# 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, 2015a).[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 electricity generation,

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 2015*, 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.

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 (2015a). 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.

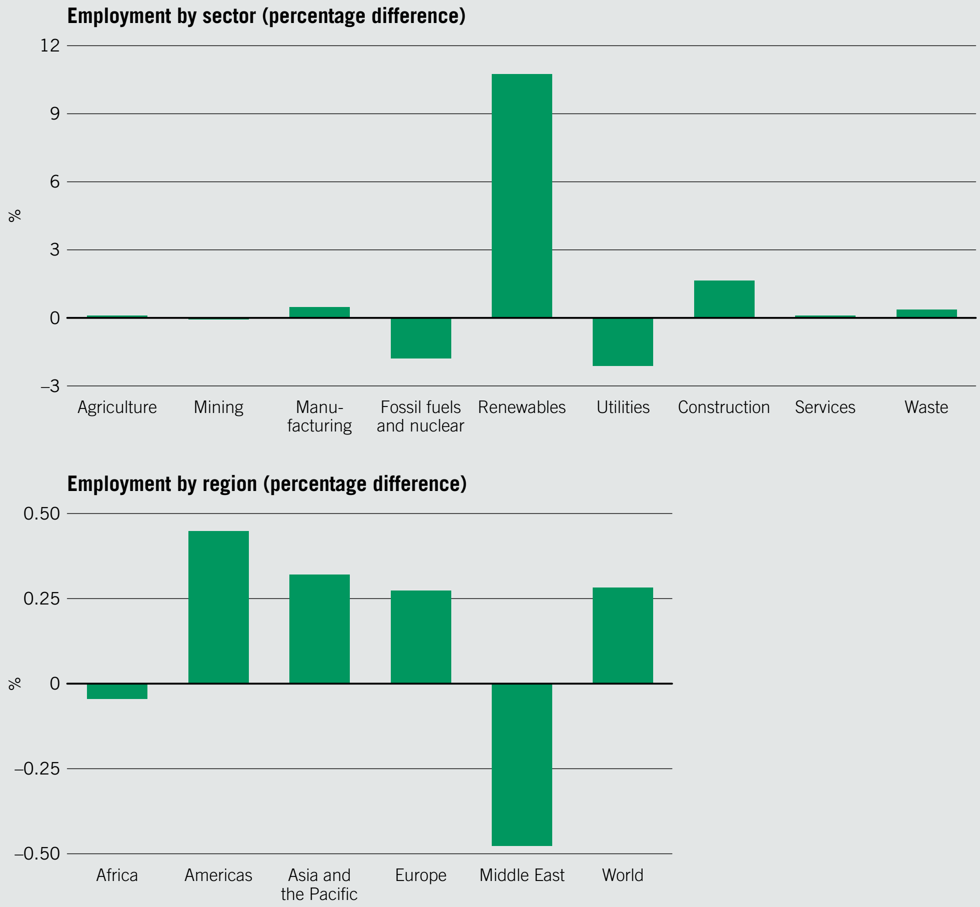
6. This scenario explores only one dimension of sustainability in the transport sector, namely a shift away from the internal combustion engine and towards electric vehicles for people transport. It ignores other initiatives to promote sustainability in the sector, including in public transport, maritime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

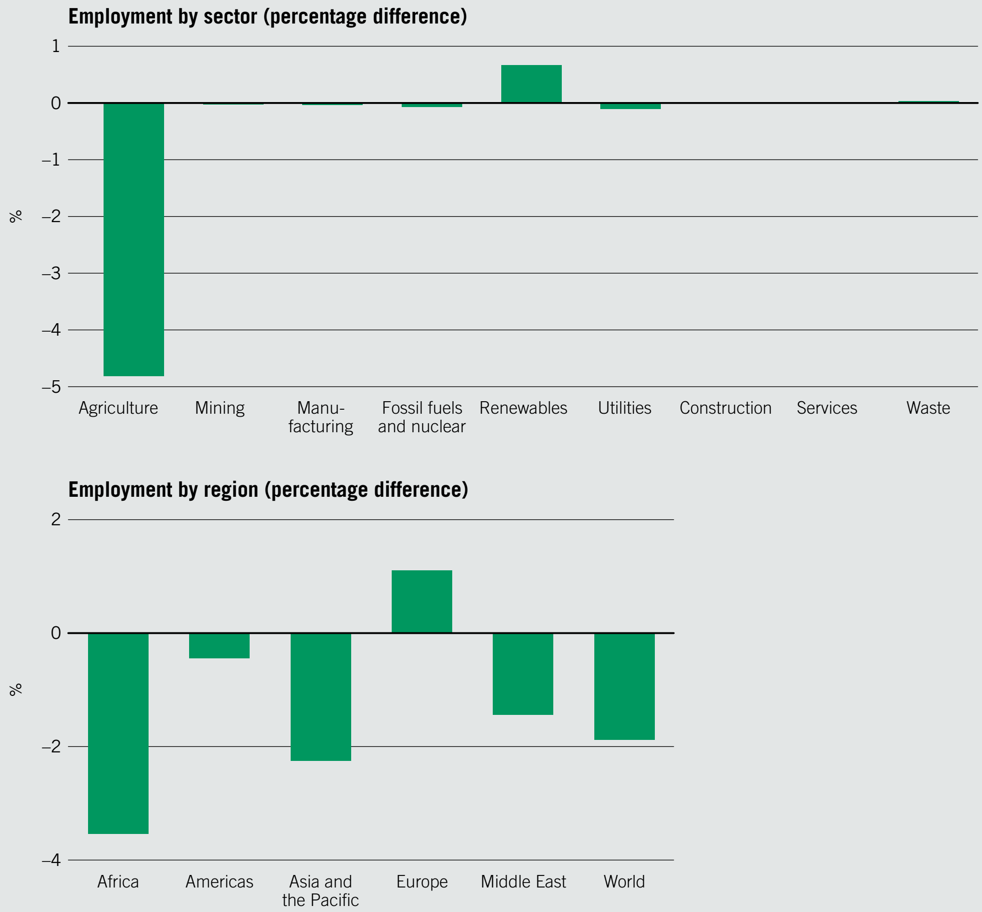
Conservation agriculture and organic agriculture can be sustainable if adequate crop, soil, pest, nutrient and waste management techniques are adopted alongside investments in infrastructure, access to finance, outreach, social protection and other policies. This section explores a scenario in which 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 the Americas (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 noted 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 was also involved in the Euro-Mediterranean Green Jobs (EGREJOB) project which brought 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**

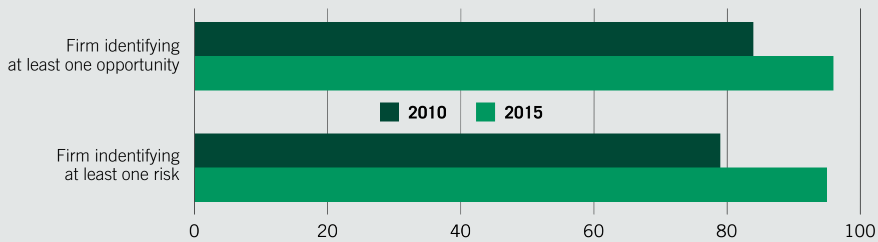
**The business implications of environmental degradation**

| 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)**

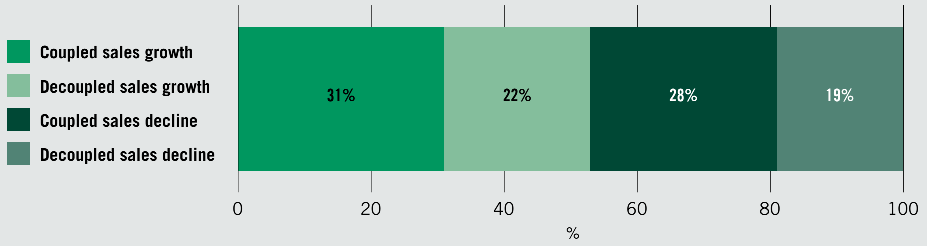



*Notes: Results based on 760 enterprises with information in FactSet reporting to CDP in 2010 and 2015. Appendix 2.3 provides more information about the firms in the sample. Enterprises were asked about the existence of climate change-related risks and opportunities arising out of: (i) physical climate 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, agriculture, 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

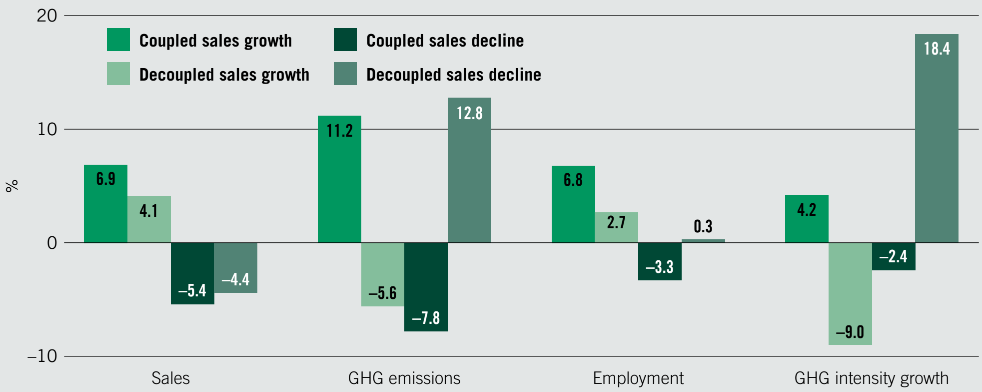
A key debate concerns the extent to which a shift to environmental sustainability can be complementary with current models of enterprise profitability or requires alternative business models. For some, all the efforts made, although welcome, will ultimately fail if they do not reflect positively on the 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).

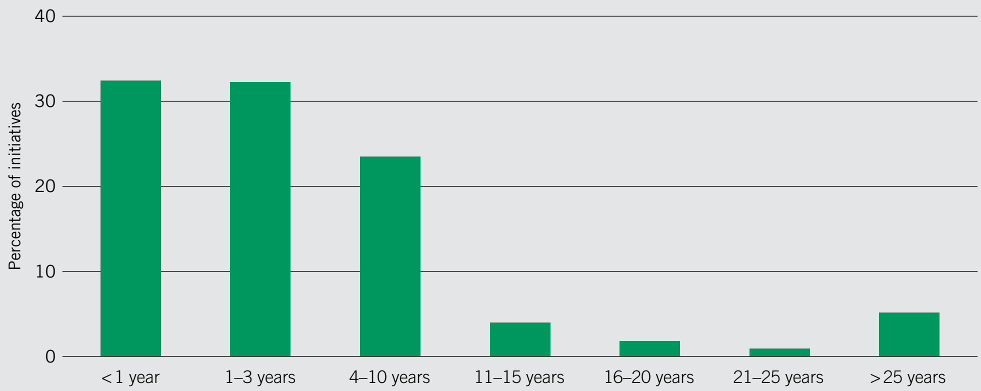
In the long term, sustainability reduces risks, lowers the cost of capital and improves revenue performance and operational efficiency (ITC-ILO, 2016). The Ellen MacArthur Foundation (2013) shows how embracing a circular mode of production provides short-term cost benefits, new profit tools and long-term 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, 2015b). 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 $CO_2$eq 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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