to foster changes in policy and structures, as well as in individual behaviour, and may prove to be more effective in reducing carbon emissions than measures taken at the individual level.

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4 Protecting workers and the environment

KEY FINDINGS

Climate change and other forms of environmental degradation undermine people's livelihoods; effective and tailored measures are required to protect workers and their families.

Ensuring a just transition requires a package of benefits and services. Income support measures should be supplemented by job placement, skills retraining and support for relocation. In particular, unemployment protection schemes can play a key role in supporting a just transition for workers who lose their jobs in the shift to a more environmentally sustainable economy.

Cash transfer programmes can compensate for the loss of income experienced by households as a consequence of adverse environmental events or structural changes resulting from the implementation of green policies.

Public employment programmes have become crucial policy tools that combine economic, social and environmental objectives in support of adapting to and mitigating environmental degradation and climate change.

If carefully designed and implemented, payments for ecosystem services schemes can offer cost-effective protection for the environment, while at the same time supporting household incomes.

Projections show that policies that extend transfers (such as unemployment benefits, cash transfers, public employment programmes and payment for ecosystem services), strengthen social protection and support green investment are financially viable and conducive to higher growth, employment creation and fairer income distribution.

Introduction

Social protection policies safeguard and promote human rights. They are an essential foundation stone for ensuring a just transition to a green economy and protecting workers against the detrimental effects of climate change and other forms of environmental degradation. They are central to economic and social development strategies, at both national and international level, as recognized in the Sustainable Development Goals (SDGs). Social protection consists of social and economic measures that protect people over the life cycle in the face of events that jeopardize their ability to earn income or access essential services[1] (ILO, 2017). Universal social protection has highlighted the importance of combining contributory and non-contributory schemes, integrating a set of policies designed to ensure income security and support to all people across the life cycle – paying particular attention to people in poverty and the vulnerable (ILO and World Bank, 2015). The combination of comprehensive social protection and employment policies can ensure that people enjoy income security throughout the life cycle.

The need for comprehensive and integrated social protection systems is also likely to increase because of the ongoing negative impact of climate change, such as rising temperatures, changes in precipitation patterns and the increased frequency and magnitude of natural disasters (see Chapter 1). This will be reflected in stagnant incomes for most households and a chain of deflationary effects on consumption, investment and tax revenues. Through their support for incomes, and for economic security in general, social protection systems contribute to a just transition to a green economy and to environmental action in two distinct ways.

First, social protection facilitates the adaptation of individuals and families to environmental degradation and climate change. The term "adaptation" refers to measures aimed at preventing environmental degradation from causing too much environmental damage (e.g. building dams through public employment programmes) or measures that aim at reducing the social and economic consequences of environmental disasters (e.g. financial assistance through cash transfers). For instance, social protection can be used to protect populations who are victims of adverse environmental events such as droughts, typhoons, heatwaves or floods. Cash transfers and public employment programmes can help families affected by extreme climate events or the progressive degradation of the environment (such as soil erosion and biodiversity loss). This chapter reports evidence that many countries are adapting their social protection systems or developing new schemes to ensure that they offer support that is adapted to the situation of people affected by environmental disasters or climate events (ILO and AFD, 2016a and 2016b). In addition, coverage for employment injury benefits for workers who become victims of an environmental hazard at work, including heatwaves, is a fundamental right as evidenced in international standards for workers' compensation dating back to the early days of the International Labour Organization (see Chapter 3). For example, construction workers in countries experiencing extremely high temperatures acquire health conditions that necessitate medical treatment and sometimes income replacement if they become disabled and unable to work. The policies and measures to ensure the right of workers to compensation are integral to several of the Multilateral Environmental Agreements.

Second, social protection contributes to the mitigation of environmental degradation and climate change. As shown in Chapter 2, green policies and the transition to sustainable forms of economic growth will inevitably cause job losses and lead to the elimination of sources of income for some households. For example, the closure of mines, as being planned in the Philippines, or limitations on the exploitation of forests, as imposed in China at the end of the 1990s, entail the reduction or suppression of the main or sole source of income for thousands of households (ILO and AFD, 2016c and 2016d). Similarly, the elimination of fuel subsidies, as was recently done in Egypt, is certainly good for the environment, but it has a long-lasting negative effect on households in poverty that depended on these subsidies to buy the fuel needed for their own consumption (ILO and AFD, 2016e). These green policies may therefore not be socially acceptable unless they are accompanied by social protection measures (such as unemployment protection and social assistance) to support a just transition to a more environmentally sustainable economy.

In addition to social protection policy tools, the present chapter analyses payments for ecosystem services schemes. If carefully designed and implemented, these environmental programmes can

1. Social protection includes (i) family allowances to ensure that families have sufficient resources to provide good nutrition, education and care for their children; (ii) social health protection to ensure that ill health does not push people into poverty; (iii) unemployment benefits to secure household income in the event of loss of jobs; (iv) old-age pensions to ensure that older persons can live in dignity; and (v) employment injury benefits to protect workers in case of accidents or disease resulting from employment.

offer environmental protection while at the same time supporting household incomes. This follows the approach of Chapter 3, which discusses environmental laws, regulations and policies that include elements of the Decent Work Agenda.

In this context, this chapter first discusses the close relationship between poverty, social protection, income security and the environment. It then analyses four policy areas that can contribute to adaptation and mitigation measures: unemployment protection, cash transfer programmes, public employment programmes and payments for ecosystem services. While the examination of unemployment protection and cash transfer programmes recalls the need for strong social policies to protect people from adverse environmental impacts and to ensure a just transition to a green economy, public employment programmes and payments for ecosystem services offer the potential to explore the combination of economic, social and environmental objectives within one policy measure. After reviewing experience in these areas, a macroeconomic simulation projects the impact of an increase in environmentally oriented social protection on the global economy.

A. The link between poverty, social protection, income security and the environment

As noted in Chapter 1, people in poverty, indigenous and tribal peoples and other vulnerable population groups are particularly exposed to the risks and damages associated with environmental degradation as they tend to have lower capacity to mitigate the social, physical and economical damage. Moreover, they often rely more heavily than others on ecosystem services for their livelihoods and well-being, which therefore depend directly on a stable environment. This is particularly the case in rural areas (Suich, Howe and Mace, 2015).

Some of these groups also often find themselves locked into environmentally damaging activities, such as communities for whom deforestation is the only available source of both income and fuel. Social protection can therefore help to protect vulnerable groups from the effects of environmental degradation and reduce their reliance on activities that are detrimental to the environment (Duraiappah, 1998; ILO, forthcoming).

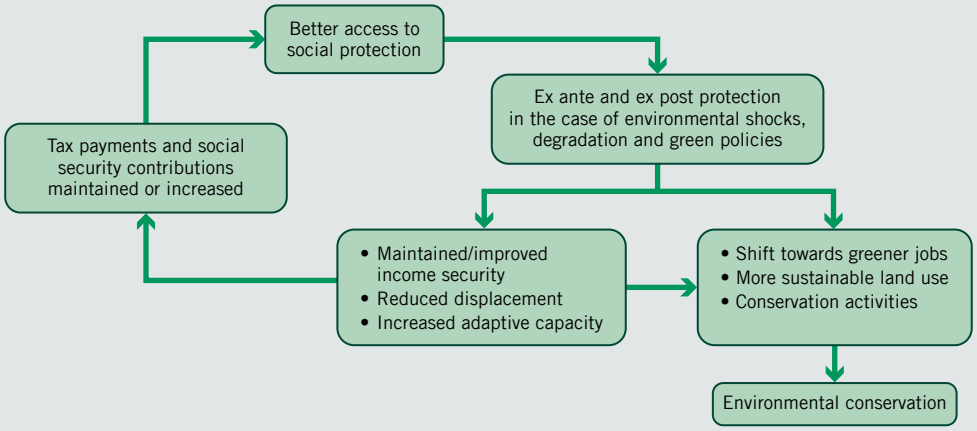
Confronted with multifaceted forms of insecurity that are exacerbated by environmental factors, along with inadequate access to social protection in rural areas, many women and men have been migrating to urban areas in search of income-generating opportunities. While migration can be an adaptation strategy, it can nevertheless leave migrant workers vulnerable to discrimination and exploitation in destination areas, especially urban areas, where they tend to find employment within the informal economy. Moreover, relocation to urban areas often also entails living in slums that lack access to basic social services and resilient infrastructure. In numerous urban centres, slums or informal settlements are highly vulnerable to environmental shocks and the impacts of climate change. In this context, adequate access to social protection for workers in urban areas can play a vital role in disaster risk reduction as well as in providing further opportunities for enhancing adaptive capacity, improving resilience, income security and positive health outcomes.

Figure 4.1 shows that social protection and environmental sustainability are inextricably linked. Social protection reduces the financial impact of environmental degradation, natural disasters and environmental laws and policies. It also provides a secure income and increased adaptive capacity which mitigates poverty and protects the environment while at the same time increasing tax payments and social security contributions. For example, if rural households have a guarantee of stable incomes, they are better able to invest in tools and land use practices that have a positive impact on soil and water quality and increase carbon sequestration. A well-preserved ecosystem, in turn, makes them less vulnerable to the negative consequences of environmental effects, shocks and disasters (Schwarzer, Van Panhuys and Diekman, 2016).

According to Hallegate et al. (2016), forward-looking scenarios suggest that unmitigated climate change could drag 100 million people into poverty by 2030. This figure could be reduced substantially to 20 million through the adoption of climate-informed development and pro-poor social protection

Figure 4.1

Socio-economic and environmental challenges are intricately interlinked



Source: ILO Social Protection Department.

policies (ibid.). Drawing on this analysis, the following sections critically assess the merits of four policy instruments, which can be specifically (re)designed to address environmental and social issues and thereby offer an efficient means of achieving progress towards the environmental, social and economic sustainability objectives embedded in the SDGs. The four instruments are, as mentioned above: unemployment protection; cash transfer programmes; public employment programmes (PEP) with environmental components; and payment for ecosystem services (PES) with social components.

B. Unemployment protection and structural transformation in the context of climate change

As discussed in Chapter 2, efforts to mitigate the root causes of climate change, and particularly to reduce GHG emissions, may not only improve energy and resource efficiency, but also open new job opportunities in sectors that will benefit from the green transition. However, as countries face difficult choices when phasing out carbon-intensive activities, workers whose livelihoods depend on less environmentally friendly practices require active support to shift towards more sustainable means of production. Measures are therefore necessary to provide workers with the right skills (see Chapter 5), facilitate re-employment through job placement services and relocation grants, and protect those who lose their jobs by means of income compensation measures in the form of unemployment benefits, social assistance or public employment programmes. Regarding the crucial issue of financing, governments should – in consultation with social partners and taking into account the economic and fiscal capacities available – articulate long-term financing needs and establish sustainable funding mechanisms for the implementation of these measures.

Unemployment protection provides income support over a determined period, as well as facilitating access to skills development and job placement services for unemployed workers or people who are looking for a new job (ILO, 2017). This includes workers who lose their jobs due to environmental laws, regulations and policies such as banning forest exploitation, introducing a fishing moratorium or closing down polluting and unsustainable industries (for example, in the mining sector). By guaranteeing unemployed workers and their families income security in the event of job loss, unemployment protection schemes contribute to preventing poverty, reducing vulnerability and facilitating the transition to new jobs, particularly if they are combined with skills development, job placement support,

and relocation grants. Unemployment protection is a fundamental measure in any social protection system, as recognized in the ILO's Social Protection Floors Recommendation, 2012 (No. 202). Where they exist – putting aside for the moment questions of resourcing, coverage and effective implementation – unemployment protection schemes involve the provision of employment services such as job matching and counselling, entrepreneurship support and access to enhance, update and develop skills necessary for workers transitioning from unsustainable means of livelihood to new jobs (ILO, 2014 and 2017; Peyron Bista and Carter, 2017).

Unemployment protection not only plays an important role at the individual level, but also contributes to stabilizing employment and aggregate demand, providing safeguards against informality and facilitating structural change in the economy (Berg and Salerno, 2008). As countries go through processes of structural transformation, there may be broad population shifts, including rural-to-urban migration and employment shifts from low-productivity and labour-intensive sectors (such as subsistence and non-mechanized agriculture) to high-productivity and skills-intensive sectors (industry and services). These types of resettlement and sectoral shifts often entail increased urban unemployment and informal employment. Adequately resourced and effectively implemented systems of unemployment benefits can therefore support structural transformation towards a greener economy, higher levels of productivity and inclusive economic development (Behrendt, 2013), as well as a just transition towards a more environmentally sustainable economy.

In recent years, unemployment protection schemes have been used to soften the effects of job losses in unsustainable industries by ensuring income security and supporting the reskilling of displaced workers. Several country examples are relevant. For example, when in 1998, in an effort to reduce deforestation, the Government of China imposed bans on logging in natural forests, unemployment protection measures were used to provide financial assistance to those affected. Workers were also offered lump-sum payments, together with training to assist them to open their own businesses. Those still unable to find work elsewhere received basic unemployment benefit (ILO and AFD, 2016d). There is also the case of Poland, which – in a bid to mitigate GHG emissions and promote the transition to renewable sources of energy – is currently closing uncompetitive coal mines in compliance with European Union aid regulations and with a view to transitioning towards more sustainable energy sources. As around 100,000 people work in the Polish coal industry, financial support (1.9 billion euros) is being provided to those affected by job losses to help in their adaptation to changing labour market demands in the context of the transition to a more environmentally sustainable economy.[2] Similarly, following Romania's decision to close two uncompetitive coal mining units by 2018, financial support totalling 54 million euros has been earmarked to provide income support to workers who will become unemployed and to reskill former employees so that they can find jobs in more environmentally sustainable professions.[3] In the Philippines, the planned closure of mines has been put on hold until appropriate compensation measures are agreed and implemented to support the workers affected and facilitate their transition to new jobs or locations. These examples show that the transition to a greener economy cannot be undertaken if the resources to cushion the social costs are not specified in advance.

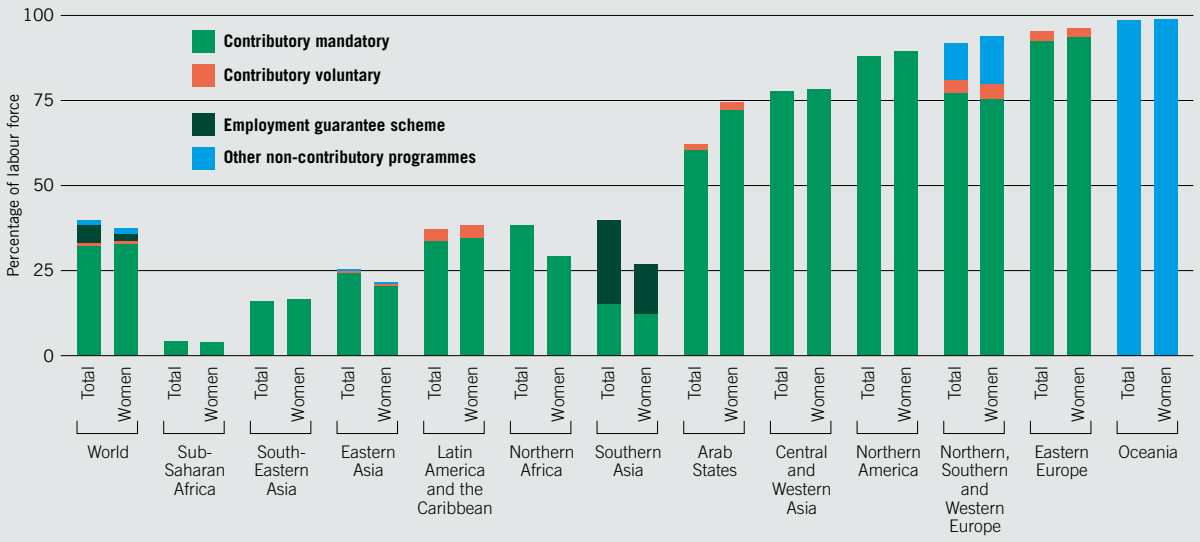
However, the potential of unemployment protection schemes to support the transition to greener economies is severely limited by the fact that such schemes do not yet exist in many countries. Even where they exist on paper, the schemes may cover only a small proportion of workers, often excluding workers who are underemployed and/or engaged in non-standard forms of employment, indigenous and tribal peoples, ageing populations and smallholder farmers, all of whom consequently have to rely on informal community or family support systems. Figure 4.2 shows that only around one-third (38.6 per cent) of the global labour force is covered by unemployment protection under national legislation, mostly through mandatory contributions. Legal coverage ranges from 4.2 per cent in sub-Saharan Africa to over 80 per cent in Europe, Oceania, and Northern America, with women being less likely to be legally covered in Eastern Asia, Northern Africa and Southern Asia. In this context, increases in non-contributory social assistance such as cash transfers (discussed in the next section) simultaneously compensate, at least in part, for non-existent or low coverage of unemployment protection during the transition to a green economy and strengthen the adaptive capacity of households in the case of slow and rapid-onset natural disasters. A gender-sensitive approach is required to compensate for existing disparities and to prevent their emergence in the first place.

2. See https://www.reuters.com/article/us-poland-coal-subsidies-eu/eu-clears-1-9-billion-polish-support-for-mine-closures-idUSKBN13D16Y

3. See http://europa.eu/rapid/press-release_IP-16-3981_en.htm

Figure 4.2

Percentage of workers covered by unemployment protection schemes, by region, latest year available



Note: Regional estimates are weighted by the labour force.

Sources: ILO, 2017, figure 3.16, based on World Social Protection Database; ISSA/SSA, Social Security Programs Throughout the World; ILOSTAT, completed with national statistical data for the quantification of the groups legally covered.

Link: http://www.social-protection.org/gimi/gess/RessourceDownload.action?ressource.ressourceId=54640

C. Cash transfer programmes

A second set of policy instruments, cash transfer programmes, can play a significant role in strengthening the adaptive capacity and resilience of individuals in response to climate change. They can also support a just transition to a green economy by protecting people from possible loss of income caused by the implementation of environmental policies. The concept refers to non-contributory schemes providing cash benefits to individuals or households, usually financed out of taxation, other government revenue, or external grants or loans. Programmes that provide cash to families subject to the condition that they fulfil specific behavioural requirements are referred to as conditional cash transfer (CCT) programmes.

Cash transfer programmes and adaptation strategies

Cash transfer programmes have expanded considerably over recent decades, particularly in low- and middle-income countries. They are typically designed to address the everyday deprivation faced by households in poverty, or by certain categories of the general population. In the context of climate change and environmental degradation, the role that cash transfers can play in strengthening the adaptive capacity and resilience of individuals and households is widely recognized, particularly in developing countries, where existing social protection is inadequate (Wood, 2011; Béné et al., 2014).

Wood (2011) identifies various channels through which cash transfer programmes contribute to adaptive capacity in the context of climate change. First, by helping people in poverty to meet their basic needs, cash transfers contribute to the reduction of short-term vulnerability. Second, they can provide support for households affected by climate-related hardship, such as extreme weather events and

slow-onset environmental degradation. Third, they have the potential to reduce pressures to engage in asset-depleting strategies, which weaken long-term adaptive capacity. By helping vulnerable households to consider investment decisions and innovations, cash transfers also increase their adaptive capacity. Finally, in some cases, when climate change makes livelihoods less viable, temporary or permanent migration can be the only response. In this context, by reducing the costs of migration and providing a degree of insurance to migrants, cash transfers can facilitate mobility and thus increase the options available to vulnerable households to improve their adaptive capacity. Another way to facilitate workers' mobility and strengthen their adaptive capacity is to ensure portability of social protection between employers and States.

More recently, certain climate-sensitive features have been added to otherwise pro-poor transfer programmes in countries such as Kenya and Ethiopia. In Kenya, the Hunger Safety Net Programme (HSNP) is an unconditional cash transfer programme that builds resilience and reduces extreme poverty in four arid counties in the northern part of the country. As of November 2017, the HSNP provides regular electronic and unconditional cash transfers to 100,883 households,[4] which represents about 27 per cent of households in the region. The transfers are worth approximately US$ 50 and are paid every two months. Since 2014, systems have started to be built to help the Government of Kenya put in place the capacity to scale up cash transfers to mitigate the effects of drought. Drought conditions are monitored by satellite. If they reach severe levels in any given month, an additional 25 per cent of households in drought-affected areas receive a one-off emergency payment. If conditions worsen to extreme levels, then coverage increases to 75 per cent of all households. During 2015, HSNP scaled up four times to provide emergency cash transfers to over 207,000 additional households beyond its regular beneficiary households. The first three payments were in response to drought and the last payment was made in anticipation of the El Niño weather system. According to the impact evaluation, the majority of beneficiaries used transfers for food and basic needs, but some were able to pay off debts, make modest investments in small livestock and contribute to the costs of schooling their children. There is evidence to suggest that the transfers enabled poorer routine beneficiaries to move towards a better standard of living, which increased their resilience to shocks. However, emergency beneficiaries used transfers almost exclusively to cover basic needs rather than investing in productive assets that may enhance resilience. As 62 per cent of the recipients are women, the programme increased their purchasing power and hence their visibility as economic actors and improved their status within their households (Farhat, Merttens and Riungu, 2017; Otulana et al., 2016).

Similarly, in Ethiopia, a cash transfer component of the pro-poor Productive Safety Nets Programme (PSNP)[5] provides timely scale-up payments for certain beneficiaries in anticipation of droughts or floods, based on meteorological data indicating the anticipated impact on the food security of beneficiaries. A recent study focusing on the impact of Ethiopia's PSNP on long-term effects of drought indicates that the negative impact of drought shocks on food security persists for up to four years after the drought has ended. The study also shows that receiving PSNP payments reduces the initial impact of drought shocks by 57 per cent and eliminates their adverse consequences on food security within two years (Knippenberg and Hoddinott, 2017). Cash transfer programmes addressing specific climate-related risks are particularly relevant for countries seeking to develop adaptation measures to protect households against the financial losses and damage associated with the impact of climate change and environmental degradation.

Cash transfer programmes and mitigation strategies

Besides helping climate change adaptation, cash transfer programmes have also been part of public efforts to address the root causes of climate change. In addition to the negative effects on employment of the closure of polluting and carbon-intensive industries, some response measures to reduce or sequester GHG emissions may have an adverse impact on people whose livelihoods or consumption patterns are tied to unsustainable practices. Cash transfer programmes have been combined with pro-climate reforms to compensate in part or in full for income losses among those affected by new restrictions on economic activities or energy consumption.

4. Against a total target of 101,354 households (see: http://www.hsnp.or.ke/index.php/dashboards/at-a-glance).

5. The major component of the PSNP is a public employment programme (discussed in section D below). However, the direct support component provides cash transfer for those who are unable to work due to disability, illness or age.

For example, when China introduced the ban on unsustainable logging, referred to above, nearly 1 million state forest workers lost their jobs as a result, and the livelihoods of 120 million other rural workers were affected. However, thanks to the introduction of cash transfers and other social protection measures to supplement existing protection, four years later two-thirds of the nearly 1 million workers affected had either found other jobs or retired, and some 32 million rural households began to receive cash payments to perform conservation activities. These measures resulted in the afforestation of nearly 27 million hectares of former farmland and deforested areas (ILO and AFD, 2016c and 2016d). Some years later, in 2013, the Egyptian Government faced drastic and severe fiscal burden because of spending 20 per cent of the budget on fossil fuel subsidies. These subsidies were reduced to balance the budget and bring down wasteful consumption and emissions. According to officials, the removal of fossil fuel subsidies could reduce the country's CO_2 emissions by 13 per cent. The phase-out of fossil fuel subsidies was inaugurated alongside two new cash transfer programmes to help offset the impact of substantial fuel price increases on poor and vulnerable households. These programmes, partially financed by the government savings, were aimed at two vulnerable groups: one was tailored for households in poverty and children *(Takaful programme)* and the second (*Karama programme*) provides social pensions for persons with disabilities or aged 65 and above. While the Takaful programme provides monthly benefits of US$40.50 per month with top-up payments ranging between US$7.5 and US$12.5 per child, the Karama programme provides a payment of US$43.50 for each qualifying individual in the household. By 2017, the World Bank estimated that these programmes covered about 1.5 million families (6 million Egyptians) out of the 1.7 million families targeted (ILO, 2017; ILO and AFD, 2016e; World Bank, 2017).

D. Public employment programmes

The social and environmental potential of public employment programmes

The concept of public employment programmes (PEPs) covers any government programme that directly creates employment without expanding the regular civil service. PEPs include emergency public works programmes (PWPs) such as the Gonaives programme in Haiti, and employment guarantee schemes (EGS) such as the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA) in India, as well as a range of intermediate options. While PWPs are normally a temporary response to specific shocks and crises (although they can also have a longer-term horizon), EGS are long-term, rights-based employment programmes that entitle people to work and offer predictable and stable income while creating needed public assets and services (Lieuw-Kie-Song et al., 2010). PEPs contribute to a fair and just transition.

PEPs target multiple objectives simultaneously, which makes them attractive policy tools. While many combinations are possible, PEPs are usually aimed at: (i) employment creation and income security; (ii) poverty reduction; and (iii) the provision of public and/or social goods and services, such as infrastructure or environmental assets. Many of these environmental programmes, often described as Green Works, are also contributing to building more climate-resilient adaptive infrastructure contributing to disaster risk reduction.

The vast majority of PEPs implemented in recent years, particularly in low- and middle-income countries, have focused on the most vulnerable groups through the enhancement of income security and the development of health-care, educational, environmental and other public services. In general terms, PEPs are social protection tools with the objectives of providing temporary employment and investing in labour-intensive infrastructure in support of the provision of social services (Subbarao et al., 2013; McCord, 2012). At the same time they are extending social protection schemes in countries where there is insufficient or inexistent social protection coverage. The ILO's Social Protection Floors Recommendation, 2012 (No. 202), recognizes PEPs as a means of providing basic social security guarantees. However, while all PEPs include a social component, there are often trade-offs between multiple objectives (employment, poverty reduction and the provision of assets and social services). Thus, policy design and implementation require the prioritization of one function over the others (ILO, 2014), without undermining their potential to achieve secondary or tertiary objectives.

In recent years, there has been renewed interest in PEPs for two main reasons. First, they were part of the recovery plans and used as countercyclical measures in many countries following the Great Recession (ILO and World Bank, 2012). For this reason, they are referred to in the ILO's 2009 Global Jobs Pact as a response to the risk of long-term unemployment and increased informality, and as building blocks for social protection systems. Second, a range of innovations in the design and implementation of PEPs has improved their social, economic, environmental and institutional outcomes. Among these innovative aspects, which include longer-term approaches, broader scale and greater complementarity with social protection programmes, innovations in the type of work provided under the programmes are opening up new opportunities for convergence with other policy areas. In particular, PEPs performing work in the environmental sector have the potential to contribute to climate change mitigation and adaptation (Lieuw-Kie-Song et al., 2010; Philip, 2013).

The main way in which PEPs can contribute to climate change mitigation and adaptation is through the work performed. For example, mitigation components of environmental projects usually include jobs in reforestation, water and soil conservation, while adaptation can be targeted through employment in flood control and erosion reduction measures. Given their local nature, adaptation can also be integrated into projects that enhance community resilience. In vulnerable areas heavily affected by natural disasters and climate change, emergency employment programmes can provide social protection while at the same time reducing the impact of negative shocks. Employment generated through rehabilitation and reconstruction following natural disasters is reactive adaptation. The third way in which PEPs can contribute to environmental objectives is through anticipatory adaptation. As the majority of PEPs involve the construction of infrastructure, it is possible to integrate PEP projects with climate adaptation measures, such as improvements in irrigation and drainage systems, roads and transportation. Mitigation can also be achieved through jobs that target resource efficiency in infrastructure. Importantly, these types of employment offer opportunities to enhance skills for the green transition (see Chapter 5). Last but not least, these employment-intensive schemes use hands-on training to raise and strengthen awareness of the importance of climate resilience and the risks of environmental degradation. PEPs can therefore combine adaptation and mitigation measures with social protection and poverty reduction, while enhancing local participation and the rehabilitation of natural resources (Harsdorff, Lieuw-Kie-Song and Tsukamoto, 2011). Many of these programmes also include a productive component, making them attractive to ensure that they are sustainable and provide the needed livelihoods.

In this context, PEPs become crucial policy tools to combine economic, social and environmental objectives through green jobs (box 4.1). Their use is likely to increase over the coming years, as climate change and other forms of environmental degradation add to existing environmental challenges. Increasing numbers of activities related to the mitigation of and adaptation to climate change can be expected.

Examples highlighting the potential of environmental PEPs

Three examples illustrate how PEPs can combine social and environmental outcomes: The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India, the Working for Water programme in South Africa, and the Productive Safety Net Programme in Ethiopia. All these examples promote adaptation from and mitigation of environmental risks.

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India is aimed at providing social protection and economic security for rural people in poverty, strengthening drought-proofing and flood management and empowering marginalized communities. Through the MGNREGA, each rural household is entitled to 100 days of employment a year. People are employed in unskilled manual work, such as the construction or improvement of community infrastructure, or the generation of ecosystem services that protect environmental resources. According to the Ministry of Rural Development, 60 per cent of the work hours provided through the programme in 2012 involved water conservation and 12 per cent were related to the provision of irrigation facilities (Das, 2013). The programme also increased female labour participation and in some cases women's autonomy in household decision-making by providing higher wages than other rural employment opportunities (ILO, 2017).

The Working for Water programme was introduced in South Africa in 1995 as a response to an invasive alien vegetation species problem that caused damage to the South African economy and its biodiversity, threatened water security and increased soil erosion. Since 2003, Working for Water has been

Box 4.1

High-impact opportunities for environmentally oriented public employment programmes

Lieuw-Kie-Song (2009) identifies six sets of circumstances in which environmental public works programmes can be particularly effective policy options on their own, or when integrated into other activities.

Circumstances of acute environmental distress

Depleted natural capital due to acute environmental degradation, such as deforestation, soil erosion, flash floods and invasive threats, can reduce the productivity level of the poor. In this context, investment in restoring degraded natural capital through PEPs can create employment opportunities and raise productivity in the long term.

Complementing other rural development strategies and schemes

PEPs can complement rural development programmes by raising agricultural productivity and creating livelihoods. Investment opportunities in natural capital can be as diverse as water harvesting, increasing attractive features for tourism, and maintaining catchment areas to improve water supply for local communities, as well as downstream communities or cities.

Offering alternatives for those engaged in destruction/over-harvesting

PEPs can provide alternative employment with better working conditions and income for poor persons who are engaged in deforestation and over-harvesting. PEPs can direct their labour towards environmentally sound activities such as reforestation and other agro-forestry activities, instead of environmental destruction.

Urban areas with high concentrations of poverty and unemployment

In urban areas with a high concentration of poverty, PEPs that include environmental activities alongside other components can produce improvements in sanitation, rainwater capture, the insulation of homes and the provision of solar water heaters. Other opportunities could include tree planting, waste management and recycling.

Responses to natural disasters

PEPs implemented in response to natural disasters can have both a short- and a long-term impact. In the short term they can be used to reverse disaster damage, while in the long term they can restore the environment, which can help limit the impact of similar disasters in future. For example, mangrove forests can help reduce the impact of floods and tsunamis, as well as playing a critical role as breeding grounds for many species of fish.

Climate change adaptation

PEPs that include adaptation measures can minimize the impact of climate change and benefit the poor who are directly affected by providing them with additional income through employment. Although effective measures to adapt to climate change are still being identified, this field is developing rapidly and some opportunities can already be outlined, such as watershed management, the construction of dykes or eco-based adaptive measures to protect against rising sea levels and water harvesting.

part of the Expanded Public Works Programme. It is a water-clearing PEP that provides unemployed workers with short-term public contracts to remove water-intensive alien tree and plant species from local water catchment areas. Working for Water is also aimed at poverty alleviation and specifically targets vulnerable groups by seeking to employ 60 per cent women, 20 per cent youth and 5 per cent persons with disabilities. The programme has resulted in the clearance of over 1 million hectares of invasive alien plants since 1995, releasing an additional 50 million cubic tonnes of a water a year (Schwarzer, Van Panhuys and Diekman, 2016).

The Productive Safety Net Programme (PSNP) has contributed to improving food security in Ethiopia through land restoration and reforestation, and has become Africa's largest climate resilience programme. The PSNP has benefited 7.8 million persons and supported the restoration of the local environment. Total expenditure under the PSNP between 2015 and 2020 amounts to US$4 billion.

Evidence shows that PSNP public works have improved the capacity to grow food by increasing land productivity by three to four times, with a positive impact on community resilience. Higher crop yields have been achieved by reducing soil erosion and sediment loss by 50 per cent. The average household food gap (the total number of days during which households cannot meet their food needs) has fallen from 3.6 months to 2.3 months. The PSNP has also contributed to the mitigation of climate change by promoting land use practices that increase carbon sequestration (Fortun, 2017).

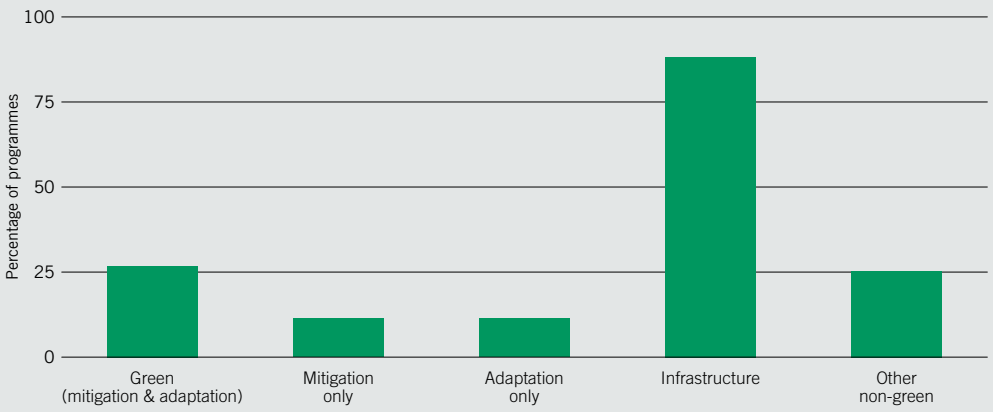
Many PEPs include environmental objectives

While most of the literature focuses on national experiences of integrated PEPs combining social and environmental outcomes, little is known about their implementation at the global level. A rough estimate is made in this chapter by using the available cross-country data on PEPs with a safety net orientation, retrieved from Subbarao et al. (2013).[6] The available data provide information on 86 PEPs covering 62 countries in five regions.

Figure 4.3 shows that 50 per cent of the PEPs reviewed include an environmental component, whether related to mitigation of or adaptation to environmental risks. While 26 per cent of the sample integrate both mitigation and adaptation components, 12 per cent include only mitigation work and an additional 12 per cent include only adaptation measures. Unsurprisingly, 88 per cent of the PEPs focus on infrastructure. The results also show that 26 per cent of the PEPs provide social services such as health-care and educational services. As each PEP tends to consist of various components, percentage figures do not add up to 100 per cent.

Figure 4.3

Public employment programme components



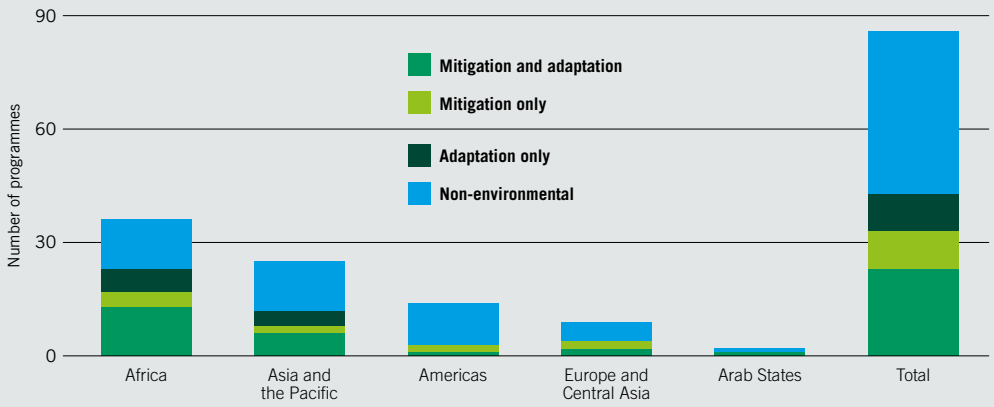
Note: ILO estimates based on the description of the work or projects undertaken under each PEP available in the database. In view of the limited information available in the data describing the work or projects undertaken under each PEP, a conservative approach has been adopted, considering mitigation or adaptation components to be present only if they are explicitly mentioned. For example, the construction of irrigation canals is considered to be infrastructure work if the objective of reducing the impact of drought is not mentioned. The percentage of programmes with environmental components may therefore be underestimated.

Source: ILO calculations based on data from 86 PEPs in Subbarao et al., 2013.

6. The data were obtained from a review of existing research on specific public works programmes implemented over the past 20 years. The data are supplemented by a survey of PEP implementation conducted at the South South Learning Forum: Making Public Works Work, held in Arusha, United Republic of Tanzania, in 2010. In addition, as explained by Subbarao et al., 2013, the work focuses on safety net-oriented PEPs.

Figure 4.4

Public employment programme components, by region



Note: ILO estimates based on the description of the work or projects undertaken under each PEP available in the database. In view of the limited information available in the data describing the work or projects undertaken under each PEP, a conservative approach has been adopted, considering mitigation or adaptation components to be present only if they are explicitly mentioned. For example, the construction of irrigation canals is considered as infrastructure work if the objective of reducing the impact of drought is not mentioned. The number of programmes with environmental components may therefore be underestimated.

Source: ILO calculations based on data for 86 PEPs in Subbarao et al., 2013.

At the regional level, figure 4.4 shows that Africa has the highest incidence of PEPs that include environmental components, with 23 out of 36 PEPs including mitigation or adaptation activities. Africa is also the region for which data are available on the largest number of PEPs. In Asia and the Pacific, 12 of the 25 PEPs considered include an environmental component, with six programmes undertaking both mitigation and adaptation activities, two programmes including only mitigation and four only adaptation work. In Latin America and Europe, the prevalence of environmental components is lower, with three out of 14 PEPs including an environmental component in Latin America and four out of nine in Europe. In the Arab States, the data cover only two programmes, of which only one includes both mitigation and adaptation activities.

E. Payments for ecosystem services

In line with the discussion on environmental policies that comprise elements of the Decent Work Agenda (see Chapter 3), this section turns to the fourth selected policy instrument, namely payments for ecosystem services (PES), as a concrete example of an environmental policy with the potential to achieve social outcomes. With the growing need for integrated policy measures that address social, environmental and economic challenges, innovative policy tools such as PES are raising considerable interest. While the previous section discussed the possibility of including environmental components in PEPs which are primarily designed with a social objective in mind, this section focuses on the integration of a social dimension into PES schemes originally designed with an environmental objective.

Designing PES with poverty alleviation objectives

Ecosystem services are the benefits to humans provided by the ecosystem. They include: provisioning services (such as the supply of food, water and timber), regulating services (including the regulation of air quality, climate and flood risks), cultural services (such as the recreational, aesthetic and spiritual

benefits of ecosystems) and supporting services (including soil formation, pollination and nutrient cycling (MEA, 2005). As Chapter 1 shows, environmental degradation limits the ability of ecosystems to provide these services, threatening individual health and well-being and economic activity. As most ecosystem services are not priced, they therefore constitute implicit subsidies to those that enjoy them, with no liability if their provision ceases (Smith et al., 2013). Adequate pricing, which can include the benefits that ecosystem services bring to jobs, can go a long way towards generating incentives for the services to be maintained, in addition to providing revenue for individuals and communities (Barbier and Markandya, 2013; Gómez-Baggethun et al., 2010; Pagiola, Arcenas and Platais, 2005). In this context, PES have attracted considerable interest as a means of preserving ecosystem services through markets (Daw et al., 2011; Jayachandran et al., 2017; Schwarzer, Van Panhuys and Diekman, 2016). In recent years, many studies have highlighted the potential positive effect of PES on the livelihoods of smallholders (Grieg-Gran, Porras and Wunder, 2005; Pagiola, Arcenas and Platais, 2005; Wunder, 2008; Zilberman, Lipper and McCarthy, 2008).

The basic principle behind all PES is that resource users and communities (usually land owners) who are in a position to provide environmental services should be compensated for the cost of their provision, and that those who benefit from these services (private, public or a combination of both) should pay for them, thereby internalizing the benefits[7] (Mayrand and Paquin, 2004; Pagiola and Platais, 2002).

In this context, a growing body of evidence demonstrating that people in poverty are providers of environmental services means that PES have the potential to combine their initial environmental objectives with social objectives. The specific characteristics of PES programmes (see box 4.2) and the areas in which they are implemented are likely to play a critical role in the relationship between PES and poverty (Pagiola, Arcenas and Platais, 2005). While in some cases PES can achieve both objectives in a cost-effective manner, in others their socio-economic and institutional context is such that poverty alleviation and environmental protection objectives compete. If the poverty alleviation components of PES programmes come at the expense of the environmental service, the programmes may fail, in which case neither the environmental conservation nor the poverty reduction objectives will be achieved (Wunder, 2005). For instance, when people in poverty and vulnerable people are included in PES programmes, they are often relatively low-cost providers of environmental services. The economic opportunity cost for poor participants is lower than for others, in view of the lack of viable alternative economic opportunities. This makes them attractive participants in PES schemes. However, the ecological impact of the services they provide may be limited in comparison with ecological assets for which opportunity costs are much higher (such as the prevention of industrial-scale land development). When the socio-economic and institutional context allows, the issues related to trade-offs between environmental and social objectives can be addressed by the design and implementation of the programmes.

The integration of economic, ecological and social criteria into the design and implementation of PES makes them more complex, but may in some cases lead to them supporting sustainability by promoting economic resilience, environmental integrity and social development (FAO, 2011). A key question when designing such programmes is whether any constraints prevent people in poverty from entering them. If formal land title is not secured, PES that require land ownership or a minimum land size for participation are likely to exclude the landless poor and smallholders (Pagiola, Arcenas and Platais, 2005; Wunder, 2005). Similarly, complex and/or expensive application processes may lead to the exclusion of people in poverty. It is therefore important to keep the application process as simple as possible and, if necessary, to provide free (or low-cost) assistance. If the programme is to be effective in reducing poverty, the financial impact of the payments has to be sufficient to increase the total income of the participants. For this to be the case, the net payments made have to exceed the opportunity cost, which includes income from previous land use and transaction and investment costs. This is often assumed to be the case, as providers supposedly enter PES contracts on a voluntary basis. However, opportunity costs need to be carefully considered and estimated in order to determine the appropriate level of compensation (Schwarzer, Van Panhuys and Diekman, 2016). A PES scheme can also strengthen – or lead to the creation of – community associations, especially if the contracts are signed with the community, or if agreements are negotiated on a collective basis. In the latter case, coordination between potential providers at the community level can give individuals more bargaining

7. In recent decades, the definition of PES has been the subject of intense debate. Wunder (2015) revisited his work to take into consideration the criticisms and analyses made in the literature. According to the new definition, PES are "voluntary transactions between service users and service providers that are conditional on agreed rules of natural resource management for generating offsite services". In practice, many PES schemes do not meet all these criteria. The difficulty in reaching consensus on the definition of PES reflects the great variety in their design.

Box 4.2

Features of payments for ecosystem services (PES) schemes

Types of environmental services provided:

- Carbon sequestration and storage, usually in accordance with climate change mitigation objectives. For example, polluting companies in industrial areas can pay farmers in the tropics to plant more trees and maintain forests to offset their carbon footprint.
- Biodiversity protection, with the aim of maintaining or increasing biodiversity against a variety of land uses. For example, farmers are paid to set aside their land for conservation or to reduce their agricultural activity on such lands. Environmental service buyers of this type are often conservation organizations, ecotourism or wildlife companies, or governments (Wunder, 2005).
- Watershed protection, to reduce the negative impact of upstream water users on water quantity and quality. For example, downstream water users (which may be companies or households) pay upstream farmers to adopt sustainable land use practices.
- Landscape beauty, to maintain biodiversity and ecosystem qualities that contribute to natural beauty. This type of PES scheme often includes tour operator companies on the demand side and farmers or foresters on the supply side.

A majority of PES schemes target single environmental services, but some target multiple services. For example, the National Payment for Environmental Services programme in Costa Rica rewards forest owners for the four types of services mentioned above (Schwarzer, Van Panhuys and Diekman, 2016).

Sectors financed:

- Public PES schemes are managed and financed, often through taxes, by a local or national centralized public administration acting as a buyer on behalf of the public or a group of private end users. These programmes are often large scale, nationwide and include side objectives, such as livelihood impacts, community development and pro-poor action.
- Private schemes are often on a smaller scale and focus on a local area, in which buyers pay service suppliers directly (or through intermediaries, such as forestry funds, commodity funds or NGOs).
- Donor-led schemes are encouraged and financed by international donors, such as the GEF, the World Bank, IFAD and CARE. These schemes tend to support smaller scale and more locally focused programmes within larger initiatives covering more than one country, such as the IFAD Rewarding Upland Poor for Environmental Services (RUPES) programme.

In practice, PES schemes are often a combination of the above. Government-financed PES schemes may receive partial funding and technical support from international organizations, and donor-led programmes tend to incorporate private companies with the aim of the contracts being taken up by private users after the donations fade out (Ezzine-de-Blas et al., 2016).

Forms of land use:

- Use-restricting, whereby areas under conservation or protection are set aside, and service providers receive compensation for the opportunity cost of not using the resource. For example, under China's Sloping Land Conversion Programme (SLCP), farmers in erosion-prone areas volunteer to set aside part of their cropland and receive compensation that is higher than the opportunity cost.
- Asset-building PES schemes, through which payments are made for efforts to improve environmental services (for example, through afforestation and reforestation).

While "use-restricting" can by definition generate additional income through compensation, it limits the creation of new economic activities. In contrast, "asset-building" allows the creation of new jobs and innovative value aggregation chains, and therefore develops sustainable "exit doors" and provides better safety nets for households (Schwarzer, Van Panhuys and Diekman, 2016).

Forms of payment: payments under PES schemes can be in cash or in kind, or a combination of both:

- Cash payments can be one-off payments from buyers to an intermediary fund, which are then distributed to service providers during contract periods or paid on a more regular basis, for example as a wage to conservationists and foresters.
- In-kind payments can take many forms, ranging from the provision of planting materials and tools to capacity-building, training and technical assistance. A more indirect channel of in-kind payment is through social services such as education, health care and infrastructure development.

Spatially, schemes can vary from local (ranging from very small programmes to medium and large sizes) to schemes carried out on a national scale.

power and reduce transaction costs (Grieg-Gran, Porras and Wunder, 2005; Pagiola, Arcenas and Platais, 2005; Schwarzer, Van Panhuys and Diekman, 2016; Wunder, 2005).

Another concern that needs to be addressed is the potentially negative impact of PES on the non-participating poor. First, there may be a drop in employment opportunities if the alternative land use promoted by the scheme is less labour intensive (Wunder, 2005). However, Chapter 2 shows that sustainable methods of production can be more labour intensive. Second, people who are not participating in a PES scheme may be priced out of the services it provides, in the sense that they may now have to pay for the service which, since it is now priced, may become unaffordable. They may also be affected indirectly through a rise in the cost of living resulting from higher food prices (Schwarzer, Van Panhuys and Diekman, 2016).

Growing interest in PES schemes with social objectives

In recent years, as the interest of policy-makers has grown in the potential of PES schemes to address environmental degradation as well as poverty reduction, some countries have begun to change the design of PES. For example, the Payment for Environmental Services (PPSA) scheme in Costa Rica and the Payment for Hydrological Environmental Services (PSAH) scheme in Mexico did not originally have an anti-poverty objective, but have become pro-poor over time. In other countries, social dimensions have been included in existing PES schemes from the outset, such as the Social Forest programme in Ecuador and the *Bolsa Verde* in Brazil, which link an existing social protection programme with a PES approach.

At the global and regional levels, there are several multi-country actions and learning initiatives to promote the development of local PES schemes with an anti-poverty focus. The most important are global initiatives, such as Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks (REDD+) and Ecosystem Services for Poverty Alleviation (ESPA), as well as regional initiatives such as Rewarding Upland Poor for Environmental Services (RUPES) in South-East Asia and Pro-poor Rewards for Environmental Services in Africa (PRESA). All these initiatives cover regional action sites in different countries, combined with a focus on research and a platform for the exchange of experience and the development of lessons for future projects. There are also international and regional exchange groups focusing on PES, including the Katoomba Group, an international network serving as a forum for the exchange of ideas and information about PES and for collaboration between practitioners on PES projects and programmes. The East African Forum for Payment for Ecosystem Services is an interactive regional forum for the exchange of knowledge, ideas and experience, which also provides support for ongoing and emerging PES projects in East Africa and beyond (Schwarzer, Van Panhuys and Diekman, 2016).

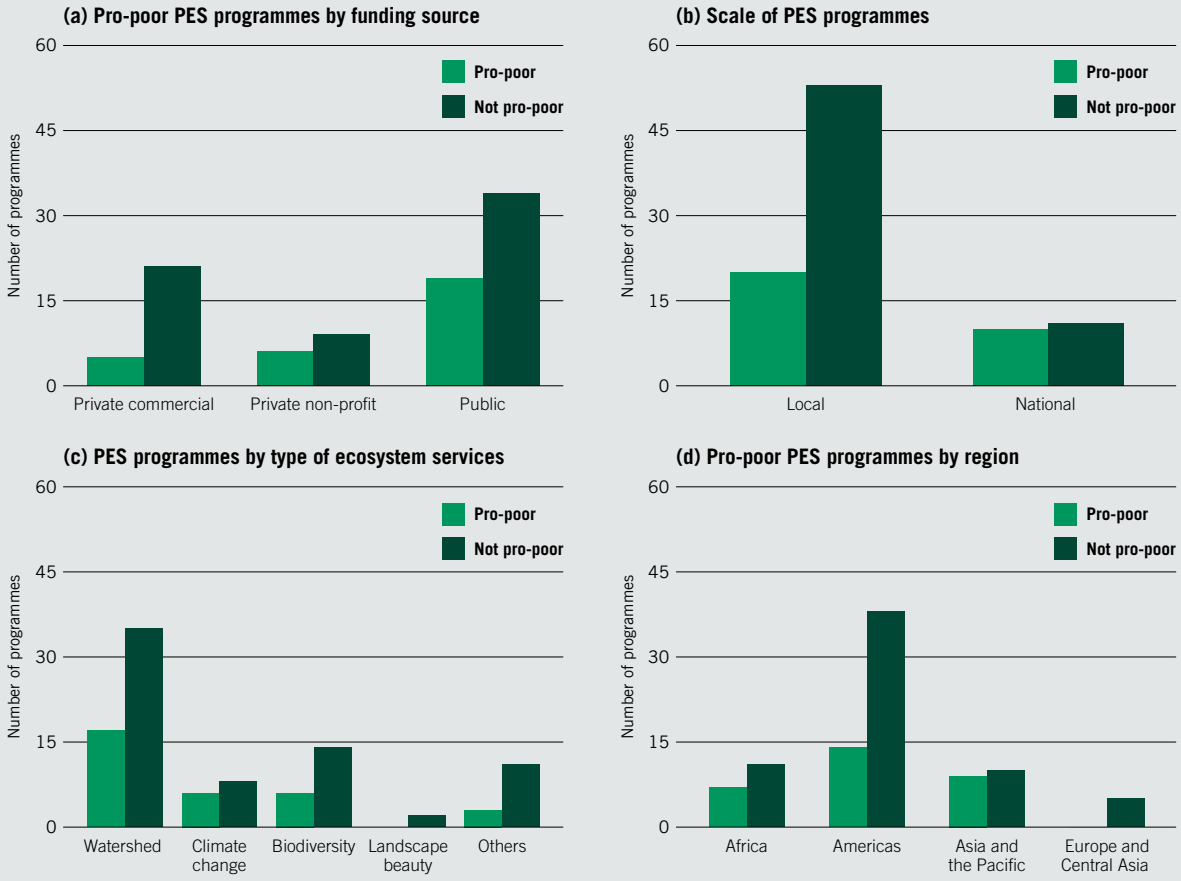
In line with these recent trends, figure 4.5 suggests that PES programmes financed by governments and non-profit organizations are more likely to include a pro-poor objective than privately funded schemes. While 19 per cent of the privately funded PES reviewed include a pro-poor focus, the figures are respectively 40 and 36 per cent for non-profit and publicly funded PES, which also focus on poverty alleviation. It would also appear that 47 per cent of the large national programmes (often financed through public funds) include a pro-poor focus, compared with 27 per cent of local schemes (usually privately financed). The results also suggest that PES that include carbon sequestration are more likely to be pro-poor than those focusing on other environmental services.[8] At the regional level, PES schemes are more common in Latin America than in other regions. However, a larger share of the schemes have a pro-poor focus in Asia and the Pacific and Africa.

Althought estimates suggest that a significant number of PES already include poverty alleviation objectives, monitoring the impact of PES on ecosystems and poverty is crucial to measuring their environmental and social outcomes and longevity.

8. "The nature of the environmental service often determines whether the poor can participate. In the case of watershed services, once a particular catchment has been identified for providing hydrological services, the program is bound to work with the communities that live in that catchment, irrespective of their socioeconomic status. On the other hand, land users anywhere in the world can provide carbon sequestration services. Poor farmers who depend on marginal lands can provide carbon sequestration services more cheaply than farmers in industrialized countries, where land prices and opportunity costs are much higher. Therefore, many carbon projects, such as the World Bank's BioCarbon Fund, are able to target poor communities for providing carbon sequestration services." (Jindal and Kerr, 2007, p. 4).

Figure 4.5

Pro-poor components in payment for ecosystem services (PES) schemes



Note: Data for 94 PES programmes consolidated from Schwarzer, Van Panhuys and Diekman, 2016, and Ezzine-de-Blas et al., 2016. Programmes listed in both sources are combined. Programmes with a pro-poor focus are those that either explicitly mention poverty reduction in their objectives or are assessed as having pro-poor effects in the socio-economic impact sections in the literature. Due to limited data collection from the literature review, a conservative approach is adopted in counting pro-poor programmes, as not all the literature analyses socio-economic impacts. Due to the differences between the two data sets in categorizing financing, the financing sector is defined as public, private commercial or private non-profit, as in Ezzine-de-Blas et al., 2016. Programmes classified as donor-led in Schwarzer, Van Panhuys and Diekman, 2016, are classified as either public (if the majority of funding is from international organizations or provided as aid) or private non-profit (if the majority of funding is from NGOs, foundations or grassroots organizations).

Source: ILO calculations based on 94 PES programmes in Schwarzer, Van Panhuys and Diekman (2016) and Ezzine-de-Blas et al., 2016.

F. Simulation

In this section, a simulation model is applied to help illustrate the overall effect of the social protection policies examined in this chapter. Using the United Nations Global Policy Model, we project the impact of a policy package containing PEPs, PES, cash transfers, unemployment insurance and investment in clean energy on growth, employment and income distribution.

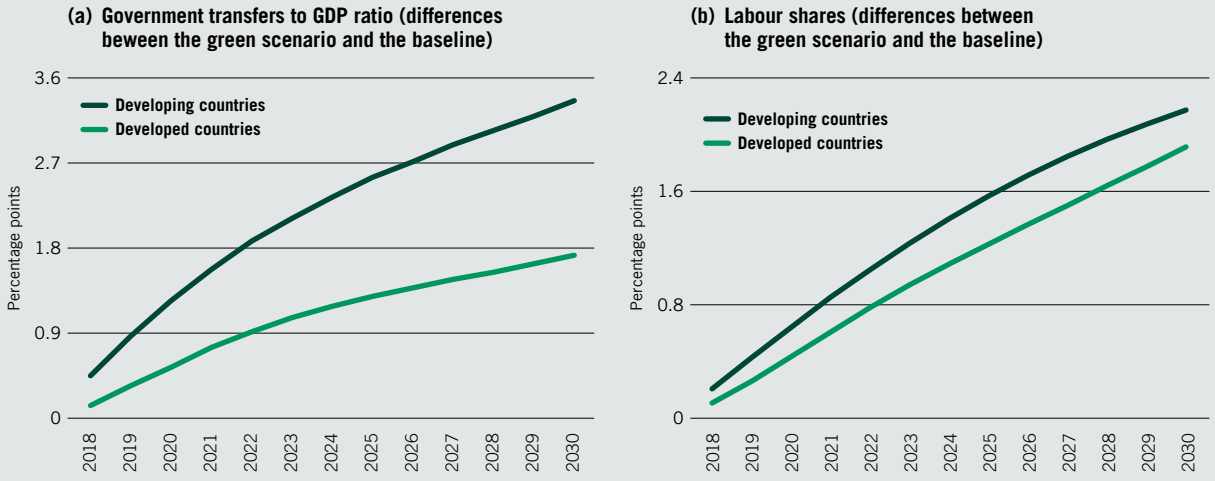
A simulated policy package shows benefits

The simulation covers the global adoption of a policy package in support of household and workers' incomes for the promotion of sustainable growth. The term "sustainability" is used in this context in both an environmental sense, as growth that does not rely on the greater use of fossil fuels, and an economic sense, as a growth pattern that eschews the accumulation of macroeconomic imbalances which may lead to instability. To achieve this double goal, changes are examined in social protection policy, taxation, primary income distribution and energy policy.

Two changes are assumed in social protection policy (figure 4.6). First, social transfers are assumed to increase as a result of payments for environmental services, public employment programmes and cash transfers. The increase is assumed to be faster in countries with a lower ratio of total transfers to GDP (where the ratio is assumed to increase by 1.5 per cent a year), and slower in other countries (0.75 per cent a year). To justify this assumption, one may argue that those countries which have already put in place the relevant programmes to be scaled up have lower needs in terms of extending the coverage or the level of benefits. Developing countries, which often tend to experience higher levels of growth as well as lower social protection system coverage, have more needs to be met and more potential to extend social protection, provided they have the fiscal space and the institutional capacity to do so in the first place. In the short term, this rise in spending is compensated by a rise in direct taxes, with more emphasis on marginal rates. A greater increase on marginal rates contains the impact of direct income support on aggregate consumption. Indeed, a drive towards higher consumption may lead to unsustainable, short-term, high-interest borrowing, which is likely to generate financial bubbles. In the longer term, the increase in social spending pays for itself, as higher growth and employment generate higher tax revenue.

Figure 4.6

Social protection policies for a green economy



Note: The lines in each panel represent differences between the two scenarios. For example, in panel (a) the lines indicate that transfers/GDP ratios are increasingly higher in the green scenario compared to the baseline scenario.

Source: ILO calculations based on the United Nations Global Policy Model.

Figure 4.7

GDP growth rate (baseline scenario vs green scenario), selected countries

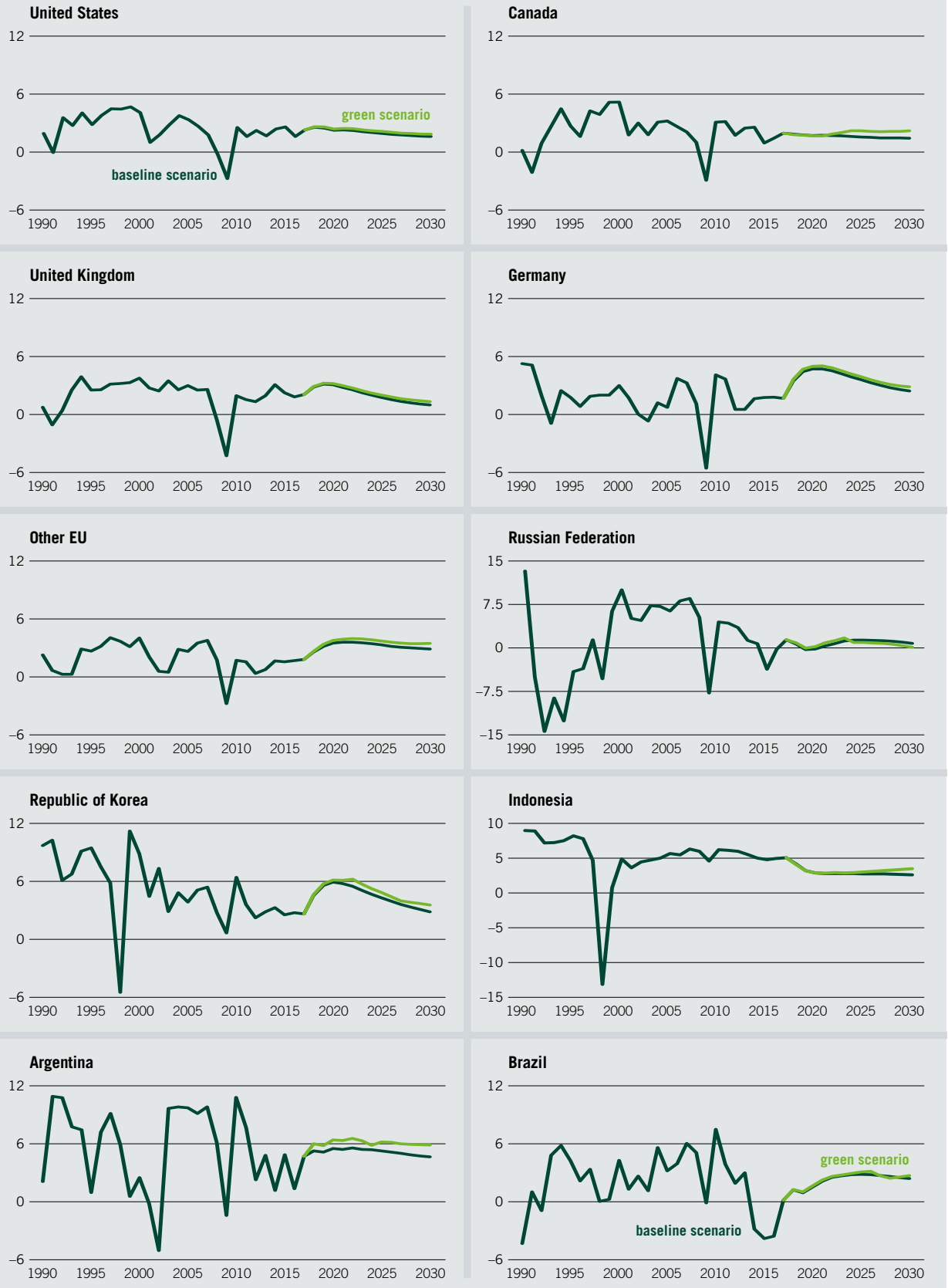


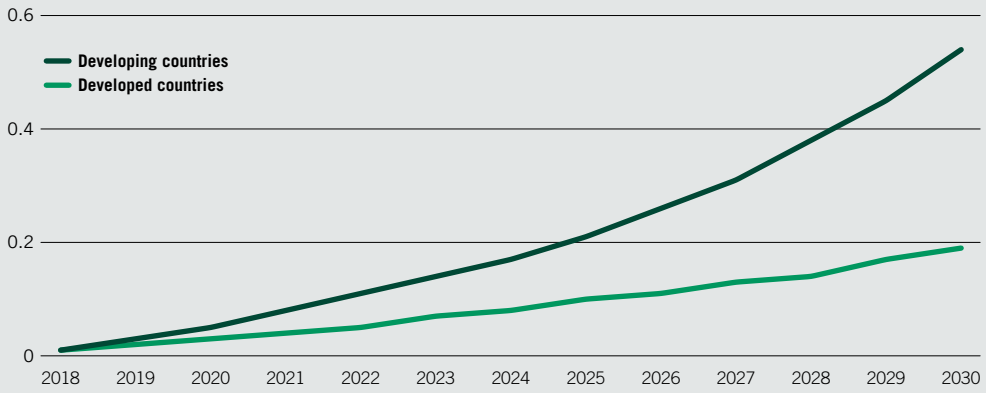
Figure 4.7

(cont'd)

Source: ILO calculations based on the United Nations Global Policy Model.

Figure 4.8

Employment rate (difference between the green scenario and the baseline scenario)



Source: ILO calculations based on the United Nations Global Policy Model. The graph represents the difference in percentage point employment rates between the two scenarios.

Second, it is assumed that social insurance policies, including unemployment insurance, will be strengthened through increases in social security contributions. These increases could represent a larger share of workers being covered against various risks (old age, poverty, work accidents, unemployment, etc.), or higher benefits. This is reflected in the simulation of an increase in the labour share of income, which includes employees' compensation and employers' social security contributions. Even though tax increases rarely enjoy public support, there are a number of examples in recent years suggesting that, depending on national circumstances, increases in social security contributions are feasible. In Brazil and other emerging economies, targeted measures for small and medium-sized enterprises have resulted in an increase in the number of workers being covered by social security. In Spain, self-employed workers were granted the right to unemployment benefit compensation under certain circumstances in 2007, following the adoption of the Self-employed workers' statute *(Estatuto del Trabajador Autónomo)*. A survey of 77 countries' response to the financial and economic crisis of 2008 revealed that a large number of them adopted expansionary measures, usually with a limited time frame, such as facilitating and extending access to existing unemployment benefits, increasing the maximum period during which benefits were paid, raising the level of benefits, and adopting work-sharing arrangements (also called partial unemployment benefits) (Bonnet, Saget and Weber, 2012). Two countries – Uruguay and Viet Nam – adopted new unemployment insurance schemes during the crisis period.

Energy policy is represented in the simulation by the ratio of carbon energy to non-carbon energy use. Although admittedly narrow, this measure makes it possible to set ceilings for the expansion of carbon energy use, and the related emissions, reflecting those negotiated in international agreements such as the Kyoto Protocol and the Paris Agreement. However, no specific inference is drawn regarding the application of these agreements. The simulation calls for a reduction of total CO_2 emissions and a decrease in overall energy demand. It is assumed that the fall in overall energy demand is met by increasing the supply of non-carbon energy and reducing that of carbon energy. The general implication of these assumptions is the requirement for the economy to become more energy efficient, reversing a long-standing trend.

Finally, it is important to note that stimulus measures (such as increases in social spending and incentives for green investment) are balanced by countervailing measures (such as increases in taxes) to make sure that growth exceeds the baseline level by at least 0.25 per cent.

The results are encouraging; indeed, 12 years after the introduction of the package, improvements are projected in GDP growth, employment, income distribution and energy efficiency. By 2030, the last year of the projections, all regions and almost all countries show positive effects on GDP growth (figure 4.7). Over the same time horizon, an increase in employment rates of approximately 0.2 per cent is projected in developed countries and 0.55 per cent in developing countries (figure 4.8). The larger increase for developing countries makes sense given the high level of underemployment in these countries. Based on labour force projections, these effects imply the net creation of approximately 2 million jobs in developed countries and 29 million jobs in developing countries. Compared to a projected labour force of approximately 3.7 billion workers in 2030, these figures are not high, but they nevertheless indicate that a "green economy" can be achieved incrementally, without labour being sacrificed.

Conclusions

Social protection systems are the first line of defence against the negative impact on incomes of climate change and environmental degradation. Indeed, social protection and environmental sustainability are inextricably linked. By reducing vulnerability to social risks, providing secure income and better access to health care and other basic services, social protection can reduce poverty and protect the environment. Social protection policies also support the economy by stabilizing household incomes and aggregate demand.

Four policy areas in particular, namely unemployment protection, cash transfer programmes, public employment programmes (PEPs) and payments for ecosystem services (PES), if properly resourced and effectively designed, offer synergies between social protection, environmental policy and macroeconomic policy. These programmes can target environmental and social protection objectives in an efficient manner, either simultaneously or as part of a policy mix.

Investing in people through unemployment protection schemes helps to prevent and reduce poverty by providing immediate income replacement for those who lose their earnings as a result of structural change and efforts to mitigate climate change. In addition, unemployment protection schemes provide support to workers for the development of their capacities in the long term by facilitating their access to new jobs in sustainable sectors and strengthening their employability. As a crucial element of structural transformation and a just transition towards sustainable economies and societies, unemployment protection needs to be part of any long-term strategic planning for climate-related action. However, the potential of unemployment protection schemes to support the transition is limited by their low coverage. In this context, increases in non-contributory social assistance such as cash transfers and PEPs may simultaneously compensate for non-existent or low coverage of unemployment protection and strengthen the adaptive capacity of households in the event of natural disasters.

While social protection policies protect households against loss of income resulting from environmental degradation, they also protect them against the possible negative effects of environmental policies on their livelihoods. Well-designed social protection systems can also facilitate the transition to environmentally sustainable methods of production that contribute to slowing the pace of climate change. Ensuring portability of social protection between employers and States as well as implementing cash transfers for victims of the effects of environmental degradation can facilitate mobility and thus increase the options available to poor and vulnerable households to improve their adaptive capacity.

Analysis of the available data on PEPs and PES provides evidence that the integration of a combination of social and environmental objectives in environmental and social policy tools is arousing interest in many countries and regions. The results show that half of the 86 PEPs surveyed in 62 countries include an environmental component, either related to mitigation or to adaptation to environmental risks. Moreover, although PEPs are usually aimed at infrastructure investment, they often provide health care, education and other benefits. They are powerful tools to address the impact of climate change on workers and their incomes, while also enhancing mitigation. Similarly, it has been shown that PES, although originally conceived with an environmental objective, can also be effective in supporting household income. This is already the case in more than one-third of non-profit and publicly funded PES, which target poverty alleviation and environmental conservation simultaneously. In view of the complexity of the linkages between poverty and the environment, and the danger of vulnerable segments of the population being excluded or priced out, it is important to monitor the environmental and social impacts of PES to ensure their durability.

Beyond their beneficiaries, social protection systems also have the potential to benefit the economy and society as a whole. A modelling exercise shows that a policy mix comprising transfers (such as cash transfers, PEPs and PES), stronger social insurance and limits on the use of fossil fuels leads to faster economic growth, stronger employment creation and fairer income distribution, while also achieving lower GHG emissions.

As outlined above, the transition to greener economies and societies requires stronger social protection, including both income security and health protection, based on a life-cycle approach. The strengthening of social protection systems, including social protection floors, is therefore one of the elements of an integrated policy response in support of the just transition toward environmentally sustainable economies and societies for all.

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5 Skills for the green transition

KEY FINDINGS

Some countries have been successful in integrating skills development with environmental policy, particularly in key priority sectors such as renewable energy and energy efficiency. Most countries, however, have not established sound linkages between their environmental sustainability plans and skills policies.

In the majority of countries surveyed (21 out of 27), skills mismatches are identified as major obstacles to the greening of the economy. The lack of knowledge of the environment–skills nexus, the absence of regularly conducted employment projections and of financial mechanisms to promote investments in skills development for the green transition and the sluggish participation of social partners are still hindering the achievement of an effective transition.

There are signs of emerging policy coherence in some countries, where environmental sustainability policies make explicit reference to skills and/or human resource development or fully fledged skills development policies and legislation for green transition are set up. However, these references are often limited to specific areas such as skills needs identification and initial Technical and Vocation Education and Training (TVET).

Most of the countries surveyed (22 out of 27) have established platforms to anticipate skills needs and adapt TVET systems in general. Of these 22 countries, 19 have addressed issues related to developing skills for the green transition. Four of the sample countries have established specific bodies to consider the question of skills for the green transition. Discussions on skills for the green transition tend to be led by governments, with some involvement of employers, and to a lesser extent of trade unions. The involvement of social partners improves the matching of skills demand and supply, and equity outcomes, including gender equality.

Policies and programmes on skills for the green transition tend to adopt a sectoral approach. Skills interventions in renewables and energy efficiency have been implemented, based on the legal requirements for vocational certification and training set out in the regulations. They highlight the relevance of the regulatory framework to integrate environmental and decent work outcomes, as discussed in Chapter 3. Other sectors with green potential have been promoted through more ad hoc skills development projects, often relying on international support.

The evolving nature of skills for green transition, the absence of consensus on the definition of green jobs and the lack of labour market information and analysis make it difficult for policy-makers to devise a long-term and economy-wide skills policy portfolio.

The sustainability of policies requires coordination among stakeholders and overall political stability at the national level. Social dialogue and good governance are therefore imperative. In addition, raising awareness of environmental issues among the general public and policy-makers is required to ensure the sustainability of policies in the medium to long term.

Introduction

Both the Sustainable Development Goals (SDGs) and the ILO *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (ILO, 2015a) are vehicles to mainstream and advance decent work and environmental sustainability. Alongside an integrated legal framework (see Chapter 3) and social protection (see Chapter 4), skills development is a key component of a response to environmental challenges that also promotes decent work. Skills development can promote innovation, investment and competitiveness, which in turn feed back into social development, thus creating a virtuous cycle (ILO, 2010). Through green jobs (see Chapter 2), skills development can accelerate the transition to a green economy.

The transition to a green economy entails changes in the production system on a scale equivalent to an industrial revolution. Advancement in technologies, innovation and changes in production processes are major drivers of green transition, thus their implications for the world of work attract the attention of policy-makers around the world. As noted in Chapter 2, jobs will be created in certain sectors and destroyed in others, while those that remain will also change dramatically, as in any structural transformation. The anticipation and monitoring of skills needs, the provision of the right set of skills and the recognition of workers' skills will help workers to move more easily to sectors with employment growth, and also to better jobs, hence increasing their resilience to potential job displacement and income losses resulting from economic change (OECD, forthcoming), including the transition to a green economy.

Skills are key to making the transition to a green economy that advances decent work. Our survey of regulations and policies pertaining to skills for green transition in 27 countries identified a number of policy challenges, such as the lack of capacity to collect data on skills for green transition, the low level of awareness of environmental sustainability and the weak institutional mechanisms for policy-making and social dialogue that prevent skills development from playing a stronger role in the just transition.

With a view to contributing to effective formulation and implementation of skills development measures, this chapter conducts a global review and assessment of regulations, policies and programmes implemented in 27 countries around the world, representing various levels of development and environmental challenges. It takes stock of the existing measures through country studies, updating the information on the 21 countries[1] analysed in a study conducted by the ILO and the European Centre for the Development of Vocational Training (Cedefop) in *Skills for green jobs: A global view* (Strietska-Ilina et al., 2011), and adding information on six other countries[2] (see Appendix 4 for methodological details).

The chapter is organized in three sections. Section A analyses the integration of regulations and policies pertaining to economic growth, environmental sustainability and skills development at the national, local and sectoral levels since 2010. Section B then takes a closer look at individual programmes, including the activities carried out to implement the regulations and policies introduced in section A, as well as other ad hoc initiatives. Two types of programmes are discussed, namely skills needs identification and training provisions. Section C analyses institutional mechanisms that facilitate or hinder regulatory and policy coherence and programme implementation. It also highlights successful factors as well as obstacles. The chapter concludes by evaluating the current state of skills development measures against the objective of promoting a just transition, and offers policy recommendations.

1. The research on these 21 countries consists of 15 studies coordinated by the ILO (Australia, Bangladesh, Brazil, China, Costa Rica, Egypt, India, Indonesia, the Republic of Korea, Mali, Philippines, South Africa, Thailand, Uganda and the United States) and six coordinated by Cedefop (Denmark, Estonia, France, Germany, Spain and the United Kingdom). See Appendix 4 for more details.

2. These six countries are Barbados, Guyana, Kyrgyzstan, Mauritius, Montenegro and Tajikistan.

A. Skills development regulations and policies

As indicated in Chapter 1, environmental sustainability is key for the world of work, just as – through general economic activity and green jobs – the world of work is key for the achievement of environmental sustainability. The transition to a low-carbon and resource-efficient economy requires environmental policy, but also a change in modes of production that directly affect the world of work through job creation, job destruction and occupational change. These changes lead to an important shift in skills requirements across the economy, making skills policy a pivotal element for a successful transition (Bowen, Duff and Frankhauser, 2016; Bowen and Kuralbayeva, 2015; ILO, 2012; Strietska-Ilina et al., 2011). In order to inform policy discussions, this section illustrates the current state of skills development regulations and policies at national, regional and sectoral levels, revealing patterns observed in the countries surveyed.

There has been much progress at the national level in advancing environmental sustainability, but progress in developing skills for the transformation lags behind

In comparison with 2010, more countries have formulated comprehensive environmental policies.[3] As in 2010, however, most of these policies in the countries surveyed make no explicit reference to skills development at the national level. Barbados, China, Costa Rica and Kyrgyzstan are examples of countries that commit to environmental sustainability, but without any mention of the skills development required to achieve their goals. The same is true of Mali, Mauritius and Tajikistan.

In Barbados, for example, a strong partnership between the four main stakeholder groups is promoting the transition to a green economy. These are government agencies (including ministries, the Barbados TVET Council and national training institutions), private sector companies, international institutions and NGOs. Despite the effective action for transition, Barbados lacks national skills development policies targeting green jobs or skills development for a just transition, and institutions to translate the effect of strong partnership to the skills training in workplaces. And yet, although there is no policy initiative at the national level linking environmental sustainability and the corresponding skills development, this is happening at the sectoral level (see the section on sectoral policies).

China has made considerable efforts to formulate environmental policy, strategies and regulations over the past decade. However, skills development is largely absent from these efforts which focus mainly on "capacity building" for adaptation, as shown in Chapter 3, without an explicit reference to skills.

Costa Rica has adopted a vision of becoming the "Green Hub" of Central America, where decarbonization is a strategy to strengthen national competitiveness. To that end, the National Apprenticeship Institute (INA) undertook a series of skills needs assessments in environmental management, carbon neutrality management, and environmentally friendly transport sectors.[4] Yet no specific skills policies or strategies have been formulated to conduct assessments for other sectors relevant for the transition or to adapt training provision based on the skills needs identified. Thus, the country is still in the process of establishing skills policies and systems for green transition. A similar situation can be observed in Kyrgyzstan, where the orientation towards sustainable development has led to the adoption of the "Concept of Ecological Safety" and the "National Strategy for Sustainable Development 2013–2017" (Djakupov et al., forthcoming), although the linkages between those strategies and skills development programmes are limited. Similarly, the National Council for Job Skills Development, established in 2012, makes no reference to environmental sustainability or skills development for a just transition. Lastly, in Tajikistan, a number of regulations, concepts and programmes have been adopted with a view to achieving sustainable development focusing on rational uses of land, water and other natural resources. Recent instruments include the "State Environmental Program of Republic of Tajikistan for the period 2009–2019" and the Law of the Republic of Tajikistan "On Environmental Education of the Population". However, skills development for the occupations that are relevant to green transition is not explicitly recognized as the priority in these instruments (Saidmurodov and Mahmud, forthcoming).

3. For example, the National Environmental Policy (NEP), 2013 in Bangladesh, which integrates environment issues in the development agenda; the Bangladesh Water Act, 2013, which makes provision for the development and protection of water resources (Mondal, forthcoming); the Law on Environmental protection, 2011 in Tajikistan, complemented by laws at sectoral level in forestry, water, fisheries, and radioactive waste management (UNECE, 2017); and the Climate Resilience Strategy and Action Plan (CRSAP), 2015 in Guyana, which identifies climate resiliency actions across 15 sectors (Small and Witz, 2017).

4. For example, see Sánchez Calvo and Alfaro Trejos, 2014.

Box 5.1

The Philippines Green Jobs Act of 2016

The Green Jobs Act (GJA) is the Philippines' first legislation designed to generate and sustain green jobs. The Act contains clauses promoting skills for green jobs through initiatives such as identifying skills needs, maintaining a database of green careers, formulating training regulations, skills assessment and certification, curriculum development, and the implementation of skills training programmes and fiscal incentives to encourage the provision of training by enterprises. The Implementing Rules and Regulations (IRR) of the GJA, adopted in 2017, were based on extensive consultation and the involvement of the tripartite constituents.

The Act mandates the Technical Education and Skills Development Authority (TESDA) and its Green Technology Center (GTC), established in 2015, and the Professional Regulation Commission (PRC) to develop training regulations and a qualifications framework, respectively. The Climate Change Commission issues training certificates, in collaboration with other bodies. The GTC is a new training centre created in 2015 and offering training courses in skills for green transition to cater for the needs for emerging green jobs. It is responsible for developing and delivering quality green TVET programmes; developing models of a green working environment and workplaces; developing training regulations[1] for green sectors; promoting green technology research and adaptation through the establishment of networks of institutions and researchers and the hosting of green events, while serving as a hub for entrepreneurs in green sectors. The Centre provides TVET training in such areas as photovoltaic systems, hydroponics, vertical gardening, landscaping, inverter technology and e-trike (an electric three-wheeled vehicle) servicing (Usman, 2015).

[1] Training regulations are TESDA-promulgated documents that define the competency standards for a specific national qualifications and how such qualifications can be gained, assessed and recognized. They serve as the basis for the development of competency-based curricula, training materials and competency assessment tools. As of 2017, a total of 26 green training regulations have been developed (TESDA, 2011).

Despite slow progress overall, there are signs of policy coherence between environmental sustainability and skills development in certain countries

In countries such as Denmark, Estonia, France and Germany, as well as in India, the Republic of Korea, the Philippines and South Africa, a number of environmental policies and national development strategies make reference to skills development for the green transition. Similarly, in some of these countries, skills development strategies, Technical and Vocational Education and Training (TVET) policies and their implementing institutions are acknowledging the rising demand for skills required for greening the economy.

Since 2010, the Philippines has adopted a number of regulations and policies at the national level for the transition to a green economy, many of which explicitly recognize the role of skills development in the transition (see, for example, the Green Jobs Act (GJA) of 2016, described in box 5.1). The Philippines recently adopted its Development Plan 2017–2022, which emphasizes the need for TVET programmes to meet international standards and match skills demand through quality training provision and certification (NEDA, 2017). The Development Plan will integrate green requirements into the curriculum and training system as part of the implementation of the GJA. In addition, the National Green Jobs Human Resource Development Plan is currently being developed, focusing on 12 key economic sectors: agriculture, construction, forestry, fisheries, renewable energy, manufacturing, transportation, solid and wastewater management, tourism, wholesale and retail trade, health and IT (Fernandez-Mendoza and Lazo, forthcoming).

In France, a number of environmental policies and complementary instruments have been introduced since the adoption of the Grenelle Environment Roundtable commitments in 2007. The governments (national and regional[5]), workers' and employers' representatives and NGOs have been participating in the development and implementation of those polices and instruments, and facilitating the integration of labour market and skills issues (Cedefop, forthcoming b). In 2010, a fully fledged skills development strategy was established, a mobilization plan for green jobs was launched, and the National Observatory of Jobs and Skills in the Green Economy (Onemev) as well as regional observatories were created in order to monitor employment trends. The observatories bring together various institutions to

5. France is divided into 18 administrative regions.

Box 5.2

Nationwide survey of renewable energy jobs in India

India has set itself the goal of generating 175 gigawatts of electricity from renewable sources by 2022, which corresponds to around half of its total electricity production. The Council on Energy, Environment and Water (CEEW) and the Natural Resources Defence Council (NRDC) have estimated the sectoral employment impact of this change. Using surveys of solar and wind companies, developers and manufacturers, the study finds that over 300,000 workers will be employed in the solar and wind energy sectors to meet the 2022 target (CEEW, NRDC and SCGJ, 2017), against 154,000 in 2009 (IRENA, 2011). To meet the target, the number of workers required by ground-mounted solar, rooftop solar and wind power projects, will need to increase. Table 5.1 shows the additional jobs required for 2017–18, disaggregated by occupations. The potential for employment creation is conditional on the domestic capacity of solar module manufacturing and the establishment of vocational training programmes and certification schemes.

Table 5.1

India: Estimated additional workforce required in solar and wind energy sectors, 2017–18

Occupations	Sectors			
	Ground-mounted solar	Rooftop solar	Wind power	Total
Business development	99	765	36	900
Design and pre-construction	395	4425	66	4886
Construction and commissioning	5330	6920	360	12610
Operation and maintenance	3835	250	3000	7085
Total number of jobs	9659	12360	3462	25481

Source: CEEW, NRDC and SCGJ, 2017.

analyse occupations and employment shifts in the green economy, based on the definitions of green occupations accepted by all the actors. Most key actors involved in skills identification include in their activities a component on trends in jobs and skills related to the green economy. Skills curricula are frequently renewed or adapted to take account of developments in the green economy. Many diplomas and certificates now include awareness-raising on issues related to environmental sustainability, and some have undergone more advanced and specific adaptation to the techniques, knowledge and skills required by the ecological transition. The role of skills has been integrated into environmental regulations such as the 2016 Act on reclaiming biodiversity, nature and landscapes, which includes support for vocational training, research and education, as well as for innovation by SMEs.

India has made environmental sustainability a central objective of its development strategy in its twelfth Five-Year Plan (2012–17) and set up a comprehensive framework for skills development for green transition at the national level, targeting key sectors. Several institutions were created as a result, including the Skills Council for Green Jobs in 2015, with the backing of the Ministry of New and Renewable Energy (MNRE) and the Confederation of Indian Industry (CII). The objective of the Council is to identify skills needs in the areas of renewable energy, energy efficiency and waste and water management (see box 5.2). Based on the identification of skills needs in these sectors, 26 new TVET courses have been developed for occupations ranging from water treatment plant helper to solar PV project manager and improved cooking stove installer (NISTADS, forthcoming). Private institutions have also developed 70 courses oriented towards environmental sustainability (for example, in apparel and footwear manufacture and banking).

In the Republic of Korea, environmental regulations and policies have also to some extent taken into consideration the importance of human resource development. This may have facilitated various skills needs identification and anticipation surveys and expert consultations carried out by the government ministries in charge of environment, labour, trade and industry and energy. As a result, the 3rd Environmental Technology Manpower Development Plan (2013–2017) was established, with a strong focus on highly skilled labour. In addition, new National Technical Qualifications have been developed in some specific green sectors with a view to supporting the national effort to meet the environmental targets. However, the country still lacks a comprehensive skills development policy specifically targeted at strengthening TVET for the green transition, identifying skills needs, adapting the training curriculum, creating teaching materials and developing incentives for private initiatives.

In South Africa, the central government and some national government departments have adopted several policies and strategies relating to environmentally sustainable development. The 2011 National Climate Change Response White Paper recognizes the role of the labour market in the green transition and pays special attention to youth (DEA, 2011).

In Estonia, qualification standards have been updated for the existing occupations linked to the transition (e.g. energy auditors and steelworkers) or added to reflect the emergence of new occupations (e.g. biogas technology technician). This shows that the relevant skills are being integrated into the country's skills development system. However, the country lacks a comprehensive framework to develop skills for the green transition (Cedefop, forthcoming c). In Denmark, new TVET programmes have been developed to reflect the demand for new skills, such as training for wind turbine operators in 2010 and environmental technologists in 2013 (Cedefop, forthcoming d). Finally, in Germany, skills for the green transition are integrated into initial and continuous vocational training, under the "Education for Sustainable Development (ESD)" framework. The national platform "Education for Sustainable Development", which brings together 37 representatives from politics, science, industry and civil society, in 2017 adopted the national action plan called "Education for Sustainable Development". However, despite the efforts on mainstreaming environmental sustainability to the country's education system through the ESD, Germany has developed no specific strategies on skills for green transition (Cedefop, forthcoming e).

In countries which have curtailed progress towards environmental sustainability, the promotion of skills for the transition has also slowed down. This is the case in Australia, Brazil and the United States. However, in Australia and the United States, local governments and the private sector still recognize the value of environmental sustainability and the development of the respective skills policies and programmes (Fairbrother et al., forthcoming; Garrett-Peltier, forthcoming; Rabe, 2002; Saha and Muro, 2016).

Local government plays a key role in integrating skills and environmental policy

In countries such as China, France, the Republic of Korea, the United Kingdom and the United States, local government integrates skills needs into policy formulation and implementation, due to its familiarity with the regional economy and labour market (for France and the United Kingdom, see Cedefop, forthcoming a). Indeed, the local government's autonomy and mandate for policy-making in the area of skills development can be important in facilitating a just transition to a green economy.

In the United States, the State of California adopted a Clean Energy Jobs Act in 2013, covering a five-year period. Government agencies and training institutions were involved in its design and implementation.[6] The Act introduces a fiscal reform under which corporate income tax is channelled into the California General Fund and the Clean Energy Job Creation Fund, generating up to US$ 550 million annually (CEC, 2017), which has been invested in energy efficiency and renewable energy. This investment could produce a significant increase in demand for inputs from the renewable energy and energy efficiency sectors, which would in turn generate both direct and indirect jobs in the energy and construction sectors (Zabin and Scott, 2013). To meet the demand for skills created by the Act, three- and five-year state-certified apprenticeship programmes have been implemented, largely self-funded by employers and workers. In addition, pre-apprenticeship programmes have also been introduced so that trainees without the required skills levels can also enter the apprenticeship programmes. For quality assurance of the pre-apprenticeship programmes, the Department of Labor has set the standards based on which training and curricula are approved by the registered apprenticeship partners. In the Republic of Korea, the Seoul Regional Council for Human Resource Development[7] has formulated and implemented policies on the green transition and TVET which have resulted in new training programmes. The United Kingdom takes a decentralized approach to skills development for the transition to a green economy by shifting the decision-making power from the central government to the local governments. This localized approach is adopted so that local governments work closely with businesses through local bodies such as Local Economic Partnership in England, Scottish Enterprise and Invest Northern Ireland, and skills development measures become more demand-led (Cedefop, forthcoming f).

6. To implement this Act, the California Energy Agency collaborates with the State Department of Education, the Community Colleges 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.

7. The Seoul Regional Council for Human Resource Development is one of 16 regional councils in the country.

Despite the positive roles played by local governments, decentralization can also give rise to regional disparities and fragmentation if it is not accompanied by effective mechanisms for the integration of local approaches into the national context. In China, for instance, local governments face difficulties in establishing a well-constructed skills development policy framework for a green transition due to the lack of consensus on the definition of green jobs (IUES, forthcoming). Similarly, without a unified national approach, the local governments in the United Kingdom have developed different approaches to meet the standards set out by EU directives; as a result, different definitions and classifications of skills for transition are utilized in different sources and skills anticipation activities are structured in different ways (Cedefop, forthcoming f).

Progress in skills policy formulation for the transition is more visible at the sectoral level, particularly in energy, waste management and resource efficiency

As highlighted in Chapter 1, the energy sector is one of the major contributors to greenhouse gas (GHG) emissions. Countries have adopted policies, strategies and regulations focusing directly on the energy sector, many of which make specific reference to skills development. Yet, as shown in table 5.2, and as further examined below, sectoral efforts are not restricted to the energy sector.

Barbados recently adopted its National Energy Policy 2017–2037, which recognizes the contribution of skills to the development of the renewable energy sector. The policy outlines specific elements of skills development such as qualification standards; curricula at various educational levels, with strong emphasis on innovation; TVET programmes; information-sharing systems between educational institutions and the energy sector; and scholarship programmes related to energy in general, as well as to sustainability in the oil and gas sector.

The United Kingdom has established the Energy and Utilities Skills Partnership (2017). This partnership is a platform for developing sectoral strategies and skills assessment mechanisms in the renewable energy sector, which is in turn expected to make the sector more attractive to workers (Cedefop, forthcoming f).

In addition to policies and strategies, regulatory instruments can also promote environmentally sustainable behaviour on the part of firms and consumers, and contribute to mitigation efforts. Skills development contributes to the implementation of regulations in the energy sector, since compliance with energy regulations requires specialized skills and knowledge, as well as heightened awareness of environmental sustainability. In fact, all of the 27 countries surveyed have adopted regulations on renewable energy or energy efficiency, including rules on skills certification and/or the training of professionals. These rules are often targeted at specific occupations, such as energy auditors, inspectors, assessors, energy managers, installers and operators of equipment and buildings. Some regulations are more elaborate than others in their description of implementation mechanisms, including the establishment of authorities (with defined functions and responsibilities), training institutions and funds.

For instance, Indonesia requires energy users that consume more than 6,000 tonnes of oil equivalent a year to implement an energy management system. In accordance with this regulation, in 2010 the Ministry of Energy and Mineral Resources established the Mandatory Competency Standard for Energy Manager in Industry. These developments have led to additional regulations on the Standard Work Competence of Indonesia for energy managers and energy auditors, adopted by the Ministry of Manpower and Transmigration. Against this backdrop, skills development and certification in the energy sector have been promoted by two Professional Certification Institutes (*Lembaga Sertifikasi Profesi* (LSP)).

Although the impact of skills development measures on energy use is difficult to quantify, there is some evidence that when regulations are well targeted and their certification and training measures are well implemented, countries tend to see an increase in the number of qualified professionals and a reduction in energy use. For example, in Indonesia, one of the Professional Certification Institutes, the Association of Energy Conservation Experts (*Himpunan Ahli Konservasi Energi* (HAKE)), has administered an increasing number of competency tests for energy managers and auditors since 2012, and had awarded certification to about 550 workers as of 2016 (figure 5.1).Likewise, in Australia, the Building Energy Efficiency Disclosure Act 2010 established the Commercial Building Disclosure (CBD) programme and sets a legal requirement for the disclosure of information on energy efficiency for buildings of over 2,000 m^2. The Act contains detailed rules on the training and accreditation of energy assessors and establishes an auditing authority. In addition, training materials and online examinations

Table 5.2

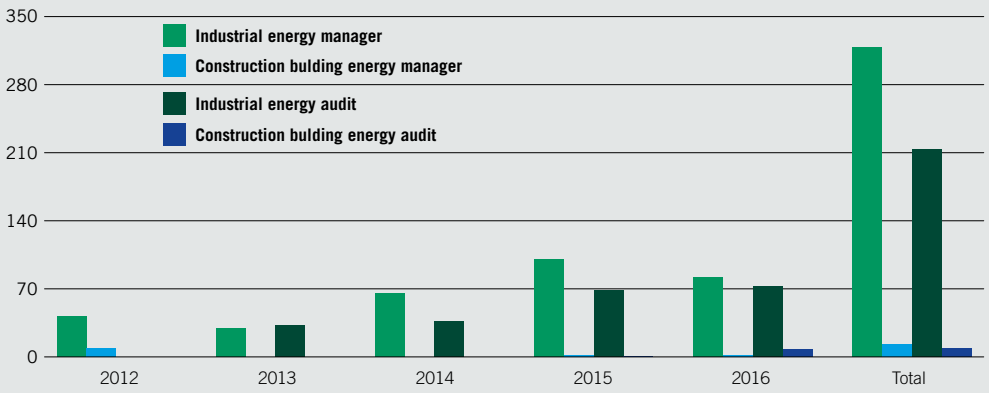
Priority sectors and occupations affected by the transition to a green economy

Country	Sectors most relevant for the green transition	New occupations identified/greening of old occupations (examples)
Bangladesh	Energy, waste management, construction (brick manufacturing), transport, telecommunications (introduction of eco-friendly cell phones), agriculture, fishery (shrimp) and forestry	In brick manufacturing, chimney kiln operators
Barbados	Renewable energy	Electricians, electrical and mechanical engineers, solar PV designers, site assessors, PV installers, energy auditors, energy conservation and efficiency specialists, plumbers, specialists in construction standards, trainers for project managers, health and safety trainers
China	Agriculture, manufacturing, energy, building and construction, transport, environmental protection and pollution treatment, services	Wind turbine manufacture, equipment operators, renewable energy management, research and training, engineering, power technology, solar power generation, wind power generation, eco-design for buildings, construction labourers, building retrofitting workers, electricians, roofers, building inspectors, E-vehicle manufacturer, high-rail construction workers, metro and e-vehicle bus drivers, recycling and waste management, waste management, coal washing and preparation, desulfurization and denitrification equipment manufacture, research and training, energy conservation services, financial consultant
Costa Rica	Agriculture, food, construction, lithographic, wood, metalworking, plastics, chemicals, textiles, services	Environmental engineers, food scientists and technologists, environmental civil engineers, environmental designers and nanotechnologists, sustainability specialists, electromechanical technicians, software developers, commercial and industrial designers, industrial engineering technicians, agronomists, biotechnologists, biologists, forest engineers, veterinarians
Egypt	Renewable energy/solar and wind energy, energy efficiency, waste management, agriculture, manufacturing/leather	Solar installers, solar service technicians, solar plant managers, electricians with solar expertise, plumbers, HV AC technicians, wind turbine technicians, wind plant managers, quality engineers, energy efficiency managers, energy efficiency auditors, plant managers for cleaner production, CP auditors, technicians, supervisors, waste management specialists, organic farm auditors and certifiers, pesticide operators, machine operators (bio-fuel generators)
Estonia	Agriculture, forestry, industry, waste and the circular economy, construction, renewable energy and maintenance, technology development, geomantics, transport, education sector, green public procurement	Engineers, technicians, construction specialists, green architects and designers, harvesters, forwarder operators, woodworkers, personnel dealing with ozone-depleting substances, biology teachers and scientists
Guyana	Biodiversity, agriculture, energy, water, solid waste management, environmental education, climate change education, disaster risk management	New occupations identified in the energy sector and for the Guyana Energy Agency
Indonesia	Energy, construction	Industrial energy auditors and managers, construction building energy managers and auditors
Kyrgyzstan	Agriculture, construction, mining, metalworking, ecotourism	Agronomists, agricultural engineers, machine operators, estimating engineers, welders, crane operators, mining engineers, shotfirers, metalworkers, moulders, steel-melters
Mauritius	Renewable energy, tourism, private sector/green business, public sector	Technicians, PV installers, energy auditors, eco-tourism operators, eco-guides, eco-entrepreneurs, green public officers
Montenegro	Tourism, agriculture and energy sectors	Production and installation of energy-efficient windows and doors, organic production, mountain guides
Philippines	Public sector/green procurement, solid waste management and garbage collection, renewable energy, tourism	Green procurement managers, operators of sanitary landfills, project engineers, environmental and social safeguard focal persons, renewable energy experts, hydrologists, wind, solar and biomass experts, biologists, chemists and disposal officers, solar PV fitters, aerospace technicians, wind-turbine technicians, offshore oil/wind maintenance technicians
Spain	Forestry, waste, services, energy	Forest and environmental agents, qualified workers in hunting activities, forest fire workers, qualified workers in forestry and natural environmental activities, prevention of labour and environment risk agents, waste classification workers, environmental and forest technicians, vehicle cleaners, sweepers, power plant technicians, electricity technicians
Tajikistan	Renewable energy/ hydro, agriculture, ecotourism, construction	Organic farmers, managers, energy auditors, engineers, operational and maintenance specialists in hydro, solar and biomass energy, solar panel installers; tour operators, eco-guides
Thailand	Energy	Carbon-related project analysts, green marker officers, public relations officers, green engineers, green architects
Uganda	Agriculture, industry, energy, cities/transport	Production and processing of organic products, soil fertility management, weeding and post-harvest handling

Source: ILO compilation based on country studies.

Figure 5.1

Indonesia: Number of graduates certified as energy managers and energy auditors, 2012–16



Source: LSP HAKE, 2017.

have been developed and utilized. An impact assessment concluded that the regulation was effective in reducing energy consumption and GHG emissions and generating economic benefits between 2010 and 2014 (ACIL Allen Consulting, 2015). Renewable energy and energy efficiency regulations therefore show how environmental sustainability and skills development can be integrated. Policy-makers are encouraged to consider a similar approach in other sectors, such as agriculture and waste management.

In Egypt, the Waste Management Regulatory Authority (WMRA) was established in 2015, with the responsibility to identify environmental challenges and enforce laws in all governorates and municipalities. As such, the WMRA provides training in waste management, hazardous waste management, hazardous waste compliance, the handling and disposal of waste, the operation of waste facilities, waste to energy conversion, chemical waste management, waste management regulation, waste management in health care and the tracking and transport of waste (Amin, forthcoming). Set up in 2005, the Egypt National Cleaner Production Centre (ENCPC) coordinates and promotes cleaner production, waste management, innovation and energy efficiency issues for Egyptian industry. As part of its capacity-building activities, the ENCPC provides training in waste tyre management and recycling and is developing an accredited capacity-building programme to train energy managers in energy efficiency. Two other providers, the Regional Center for Renewable Energy and Efficiency (RCREEE) and the Industrial Modernization Centre (IMC) also offer professional certification programmes for energy experts and managers.

Although the sectoral approach has many benefits, including the relative ease of stakeholder coordination and the identification of specific skills needs (Strietska-Ilina, 2017), it is not sufficient for ensuring comprehensive skills development for green transition (Cedefop, 2015; Strietska-Ilina et al., 2011; OECD, 2014). From an economy-wide perspective, not only priority sectors, but all sectors have the potential for greening (ILO, 2013). Such a perspective allows stakeholders to identify skills needs arising out of both direct and indirect job creation along supply chains, and in turn to design and implement training programmes for a wide range of sectors and jobs at all skill levels.

In practice, the implementation of an economy-wide approach is more challenging than a sectoral approach. Cross-sectoral coordination is often seen by stakeholders as being "too costly", as it often gives rise to conflicting and overlapping priorities (Watson, Brickell and McFarland, 2013).[8] Because of these difficulties, there are few examples of good practices. As a result, policy-makers and other actors have not yet developed a good understanding of what is required for successful cross-sectoral coordination.

Despite the difficulties, some countries (such as Denmark and France) provide good examples (Cedefop, forthcoming a). These countries are characterized by several common factors, including: (1) a high level

8. On the other hand, some argue that cross-sectoral coordination would lead to a reduction in transaction and implementation costs compared to the cost of separate sectoral initiatives (ibid.).

of public acceptance of environmental sustainability; (2) provision for skills development for the green transition in policies at the national level; and (3) the existence of institutional mechanisms for cross-sectoral coordination on skills for green transition. The high level of public acceptance of environmental sustainability issues may have facilitated cross-sectoral coordination and consensus building with an economy-wide perspective. Thus, raising awareness of environmental issues is a powerful tool for the development of skills for the greening of the economy as a whole, and not only in priority sectors. One policy tool to increase environmental awareness is to incorporate "core skills"[9] into education systems at all levels (Strietska-Ilina et al., 2011). Core skills are non-vocational and non-technical competencies that are needed to perform at work and in society (Gregg, Strietska-Ilina and Büdke, 2015) and which, in the context of green transition, include "environmental awareness and willingness to learn about sustainable development" (Strietska-Ilina et al., 2011, p. 107). Core skills can facilitate shifts in consumer behaviour towards environmentally sustainable goods and services. They can also improve the employability of workers across multiple sectors or occupations, thus contributing to the resilience of workers in the face of possible job displacement and income losses during the transition to a green economy.

Supranational or regional initiatives can bring about economies of scale

Establishing regional policies on skills certification and training provision may increase investors' confidence in the regions' skills base. In addition, regional agreements on the recognition of qualification help ensure that migrant workers with certified skills can contribute to a green economy in the region whether they are in home or destination countries. Since 2010, there has been an increase in policies on environmental issues and skills development at the supranational/regional level. For example, the ASEAN Green Hotel Standard, adopted in 2016, establishes the qualification and experience requirements for green hotel inspectors. In Africa, the Economic Community of West African States (ECOWAS) adopted regional Energy Efficiency Policy and Renewable Energy Policy in 2013, with strong emphasis on developing a harmonized framework for qualification standards and skills certification.

Policy coherence is emerging, but more needs to be done

In summary, this section has shown that the regulatory and policy coherence between skills development and environmental sustainability is certainly emerging in some countries, but the majority of the sample countries are still at the initial stage of their efforts to achieve such coherence. In many countries, environmental law reforms introduced since 2010, especially in the areas of energy, building and construction and waste management, have led to the establishment or revision of professional qualification standards. This has, in turn, led to changes in certification systems. Both public and private institutions have responded to these policy changes by developing training curricula and carrying out skills assessment tests. Regulatory instruments have been a major driver in setting, formulating and implementing skills policies, although it may be difficult to adapt them to changing skills needs.

There are some issues that warrant the attention of policy-makers. First, spatial challenges may arise if green economy jobs are created in locations other than those that suffer the bulk of job losses. Education and training efforts therefore need to be linked with economic development strategies and just transition policies. In the United States, employment in coal (with the potential for job loss) and most employment in solar and wind power are located in different states. China, the world's largest coal producer, expects to lay off 1.8 million coal and steel workers (15 per cent of the workforce) in the coming years. Efforts to strengthen skills training for the workers affected will be part of the measures taken by central and local governments to smooth the transition (IUES, forthcoming). In this regard, granular assessments of skills and competences at the company, community and sub-provincial levels may provide useful tools for facilitating equitable structural transformation in China (see, for example, Caldecott et al., 2017).

Second, in smaller countries, the limited size of the market may be insufficient to develop traditional forms of specialized training. In Montenegro, for example, skills development for the green transition to promote ecotourism (e.g. mountain guides) might be difficult to organize, at least given the current size of the market for ecotourism (Djuric, forthcoming). Another deterrent, for example in Guyana, is the emigration of skilled labour.

9. See Gregg, Strietska-Ilina and Büdke (2015) for the definition, and ILO (2011) for specific examples of core skills in the context of green transition.

Lastly, when environmental sustainability is not deeply rooted in the national growth strategy, policy debate can be shifted away from long-term issues in the face of economic downturn and weak labour market performance. The de-prioritization of environmental sustainability in national growth strategies has had a concrete impact at the policy level, in some cases leading to the relaxation of restrictions set out in or enforcement of environmental laws or a significant reduction in the public funding allocated for climate change policies. Even when national policy supports environmental sustainability and the transition to a green economy, the importance of skills tends to be overlooked, signalling insufficient levels of awareness among stakeholders regarding the role of skills in this respect.

B. Skills development programmes and initiatives for greening the economy

Following the examination of regulatory and policy coherence in Section A, this section takes a closer look at the micro level and analyses the details of implementing programmes in the areas of skills needs identification and training provisions. In so doing, it highlights overall trends in programme implementation in terms of the actors involved as well as administrative levels, sectors and types of target audience.

Identifying skills needs is a key first step in meeting labour market needs

The assessment of skills needs can be both quantitative and qualitative. The green transition comes along with the changes in the number of workers in different occupations (hence the need for quantitative assessment), as well as the changes in the skills required for a particular occupation without changing the number of jobs (hence the need for qualitative assessment) (Gregg, Strietska-Ilina and Büdke, 2015). The 27 country studies conducted for this chapter show that the latter is more common. This can be due to various reasons, such as qualitative shifts in skills needs (e.g. greening existing occupations) being deemed more relevant, or quantitative data not being available.

Since 2010, many countries have continued their efforts to identify the skills needed for the green transition at the national, local and sectoral levels. These efforts are often embedded in broad economy-wide efforts, but in recent years various ad hoc initiatives have responded to the increasing and specific needs of the transition to a green economy (for example, in Costa Rica, Thailand and the United Kingdom). Ad hoc initiatives are also common in countries with limited financial resources and know-how to carry out structural reforms of their skills development measures (for example, a survey conducted in Barbados by Sault College and Samuel Jackman Prescod Polytechnic in 2014).

Several countries have established regular systems for the identification and anticipation of skills needs throughout the economy (OECD, 2016; Strietska-Ilina et al., 2011). For instance, a list of occupations in high demand, including occupations related to green sectors, is published regularly in South Africa. In France, the National Observatory of Jobs and Skills in the Green Economy (Onemev) conducts regular assessments on the employment trends in green economy and publishes the results in activity reports and other publications (Cedefop, forthcoming b). Finally, Thailand's *Occupational Trends* report, regularly published by the Department of Employment (DOE) under the Ministry of Labour, also identifies the demand for occupations, including those related to green sectors.

Skills identification efforts are also emerging at the local/regional and sectoral levels, with a growing role for employers

In Thailand, the Climate Change Technology Needs Assessment estimates skills needs in some priority sectors (i.e. agriculture, modelling, and water resource management) (Bhula-or, forthcoming; STI and URC, 2012). In addition, the demand for labour is often identified in private companies by human resources or business strategy divisions. The employers' association participates by organizing meetings and drawing up a list of training courses based on the needs identified by private companies. The needs identified and the list of training courses are then communicated to government bodies, such as the Department of Skills Development (DSD).

In Costa Rica, the Chamber of Industry has carried out a study covering 100 of its 800 members to identify their skills needs for the green transition (INCAE Business School, forthcoming). In the United Kingdom, employers' associations play an increasingly important part in the skills needs assessment conducted by the Sector Skills Councils (Cedefop, forthcoming f). In the United States, despite the roll-backs at the federal level, there are environmental rules and regulations at state level, and some state governments are active in identifying skills needs for the green transition. One example is MassCEC's annual Massachusetts Clean Energy Industry Report, which contains information on skills needs in the clean energy sector.

The inclusion of skills for green transition into the formal vocational training system is still in its early stages in many countries

In the majority of countries analysed in this report, skills for green transition are not yet part of the TVET curriculum. This is often due to the disconnect between TVET systems, environmental policies and national development strategies, as well as between TVET institutions and industry. In many cases training for the green transition is provided by employers, mainly because they are directly exposed to changing skills needs, and partly because of the insufficient development of such training through formal TVET systems. By filling this gap, the private sector is playing a key role in providing opportunities for work-based learning, such as apprenticeships, and in creating closer links between training institutions and companies. Communication between the private sector and the formal TVET system is crucial in helping the latter to adapt to skills needs in the longer term.

When skills for green transition are incorporated into the formal education system, the programmes are often provided at the level of post-secondary education, and include associate degrees at community colleges and Bachelors, Masters, PhD and postgraduate degrees at universities.

The Republic of Korea has seen many developments in the greening of its vocational education and training system since 2009. National Competency Standards (NCS) in skills for green transition have been determined for jobs in the environmental energy, transport and machinery sectors in collaboration with industry experts and with financial support under the National Strategy for Green Growth (2009–2050). The New National Technical Qualification in skills for green transition has been established, as well as many courses and programmes at TVET institutions and university departments. Within the framework of the National Strategy for Green Growth, the Government has invested in research and development in green technologies. In addition, vocational colleges, such as poly-tech colleges, now offer associate degree programmes and non-degree vocational training courses, allowing mid-career professionals to improve their skills without completing full degree programmes. The Ministry of Employment and Labour (MOEL), which oversees TVET institutions, has supported curriculum and textbook development based on the NCS. And TVET institutions, such as poly-tech colleges, have actively implemented dual work–learning programmes, which allow workers to receive work-related training, for example on environment and energy, at their workplace or in regional training centres.

Thailand offers another example of good practice in skills development through formal education. In 2011, the Thailand Professional Qualification Institute (TPQI), a public institution, was set up to develop skills and occupational standards. This has led to extensive coverage of skills standards, including skills for the green transition. TPQI's skills and occupational standards are developed to reflect the skills needs expressed by the private sector, and are in line with national strategies for the promotion of the digital sector (i.e. Thailand 4.0) and an environmentally friendly economy.

Public institutions affiliated with ministries usually provide both initial and continuous training

Government agencies, often in accordance with sector-specific mandates, carry out the provision of both initial and continuous training. In the Republic of Korea, the Ministry of Environment and the Ministry of Land, Transportation and Construction provide training directly through their training institutions for professionals and new entrants to the labour market (Jin, forthcoming).

In South Africa, the National Cleaner Production Centre of South Africa (NCPC-SA) offers a six-month internship programme to strengthen the employability of young engineers by providing them with training and experience in greener production in various sectors: clothing, textiles, footwear and

leather; chemicals, plastics, cosmetics, pharmaceuticals; automotive; and agro-processing. The combination of training, mentoring and workplace experience is effective in promoting the employability of trainees, suggested by the employment rate of interns at 83 per cent between 2010 and 2013 (OneWorld Sustainable Investments, forthcoming). In 2010, the NCPC-SA launched the Industrial Energy Efficiency Improvement Project (IEE project), which offers training courses in energy management systems and energy systems optimization. The IEE project is implemented through collaboration between the Department of Trade and Industry, the Department of Energy, the Department of Environmental Affairs, Business Unity South Africa (BUSA) and international cooperation with UNIDO and Switzerland's State Secretariat for Economic Affairs (SECO).

Private training institutions also play an important role…

With a view to improving its quality through market competition, some training is provided by private training institutions. A number of these institutions are funded by the government, with training being outsourced, while others are totally privately funded. However, some country studies refer to concerns regarding the quality of training delivered by private TVET providers when the training is publicly funded. For example, in Australia, where publicly funded TVET has been contracted out to private colleges, the Skills Quality Authority has identified some weaknesses in endeavouring to ensure high-quality training based on competition between private providers. This is due, first, to the inadequate specification of standards relating to the volume, duration and quality of training. Second, there is information asymmetry between training providers and students, who are often unaware of the real quality of training. Third, market forces can potentially induce private training institutions to invest in factors other than the quality of training, such as enhanced brand image through advertising.

… as do local government initiatives

As noted above, local governments play a major role in designing and implementing the provision of training, largely due to their familiarity with local economies and labour markets. Local skills development programmes can be quite extensive, but without coordination at the national level, they may give rise to regional disparities and inefficiency.

In the Republic of Korea, the local government of the city of Seoul, in collaboration with the Northern Technical Training Centre, which is part of the Ministry of Employment and Labour, provides training courses in renewable energy and green car maintenance. The training is provided free of charge, together with job placement and counselling services. However, Seoul's initiative is fairly exceptional and is related to the fact that the city accounts for at least half of the economic activity, jobs and population of the Republic of Korea, and that it has much greater financial capacity than the other 16 local governments in the country (Jin, forthcoming).

Employer-led initiatives can also give rise to training opportunities…

Employers also design and provide training, especially short training programmes. These can be more timely and responsive to changes in the labour market. In Thailand, for example, private companies play an important role through public–private partnerships, not only in identifying and anticipating skills needs, but also in providing training for the green transition. The employers' association sometimes organizes paid training seminars on topics such as energy saving and environmental awareness, which are open to members and non-members alike. When instructors are not readily identifiable in the country, they are invited from abroad.

Financial incentives can expand the scope of training provided by employers. Since 2010, an increasing number of employees have received training on skills for green transition supported by such incentives. In Spain, for instance, employers who offer training benefit from reductions in social security contributions. Between 2009 and 2016, the number of employees who received training for the green transition under this system doubled from 30,382 to 61,984 (Cedefop, forthcoming g). SMEs tend to face greater barriers in accessing the system, due to their lack of necessary knowledge, the administrative burden involved and their lack of trust in the system. In order to lower these barriers, the State Foundation for Training for Employment (Fundae) and the Spanish Confederation of Employers' Organizations (CEOE) organize guidance workshops and provide other assistance to SMEs.

The provision of TVET can also respond to direct demand from the private sector, for instance once a substantial number of companies are operating in the green economy or have created a "green cluster" in a region. In Spain, enterprises manufacturing electric cars in Castilla y León, a region with an automotive industry cluster, were able to persuade the regional government to invest in 2009 in a higher automotive technician diploma (Cedefop, forthcoming g).

Collaboration between a government agency and a specific enterprise can also lead to the provision of TVET. In Thailand, for example, the Department of Skills Development (DSD) started cooperating in August 2017 with a private company, DAIKIN, and the German Agency for International Cooperation (GIZ) to develop skills standards and competencies for air-conditioning technicians working on refrigerators using natural refrigerants. The collaboration will result in courses, curricula, assessment tools and training equipment at DSD training centres (Bhula-or, forthcoming).

In Bangladesh, a waste management company produces organic fertilizer using fruit and vegetable waste from the markets of Dhaka. Composting all the organic waste in Dhaka could create new jobs for 16,000 people from lower socio-economic backgrounds. The company has set up a Regional Recycling Training Center, in collaboration with the municipal government (Mondal, forthcoming).

In Brazil, the sugar cane sector employs a relatively large number of workers, with half the production being concentrated in the State of São Paulo. However, most of the jobs are damaging to the environment, as pre-burning causes serious atmospheric pollution. Mechanization avoids pre-burning and provides better working conditions, but for a smaller number of workers. In accordance with the Agro-Environmental Protocol of the Sugar and Energy Sector to end burning in sugar cane plantations, signed by the Secretariats of the Environment and Agriculture of São Paulo and the Union of the Sugar Cane Industry (UNICA), there was a 41 per cent drop in the workforce employed in the sugar energy sector between 2007 and 2014 (UNICA and FERAESP, 2015).

An important training initiative for displaced sugar cane cutters was introduced in 2009. Known as Projeto RenovAção ("Project RenovAction"), it is based on an agreement between UNICA, the National Industrial Training Service of São Paulo (SENAI) and several other educational institutions and partners. Training is provided for workers in new occupations in the sugar energy sector itself, and various courses are also offered to develop skills required in other sectors. Through the RenovAção project, workers can dedicate themselves to the courses, receiving monthly wages and other benefits (such as social contributions), as if they were working. The training initially targeted a quota of 20 per cent women participants, and was based on social dialogue. There is a specific teaching module for illiterate and semi-literate workers (the "Pre-RenovAção"), leading to a qualification consisting of basic subjects (reading, writing, mathematics, general knowledge, citizenship), which enables the workers to subsequently take part in Projeto RenovAção training courses. Most of the courses entail over 300 hours of training, with a total of 6,650 workers receiving training between 2010 and 2015 (ibid.; Young et al., forthcoming).

There are many examples of enterprises cooperating with universities and training centres for the development of curricula to address specific skills gaps, such as training for the installation of photovoltaic cells and the installation and use of solar water heaters in Barbados (University of the West Indies, forthcoming) and skills in the cement industry in Indonesia (IBCSD, forthcoming).

Finally, capacity building based on networks of enterprises and the principles of the circular economy can enhance resource productivity and the environmental performance of SMEs, as in the case of Mauritius (Sultan, forthcoming).

… and workers' organizations are increasingly involved

There are examples of workers' organizations involved in training for the green transition, such as Green Masonry Training in the Philippines in 2012, which was the result of collaboration between the Association of Construction and Informal Workers and the National Union of Building and Construction Workers and other partners (Fernandez-Mendoza and Lazo, forthcoming). Similarly, in the United Kingdom, trade unions have increased their involvement in skills development for green transition through an organization called Unionlearn, which has established "Greener Jobs Alliance" with the University and College Union (UCU) in order to step up trade union activities in localities and regions with the aim of influencing school curriculum (Cedefop, forthcoming f).

Training programmes often focus on specific sectors

Energy

In the United States, the Department of Energy (DOE) plays an active role in providing skills training for the energy sector, both at the national and local government levels. Over recent years, it has proposed 22 workforce training programmes through its Office of Energy Efficiency and Renewable Energy (DOE EERE), targeting a wide audience including professionals, students, entrepreneurs, industry stakeholders, jobseekers and the general public.

In Mali, the Ministry of Energy and Water promotes renewable energy loans to facilitate access to credit by consumers interested in installing solar equipment. To advance this programme, the Agency for Renewable Energy in Mali (AER-Mali) and the Support Fund for Vocational Training and learning (FAFPA) are currently working together to develop training modules for bank sales managers.

In Egypt, with a view to harnessing solar power, an NGO called Solar Energy Development Association (SEDA) offers several short-term intensive training courses for professionals on such topics as photovoltaic grid connected (on-grid) systems, solar water pumping and comprehensive photovoltaic systems.

In developing countries there is a large potential to increase energy efficiency in household consumption. About half the world's population use solid fuels, such as wood and coal, to meet their cooking needs (UNDP and WHO, 2009). As in the case of Uganda (box 5.3), access to training in the use of more efficient stoves can improve energy efficiency and contribute to local development.

Box 5.3

Training in the use of improved cooking stoves in Uganda

In Uganda, open fire is the major cooking method used by 94 per cent of rural households, while charcoal stoves are common in urban areas (MEMD, 2016). The use of inefficient cooking methods is a contributing factor to poverty, as low-income families spend up to 15 per cent of their income on charcoal or wood, and the search for wood can take up to six hours a day, which could have been used to earn income through paid work. However, about 10 per cent of the population uses improved charcoal or wood stoves, which reduce fuel consumption by an average of 36 and 58 per cent, respectively (Kabasa et al., forthcoming).

In rural areas, many local stove projects use resident artisans to manufacture stoves adapted to local needs and train them in specialized ceramic skills so that they can enhance the functionality of the stoves.

Training of artisans in the production of improved stoves is usually organized by the private sector with informal curricula, which are not approved by the Directorate of Industrial Training (DIT). Fees range between 200,000 (US$ 55) and 500,000 (US$ 140) Uganda shillings for four weeks. This training could be mainstreamed in the vocational training system at a later stage if the curriculum is approved by the DIT. "Energising Uganda" has trained more than 500 rural artisans since 2014 to produce and sell rural firewood stoves. Other support is provided to the artisans to ensure the sustainable growth of supply. User training, which is usually offered free-of-charge by the enterprises that sell the stoves, is key to the successful adoption of more efficient cooking methods.

The production of improved cooking stoves is an income-generating activity which could also have indirect employment effects. To maximize the benefits, the certification of training and the development of quality production is important. For example, the acquisition by small enterprises of production and distribution franchises from large producers can help to improve quality, reputation and consumer satisfaction. Keeping the cost of improved stoves affordable is still a challenge, and skills development could help to make the product more competitive. Training provided in trade fairs and during the Energy Efficiency Week could be scaled up and could inform consumers of the health benefits that improved cooking devices bring by mitigating indoor air pollution.

Source: Based on Kabasa et al., forthcoming.

Agriculture

Skills programmes in the agricultural sector are generally oriented towards food production efficiency rather than promoting the adoption of environmentally sustainable production systems. Weak coordination, the failure to identify skills needs, the sluggish involvement of the social partners and poor working conditions are all key challenges to overcome if agriculture is to go green.

In Mauritius, since 2016 over 3,200 farmers have benefited from the Compost Subsidy Scheme and the Sheltered Farming Scheme to shift from using chemicals to organic inputs (Sultan, forthcoming). The Food and Agriculture Research Extension Institute (FAREI) provides training for farmers, particularly in horticulture, agro-processing and agri-business. Participants can obtain MauriGAP certification in bio-farming. In addition, the FAREI Farming Training School offers bio-farming courses in collaboration with the Mauritius Institute of Technical Development (MITD). MITD provides a rainwater harvesting course in techniques for the reuse of plastic containers. Occupational safety and health components are integrated into all the training provided by MITD (ibid.).

In Mali, agriculture – and particularly cotton and food production – is a major sector for socio-economic development. It is also the sector most vulnerable to climate change, including erratic weather and water supply (Nyetaa, forthcoming). Firms exporting agricultural products need to have specific skills, such as knowledge of certification rules and international trade standards, organic farming, composting and food standards. Farmers producing for the domestic market lack training in sustainable agriculture, although some progress has been made. For example, a five-year project in the cotton-growing regions of southern Mali, which includes awareness-raising and training on key sustainability issues, has been able to reduce the use of chemical pesticides by 90 per cent (IFC et al., 2015).

Uganda has the largest farm area under organic management in all of Africa, with employment estimates ranging from 200,000 to 400,000 farmers. The National Organic Agriculture Movement (NOGAMU) is an NGO which brings together training institutions, national and international agencies and the private sector to support the development of organic farming in the country. NOGAMU has identified skills needs in the production and processing of organic products, and training needs for farmers interested in sustainable pest and disease management, soil fertility management, weeding and post-harvest handling. NOGAMU offers a range of training services in collaboration with education and training institutions, such as the College of Veterinary Medicine of Makerere University and the Uganda Martyrs University.

In other countries too there are many examples of training for organic agriculture or small-scale farming through non-formal courses and training programmes implemented on a project basis (e.g. Bangladesh, Egypt, Mali) or through formal training (e.g. Barbados, Costa Rica, Kyrgyzstan). Guyana offers and supports climate-resilient agricultural techniques in hydroponic production.

Forestry

The Guyana Mangrove Restoration Project (2010–13) aimed to create employment and support skills development to increase carbon sequestration, strengthen coastal resiliency and reduce the risk of floods (Small and Witz, 2017). Skills were provided for the planning, harvesting and maintenance of mangroves, as well as creating awareness of the role of mangroves in protecting the environment and enterprise development. A few enterprises were created in agro-processing and ecotourism. The project, which created 1,000 jobs, adopted an innovative approach to the sustainability of mangrove forest improvement. In exchange for enterprise development services, participants were requested to actively monitor the restoration and use of the mangrove forest in collaboration with local and regional institutions and the Ministry of Agriculture. In 2014, the project unit was integrated into the Ministry of Agriculture, which should facilitate the extension of the project across Guyana's mangrove forests and its application to other sectors, such as forestry.

Ecotourism

The Philippines Department of Environment and Natural Resources (DENR) has recognized ecotourism in designated areas and provided guidelines for ecotourism planning and management. In 2013, a gender-responsive toolkit on ecotourism planning and management was developed by the Philippines Commission on Women in partnership with the DENR. The toolkit contains training sessions on ecotourism planning, trail resources and monitoring for protected area officers and ecotourism guides, and marine resources monitoring for ecotourism (GREAT and PAWB, 2013).

Box 5.4

Skills for green transition in waste management and recycling: The potential for decent work?

The waste management and recycling sector employs over 500,000 people in Brazil (CEMPRE, 2010; ILO, 2011), 62,147 in South Africa (DEA, 2012; OneWorld Sustainable Investments, forthcoming) and some 400,000 to 500,000 in Bangladesh (Mondal, forthcoming). Most of these workers are in the informal economy, primarily in urban areas, and often play an important role in increasing the level of recycling, while reducing the amount of landfill. However, they face serious decent work deficits, such as work-related hazards, low earnings and long working hours; they are often not legally registered (hence the exclusion from labour legislation and social protection) and are socially stigmatized (ILO and WIEGO, 2017; Schenck, Blaauw and Viljoen, 2012). In response to these challenges, cooperatives and other social and solidarity economy organizations have been set up in countries such as Brazil, Colombia, India and South Africa to increase the recognition and collective voice of waste pickers (ILO, 2014). According to Green Fund (2016), scaling up the potential of waste management and recycling to integrate low-skilled informal workers into the formal economy, while at the same time promoting an economy with fewer waste is key to improving working conditions in the waste sector and the environment in South Africa.

However, the important question remains regarding the role of skills development in ensuring the transition of informal waste pickers to formal employment and to better working conditions. The development of the circular economy (recycling products, giving a new life to old products) involves the need for sorting, which requires a good knowledge of waste issues, suggesting the need to extend training to workers in the informal waste management sector.

There are some initiatives that address this skills gap. In France, the Professional Federation of Recycling Companies (FEDEREC) brings together 1,300 companies in the sector. The branch benefited from public co-financing to make a prospective inventory of its needs and skills, which led to the creation and implementation of five new qualifications: manual sorting operator, mechanized sorting operator, industrial team leader, industrial equipment operator, and industrial maintenance operator (Cedefop, forthcoming b). In Bangladesh, a private company, Waste Concern, has developed two training modules for community-based solid waste management and resource recovery (Mondal, forthcoming). Similarly, ILO and WIEGO find that waste picker cooperatives covered by their recent study[1] provide or facilitate access to training in the areas of legal recognition and technical skills related to waste management, while training in the area of OSH is largely overlooked (ILO and WIEGO, 2017).

[1] *A total of 29 cooperatives from Argentina, Brazil, Colombia, India, South Africa and Turkey were surveyed. See ILO and WIEGO (2017) for details on the research design.*

Waste management

Efforts to develop the skills of workers in waste management have also been made in a large number of developed and developing countries with a view to reducing the amount of landfill and increasing recycling (box 5.4).

Programmes organized by target group

Adult workers

Adult training for the greening of occupations and retraining of displaced workers can take the form of short courses. In Denmark, for example, a four-day course on environmental care is provided for property caretakers (Cedefop, forthcoming d). In many developing and emerging countries (e.g. Bangladesh, India and Uganda), on the other hand, adult training is less common. This may be due to the fact that in lower-income countries lower-skilled occupations make up a large share of employment, and skills may be considered as being relatively more transferable among those occupations even without training. For example, in Uganda, no training was provided when motorcycle taxis *(bodaboda)* were replaced by the city bus service, and many of the workers who lost their jobs have become touts and conductors to direct passengers to the buses.

Persons with disabilities

By focusing on training for persons with disabilities in developing skills for the green economy, it is possible to contribute to reducing inequality in access to education and employment. In Indonesia, nearly half of persons with disabilities have not completed primary education, and their employment share in urban areas is low (ILO, 2017a). Evidence from other countries suggests that such programmes can generate positive outcomes at the village level or in coastal areas in countries with a high level of outward migration. In Bangladesh, for instance, 200 persons with disabilities (mainly women) were trained in organic mushroom production and marketing in partnership with eight mushroom cooperatives (Mondal, forthcoming). The key success factor was the creation of partnerships between skills councils and the private sector in targeted sectors, with a commitment to a 5 per cent admission quota for persons with disabilities in TVET institutions. In Guyana, a project launched in 2014 provided training in hydroponic agriculture to almost 100 deaf students, 12 teachers and some parents (Small and Witz, 2017).

Indigenous and tribal peoples

Although indigenous people are vulnerable to climate change, they can play an essential role in sustainable policies and programmes as change agents for addressing environmental degradation (ILO, 2017b). Article 29 of the Indigenous and Tribal Peoples Convention, 1989 (No. 169), emphasizes the importance of skills development to ensure their full participation in the national economy. The provision of skills to indigenous people can support climate change mitigation through payments for ecosystem services (PES) schemes (see Chapter 4) and ecotourism. More importantly, indigenous and tribal peoples' knowledge about sustainable natural resource management (in forests, fisheries, wildlife, agriculture) can be streamlined into skills development programmes and adopted more widely to enhance the sustainability of these sectors.

In Australia, over 250 indigenous people in the Warddeken Indigenous Protected Area were provided with accredited training courses in 2010–11 to deal with the tasks of fire management, feral animal management, weed control and the monitoring of endangered species. The project has achieved 901,075 tonnes of CO_2eq in carbon abatement, which is worth US$4.4million (Fairbrother et al., forthcoming). Other impacts were reported, such as increased confidence and better health and well-being among the participants (ibid.).

The involvement of indigenous communities and the use of indigenous technologies in maintaining ecological balance can support clean local development, such as ecotourism in the Himalayas and the Western Ghats mountain range in India. Recognizing the multiple challenges faced by indigenous women, the "Moco-Moco" programme in Guyana is a female entrepreneurship initiative to alleviate the negative effects of natural disasters in indigenous communities of Region 9 (Upper Takutu-Upper Essequibo) by improving cassava and flour production for food security. It has improved the financial independence of the participants (Small and Witz, 2017).

Reducing gender inequality

Gender equality is central to sustainable human development and is one of the fundamental principles for the effective greening of economies. However, the absence of equal opportunities in access to decent jobs and training hinders the full contribution of women to the green economy (ILO, 2015b). Gender mainstreaming in skills development could enable women to move from low-skill and entry-level positions to high-skilled jobs and would enhance their livelihoods and independence. However, without conscious efforts, women's participation in the green economy will not increase rapidly enough to close the existing gender gap (von Hagen and Willems, 2012).

There are examples of good practice in the national studies in achieving gender equality. For example, the Australian Gas Light Company (AGL) promoted and assigned over half of its non-traditional roles to women under its Workplace Gender Equality Agency definition. The AGL is committed to increasing the number of women in the Senior Leadership Pipeline to 40 per cent by 2019 (Fairbrother et al., forthcoming). In Guyana, Ruppuni Essence is a cosmetics firm that relies on single mothers to grow lemongrass and promotes business opportunities through cooperatives (Small and Witz, 2017). In the Philippines, rural women are offered training in organic farming to empower them and improve their income (Mendoza and Lazo, forthcoming).

As illustrated in Chapter 2, the renewable energy sector has great potential for employment generation. Achieving gender equality in the renewable energy sector is crucial, as women are under-represented in this sector; their share in renewable energy employment stands at around 20–25 per cent in some advanced economies (Baruah, 2016). The gender gap is narrowing, albeit slowly. In the United States, the share of women in solar employment has grown to 28 per cent in 2016, although their skills levels are lower than in other national industries (Garrett-Peltier, forthcoming). In France, the proportion of women working in the production and distribution of energy and water has risen from 15 per cent in 2008 to 21 per cent in 2012 (Cedefop, forthcoming b). In developing and emerging economies, informal training provision plays an important role in promoting women's skills development in solar engineering and their participation in the sector. For example, the Barefoot College, an NGO active in India, has pioneered skills training of women in non-electrified rural villages in the field of solar electrification, and has successfully replicated the training provision model in Latin America and Africa (von Hagen and Willems, 2012; Enel, 2017).

C. Mapping the institutional structure of skills policies and programmes

Sections A and B have examined current efforts towards regulatory and policy coherence, as well as in the implementation of skills development programmes in the countries surveyed. This section focuses on institutional mechanisms that may facilitate or hinder those efforts, with an aim to draw attention to common successful factors and bottlenecks. In particular, the analysis highlights the challenges associated with promoting social dialogue on skills development for green transition.

Institutional mechanisms and social dialogue are key for effective policy formulation, identification of skills needs and development of training provision

The coordination across public agendas is essential for an effective design and implementation of public policies in general, but in the case of environmental sustainability it is absolutely vital. Indeed, conflicts of interest among issues such as environmental sustainability, economic growth and employment can be difficult to overcome when a country's economic activity and employment are largely reliant on environmentally harmful industries (van de Ree, 2017). Unsuccessful coordination of interests would hinder the promotion of skills development for the green transition.

Given this challenge, a well-functioning set of institutions and decision-making mechanisms (hereinafter "institutional mechanisms"), which can integrate a wide-range of public agendas, such as economic growth, public finance, social inclusion, education and employment, is essential for successfully promoting skills development for green transition. Such institutional mechanisms include not only those that are traditionally concerned with skills development issues (e.g. sector skills councils, advisory committees for vocational training), but also the ones that address environmental concerns (e.g. round tables on environment and sustainable development). In addition, the active participation of governments, social partners and other interested bodies in the process of designing and implementing skills development measures is imperative, as stipulated in the Human Resource Development Convention, 1975 (No. 142), and encouraged by the Human Resource Development Recommendation, 2004 (No. 195).

The experience of the 27 countries surveyed shows that the engagement among national governments, local governments and the social partners in the design of skills polices has led to the adoption of fully fledged policies dedicated to developing skills for the green transition or the incorporation of green skills into TVET policies. In particular, roundtables, advisory councils and skills councils are shown to be effective for tripartite involvement.

Mapping of policies reveals two types of institutional approaches to devising skills development measures for green transition, namely, establishing new bodies or councils specifically dedicated to skills for green transition, and mainstreaming environmental sustainability into the existing mechanisms for

Table 5.3

Institutional mechanisms to anticipate skills needs and adapt training provision (27 countries)

Policy questions	Are skills for green transition addressed through existing institutional mechanisms to anticipate skills needs and adapt training provision?	Is there a specific body or council to address skills development for green transition?
Australia	Yes	–
Barbados	Yes	–
Brazil	Yes	–
China	Yes[1]	–
Costa Rica	Yes	–
Denmark	Yes	–
Estonia	Yes	–
Germany	Yes	–
Guyana	Yes	–
Mauritius	Yes	–
Indonesia	Yes	–[5]
Republic of Korea	Yes	–
Spain	Yes	–
Thailand	Yes	–
United States[2]	Yes	–
Philippines	Yes	–[3]
India	–	Yes
France	Yes	Yes
South Africa	Yes	Yes
United Kingdom	Yes	Yes[4]
Bangladesh	–	–
Egypt	–	–
Kyrgyzstan	–	–
Mali	–	–
Montenegro	–	–
Tajikistan	–	–
Uganda	–	–
Total (number)	19	4
Total (percentage)	70.4	14.8

[1] Institutional mechanisms exist at the provincial and municipal levels, but not at the national level. The 2015 edition of the Dictionary of Occupations identifies 127 green occupations but provides no description of the criteria used for the categorization. It also acknowledges that those 127 occupations are only part of all the green occupations that enjoy a high degree of social acceptance. [2] In the United States, the responsibility for governing education systems is decentralized and given to each individual state. The United States data are only for the state of California. [3] The Philippines Green Jobs Act 2016 mandates the Technical and Skills Development Authority (TESDA), Green Technology Centre and the Professional Regulation Commission (PRC) for the development of training regulations and qualifications framework pertaining to green jobs. [4] Unionlearn, the learning and skills organization of the Trade Union Congress, has established "Green Skills Partnership", which involves unions, employers, local councils, environmental organizations, education providers, community groups and state agencies. [5] The Green Building Council Indonesia (GBCI) Association offers several types of training programmes in environmentally sustainable building.

Source: ILO compilation based on country reports and consultations with ILO specialists.

skills development in general (table 5.3). These approaches are not mutually exclusive; some countries, such as France, South Africa and the United Kingdom, use them simultaneously. Of the 27 countries surveyed, four have set up specific institutional mechanisms to address skills for the green transition, focusing on a few priority sectors. Much more commonly, 22 out of 27 countries had already established institutional mechanisms for skills development issues in general, and 19 of them address skills for green transition. This means that skills for green transition are not always addressed through the existing mechanisms. In some developing and emerging economies, institutional mechanisms for skills development in general are yet to be set up (e.g. Egypt and Mali), or have just been launched and are active only when there are donor-funded projects with specific sectoral coverage (e.g. Bangladesh), hence the lack of systematic platforms to regularly address skills development for green transition. In other countries, skills for green transition are addressed only through ad hoc surveys with employers (e.g. Costa Rica). Thus, developing and emerging economies have relatively weaker institutional capacity for integrating skills and environmental sustainability.

In addition to the institutional mechanisms, the participation of employers' and workers' organizations is also a key determining factor for effective skills needs identification and training provision. Employers can enhance the efficiency of skills development policies by identifying trends in the competencies required by the enterprises, improving the matching of skills demand and supply – including for migrant workers (ILO, 2017c), and linking technological innovation with the creation of employment and skills development opportunities.

On the other hand, workers' organizations can ensure that the equity concerns are taken into consideration, by addressing issues such as equitable access to training by workers of different skills levels, migration status, gender and contractual forms (TUAC, 2016; ILO, 2016), as well as translating skills development into higher pay and recognizing skills acquired on the job.

A positive link between the involvement of trade unions and the development of training provision[10] has been identified in studies of advanced economies such as France (Le Deist and Winterton, 2012) and the United Kingdom (Stuart and Robinson, 2007) and of emerging economies such as Argentina, Hong Kong (China) and the Philippines (Bridgford, 2017; Smith, 2014). This is also the case in Denmark, where stakeholders, including employers and trade unions, meet in the Advisory Council on Initial Vocational Training (REU) (Cedefop, forthcoming d). In light of this evidence, policy-makers and other stakeholders are encouraged to consider various ways in which trade unions can become more involved in skills training, such as the development of skills-based collective agreements at the sectoral level and the inclusion of training arrangements in collective bargaining at the enterprise level (Bridgford, 2017).

The 27 country studies show that skills development policies, including those for green transition, are led by governments based on their primary responsibilities for education and pre-employment training. The governments often engage with employers in an aim to achieve better matching of skills supply with demand, while trade unions are less likely to be involved (e.g. Bangladesh, China, Costa Rica, India and the Republic of Korea). Limited trade union participation carries the risk that inadequate consideration will be given to the needs of workers disadvantaged on the grounds of disability, gender, skill level, migration status, or age. For these reasons, and as specified in ILO Recommendation No. 195, governments should strengthen their support for social dialogue (Paragraph 5(h)(i)) and collective bargaining (Paragraph 9(c)) in relation to training at all levels, including the national, sectoral and enterprise levels. Furthermore, social partners are encouraged to increase their participation in designing and implementing skills development measures for green transition.

Public funding arrangements are instrumental in supporting the provision of training through the formal education system

Funding arrangements are one of the key drivers for the effective implementation of policies for the transition to a green economy. National studies find that public financial support has led to the creation of new channels for the provision of training, including departments at universities and graduate schools, and training programmes in TVET institutions (e.g. Republic of Korea). Importantly, public financial support has enabled disadvantaged groups to participate in training programmes free of charge. However, the sustainability of public funding remains a concern, suggesting the need for complementarity with a market-based approach and employer-led initiatives.

Fiscal instruments have generated strong incentives for employers to provide training

Fiscal reforms in the form of tax exemptions and social security rebates have proved to be a successful incentive for the provision of training by employers in the area of skills for green transition. When such fiscal incentives are in place, the number of employees receiving such training is seen to go up (Cedefop, forthcoming g). However, the experience of some countries (e.g. Spain) shows that, while the number of employees trained has increased, the quality of the training may not have been high, suggesting the need for quality assurance mechanisms.

10. See Bridgford (2017) for a review of the literature.

The absence of national or sectoral policies can undermine the sustainability of training programmes

In developing countries, training programmes are often implemented with the support of international development agencies and tend to be discontinued when the projects come to an end. A country-led approach is an effective way of ensuring the sustainability of these programmes and their progressive application to more sectors of the economy. In addition to sustainability, the training of trainers is a challenge. The development of new training techniques, especially through the use of information technology, may offer opportunities for improvement.

The lack of consensus on the definition of green jobs at the national level hinders skills development for green transition in many countries

The 27 country studies show that most of the sample countries have not yet reached consensus on the definition of green jobs.[11] In countries such as Denmark, France, the Philippines, South Africa, the United Kingdom and the United States, official definitions of green jobs exist – and yet even in those countries the debate over what should be defined as green jobs is still ongoing. This lack of consensus on the definition of green jobs is an obstacle to the systematic design and implementation of skills strategies, skills needs identification and training provision. In 2013, progress was made towards establishing an operational definition of green jobs at the 19th International Conference of Labour Statisticians (ILO, 2013). However, implementation of the definition largely depends on country-specific contexts and capacity, and many of the sample countries face challenges in this regard. In order to support its member States, the ILO has conducted pilot projects for generating statistics on green jobs based on the 2013 operational definition in Albania and Mongolia, which led to initial identification of green jobs by sex, level of education, occupation and main economic activity (Stoevska, Elezi and Muraku, 2014; Oyunbileg and Stoevska, 2017). In addition to surveys, other data sources such as input–output tables can also be used for projecting the employment impact of the green transition. In this regard, the Green Jobs Assessment Institutions Network (GAIN) published a training guidebook in 2017 (GAIN, 2017).

Conclusions

This chapter has examined the formulation and implementation of existing policies and programmes in the area of skills development for the green transition in terms of their policy coherence with broader environmental sustainability policies, and identified success factors and obstacles.

There are signs of emerging policy coherence between skills development and environmental sustainability policies. However, the scope and degree of this emerging policy coordination tends to be limited to specific policy areas, target groups, sectors and regions. Among the success factors, regulatory instruments (e.g. energy law reforms) are often found to be effective in initially setting in motion skills policy formulation and implementation. However, in view of the prescriptive nature of regulatory tools, such as the vocational qualification and training requirements set out in energy regulations, the adaptability of training to changes in skills needs is still unproven. Policies and regulations have to achieve the right balance between flexible adjustment to the skills needed in the market, the establishment of qualification standards and the mainstreaming of skills for green transition in formal TVET systems over the longer term. National experience reveals a wide range of challenges faced by policy-makers, social partners and other relevant stakeholders. These challenges include the absence of consensus on the definition of green jobs, lack of capacity at the national level to collect, disseminate and analyse relevant data, and the evolving nature of skills needed for the green transition.

11. See van de Ree (2017) for a review of the various definitions.

Given the current pace of progress, there is a risk that some of the commitments made in nationally determined contributions (NDCs) and the SDGs will not be met by the target year. In light of the *Guidelines for a just transition to environmentally sustainable economies and societies for all* (ILO, 2015a), there are a number of areas in which greater efforts are needed. Consideration of the following areas is particularly important in ensuring decent work and social inclusion.

First, gender mainstreaming needs to be strengthened in many skills development policies and programmes. The ILO (2017d) finds that there are considerable gender inequalities in the form of occupational and sectoral segregation. However, the 27 country studies show that gender equality is not mainstreamed in key policy documents on skills development for the green transition. Without a clear recognition of and efforts to narrow the gender gap in terms of sectoral/occupational segregation and access to training, there is a high risk that the transition to a green economy will only perpetuate the existing situation. For example, women are under-represented in the science, technology, engineering and mathematics (STEM)-related fields, and over-represented in recycling and waste collection, which are characterized by low pay and poor working conditions (Strietska-Ilina, 2011). Consequently, current efforts to narrow the gender gap in entry, retention and advancement rates during vocational training programmes in STEM fields, as well as those aimed at promoting working conditions in waste management sectors, need to be stepped up.

Second, global and regional partnerships need to be strengthened in the area of skills development for a green transition. In this regard, international and technical cooperation in human resource development should promoted national capacity building to reform and develop training policies and programmes.[12] The research conducted for this chapter confirms that there is strong demand from lower-income countries for the sharing of good practices, in terms of both the formulation and implementation of policies and regulations. Cross-border knowledge-sharing can promote regional and international approaches to skills development for the green transition, which can in turn address the competitiveness concerns of individual countries.

Finally, most of the policies and programmes identified in this chapter are targeted at semi-skilled and skilled jobs, with the latter being concentrated especially in the energy sector and other sectors closely related to environmental protection. In terms of support for the transition of low-skilled workers, some examples of short or ad hoc training have been identified, but hardly any more systematic active labour market policies to support disadvantaged groups in the development of appropriate skills. In developing and emerging countries, low-skilled workers might benefit from social protection measures and programmes to formalize employment, in addition to skills development. It should be recognized that training in environmental hazard management and environmentally friendly techniques could make a significant contribution to workers' health and well-being (Chapter 4).

The challenges described in this chapter suggest that there is an urgent need to improve understanding of the mechanisms through which a country-specific policy mix can have an impact on skills development for the green transition. In recognition of this need, the ILO will follow up on the analysis undertaken in this chapter with a view to developing detailed policy recommendations for each country that could lead to technical assistance to the countries surveyed.

12. Paragraph 21 of Recommendation No. 195.

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Appendices

Appendix 1

1. COUNTRIES THAT HAVE DECOUPLED ECONOMIC GROWTH FROM GREENHOUSE GAS EMISSIONS

In a green economy it is said that economic activity is decoupled from greenhouse gas (GHG) emissions. At the first level, this means that economic activity is decoupled from the GHG emissions embedded in the *production* of goods and services. At the second level, and in open economies, this means that economic activity is decoupled from the GHG emissions embedded in the *consumption* of goods and services. Economic growth is therefore compared with the growth in production-based emissions to identify countries that have decoupled production:

- Using data from the *World Development Indicators* (World Bank, 2017), country-specific trends are constructed from 1995 to 2012, country-level statistics for annual per capita GDP and annual per capita GHG emissions.
- Using OLS regression models, the average annual growth is estimated in per capita GDP and per capita GHG emissions (in per cent). For each country c, we estimate:

$$logGDP_{c,y}=\beta_{0,c}+\beta_{1,c}\,year_y+e_{c,y}$$

and

$$logGHG_{c,y}=\gamma_{0,c}+\gamma_{1,c}\,year_y+e_{c,y}$$

where $\beta_{1,c}$ and $\gamma_{1,c}$ are each country's average annual percentage changes in per capita GDP and GHG emissions, respectively.

- Countries with $\beta_{1,c}>0$ and $\gamma_{1,c}<0$ are countries that experienced economic growth in the 1995–2012 period and reduced their per capita emissions during that period. These countries decoupled economic growth from production-based emissions.

Of the subset of countries that decoupled economic growth from production-based emissions, those that also decoupled from consumption-based emissions are identified as follows:

- Using historical data from the National Footprint Accounts covering the years 1960–2012, augmented by 2013 data (Global Footprint Network, 2016 and 2017), country-specific annual carbon consumption-based emissions trends are constructed.
- Using OLS regressions, the average annual change in the carbon footprint is estimated:

$$logCFoot_{c,y}=\mu_{0,c}+\mu_{1,c}year_y+e_{c,y}$$

- Countries with $\beta_{1,c}>0$, $\gamma_{1,c}<0$ and $\mu_{1,c}<0$ are countries that decoupled economic growth from production-based emissions and consumption-based emissions.

2. THE RELATIONSHIP BETWEEN EMPLOYMENT OUTCOMES AND DECOUPLING GDP GROWTH AND EMISSIONS

Figure 1.5, analysing the relationship between employment outcomes and the ability of countries to decouple GHG emissions from GDP, measures the correlation between decent work indicators and GHG emissions for countries worldwide with the data available between 1995 and 2014. Regression models estimate

$$logGHG_{y,c} = logEmp_{y,c} + c + y + e_{y,c}$$

as the marginal model where $logGHG_{y,c}$ are country c's GHG emissions per capita in year y and c and y are country and annual fixed effects, respectively. We also estimate

$$logGHG_{y,c} = logEmp_{y,c} + logGDP_{y,c} + logEInt_{y,c} + logPop_{y,c} + logUrban_{y,c} + c + y + e_{y,c}$$

as the conditional model, which adds controls for log GDP per capita, log energy intensity, log population and the log share of the urban population. For both the marginal and conditional models, one distinct model is estimated for each employment outcome, namely, working poverty (the percentage of workers living in extreme or moderate working poverty who live on less than US$3.10 PPP per day), the labour share of income, the female labour participation rate, the employment-to-population ratio and interaction effects to evaluate the sectoral distribution of employment, and self-employment (the percentage of workers who are employers, own-account workers, contributing family workers or members of producer cooperatives).

Results hold when the regressions are carried out separately for high-income, upper middle-income, lower middle-income and low-income countries. Results also hold when the regressions are carried out separately for coupled and decoupled countries. For results to hold within each country categorization, outlier cases are eliminated: Equatorial Guinea (average annual percentage change in GHG emissions of 54.8 and average annual percentage change in GDP per capita of 19.7), Afghanistan (20.4, 4.6), Angola (13.8, 4.4), Bosnia and Herzegovina (12.3, 11.7), Lao People's Democratic Republic (10.4, 5.3), Mozambique (9.5, 5.5) and Swaziland (9.4, 2.0).

Table A1.1 shows the regression results for the full-country model:

Table A1.1

Relationship between employment outcomes and GHG emissions

a. Working poverty

	Marginal	Conditional
Working poverty	–0.703***	–0.185***
	(0.0648)	(0.0546)
GDP growth		1.254***
		(0.0344)
Population growth		0.831***
		(0.0604)
Energy intensity		0.789***
		(0.0249)
Share of urban population		0.0780
		(0.172)
Constant	0.0732**	–25.24***
	(0.0360)	(1.117)
Year FE	*YES*	*YES*
Country FE	*YES*	*YES*
R-squared	*0.302*	*0.607*
No. countries	*121*	*121*
No. observations	*2233*	*2233*

b. Labour share of income

	Marginal	Conditional
Labour share of income	–0.302***	–0.0362
	(0.113)	(0.0867)
GDP growth		1.108***
		(0.0285)
Population growth		0.508***
		(0.0415)
Energy intensity		0.722***
		(0.0250)
Share of urban population		0.810***
		(0.156)
Constant	0.913***	–19.07***
	(0.0650)	(0.762)
Year FE	*YES*	*YES*
Country FE	*YES*	*YES*
R-squared	*0.110*	*0.500*
No. countries	*126*	*126*
No. observations	*2402*	*2402*

Table A1.1 (cont'd)

c. Female labour participation rate

	Marginal	Conditional
Female labour participation rate	–2.072***	–0.724***
	(0.317)	(0.234)
GDP growth		1.198***
		(0.0254)
Population growth		0.552***
		(0.0387)
Energy intensity		0.788***
		(0.0209)
Share of urban population		0.772***
		(0.138)
Constant	1.202***	–20.34***
	(0.126)	(0.713)
Year FE	*YES*	*YES*
Country FE	*YES*	*YES*
R-squared	*0.150*	*0.555*
No. countries	*170*	*170*
No. observations	*3170*	*3170*

d. Employment-to-population ratio

	Marginal	Conditional
Employment-to-population ratio	–1.798***	–0.174
	(0.178)	(0.136)
x Industry	4.383***	0.501***
	(0.232)	(0.188)
x Service	1.891***	–0.783***
	(0.180)	(0.146)
GDP growth		1.229***
		(0.0241)
Population growth		0.481***
		(0.0364)
Energy intensity		0.769***
		(0.0203)
Share of urban population		0.751***
		(0.135)
Constant	0.530***	–19.45***
	(0.0988)	(0.652)
Year FE	*YES*	*YES*
Country FE	*YES*	*YES*
R-squared	*0.230*	*0.587*
No. countries	*177*	*177*
No. observations	*3473*	*3473*

e. Self-employment

	Marginal	Conditional
Self employment	–1.601***	0.0935
	(0.139)	(0.114)
GDP growth		1.305***
		(0.0345)
Population growth		0.858***
		(0.0609)
Energy intensity		0.791***
		(0.0256)
Share of urban population		0.0987
		(0.174)
Constant	0.618***	–26.23***
	(0.0780)	(1.144)
Year FE	*YES*	*YES*
Country FE	*YES*	*YES*
R-squared	*0.307*	*0.605*
No. countries	*121*	*121*
No. observations	*2233*	*2233*

*Notes: Standard errors in parentheses. A marginal and conditional time series (1995–2014) regression is estimated for each decent work indicator. All regression models consider yearly logGHG emissions per capita as the dependent variable and the decent work indicator as the independent variable. All models include country and year fixed effects. The marginal model includes only the relationship between each decent work indicator and logGHG emissions per capita. The conditional model adds controls for logGDP, log population, log energy intensity and the log share of the urban population. The model for employment shares by sector includes agriculture as the reference category. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*

Source: ILO calculations based on World Development Indicators, Penn World Tables and ILOSTAT.

3. THE CARBON AND RESOURCE INTENSITY OF EMPLOYMENT

For GHG emissions (carbon) and each resource (material, freshwater and land), the total emissions (in Kt) or resources (in Kt, billion m^3 or thousand Ha) are estimated that are associated with each employed person. In particular:

- for the carbon intensity of employment, each region's total GHG emissions (World Development Indicators) are divided by its total employment in thousands (ILO-modelled estimates) (ILOStat);
- for the material intensity of employment, each region's total material extraction (Material Flows Data) is divided by its total employment in thousands (ILO-modelled estimates) (ILOStat);
- for the freshwater intensity of employment, each region's total freshwater withdrawals (World Development Indicators) are divided by its total employment in thousands (ILO-modelled estimates) (ILOStat); and
- for the land use of employment, each region's total land use (FAOStat) is divided by its total employment in thousands (ILO-modelled estimates) (ILOStat).

4. WORKING-LIFE YEARS LOST DUE TO HUMAN-INDUCED DISASTERS

The estimate of working-life years lost due to disasters adapts Noy's (2014) methodology to the world of work. It takes into account the fact that people do not work during their entire life and that not all the population works. Noy estimates a benchmark index for life years lost due to disasters whereby

$$Lifeyears = L(M, A^{death}, A^{exp}) + I(N) + DAM(Y,P)$$

- $L(M, A^{death}, A^{exp}) = M(A^{exp} - A^{med})$ is the number of years lost due to mortality as a result of events, calculated as the difference between age at death and life expectancy. In global data sets, information about the age at death is not available, so the median age of the population (A^{med}) is used instead.
- $I(N) = eTN$ is the cost function associated with people who were injured or otherwise affected by the disaster, which follows the WHO (2013) methodology for calculating disability-adjusted life years (DALYs). The coefficient e is the "welfare-reduction weight" that is associated with being exposed to a disaster. The WHO weighting is adopted for disability associated with "generic uncomplicated disease: anxiety about diagnosis" ($e = 0.054$). $T(= 3\ years)$ is the time it takes an affected person to return to normality or for the impact of the disaster to disappear, while N is the number of people affected.
- $DAM(Y,P) = Y(1-c) \times pcGDP^{-1}$ estimates the number of life years lost as a result of the damage to capital assets and infrastructure (the opportunity cost of spending human resources (effort) on the reconstruction of the destroyed assets). Y is the amount of financial damage usually indicated in information about disaster impacts. P is the monetary amount obtained in a full year of human effort. Income per capita ($pcGDP$) is used as an indicator of the cost of human effort, but discounted by 75 per cent (c) to account for the observation that much time is spent in activities that are not related to work.

The index is adapted to relate better to the world of work and considers only disasters caused or enhanced by human intervention in the environment (anthropogenic disasters). In practice, we estimate:

$$Worklifeyears = [L(M, A^{death}, A^{retirement}) + I(N) + DAM(Y,P)]e$$

Noy's approach is adapted by measuring $A^{retirement}$ instead of A^{exp} because people are not expected to continue working beyond the age of 65. When a country's life expectancy is higher than 65, $A^{retirement} = 65$, otherwise $A^{retirement} = A^{exp}$ is used.

In addition, the final result is weighted by the employment-to-population ratio (e) to take into account the proportion of a country's population that works.

Finally, disasters and natural hazards in the EM-DAT Disaster Database are only considered when they are caused or enhanced by human intervention in the environment or environmental degradation. This includes meteorological (storms, fog, extreme temperature), hydrological (floods, landslides, wave action), climatological (drought, glacial lake outburst, wildfires), biological (insect infestation) and certain technological (industrial or miscellaneous accidents) hazards. Estimates do not include casualties, people affected or damages resulting from geophysical (earthquake, mass movement, volcanic activity), biological (viral, bacterial, parasitic, fungal or prion disease epidemics, animal accidents), extraterrestial (impact, space weather) or certain technological (transport accidents) hazards.

5. THE IMPACT OF HEAT STRESS IN THE WORLD OF WORK

The methodological details for labour impact analysis follow Kjellström et al. (2017). The analysis of the projected impact of climate change on heat stress is based on grid cell data (0.5 x 0.5 degrees or 50 x 50 km at the Equator) for climate variables combined with population size estimates for four age groups (0 to 4 years, 5 to 14, 15 to 64 and 65 years or older) and employment distribution by broad economic sector.

The climate data use 30-year averages, identified by their mid-points: 1995, 2025, 2055 and 2085. The data for 2085, for example, draw on the average projected temperatures for each grid cell between 2071 and 2099. The HadGEM2-ES (Martin et al., 2011) and GFDL-ESM2M (Dunne et al., 2012 and 2013) provide the high- and low-end climate data and projections. These two models represent the range of 25 models used in the most recent assessments by the Intergovernmental Panel on Climate Change (IPCC, 2013). This report uses the average of the two, avoiding the calculation of heat stress impact across all the various climate projections available.[1] Most models correct bias in the temperature with measured data from weather stations over a long historical period. The bias correction in this report also corrects for humidity, which is a relevant parameter in assessing the human health risks of temperature.

The results shown in the report use future modelled estimates for representative GHG pathways RCP2.6 (ibid.). Pathway RCP2.6 gives a mean global temperature increase of 1.5°C by the end of the century.

Following Kjellström et al. (2017) and Kjellström and McMichael (2014), the heat stress index (the Wet Bulb Globe Temperature (WBGT) in degrees Celsius (°C)) is calculated by combining climate temperature (°C) and humidity (dew point, in °C) assuming air movement over the skin at 1 m/s (the speed at which arms or legs move when working) and in the shade or indoors without air conditioning. The heat stress index for work in the sun in the afternoon adds 2°C to the in-shade WBGT. The monthly mean temperature and WBGT and the monthly average of the daily maximum temperature and WBGT are used to make estimates of the typical hourly distribution of heat levels.

The population data are based on United Nations population estimates and assessments of age distribution from the International Institute for Applied Systems Analysis (Lutz, Butz and Samir, 2014). For grid cells on the boundaries of regions or countries, the estimated population is distributed in the same proportion as the land distribution.

Data on workforce distribution in agriculture, industry and services at the country and subregional levels come from ILO *Key Indicators of the Labour Market* (ILO, 2015).

Following Kjellström et al. (2017), the results estimate heat stress approximate exposure–response relationships for work intensities at 200W (clerical or light physical work), 300W (moderate physical work in manufacturing) and 400W (heavy physical work in agriculture or construction). They allow for the conversion of an environmental heat level (expressed as WBGT) to a percentage of unavailable work capacity if the worker reduces work intensity to avoid clinical health effects. The loss of work hours is calculated using the exposure–response equations for each daylight hour of a month or a year for each grid cell. The lost hours per person in different work types are then added up for all grid cells in a geographic area (e.g. subregions). The number of lost hours in each occupation type is also added and compared with the total hours available for work in each daylight 12-hour period.

No matter what the conditions, some work is always possible because, if the person does not release any heat at all, the specific heat of the body (3470 J/(kg×°C)) allows at least 6 minutes in the hour before the core temperature reaches an intolerable 39°C. Also, even when working continuously, it is necessary to take "micro-breaks" to stretch, go to the toilet, or simply relax. It is assumed that 10 per cent of work time is used in this way. In the impact assessments, a cut-off is used at 10 per cent time lost (full work up to this level) and 90 per cent time lost (10 per cent of work, or 6 minutes, which is always possible).

With the large population in several regions and the calculated fractions of hot days at a very hot level based on mathematical functions, relatively large numbers of lost work hours can emerge from these fractions of days or hours. To avoid overestimating the hours affected by heat, the mathematical functions are trimmed at 1 per cent, providing conservative estimates, especially in temperate regions.

1. Both the HadGEM2-ES and the GFDL-ESM2M models are available at the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP): www.isimip.org.

Appendix 2

1. USING MULTIREGIONAL INPUT–OUTPUT TABLES TO ESTIMATE THE EMPLOYMENT EFFECTS IN A GREEN ECONOMY

This appendix provides methodological details on the procedure used to estimate the number of jobs created and destroyed, as well as the change related to wages, emissions and skills, and gender composition of the economy under certain scenarios associated with a low-carbon and resource-efficient economy. It first describes the data set, the general methodological approach and the specific assumptions used in each scenario.

Data

Exiobase is a multiregional input–output and supply-and-use table (MRIO) and reports the interlinkages between final consumption, the flow of intermediate and final goods and factor inputs into production. The environmental and socio-economic extensions to these databases allow analysis of the corresponding impacts along global value chains resulting from changes in global production networks. Exiobase covers 163 industries (for the symmetric input–output tables) and 200 products (for the supply-and-use tables) across 44 countries and five rest-of-the-world regions. It reports total employment, total female employment, total employment by skills level, vulnerable employment and total GHG emissions for each sector in each country, which is of special relevance to the present report.[1]

Tukker et al. (2013) and Wood et al. (2015) provide more information on Exiobase and its potential uses. Simas et al. (2014) provide a description of the employment and vulnerable employment accounts in the context of MRIO tables.

As described in Simas et al. (2014), Exiobase constructs labour inputs from national labour force surveys gathered from ILOStat, and a combination of labour force and industrial surveys in national accounts, obtained from the OECD STAN database. Labour data from the ILO consist of 39 economic sectors, while STAN data cover up to 60 industries, which provides a better allocation for economic output in the MRIO sectors. Labour inputs were disaggregated from broad economic sectors into industries in the MRIO according to the compensation of employees from the model. The disaggregation was made under the assumption that average wages and hours worked would be similar between all workers within a broad economic sector or industry.

Vulnerable employment in Exiobase follows ILO definitions, which include unpaid contributing family workers and own-account workers. The ILO and the OECD provide sector-level data on both employment and paid employees for all countries in the Exiobase. A weighted average ratio of paid employees per total employment for countries in the region for three broad sectors (agriculture, industry and services) identifies vulnerable employment in each of the five rest-of-the-world regions. Labour inputs in the MRIO model are divided into three skill levels (low, medium and high). The skill level of occupations is identified such that low-skilled occupations are all ISCO code 9 occupations, medium-skilled occupations are all ISCO code 4, 5, 6, 7 and 8 occupations, and high-skilled occupations are all ISCO code 1, 2 and 3 occupations. ILO sectoral data on occupations for all countries in Exiobase are used to construct the number of workers at each skill level in each sector. For the rest-of-the-world regions, each industry has a weighted average distribution of skill levels in total employment for three broad sectors: agriculture, industry and services.

Exiobase v3 maps the world economy in 2011, but has been updated to 2014 (Stadler et al., 2018). Projections up to 2030 combine International Monetary Fund (IMF) GDP projections to 2022 with the International Energy Agency (IEA) regional growth projections to 2030. Except for the changes modelled in the scenarios – as described below – the basic trade and country-specific sectoral structure of the world economy remains as described by the IMF projections (IEA, 2016; IMF, 2017).

Although analyses are carried out with the disaggregated table, the results in this report are aggregated by industry (agriculture, construction, fossil fuels and nuclear electricity production, manufacturing, mining, renewable-energy electricity production, services, utilities, and waste management and recycling), to facilitate reporting. Results are also aggregated at the regional level (Africa, Americas, Asia, Europe and Middle East). Due to data constraints, Exiobase regions differ slightly from ILO regional groupings. Table A2.1 shows the industry aggregation used in the report.

1. Exiobase is available through the project's website: www.exiobase.eu .

Table A2.1

Exiobase industry aggregation used in the report

Industries	Aggregated industry
Cultivation of paddy rice	Agriculture
Cultivation of wheat	Agriculture
Cultivation of cereal grains n.e.c.	Agriculture
Cultivation of vegetables, fruit, nuts	Agriculture
Cultivation of oil seeds	Agriculture
Cultivation of sugar cane, sugar beet	Agriculture
Cultivation of plant-based fibers	Agriculture
Cultivation of crops n.e.c.	Agriculture
Cattle farming	Agriculture
Pig farming	Agriculture
Poultry farming	Agriculture
Meat animals n.e.c.	Agriculture
Animal products n.e.c.	Agriculture
Raw milk	Agriculture
Wool, silk-worm cocoons	Agriculture
Manure treatment (conventional), storage and land application	Agriculture
Manure treatment (biogas), storage and land application	Agriculture
Forestry, logging and related service activities	Agriculture
Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing	Agriculture
Mining of coal and lignite; extraction of peat	Mining
Extraction of crude petroleum and services related to crude oil extraction, excluding surveying	Mining
Extraction of natural gas and services related to natural gas extraction, excluding surveying	Mining
Extraction, liquefaction and regasification of other petroleum and gaseous materials	Mining
Mining of uranium and thorium ores	Mining
Mining of iron ores	Mining
Mining of copper ores and concentrates	Mining
Mining of nickel ores and concentrates	Mining
Mining of aluminium ores and concentrates	Mining
Mining of precious metal ores and concentrates	Mining
Mining of lead, zinc and tin ores and concentrates	Mining
Mining of other non-ferrous metal ores and concentrates	Mining
Quarrying of stone	Mining
Quarrying of sand and clay	Mining
Mining of chemical and fertilizer minerals, production of salt, other mining and quarrying n.e.c.	Mining
Processing of meat cattle	Manufacturing
Processing of meat pigs	Manufacturing
Processing of meat poultry	Manufacturing
Production of meat products n.e.c.	Manufacturing
Processing of vegetable oils and fats	Manufacturing
Processing of dairy products	Manufacturing
Processed rice	Manufacturing
Sugar refining	Manufacturing
Processing of food products n.e.c.	Manufacturing
Manufacture of beverages	Manufacturing
Manufacture of fish products	Manufacturing
Manufacture of tobacco products	Manufacturing
Manufacture of textiles	Manufacturing
Manufacture of wearing apparel; dressing and dyeing of fur	Manufacturing
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harnesses and footwear	Manufacturing
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Manufacturing
Reprocessing of secondary wood material into new wood material	Waste mgt. and recycling
Pulp	Manufacturing
Reprocessing of secondary paper into new pulp	Waste mgt. and recycling

Table A2.1 (cont'd)

Industries	Aggregated industry
Paper	Manufacturing
Publishing, printing and reproduction of recorded media	Manufacturing
Manufacture of coke oven products	Manufacturing
Petroleum refinery	Manufacturing
Processing of nuclear fuel	Manufacturing
Plastics, basic	Manufacturing
Reprocessing of secondary plastic into new plastic	Waste mgt. and recycling
N-fertilizer	Manufacturing
P- and other fertilizers	Manufacturing
Chemicals n.e.c.	Manufacturing
Manufacture of rubber and plastic products	Manufacturing
Manufacture of glass and glass products	Manufacturing
Reprocessing of secondary glass into new glass	Waste mgt. and recycling
Manufacture of ceramic goods	Manufacturing
Manufacture of bricks, tiles and construction products, in baked clay	Manufacturing
Manufacture of cement, lime and plaster	Manufacturing
Reprocessing of ash into clinker	Waste mgt. and recycling
Manufacture of other non-metallic mineral products n.e.c.	Manufacturing
Manufacture of basic iron and steel and of ferro-alloys and first products thereof	Manufacturing
Reprocessing of secondary steel into new steel	Waste mgt. and recycling
Precious metals production	Manufacturing
Reprocessing of secondary precious metals into new precious metals	Waste mgt. and recycling
Aluminium production	Manufacturing
Reprocessing of secondary aluminium into new aluminium	Waste mgt. and recycling
Lead, zinc and tin production	Manufacturing
Reprocessing of secondary lead into new lead, zinc and tin	Waste mgt. and recycling
Copper production	Manufacturing
Reprocessing of secondary copper into new copper	Waste mgt. and recycling
Other non-ferrous metal production	Manufacturing
Reprocessing of secondary other non-ferrous metals into new other non-ferrous metals	Waste mgt. and recycling
Casting of metals	Manufacturing
Manufacture of fabricated metal products, except machinery and equipment	Manufacturing
Manufacture of machinery and equipment n.e.c.	Manufacturing
Manufacture of office machinery and computers	Manufacturing
Manufacture of electrical machinery and apparatus n.e.c.	Manufacturing
Manufacture of radio, television and communication equipment and apparatus	Manufacturing
Manufacture of medical, precision and optical instruments, watches and clocks	Manufacturing
Manufacture of motor vehicles, trailers and semi-trailers	Manufacturing
Manufacture of other transport equipment	Manufacturing
Manufacture of furniture; manufacturing n.e.c.	Manufacturing
Recycling of waste and scrap	Waste mgt. and recycling
Recycling of bottles by direct reuse	Waste mgt. and recycling
Production of electricity by coal	Fossil and nuclear
Production of electricity by gas	Fossil and nuclear
Production of electricity by nuclear	Fossil and nuclear
Production of electricity by hydro	Renewables
Production of electricity by wind	Renewables
Production of electricity by petroleum and other oil derivatives	Fossil and nuclear
Production of electricity by biomass and waste	Renewables
Production of electricity by solar photovoltaics	Renewables
Production of electricity by solar thermal	Renewables
Production of electricity by tide, wave, ocean	Renewables
Production of electricity by geothermal	Renewables
Production of electricity n.e.c.	Renewables
Transmission of electricity	Utilities

Table A2.1 (cont'd)

Industries	Aggregated industry
Distribution and trade of electricity	Utilities
Manufacture of gas; distribution of gaseous fuels through mains	Utilities
Steam and hot water supply	Utilities
Collection, purification and distribution of water	Utilities
Construction	Construction
Reprocessing of secondary construction material into aggregates	Waste mgt. and recycling
Sale, maintenance, repair of motor vehicles, motor vehicle parts, motorcycles, motorcycle parts and accessories	Services
Retail sale of automotive fuel	Services
Wholesale trade and commission trade, except of motor vehicles and motorcycles	Services
Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	Services
Hotels and restaurants	Services
Transport via railways	Services
Other land transport	Services
Transport via pipelines	Services
Sea and coastal water transport	Services
Inland water transport	Services
Air transport	Services
Supporting and auxiliary transport activities; activities of travel agencies	Services
Post and telecommunications	Services
Financial intermediation, except insurance and pension funding	Services
Insurance and pension funding, except compulsory social security	Services
Activities auxiliary to financial intermediation	Services
Real estate activities	Services
Renting of machinery and equipment without operator and of personal and household goods	Services
Computer and related activities	Services
Research and development	Services
Other business activities	Services
Public administration and defence; compulsory social security	Services
Education	Services
Health and social work	Services
Incineration of waste: Food	Waste mgt. and recycling
Incineration of waste: Paper	Waste mgt. and recycling
Incineration of waste: Plastic	Waste mgt. and recycling
Incineration of waste: Metals and inert materials	Waste mgt. and recycling
Incineration of waste: Textiles	Waste mgt. and recycling
Incineration of waste: Wood	Waste mgt. and recycling
Incineration of waste: Oil/hazardous waste	Waste mgt. and recycling
Biogasification of food waste, incl. land application	Waste mgt. and recycling
Biogasification of paper, incl. land application	Waste mgt. and recycling
Biogasification of sewage sludge, incl. land application	Waste mgt. and recycling
Composting of food waste, incl. land application	Waste mgt. and recycling
Composting of paper and wood, incl. land application	Waste mgt. and recycling
Waste water treatment, food	Waste mgt. and recycling
Waste water treatment, other	Waste mgt. and recycling
Landfill of waste: Food	Waste mgt. and recycling
Landfill of waste: Paper	Waste mgt. and recycling
Landfill of waste: Plastic	Waste mgt. and recycling
Landfill of waste: Inert/metal/hazardous	Waste mgt. and recycling
Landfill of waste: Textiles	Waste mgt. and recycling
Landfill of waste: Wood	Waste mgt. and recycling
Activities of membership organizations n.e.c.	Services
Recreational, cultural and sporting activities	Services
Other service activities	Services
Private households with employed persons	Services
Extra-territorial organizations and bodies	Services

Methods

Given that MRIO tables record the flow of intermediate goods and services in the world economy, they map the inter-industry linkages within an economy. MRIOs capture the indirect effects (changes in other industries, e.g. coal mining) of changes in one specific industry (e.g. the electricity generation sector). This logic can be extended to the estimation of effects on industry-specific employment and wages, as well as on skills demand, gender composition at the industry level and environmental impact (e.g. GHG emissions, as well as land, water and resource use).

If, for example, 10 per cent of the inputs into the car industry are provided by the steel industry and the steel industry needs ten employees to produce one unit of output, then one employee (= 10 per cent of ten employees) in the steel industry is (indirectly) employed because of the production of one unit in the car industry.

Using the common input–output notation the indirect employment effect of one unit of production of industry j is calculated as

$$\underbrace{e_j^{ind}}_{\text{indirect}} = \underbrace{\mathbf{e'Li}_j}_{\text{total}} - \underbrace{e_j}_{\text{direct employment}}$$

where $\mathbf{e}$ is a vector of direct employment per unit of output for all industries, $\mathbf{L}$ is the Leontief inverse, $\mathbf{i}_j$ is a vector where all entries are equal to zero except the entry corresponding to industry j which equals 1, and e_j is the direct employment per unit of output of industry j.

As employment is recorded in the value added block of the MRIO, this logic can be extended to other records in the MRIO, including vulnerable employment, employment by gender and skill level or the block of environmental accounts, as is the case for GHG emissions.

Miller and Blair (2009) provide more details on the use of input–output tables.

Applying input–output data in a scenario framework requires consideration of many factors. Basic input–output scenarios imply a series of direct and exogenous changes in final demand and the production structure, i.e. technological change (Koning et al., 2016; Wiebe, 2016). The results must be understood as a comparison between the status quo and a result in which the scenario, *ceteris paribus*, has been achieved. Results from MRIO scenarios are first-order impacts, devoid of the effects of assumptions about substitution elasticities, utility and profit maximization, price equilibrium, etc. Some key assumptions include:

- Prices are not endogenized, that is, relative prices between products and countries do not change. Changes in relative prices resulting from technological change would lead, for example, to changes in the production structure and production locations through substitution or complementary effects.
- All changes implemented in the model are exogenous, which makes it impossible to model systemic rebound effects (i.e. macro-economic price or growth effects).[2]
- Market shares and bilateral trade shares remain constant.

Implementing technological change in an MRIO[3]

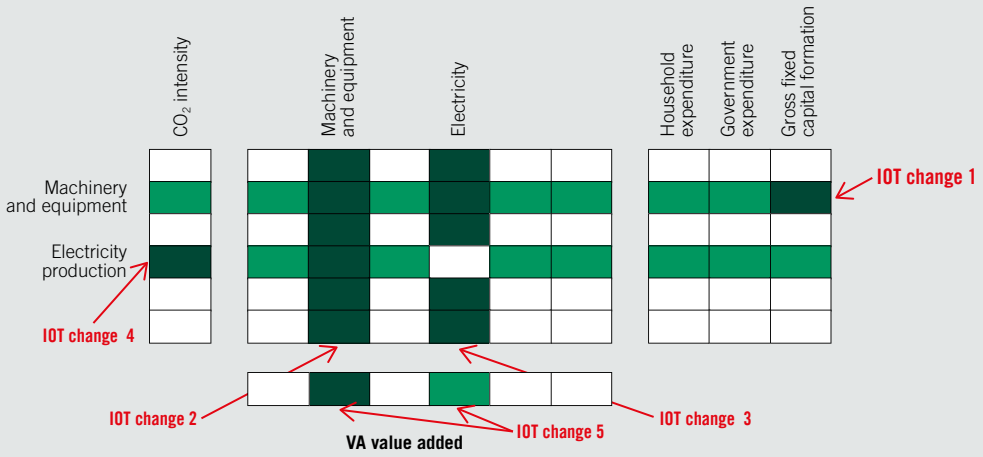
As described by Wiebe (2018), the transition to a green economy requires structural and technological change. Several scenarios in this report involve technological change to a certain extent. For example, electricity generation shifts from fossil fuels to renewables; agriculture changes to conservation or organic agriculture, shifting the sets of inputs required, and in a circular economy metal inputs change from direct manufacture and mining to recycling.

In an input–output framework, both the economic structure and technology are represented as the intermediate input coefficients. But modelling technological change in an economy by changing the input coefficients alone is not sufficient. Wiebe (2018) explains how to consistently model technological change in a forward-looking multiregional input–output model and, to this end, differentiates between five types of changes regarding parts of the input–output system (as shown in figure A2.1):

2. Gillingham et al. (2013) argue that rebound effects are generally small.
3. This section follows the discussion already noted in Wiebe (2018).

Figure A2.1

Changes related to technology diffusion in an environmentally extended input–output framework



Note: As described in Wiebe (2018), wind turbines are produced by the "machinery and equipment" (M&E) industry. Thus an increased diffusion of wind turbines is reflected in a change in the investment in M&E (IOT change 1), changing intermediate input coefficients due to the increased share of wind turbines in the total production of the M&E industry (IOT change 2). Moreover, as more wind turbines are used for electricity production (Elec), less coal and gas is needed, changing the input coefficients of the electricity industry (IOT change 3). This in turn reduces the CO_2 intensity (CO_2int) of the electricity industry.

Source: Based on Wiebe, 2018.

1. Gross fixed capital formation
2. Input coefficients for technology production
3. Input coefficients for technology use
4. Emission intensity of production (or any other relevant environmental or socio-economic extension)
5. Value added shares, including compensation of employees.

In Wiebe (2018), these changes are explained using the example of increasing electricity production through wind turbines. The goal is for more electricity to be produced by wind relative to the status quo in the current input–output system. The first step in the process is to invest in more wind parks. This is shown in figure A2.1 as input–output table (IOT) change 1, a change in gross fixed capital formation (GFCF). For the sake of simplicity, the arrow in the figure points only to the machinery and equipment industry, which produces wind turbines. But it is important to remember that the wind turbines need to be planned, which requires services from "other business activities", and to be connected to the grid, which requires products from the "electrical machinery and apparatus" industry, to mention the other two most important industries associated with an investment in a new wind park.

Once the investment is made, the technology (wind turbines) needs to be produced. As more wind turbines are produced relative to other products in the machinery and equipment industry, the structure of intermediate inputs into the "machinery and equipment" industry changes (see IOT change 2 in figure A2.1). Once the technology is available and installed, it can be used. That is, electricity is produced with more wind relative to other energy carriers. The most obvious difference in the input structure of the electricity industry is the reduced use of fossil energy carriers. The change in the composition of inputs into electricity production is labelled "IOT change 3" in figure A2.1. If, as in Exiobase, the electricity industries are already modelled by energy carrier, the switch to more wind electricity is simply modelled through increased intermediate and final demand for electricity generated by wind.

Relative to the changes in the input structure of the technology-producing industry (IOT change 2) and the technology-using industry (IOT change 3), the corresponding emission intensities of these industries need to be modified (IOT change 4 in figure A2.1). That is, if less coal input is used, the emission intensity of production of that industry decreases. This is the case for IOTs with only one aggregated electricity industry, such as the MRIO systems GRAM (Wiebe et al., 2012), the OECD ICIO (Wiebe and Yamano, 2016) or WIOD (Timmer et al., 2014). If the wind electricity industry is an individual industry in the input–output table, as in Exiobase (Stadler et al., 2018), a change in the emission coefficient of the wind industry is not necessary. The emission intensity of total electricity production will change according to the composition of electricity production.

It should be noted that the focus in Wiebe (2018) is on emissions. However, the extended input–output methodology is also applicable to any other kind of environmental and socio-economic extensions. When estimating the impact of other environmental or socio-economic factors, the corresponding stressors (e.g. the number of employees per unit of output) need to be changed as well. In other words, if it is assumed that more labour is necessary for the maintenance of renewable energy production and we model an increased VA share for compensation of employees, it is necessary to consider an increase in the number of employees or a productivity increase that is reflected in increased wages. If the compensation of employees rises but the number of employees remains the same, employees earn a higher average wage.

This leads directly to IOT change 5, changes in the value added shares, i.e. taxes and subsidies, compensation of employees and consumption of fixed capital. These value added shares may need to be updated for both the technology-producing industry and the technology-using industry. This is done using the same approach as updating the intermediate input coefficients: $\boldsymbol{va}_{j,t} = (1 - s_t)\boldsymbol{va}_{M\&E} + s_t \boldsymbol{va}_{WIND}$ for the machinery and equipment industry, where s_t reflects the share of wind turbine production in total production of the machinery and equipment industry in a given year t.

In the case described here, neither the technology used nor the technology-producing industries are explicit for the technology. In other cases, referred to briefly above in the case of the electricity industry in Exiobase, different levels of information are available for the technology-producing and technology-using industries. To model the changes in the electricity technology-producing industry, input coefficient vectors for renewable electricity technologies are available from Lehr et al. (2011). For other scenarios (e.g. organic and conservation agriculture), information is available only for selected input coefficients (e.g. fertilizer, energy, machinery and employment inputs). In that case, the entire input structure of the agriculture industries was not changed, but only those coefficients for which information is available. Naturally, any combination of levels of information on technology production and use can be available. This description therefore provides some examples of how to deal with levels of information availability.

The transition to a green economy affects several industries at the same time in different ways, including changes in individual intermediate input coefficients, capital formation, intermediate and final demand, value added shares and emission/employment intensities. When implementing these individual changes, it is necessary to bear in mind that the changes need to be consistent. If the use of fossil fuels as intermediate inputs in an industry is reduced, the corresponding emission coefficient needs to be reduced as well. If a new technology is used, it needs to be produced (capital needs to be invested). If one input coefficient of an industry is increased another input coefficient or value added share needs to be decreased or vice versa, because the sum of input coefficients plus value added component shares always add up to 1.

Scenario-specific details and assumptions

This section provides details on the specific technological changes and changes to final demand associated with each of the six scenarios evaluated in the report.

The transition in the energy sector

This scenario implements the energy pathways laid out by two of the International Energy Agency (IEA) Energy Technology Perspectives (IEA, 2017): the 2°C scenario and the 6°C scenario. It implements the IEA scenarios in the MRIO as laid out for each country and industry up to 2030, considering the changes in electricity generation and heat production, industry, transport and construction. It considers substitution of fossil fuel-based energy by renewables and improvements in energy efficiency. IEA (2017) provides more details on each of these two pathways. In the 2°C scenario, energy demands from industry in 2030 fall by 20 per cent and the resulting energy needs are met with greater reliance on biomass and waste, as opposed to electricity or other fossil fuel-based energy sources.

Inherent in this scenario is an advanced switch to electric vehicles and greater energy efficiency of buildings. These changes reflect scenarios for green transport and green construction and complement the transformation of the energy sector with changes in employment resulting from a shift from internal combustion engines to electric vehicles and the employment demand to increase the energy efficiency of existing buildings. UBS Research (2017) provides projections for the sales of electric

vehicles and the change in inputs compared to internal combustion vehicles. It also provides details on the employment and input structure related to efforts to increase the energy efficiency of buildings. Under this scenario, all savings from energy efficiency in the IEA 2°C scenario are invested in the construction sector to retrofit buildings and achieve greater efficiency.

The 2°C scenario is used as a model for greening the energy sector through changes in electricity generation, industry energy demand, transport and construction. The 6°C scenario is used as a model for the business-as-usual scenario in this and all other scenarios discussed in the report.

The transition in agriculture: Organic and conservation agriculture

A comprehensive literature review resulted in 264 coefficients that compare the crop, livestock and country-specific yields from organic agriculture and conventional agriculture. These coefficients also include the energy, employment, crop protection, machinery and fertilizer requirements for each mode of production for each of Exiobase's agriculture sub-industries (cultivation of rice, wheat, cereals n.e.c., oil seeds, sugar cane/beet, plant fiber and crops n.e.c.; cattle, pig and poultry farming; meat animals n.e.c., animal products n.e.c., raw milk and wool/silk production).

The other coefficients are imputed by combining them with World Development Indicators (World Bank, 2017) for GDP per capita and the share of labour in agriculture and the data of Lowder, Skoet and Raney (2016) on the average size per farm. A first round of 50 imputations are applied out for fertilizers, crop protection and yield. An independent set of 50 imputations are applied for employment, and another independent set of 50 imputations for energy. Second, all 50 imputations are averaged out and extreme values are trimmed. The whole table is imputed again 50 times, considering each input and yield as a categorical variable in the imputation. This imputation is then averaged once again and extreme values trimmed. Table A2.2 presents the country-to-country averages for each input and agricultural sub-industry. The full table includes specific estimates for each country and region in Exiobase.

The animal products n.e.c. and wool sub-industries could not be imputed due to the complete lack of coefficients in the literature. The animal products n.e.c. sub-industry is imputed as an average for the different livestock sub-industries. The wool sub-industry is imputed as the average of all agriculture sub-industries.

Synthetic fertilizers and herbicides are substituted by organic alternatives. In Exiobase, these are modelled through animal manure and composting and biotechnology services (research and development).

In addition, a comprehensive literature review resulted in 77 coefficients that compare the crop- and country-specific yields of conservation agriculture and conventional agriculture. These coefficients also include the energy, employment, crop protection and fertilizer requirements for each mode of production for each of Exiobase's agriculture crop-based sub-industries (cultivation of rice, wheat, cereals n.e.c., oil seed, sugar cane/beets, plant fiber and crops n.e.c.; cattle, pig and poultry farming; animal meat n.e.c., animal products n.e.c., raw milk and wool/silk production).

In view of the scarcity of coefficients in the literature, it was not possible to use multiple imputation reliably to complete the table of coefficients. Nor was it possible to consider reliably estimates by agricultural sub-industry. The average of the coefficients for crops is used for all countries and regions. This is a tenable assumption, as conservation agriculture is equally cost-effective (from a labour viewpoint, for example) in developing, emerging and developed countries alike. As conservation agriculture deals only with crop-based agriculture, coefficients for the cattle, pig and poultry farming, animal meat n.e.c., animal products n.e.c., raw milk and wool/silk production industries are set as equal to conventional agriculture. Table A2.3 presents the coefficients for each input and agricultural sub-industry.

The scenario explores the employment structure of the economy if organic agriculture were to grow to reach 30 per cent of agricultural output in developed (i.e. high-income) countries and if conservation agriculture were to grow to represent 30 per cent of agricultural output in developing (i.e. low- and middle-income) countries in 2030. FiBL and IFOAM provide the baseline figures for the size of the organic agriculture sector in each country in 2014 (Willer and Lernoud, 2017). FAOStat provides the baseline figures for the size of conservation agriculture in each country in 2014 under the indicator "Area of arable land and permanent crops under protective cover" (FAO, 2017). Each agricultural sub-industry is assumed to have the same share of organic and conservation agriculture within each country. This scenario is compared to a business-as-usual scenario defined by the IEA 6°C scenario.

Table A2.2

Input and yield ratios comparing organic and conventional agriculture

	Crop protection	Employment	Energy	Fertilizer	Machinery	Yield
Rice	0.90	1.50	0.35	0.96	0.92	0.84
Wheat	0.86	1.99	0.78	0.90	0.85	0.74
Cereals n.e.c.	0.59	1.04	0.60	0.59	0.67	0.79
Vegetable and fruit	0.61	1.35	1.02	0.57	0.67	0.82
Oil seeds	0.80	1.62	0.26	0.86	0.85	0.81
Sugar	0.78	0.37	0.78	0.82	0.85	0.86
Plant fibre	0.62	1.24	0.78	0.59	0.61	0.64
Crops n.e.c.	0.51	1.40	0.79	0.51	0.59	0.69
Cattle	0.67	1.74	0.81	0.67	0.77	0.89
Pig	0.95	1.33	0.74	0.95	0.95	0.95
Poultry	0.82	1.04	0.36	0.82	0.81	0.81
Meat n.e.c.	0.51	0.75	2.11	0.47	0.55	0.70
Animal n.e.c.	0.73	1.22	1.00	0.72	0.77	0.83
Milk	0.69	0.95	0.74	0.65	0.73	0.84
Wool	0.72	1.51	0.78	0.72	0.76	0.81

Notes: Each value denotes the country-to-country average of coefficients used in the scenarios. For example, it shows that, across all countries and regions in Exiobase, organic agriculture uses 0.90 of the crop protection inputs that conventional agriculture uses. To compute these averages, each country or region is weighted equally.

Source: ILO calculations based on literature review yielding 264 coefficients.

Table A2.3

Input and yield ratios comparing conservation and conventional agriculture

	Crop-based agriculture	Animal-based agriculture
Crop protection	1.20	1.00
Employment	0.76	1.00
Energy	0.60	1.00
Fertilizer	1.01	1.00
Yield	1.21	1.00

Notes: Each value denotes the coefficients used in the scenarios. For example, it shows that, across all countries and regions in Exiobase, conservation agriculture uses 1.20 of the crop protection inputs that conventional agriculture uses.

Source: ILO calculations based on literature review yielding 77 coefficients.

The circular economy

This scenario explores the employment impact of a sustained 5 per cent annual increase in recycling rates for plastics, glass, pulp, metals and minerals across countries, replacing the direct extraction of the primary resources for these products. This scenario also models growth in the service economy which, through rental and repair services, reduces the ownership and replacement of goods. The scenario considers a 1 per cent annual growth in the services sector, replacing the corresponding demand for the ownership and replacement of goods. It is compared with a business-as-usual scenario, as defined by the IEA 6°C scenario.

2. THE ECONOMIC DEBATE ON CLIMATE CHANGE: EMISSIONS, GROWTH AND EMPLOYMENT

This section provides a brief explanation of three key features of the economic debate on climate change. First, it reviews the range of recommendations for GHG emissions targets and reasons for the divergence in opinions between economists and climatologists. Second, it critically assesses the core assumptions underpinning the widely used Integrated Assessment Models, which forecast the costs of climate change and abatement policy. Third, it discusses proposals for emission-trading schemes as instruments to implement the GHG emissions reduction targets.

Emissions reduction targets

An appropriate policy response to climate change consists of two steps: first, identifying a target for the stock of atmospheric CO_2 compatible with climate stabilization, and, second, defining the legal instruments (including incentives, taxes and other regulatory provisions) that will lead to the necessary reduction in emissions.

The Stern Review (Stern, 2007), which highlights the relevance of GHG concentration targets to economic policy discussions, is the best-known example of the first step. Stern (2007) set the target at 550 ppm CO_2eq (a level at which 0.055 per cent of the atmosphere would be occupied by CO_2) (see table A2.4). This recommendation attracted criticism from both climatologists and economists. Many climatologists argued that Stern's target is too lenient and that 385 ppm CO_2eq would be an appropriate target. Accordingly, they called for immediate divestment from fossil fuels and for investment in renewable resources (Hare, 2009; Meinshausen et al., 2009; IPCC, 2014). Some economists, on the other hand, argued that Stern's target is too aggressive as its short-term impact would be to destabilize the global economy. Their consensus target has been much higher, fixed at a level of at least 650 ppm CO_2eq (Nordhaus, 2007; Dasgupta, 2007). Moreover, they have insisted that this level should be achieved gradually, as if over a "policy ramp".

Despite subsequent updates of these studies and of climate change projections (IPCC, 2013), the terms of the policy discussion have effectively remained unchanged. In fact, while better data can certainly contribute to improving our understanding of climate change, more recent data do not always help. In the study of climate processes, high-frequency data can in fact obfuscate long-term trends (Ackerman, 2017).

The conflict among experts' positions highlights the importance of clarifying subjective judgments about acceptable risk. As shown in table A2.4, the risks of overshooting the 2°C threshold associated with each target are very different. According to Hare and Meinshausen (2004) and Meinshausen (2005), the consensus target for mainstream economists is associated with a risk higher than 90 per cent of surpassing the 2°C threshold. With the Stern Review's target, the probability of surpassing the 2°C threshold is still much higher than the probability of remaining below it. As such, the two highest

Table A2.4

Differences in GHC emission target between experts

	GHG emission target (ppm CO_2eq)	Risk of exceeding 2°C (%)	Price of carbon (US$/t CO_2)	Discount rate (%, annual)
Nordhaus (2008)	650	>90	217	1.5
Stern (2007), IEA (2008), Markandya (2009)	550	85	420	0.1
IPCC (2007), UNDP (2007)	450	50	623*	Multiple
Hansen at al. (2008), Hare (2009), Meinhausen et al. (2009)	385	20	700	–

** author's linear extrapolation*

Source: Storm, 2017.

proposed targets listed in table A2.4 can be interpreted as "de-stabilization targets", since both are likely to create a change in climate, making it permanently unstable.

The more stringent targets proposed by international organizations (IPCC, 2007; UNDP, 2007; IEA, 2008) and by climatologists are associated with higher probabilities that the world's temperature will remain under the 2°C threshold rather than exceed it. However, the most stringent target is still associated with a 20 per cent risk of overshooting, far from offering any certainty about the future of climate stability. A negligible climate risk would require even larger reductions in the stock of GHGs.

The cost of climate change vs the cost of stopping it

Certain economists have proposed the least stringent emission reduction targets because they are primarily concerned with the consequences of emissions reduction for the economy in the short term. With no immediate change in prevailing technology, it is argued that reducing emissions may require slowing down economic growth and job creation. Slower growth and less dynamic labour markets are in turn likely to exacerbate distributive conflicts. However, these effects are largely dependent on assumptions concerning the level of investments in cleaner energy and the promotion of green jobs. As argued in Chapter 2, a new, economically viable source of clean energy would break this link, decoupling economic growth from GHG emissions. However, developing such technology and scaling it up for global availability requires investments and risk-bearing beyond the capacity of the corporate sector alone. In this light, a brief critique of the assumptions underpinning economic modelling of climate change is set out below.

Common economic analyses take into account the costs of both climate change and mitigation policy generally in terms of GDP and employment. Since the costs considered occur over a long period (100 years or more) and affect the economy in direct and indirect ways, they are summarized using models that, based on a series of assumptions, reduce them to comparable quantities. These "Integrated Assessment Models" (IAMs) are computerized models of the economy that link aggregate economic growth with simplified climate dynamics in an effort to understand and forecast the impact of GHGs and GHG reduction on growth and employment. The main IAMs are MERGE (Manne, Hendelsohn and Richels, 1995), PAGE (Hope, 2011), FUND (Anthoff and Toll, 2012) and RICE/DICE (Nordhaus and Sztorc, 2013).

Recent research has pointed out that IAMs generally include problematic assumptions that in fact lead them to underestimate both the probability of catastrophic climate change and the costs of associated social and economic damage. The key problematic assumptions concern the climate damage function and climate risk, the anticipated path of economic growth, and the mechanisms of economic adjustment, generally based on assuming full employment at all times (Ackerman, 2017; Ackerman and Finlayson, 2006; Mastrandrea, 2010; Weitzman, 2009 and 2013).

For example, the climate damage function incorporated into most IAMs relies on two questionable claims: first, that future damages and well-being weigh less than current ones in today's decisions, and, second, that the climate-related events that cause the damage follow a regular and predictable schedule.

The first assumption implies that future generations matter less than living generations in today's decision-making. This may make sense when modelling small costs expected to occur far into the future, but it is not appropriate when faced with the possibility of catastrophic climate change. Once a discount rate is applied, finite costs and incomes that are projected far enough into the future may not affect today's decisions at all.[4] However, this is not appropriate for modelling infinitely large values in the future, such as those that would arise from catastrophic climate change, which would disrupt many critical forms of economic (and human) activity. The present discounted value of such an infinitely large loss is infinitely large. However, IAMs only consider the average costs and incomes arising from future events, thereby disregarding the very high costs of rare events such as natural disasters. In practice, IAMs input a positive social discount rate, a parameter that reduces the present value of future incomes and

4. As noted in IPCC (1996, Chapter 4), two approaches to discounting are mainly used: a prescriptive approach defining the rates of discount that should be applied, and a descriptive approach based on the rates that people's choice of saving and investment reveal. While the former approach leads to relatively low rates of discount (2–3 per cent in real terms) the latter leads to relatively higher rates (at least 6 per cent and, in some cases, much higher rates).

costs. For example, with an annual discount rate of 1.5 per cent, a US$ 1,000 cost incurred 30 years ago is worth less than US$ 650 today. In general, much of the difference between the Stern Review's conclusions and those of many economists is due to the choice of a lower discount rate in the former.[5]

Concerning the second assumption, namely that climate-related events follow a regular and predicted schedule, the implication is that people can make rational decisions based on the observed probabilities of actual events, relying on average costs and incomes. But new thinking in behavioural economics suggests that this approach to risk is incompatible with actual behaviour. Recent research demonstrates that more realistic assumptions on risk aversion (assumptions that consider the cost of rare events, a better balance between immediate costs and future risks and the distraction of short-term fluctuations), which are closer to applications of the precautionary principle, would lead to more realistic models of climate change (Gerst, Howarth and Borsuk, 2010; Ackerman et al., 2013; Brekke and Johannson-Stenman, 2008). In other words, a clearer explanation of what is at stake and how real the danger is would lead people to give a higher priority to climate policy.

These limitations of commonly used models point to the fact that the usual frame of cost–benefit analysis is not an appropriate approach for informing climate policy. First, cost–benefit analysis is not suitable when human life is at stake in such large numbers, e.g. people at risk of losing their lives because of climate disasters. In the end, policy formulation must be both economically and ethically sound. For example, a cost–benefit analysis is not permitted in the context of the United States Occupational Safety and Health Act of 1970, precisely because the cost of regulation should never outweigh the benefits of lives saved. Second, it is not suitable when the costs involved are exceedingly high. In principle, no matter how high the cost of abatement policy, it makes sense to bear it because once the climate system is compromised, it cannot be restored. An implicit assumption in cost–benefit analysis is that if the cost of reducing the use of a resource is too high, then the resource ought to be exhausted first prior to sourcing an alternative on the market. The problem is that if the "climate resource" is compromised then the option of alternative sourcing on the market is not available. Third, the cost–benefit approach is inappropriate because the costs are determined by possible catastrophic events, which cannot be predicted accurately, and because "there is no single formula for risk aversion that is relevant for evaluation of policy options across the board" (Ackerman, 2017, p. 138). The overall lesson from the recent critical analyses is that commonly used IAMs understate the importance of catastrophic climate events, rendering their results and policy recommendations unreliable.

Carbon markets and other solutions

An obvious solution to climate change, increasingly adopted in cities and individual countries around the world, is to ban or regulate the activities responsible for it, for example by imposing emission standards on vehicles and heating systems of buildings, or by phasing out certain types of fossil fuels. However, the international consensus is largely informed by an alternative economic framework that seeks to integrate, and thereby diminish, the costs of climate change within a competitive market function. The framework relies on the idea of "negative externality", namely that a phenomenon, e.g. climate change, can be conceived of as a byproduct of some people's behaviour that affects everyone else. Because those who emit carbon dioxide share the cost with the rest of the world (while generally appropriating all the benefits of their activity), they can effectively consider a portion of their resource-related costs as external to their activities. The recommended solution, therefore, is to force those responsible for GHG emissions to "internalize" the full cost of their activity by making sure, with taxes or tradable permits, that they pay the entire social cost of carbon rather than a fraction of it or none at all.

Of the two ways to bring the market price of carbon closer to its social cost, taxes are generally overlooked both because they are unpopular with influential constituencies and because they do not offer any certainty about what level of carbon emissions will be legitimized. Provided carbon taxes are paid, a company or industry can in principle produce any amount of GHGs. By contrast, a cap-and-trade system – in which emissions are capped at a given level, the related permit assigned to market participants and eventually traded on an established market – provides greater certainty about the level of emissions produced. Also, a carbon-trading system would normally determine a market price for

5. Beyond the technicalities of economic calculations, discounting raises ethical questions because the future generations whose well-being is overlooked in today's decisions are also the least responsible for the climate system and the climate-affected economy they will operate in. Unsurprisingly, many experts argue for abandoning discounting altogether in the discussions on climate policy (Arrow, 2007; Ackerman and Stanton, 2008; Weitzman, 2007 and 2009).

emissions close to their social cost, creating an incentive for businesses to develop cleaner and necessarily cheaper sources of energy.

In practice, however, things play out differently, as the experiences of the Kyoto Protocol mechanisms and the European Union Emission Trading System have shown: *actual emission trading systems do not lead to the desired reductions in emissions*. Five reasons impair carbon markets' ability to deliver the desired outcomes (Storm, 2017):

1. Volatility in carbon markets, in part caused by speculative behaviour, leads to a lock-in of fossil fuel technology. In fact, for businesses to invest in alternative energy sources, they should expect a permanently high price of carbon.
2. The required measurement and enforcement apparatus is larger than that required by direct regulation. This is particularly true for carbon offsets – investments meant to absorb GHGs from the atmosphere offsetting emissions elsewhere – envisioned by the Kyoto Protocol.
3. Inherent market failures. Carbon markets would likely suffer from information asymmetries and unenforceable contracts, which would eliminate incentives to invest in alternative energy (Speth, 2008; Stiglitz, 2008).
4. Carbon markets would be efficient only if they determined a universal price for carbon, the same for all uses in all countries (Stiglitz, 2008). This does not happen in current trading systems, which create other external costs that contribute to inequalities. For example, the increase in biofuel production has been linked to increases in food prices (Mitchell, 2008) and the Kyoto Protocol's carbon offsets have been linked to land grabs (Lohmann, 2009).
5. To achieve emissions targets, the price of carbon would have to be very high, with likely harmful consequences on the poorest (Stiglitz, 2008). These could be compensated with appropriate mechanisms but any such solution would have to be clearly designed preemptively.

A reflection of the above difficulties is the difference that currently exists between the market price of carbon (which between 2001 and 2017 remained below US$ 10 per tonne of CO_2eq) and the prices that would be required for emissions to respect the various proposed targets (table A2.4). The least stringent target would require a price of US$ 217, more than 15 times the market price. The price associated with climatologists' more stringent target would be in the order of US$ 700, almost 50 times the market price (Storm, 2017).

For all these reasons, carbon markets are not likely to function in practice in the way they do in economic models. Given the reality of carbon markets and the complications related to their distributive effects, direct regulation may offer a more effective and administratively simpler alternative. This insight is picked up in at least two different approaches to economic policy: the Green New Deal and the "limits to growth" approach.

Proponents of the Green New Deal or "Big Push toward a Zero-Carbon Economy" argue that the climate change "negative externality" can be more effectively eliminated with a global carbon tax and that the tax should be accompanied both by appropriate regulation to make sure that emissions targets are respected and by policies that strengthen social protection systems to correct any negative distributive consequences of emissions reduction (Grubb, Hurcade and Neuhoff, 2014, Herman, 2015, Pollin et al., 2014). They also assert, based on recent research on the economics of innovation (Mazuccato, 2013; Mazuccato and Perez, 2014), that enforcing a carbon price close to the real social cost of carbon is not enough to mobilize the resources necessary to develop alternative energy sources. Since the risks associated with these investments are too large for the limited appetite for risk of private banks and businesses, governments would have to step in – using at least the revenues from carbon taxes – and actively promote the required R&D projects (Storm, 2017). The absence of financial markets and a discussion on financing from IAMs lends support to this view.

The "limits to growth" approach is based on the view that all economies face both ecological and social limits. Its proponents argue that market and government institutions must be assessed in light of their ability to support growth paths that do not exceed the carrying capacity of the ecosystems (with their resource use) or of society (by causing unsustainable inequalities). While this approach is compatible with all the proposals of the Green New Deal in terms of carbon taxes and innovation financing, it differs in that it maintains that formal redistribution systems (such as taxation and social protection systems) are not always able to redress market inequalities (Klein, 2014; Vira, 2015). Consequently, institutions should be assessed and possibly amended in order to ensure that they do not produce unsustainable inequalities.

3. EMPLOYERS' ROLE IN THE TRANSITION

The analysis of the role of employers in the transition draws on the Carbon Disclosure Project and FactSet, two firm-specific data sets.

The Carbon Disclosure Project (CDP) is a voluntary survey in which companies disclose their GHG emissions and give their opinions and experience on policies and their specific efforts and targets to mitigate emissions (see, for example, CDP, 2016, which provides descriptive results for the complete sample). CDP covers firms from the consumer staples, consumer discretionary, energy, financial, health care, industrial, IT, materials, telecommunications and utilities sectors. In 2015, a total of 1,997 firms responded to the questionnaire. In 2010, this figure was 1,799 companies.

CDP questionnaires and data are available through www.cdp.net.

FactSet provides historical financial information at the firm level, including information on sales and employment for 2010 and 2015. More information on it is available through www.factset.com.

Table A2.5

Size of firms available in FactSet with CDP data for both 2010 and 2015 (percentages)

Number of employees	2010	2015
0–1,000	4.9	4.0
1,000–10,000	27.0	25.5
10,000–50,000	40.0	41.8
50,000–100,0000	14.2	14.2
More than 100,000	14.0	14.5
Total	*100.0*	*100.0*
N	*760*	*760*

Notes: Only firms with data in CDP for 2010 and 2015 and with data in FactSet are considered. Percentages may not add up to 100 due to rounding.

Factset contains information on employment and sales for 760 of all firms with public CDP information for 2010 and 2015.

The descriptive analysis of the role of employers in the transition focuses on these 760 firms with complete information on employment, sales and GHG emissions. Tables A2.5 to A2.7 list the characteristics of these companies by size, sector and region.

Table A2.6

Sectoral distribution of firms in FactSet with CDP data for both 2010 and 2015 (percentages)

NACE code	Sector	Percentage
A	Agriculture, forestry and fishing	0.0
B	Mining and quarrying	8.4
C	Manufacturing	40.1
D, E	Utilities (electricity, gas, steam and air conditioning supply)	6.3
F	Construction	4.5
G	Wholesale and retail trade, repair of motor vehicles and motorcycles	4.6
H, J	Transport, storage, information and communication	12.8
I	Accommodation and food service activities	3.7
K	Financial and insurance activities	16.6
L, M, N	Real estate, business and administration	2.2
Q	Health and social work	0.8
Total		*100.0*
N		*760*

Notes: Only firms with data in CDP for 2010 and 2015 and with data in FactSet are considered. Percentages may not add up to 100 due to rounding.

Table A2.7

Regional distribution of firms in FactSet with CDP data for both 2010 and 2015 (percentages)

Region	Percentage
Africa	4.6
Americas	33.2
Arab States	0.0
Asia and the Pacific	17.0
Europe	45.2
Total	*100.0*
N	*760*

Notes: Only firms with data in CDP for 2010 and 2015 and with data in FactSet are considered. Percentages may not add up to 100 due to rounding.

Appendix 3

LINKS BETWEEN MULTINATIONAL ENVIRONMENTAL AGREEMENTS (MEAs) AND INTERNATIONAL LABOUR STANDARDS

Year	Agreement	No. of States parties	Relevant treaty provision	Relevant ILS	No. of ILS[1]
1982	United Nations Convention on the Law of the Sea, 1982 (UNCLOS)	**168**	• Obligation to ensure safety at sea with regard to labour conditions and the training of crews, taking into account the applicable international instruments (Article 94).	**MLC, 2006; Also C133, C134, C146, C147, C163, C164, C165, C166, C178, C179, C180, C185, P147, R48, R49, R75, R78, R139, R140, R141, R142, R173, R174.**	**24**
1992	Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992	**9 States and EU**	• Shipboard working conditions (Annex IV).	**MLC, 2006; Also C133, C134, C146, C147, C163, C164, C165, C166, C178, C179, C180, C185.**	**13**
1994	Convention on Nuclear Safety, 1994	**80**	• Protection of workers from radiation exposure, to be kept "as low as reasonably achievable" and not exceed prescribed national dose limits (Article 15).	**C115, R114, C155, P155.**	**4**
1994	United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa, 1994	**196**	• Increased income and employment opportunities, especially for vulnerable members of the community (Annex I, Article 8).	**Core labour standards: C87, C98, C29, C105, C138, C182, C100, C111, C122, C168, R169.**	**11**
1995	Agreement for the Implementation of the Provisions of the UNCLOS relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 1995	**86**	• Recognition of special needs of vulnerable groups in terms of enhancing their income generation and employment opportunities (access to fisheries by subsistence, small-scale and artisanal fishers and women fishworkers) (Article 24).	**C111, C122, C168, C169, R104. See also Declaration on Fundamental Principles and Rights at Work**	**5**
1996	International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996*	**1**	• Application of the Convention without prejudice to the national applicable law relating to workers' compensation or social security schemes (Article 4).	**R181, R194.**	**1**
1997	Convention on Supplementary Compensation for Nuclear Damage, 1997	**19**	• Prevalence of national schemes of workers' compensation (occupational disease compensation), where they exist (Annex, Article 8).	**R181, R194.**	**2**
1997	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 1997	**71**	• Radiation exposure of workers to be kept as low as reasonably achievable (Article 24).	**C155, P155, C174, C148, C139, C115, R114, R156.**	**8**
1998	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Heavy Metals, 1998	**34**	• The dust from all pyrometallurgical production should be recycled in-plant or off-site, while protecting occupational health (Annex II).	**C155, P155, C148, C139, R156.**	**5**
1998	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998	**157**	• Protection of workers against the potentially harmful impact of certain hazardous chemicals and pesticides in international trade (Preamble); • Notification of regulatory action includes information on the summary of hazards and risks presented by chemicals to workers and the expected effect of the regulatory action (Annex I).	**C155, P155, C148, C139, C170, C184, C184, R156, R177, R192.**	**9**
2001	Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	**181**	• Training of workers on persistent organic pollutants (Article 10); • Best available techniques to reduce chemicals as provided for by the Convention should include consideration of the need to ensure occupational health and safety at workplaces (Annex C, Part V(B)).	**C155, P155, C142, R195.**	**4**

Year	Agreement	No. of States parties	Relevant treaty provision	Relevant ILS	No. of ILS[1]
2003	Kiev Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, 2003	**36**	• Whistle-blower protection at work (Article 3).	**R094, R129, R130.**	**3**
2006	International Tropical Timber Agreement, 2006	**73**	• Need to improve working conditions in the forest sector taking into account ILO Conventions (Preamble); • Increasing employment opportunities (Article 1).	**C122, C169, C184, R104, R169, R192.**	**6**
2009	Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009*	**5**	• Occupational safety and health of workers involved in ship recycling (Preamble); • Obligation to establish management systems, procedures and techniques which do not pose health risks to the workers concerned (Regulation 17); • Policy to ensure worker safety (Regulation 18); • Identification of roles and responsibilities of employers and workers when conducting ship recycling (Regulation 18); • Devising a programme to provide appropriate information and training of workers (Regulation 18); • A system for reporting discharges, emissions, incidents and accidents causing damage or with the potential to cause damage to worker safety (Regulation 18); • A system for reporting occupational diseases, accidents, injuries and other adverse effects on workers' safety (Regulation 18); and a system to prevent accidents, occupational diseases and injuries or other adverse effects on worker safety and health (Regulation 19); • Appropriate training and equipment of workers on safe and environmentally sound management of hazardous materials (Regulation 20); • Handling of waste in a manner that does not pose a risk to the workers (Regulation 20); • Emergency preparedness and response information and training for all workers of the ship recycling facility (Regulation 21); • Worker safety (including the use of personal protective equipment) and training covering all workers, including contractor personnel and employees (Regulation 22); • A system of reporting incidents, accidents, occupational diseases and chronic effects (Regulation 23).	**C155, P155, C174, C148, C139, C115, C162, C170, C144, C142, R114.**	**11**
2009	Statute of the International Renewable Energy Agency, 2009	**143**	• Aimed at fostering the positive impact that renewable energy technologies can have on stimulating sustainable economic growth and creating employment (Preamble).	**Comment: general hortatory principle, outlining one of the intentions of the parties.**	
2013	Minamata Convention on Mercury, 2013	**43**	• Promotion of educational and preventive programmes on occupational exposure to mercury and mercury compounds (Article 16); • Cooperation and exchange of information with the ILO (Article 16); • Reduction, where feasible elimination of the use of mercury and mercury compounds in artisanal and small-scale gold mining (Article 7 and Annex C).	**C155, P155, C148, C139, R156.**	**4**
2015	Regulations concerning the International Carriage of Dangerous Goods by Rail	**n.a.**	• Training of workers in radiation protection and precautions to restrict their occupational exposure (Chapter 1.7).	**C155, P155, C148, C139, C115, R114, R156.**	**7**
2015	Paris Agreement under the United Nations Framework Convention on Climate Change, 2015	**144**	• Consideration of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities (Preamble).	**Comment: ILS broadly form part of the context of the Paris Agreement.**	**Various ILO Conventions**

*Note: * not yet in force. C = Convention; R = Recommendation; P = Protocol.*

1. Number of related instruments or number of standard-setting areas. Numbers of ILO references are approximate, as they reflect only very direct relevance.

Appendix 4

Chapter 5 provides a snapshot of the current green employment trends and skills development in 27 country studies on skills for green jobs commissioned to national experts by the ILO in partnership with Cedefop. This appendix provides background information on the national studies on skills for green jobs. All studies follow the same methodology to ensure comparability of findings.

Selection of the countries covered in the national skills studies

Of the 27 country studies, 21 had already been analysed by the ILO and Cedefop in the report *Skills for green jobs: A global view* (Strietska-Ilina et al., 2011). Six more countries were chosen in collaboration with ILO technical departments and field offices, with a view to reflecting the various environmental and decent work challenges.[1] National experts (institutions or individuals) were selected to carry out each study on the basis of their expertise in skills identification and development and their demonstrated knowledge and understanding of environmental and climate change issues. Whenever possible, the same experts were selected as for the 2011 study. Cedefop was responsible for conducting the country studies on the six European countries.

Key research questions addressed in the country studies

- Which main challenges in the structural transformation deriving from the key drivers of change (green policies, programmes and regulations, green technologies, climate change and environmental degradation, market forces and globalization, etc.) have you observed?
- What is the impact on employment and related occupational skills, as well as broader technical and soft skills needs?
- Are skills development policies and environmental sustainability/climate change policies coherent? How is the coordination of policy formulation and implementation ensured? Does policy planning involve the ILO tripartite constituents?
- What policies, programmes, regulations and measures are being implemented to adjust the competencies of the potential and current workforce, retrain workers and upgrade skills for jobs in the green economy? (Covering initial and continuing TVET, private sector skills training, workplace learning, active labour market policies, validation of non-formal and informal learning or training.)
- How do green policies, programmes and regulations include gender issues in the development of new green skills?
- How successful have these measures been in narrowing the skills gap to facilitate a smooth and just transition to the low-carbon and green economy? What are the success factors and good practices? What are the main challenges?
- Have the (recently) implemented measures been of more of an ad hoc or a systematic nature?

Methodology for the country studies

Each country study followed the same methodology, which is also the methodology used in the 2011 study, to ensure comparability across the studies, while offering flexibility to adjust to local conditions.

The studies draw on secondary analysis of quantitative data on employment and interviews conducted with representatives from trade unions and employers' associations, policy-makers at the different levels, human resource development and TVET decision-making bodies, sectoral organizations, public–private initiatives, representatives of companies at the forefront of sustainable development and those actively involved in the implementation of the greening policy agenda, and national statistical offices.

Quality check of the country studies

Each country study benefited from the comments of the network of skills and green jobs specialists in the ILO field offices as a quality check.

1. The 21 countries are: Australia, Bangladesh, Brazil, China, Costa Rica, Denmark, Egypt, Estonia, France, Germany, India, Indonesia, the Republic of Korea, Mali, Philippines, South Africa, Spain, Thailand, Uganda, the United Kingdom and the United States. The six new countries are: Barbados, Guyana, Kyrgyzstan, Mauritius, Montenegro and Tajikistan.

Methodology for analysis

Based on the frameworks for analysing public policies developed by Morestin (2012) and the National Research Council (2010), Chapter 5 adopts the following guiding principles to synthesize the information collected by the country studies and to evaluate skills development policies and programmes for green jobs:

1. Implementation of the policy:
    a. Awareness and acceptability of the role of skills development for a just transition among policy-makers and the general public;
    b. Feasibility of the policy in terms of cost and institutional support;
    c. Adaptability of the policy to changes in skills needs;
    d. Durability and sustainability of the policy.
2. Effects of the policy:
    a. Effectiveness;
    b. Equity and decent work outcomes.

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Glossary

Disclaimer: This glossary is provided for information only, to facilitate the reading and interpretation of this report. If a formal definition has been adopted by the ILO, it is used. In all other cases, the definitions provided do not constitute a formal definition or an adopted ILO position on the particular matter or an endorsement of any particular political position.

Abatement: see *mitigation*.

Absolute decoupling: economic growth that does not increase environmental pressures (e.g. greenhouse gas (GHG) emissions and/or material or resource use), or economic growth that takes place alongside a reduction of environmental pressures. A true green economy is absolutely decoupled at the global level.

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.

Cap-and-trade system: a market-based mechanism to limit pollutants (e.g. GHG emissions) by determining the absolute amount of emissions allowable in the aggregate, allowing polluters to trade emissions permits and letting the market determine the adequate price. It has been successful in the United States to limit sulphur dioxide emissions that cause acid rain. Examples of cap-and-trade systems for GHG emissions include the European Union Emission Trading Scheme, the California Carbon Allowance, as well as schemes in Australia and New Zealand.

Carbon footprint: the GHG 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.

Carbon intensity of employment: the ratio between GHG emissions and employment in an economy or sector. Measures the amount of emissions, usually expressed in *CO_2 equivalents*, needed to sustain each job in the economy or sector. The intensity of employment can be extended to material and resource use.

Carbon intensity: the ratio between GHG emissions and GDP. Measures the amount of emissions, usually expressed in *CO_2 equivalents* needed to produce one unit of GDP. Economies that have a lower carbon intensity need fewer emissions to produce each unit of GDP. The intensity can be extended to material and resource use.

Carbon tax: see *environmental tax*.

Cash transfer programme: refers to non-contributory scheme or programme providing cash benefits to individuals or households, usually financed out of taxation, other government revenue, or external grants or loans. Cash transfer programmes that provide cash to families subject to the condition that they fulfil specific behavioural requirements are referred to as conditional cash transfer programmes (CCTs). This may mean, for example, that beneficiaries must ensure that their children attend school regularly, or that they utilize basic preventative nutrition and health-care services.

Circular economy: an economy based on goods that are designed for durability, repair, reuse and recycling. It seeks to maximize the value of goods while in use, but also after their life cycle, by reincorporating components as inputs into new products. A circular economy also favours the use of goods through services (e.g. rent) over ownership. To be understood in contrast to a *linear economy*.

CO_2 equivalent (CO_2eq): several gases have the properties to be considered *greenhouse gases*, including carbon dioxide (CO_2), methane, nitrous oxides and F-gases (HFCs, PFCs and SF6). As each gas has a different global warming potential, non-CO_2 GHGs are converted to a CO_2 equivalence based on their global warming potential.

Conservation agriculture: agricultural practices that rely on minimum or no soil tillage, crop rotation and soil cover. Considered a sustainable alternative to *conventional agricultural* practices.

Consumption-based emissions/resource use: see *carbon footprint*.

Conventional agriculture: agricultural practices that rely on deep soil tillage, one crop and the application of synthetic and mineral chemical products to provide plant nutrients and control pests and unwanted herbs (weeds). Generally considered unsustainable as it degrades soil quality and risks run-off of potentially harmful chemicals into the water and surrounding environment.

Core 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.

Decoupling: see *absolute decoupling* and *relative decoupling*.

Double dividend: in the context of market-based mechanisms to reduce pollutant emissions, the double benefit of mixing market-based mechanisms that achieve mitigation with policies that use the resulting revenue to stimulate employment.

Ecosystem services: the benefits that humans obtain from the environment. Four categories of ecosystem services exist: provisioning services (e.g. food, water, wood for timber and fuel); regulating services (e.g. water purification, climate regulation); supporting services (e.g. soil formation and nutrient cycling); and cultural services (e.g. spiritual, cultural and aesthetic uses).

Ecotourism: responsible travel to natural areas that conserves the environment and improves the well-being of local people.

Emission trading scheme: see *cap-and-trade system*.

Employment guarantee scheme: a type of *public employment programme* which provides a guaranteed number of workdays per year to poor households, generally providing wages at a relatively low level (typically at the minimum wage level if this is adequately defined).

Environmental footprint: see *carbon footprint*.

Environmental goods and services: goods and services produced by an establishment that directly benefit the environment or conserve and restore natural resources. They can be specific environmental services (e.g. waste and wastewater management and treatment, energy and water saving activities, conservation and protection activities), sole-purpose environmental goods which have no use except for environmental protection or resource management (e.g. catalytic converters, septic tanks, installation of renewable energy production technologies), or adapted goods that have been modified to be cleaner or more resource efficient (e.g. manufacture of buses with lower emissions).

Environmental hazard: an event occurring in the natural environment with the potential to threaten the surrounding natural environment and/or people. Includes rapid-onset events, such as earthquakes, volcanic eruptions, extreme weather events (e.g. cyclones, blizzards), and slow-onset events, such as rising temperatures, rising sea level and changing rain patterns. Human activity can increase the occurrence of some natural hazards (e.g. the increased intensity and frequency of extreme weather events as a result of human-induced climate change). Also called natural hazard.

Environmental risk: the probability and consequences of an event transmitted through the air, water, soil or biological food chains to human beings. Environmental risks can result from human activity (e.g. water pollution from non-compliant industrial activity) or natural hazards (e.g. water pollution following a volcanic eruption); human activity can also increase the occurrence of natural hazards (e.g. increasing intensity and frequency of extreme weather events as a result of human-induced climate change) or their consequences (e.g. mangrove deforestation increases the consequences of storms).

Environmental sustainability: a state in which the use of resources and the production of waste are equal or slower than the speed at which these resources can be renewed and waste can be absorbed by the environment. Commonly used in the context of economic activity that is (or is not) environmentally sustainable.

Environmental tax: a fee associated with the emission of pollutants (e.g. the emission of GHGs in the case of the *carbon tax*). It is an effective way of internalizing the negative externalities of certain pollutants and incentivizing alternatives that either reduce emissions or eliminate them altogether. The price is set centrally.

Eutrophication: Change in the chemical composition of water, usually due to increased presence of nutrients that favour plant and algal growth. It is commonly the result of nitrogen and phosphorus run-off from agricultural activity and leads to dramatic consequences for drinking water sources, fisheries and recreational water bodies.

Footprint: see *carbon footprint*.

Global Climate Fund (GCF): an international fund established under the United Nations Framework Convention on Climate Change (UNFCCC) to support climate change adaptation and mitigation policies in vulnerable countries through gender-sensitive projects that enhance the resilience of ecosystems, build infrastructure, manage resource shortages and improve energy efficiency.

Global framework agreement: see *international framework agreement*.

Green economy: an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.

Green jobs: decent jobs that are involved in the production of environmental goods and services (e.g. renewable energy), directly related to the provision of such goods and services (e.g. natural resource conservation) or that contribute to reducing the environmental footprint of an enterprise's production process. They can enhance the transition to a *green economy*. The formal definition and guidelines for their measurement were adopted by the 19th International Conference of Labour Statisticians in 2013.

Green transition: the process through which an economy becomes a *green economy*, that is, an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is the process by which economies reduce their reliance on GHG emissions *(low carbon)* and become *resource efficient*.

Greenhouse gases (GHGs): gases that produce a greenhouse effect by absorbing infrared radiation and trapping heat in the atmosphere. The current concentration and emission rates of GHGs exceed the planet's capacity to absorb them, and GHGs therefore lead to global warming and climate change. GHGs include carbon dioxide, methane, nitrous oxides and F-gases (HFCs, PFCs and SF6).

Heat stress: a situation in which the body is at risk of overheating. Can lead to heat stroke, heat exhaustion, heat cramps or heat rashes. Can result in hyperthermia, which can cause death. Heat stress is a result of a combination of ambient conditions, as measured by the *Wet Bulb Globe Temperature* and the activity or effort of individuals, as measured by power output.

Integrated assessment models (IAMs): models that analyse the macroeconomic and/or environmental effects of projected scenarios by taking into account the interaction between the economy and the environment. For example, in the context of unmitigated climate change, economic activity may enhance global warming, which in turn produces damages, which then affect economic activity. IAMs can compare the business-as-usual scenario of unmitigated climate change with certain policy scenarios that assume the implementation and effectiveness of *mitigation* and/or *adaptation* measures.

International framework agreements (IFAs): also called global framework agreements, these are agreements between multinational enterprises (MNEs) and global union federations (GUFs). IFAs are voluntary instruments that enable cross-border social dialogue and promote minimum labour standards, in some instances by making reference to international labour standards, within MNEs and throughout their global supply chains.

International labour standards (ILS): legal instruments drawn up by the ILO's constituents (governments, employers and workers) which lay out the basic principles and rights at work. They are either Conventions, Recommendations or Protocols. Conventions are legally binding international treaties that may be ratified by member States. Recommendations are non-binding guidelines. Conventions lay down the basic principles to be implemented by ratifying countries; a related Recommendation supplements it by providing more detailed guidelines on how it can be applied. Recommendations can also be autonomous and not linked to any Convention. Protocols add new provisions to existing Conventions. All member States must submit periodic reports on the implementation of the ILS, even those they have not ratified.

Irrigation: in the context of farming practices, refers to the application of controlled amounts of water. Requires infrastructure to store and distribute water. Understood in contrast to *rain-fed agriculture*.

Just transition: a process by which economies that progress towards a *green economy* also strengthen each of the four pillars of decent work for all (i.e. social dialogue, social protection, rights at work and employment). The Governing Body of the ILO has endorsed *Guidelines for a just transition towards environmentally sustainable economies and societies for all.*

Labour share of income: an indicator of the distribution of income in an economy, it is the percentage of GDP allocated to wages.

Linear economy: an economy based on production models whereby goods are produced, bought, used and discarded with little or no opportunity for rent, repair, refurbishment or recycling. To be understood in contrast to a *circular economy*.

Low-carbon economy: an economy that relies on equal or lower GHG emissions than can be absorbed by the environment. In conjunction with *resource efficiency* and *social inclusion*, it is a critical component of a *green economy*.

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 by renewables as an energy source in the production of electricity. Also called abatement policies or efforts.

Multilateral environmental agreements (MEAs): binding agreements between three or more States dealing with environmental matters. Examples include the Paris Agreement (2015), the Minamata Convention on Mercury (2013) and the Stockholm Convention on Persistent Organic Pollutants (2001).

Multiregional input–output table (MRIO): a database that compiles the economic exchanges across industries around the world. It models the structure of the world economy. As MRIOs take trade into account, they are commonly used to explore the difference between production and consumption-based emissions/resource use. They are also commonly used to explore the economy-wide implications of investment or technological change scenarios. Exiobase is an MRIO developed by a consortium of European universities, including the Norwegian University of Science and Technology (NTNU), the Netherlands Organisation for Applied Science Research (TNO), the Sustainability Education Research Institute (SERI), the University of Leiden, the Vienna University of Economics and Business (WU) and 2.0 LCA Consultants.

Natural hazard: see *environmental hazard*.

Organic agriculture: a farming system that relies on ecological processes, biodiversity and cycles adapted to local conditions. It restricts the use of artificial products, synthetic pesticides and mineral fertilizers. Considered a sustainable alternative to *conventional agriculture*.

Payments for ecosystem services (PES): voluntary transactions between users of ecosystem services and individuals or groups that enable the provision of this service. Transactions are conditional on agreed rules respecting the management of natural resources for the generation of these services.

Production-based emissions/resource use: the emissions or material/resource use associated with the production of goods and services in an economy. May differ from *consumption-based emissions/ resource use* or *footprint* as a result of trade. Also called territorial emissions.

Public employment programmes (PEPs): government programmes that directly create employment without expanding the regular civil service. They include *public works programmes* and employment guarantee schemes.

Public works programmes (PWPs): a type of *public employment programmes* that are typically temporary by nature and implemented in response to specific shocks or crises.

Rain-fed agriculture: farming practices that rely solely on rainfall for water. Understood in contrast to *irrigation*.

Relative decoupling: economic growth that increases faster than environmental pressures (e.g. GHG emissions and/or resource use) but does not reduce them. To be understood in contrast to *absolute decoupling*.

Resource-efficient economy: an economy that takes into account the scarcity of natural resources and the limits of their regeneration. In conjunction with *low-carbon emissions* and *social inclusion*, it is a critical component of a *green economy*. A *circular economy* is one that is progressing towards *resource efficiency*.

Skills for green transition: the abilities to carry out the tasks and duties of a given job required for the process through which an economy becomes a *green economy*. These skills includes both core and technical skills and may or may not be new in the labour market. In addition, these skills may be required by jobs in all sectors, not only by the priority sectors such as agriculture, construction, renewable energy, energy efficiency, etc.

Skills shortages: both a quantitative and a qualitative lack of skills relative to their demand. Quantitatively, the term refers to a shortage in the number of workers available in the labour market, while qualitatively it refers to an imbalance between the types of skills supplied and demanded. A skills shortage in the context of the transition to a *green economy* can occur due to the lack of skills among not only workers but also trainers, in relation to the skills needed in occupations that emerge as a result of the transition to a *green economy*.

Smallholder and family farms: small-plot farms relying mainly on family labour and producing subsistence crops or a few cash crops.

Socially inclusive economy: an economy that includes all members and groups of society in economic activity and that distributes wealth among them. In conjunction with *low-carbon emissions* and *resource efficiency*, it is a critical component of a *green economy*.

Territorial emissions/resource use: see *production-based emissions*.

Unemployment protection schemes: Measures taken to ensure income security and enhance the employability of people who are without jobs and/or looking for more decent and productive jobs.

Wet Bulb Globe Temperature (WBGT): a measurement of exposure to heat stress based on a combination of temperature, humidity, wind speed, sun angle and cloud cover.

Working-life years lost: a measure of the total working time lost as a result of disasters that takes into account casualties, injuries and infrastructure and capital loss.

World Employment and Social Outlook 2018: Greening with jobs shows that the world of work is intrinsically related to the natural environment. In this context, advancing towards a green economy is urgent and constitutes a key element of the future of work. The report also demonstrates that greening the global economy will result in more jobs overall; it is the first to show how taking measures to limit global warming to 2°C will result in 18 million additional jobs across the world. Positive employment results are also expected with the adoption of the circular economy. Behind this net job creation are many jobs that will be created and others that will be lost, requiring a close combination of social protection and skills development to ensure that the transition is a just transition.

The report shows how social dialogue and policy coherence are crucial first steps in ensuring that environmental objectives also promote decent work, and that advances in decent work also serve environmental sustainability. Social protection policies are critical to protecting individuals and their families against the negative effects of environmental degradation; they can be used to advance social and environmental objectives simultaneously. Skills development helps workers make the transition to sectors with employment growth and better jobs. And finally, skills promote innovation, investment and social equity.

The analyses showcase concrete examples of best practice from around the world and point up the tight synergies between Sustainable Development Goals. The report argues that advancing environmental sustainability is desirable for the world of work and urgent for social justice.

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