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CLG Europe

Working towards a climate neutral Europe:

Jobs and skills in a changing world

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CLG Europe is the sister group of UK-focused The Prince of Wales's Corporate Leaders Group, which has frequently defined the British business response to climate change.

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Foreword

Work is at the heart of our economy. Who has which jobs, what skills are required, whether we have the right mix of workers to business needs – all of these are critical questions that help determine the shape and scale of our economy, its competitiveness, sustainability and its effectiveness in providing inclusive prosperity. With this report we have set out an analysis of the long-term factors affecting jobs and skills in Europe, and examined how a proactive policy response to the climate crisis can affect that future. The bulk of the work was completed in early March 2020 – before the impact of recent events became apparent.

At the time of writing, public concern is quite rightly focused on the spread of the virus, public health provision, and immediate loss of employment and incomes. The spread of Covid-19 into a global pandemic has led to a healthcare crisis with tragic implications for thousands of people; forcing countries across the world to declare 'lockdown' measures, and close down schools, shops and factories. This has resulted in a sharp decline in economic activity and a steep increase in new unemployment claims. The full extent of the economic and social impacts will take months and years to play out, but forecasts by the International Monetary Fund (IMF) suggest the worst recession since the Great Depression, vastly exceeding the scale of the 2008 global financial crisis.[1]

In its April 2020 *World Economic Outlook*, the IMF[1] projects the global economy will contract by three per cent in 2020 - a downgrade of 6.3 percentage points from its January forecast. The most recent estimates by the International Labour Organisation (ILO) suggest severe negative impacts and "catastrophic losses" for businesses around the world. The operations and solvency of smaller enterprises in particular are under threat, putting millions of workers at risk. According to the ILO, working hours are expected to decline by 6.7 per cent in the second quarter of 2020, equivalent to 195 million full-time workers globally and some 15 million full-time jobs in Europe.[2]

But as terrible as the short-term impacts are, the longer-term implications of the pandemic remain unclear. All of the current estimates are just that - estimates at a time of high uncertainty. They are subject to change depending on the duration of the lockdown, the speed of the economic recovery in the second half of 2020 and the effectiveness of responding policy measures. Assuming that the pandemic fades in the second half of 2020 and that policy actions are effective in preventing widespread bankruptcies and system-wide financial strains, the IMF suggests that the global economy could rebound as soon as 2021.[1] Should the lockdown continue into the third quarter of 2020, economic recovery in 2021 is likely to be considerably slower. Moreover, a resurgence of Covid-19 in 2021 could leave the global economy struggling for several years.[3]

In this context, the pressure is mounting on policymakers to implement socially and environmentally responsible recovery packages that avoid repeating the mistakes made in the aftermath of the 2008 financial crisis. Pressure that many politicians and policymakers understand and support.[4,5] In Europe, governments are increasingly recognising the need to ensure that decisions taken now should focus both on the economic recovery and achieving a prosperous and climate neutral economy by 2050.

The ability of EU policymakers to rise to the challenge of supporting a quick and inclusive economic recovery following the Covid-19 crisis will also have implications for successfully delivering on the recommendations made in this report. Whilst it has not been possible to fully integrate the expected impacts of Covid-19 in much of its content, many of its recommendations now seem even more urgent and significant. The need to build firm foundations for future employment, and to develop a skilled and competitive workforce, has grown, not diminished, and must be a core focus for future policy action.

Executive summary

At the time of writing, the EU is grappling with the impacts of the Covid-19 pandemic, which has shown the world that labour markets can be transformed in a short period of time. While it is not yet clear how long the recovery will take, or whether there will be permanent changes to the structure of labour markets from the crisis, this report considers longer-term transformations of the European labour market. These changes will likely play out over years rather than months, and their full implications are uncertain, but policymakers will need to respond to these developments, just as they are presently trying to protect people and businesses from the effect of Covid-19.

The EU's new growth strategy, the Green Deal, sets a pathway for at least EUR 1 trillion investment over the next ten years and a just transition to a prosperous climate neutral economy by 2050. This transition will have significant impacts on the labour market across all sectors of the economy. It has the potential to create millions of new jobs in renewable energy, the circular economy and low carbon technologies. At the same time, some industries and sectors of the economy will contract, decline or disappear, resulting in employment losses.

Alongside the transition to a climate neutral economy, **Europe will be impacted by other transformative forces - known as megatrends**. Many of these changes will occur regardless of policy intervention, and their impacts on the scale, competitiveness and stability of the European economy and labour markets over the next 30 years are likely to be substantial. However, a proactive and well-designed policy framework can help mitigate the most disruptive impacts of these megatrends and enable the harnessing of synergies between the megatrends and the climate transition. To manage multiple transitions, policymakers have a critical role to play supporting companies, workers and communities to respond to the changing nature and structure of the labour markets.

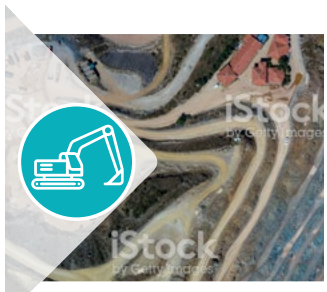
Seeking to inform policy and business actions in response to changes in employment and skills demand, this report describes the labour market impacts of the transition to a climate neutral Europe in the context of four key megatrends. The report explores how climate action interacts with these trends, how climate policies can provide direction on the future shape of the economy, and how the other megatrends may either facilitate or impede progress towards climate neutrality.

The four megatrends covered in this report are:

1 Technological change

2 Globalisation

3 Demographic change



4 Resource scarcity

These megatrends will shape the demand and supply for labour in Europe in the next 30 years. The scope and direction of the effects on employment and skills demand will be affected by policies and actions at local, regional, national and EU levels – including climate policies. While simultaneous and overlapping transitions will create new paths to prosperity, they will also disrupt existing work arrangements. Managing these disruptions and the associated impacts will present a crucial challenge to a successful transition to a fair and prosperous climate neutral economy.

Modelling the economic and environmental impact of the megatrends suggests that many of the megatrends – and in particular technological and demographic change – are likely to have far bigger impacts on the economy and the labour force than the low carbon transition.[6] Thoughtful and effective policy responses can mitigate the negative outcomes and maximise the benefits of each megatrend and are essential to avoid large scale disruption.

The impact of well-designed policies is highlighted when comparing the outcomes for the modelling scenarios that combine the effects of all of the megatrends. In the best-case scenario, featuring an aligned and effective policy framework, Europe could maintain employment levels in the face of the combined impact of the megatrends, whereas without that strong policy response it could see job losses of up to nearly 10 per cent by 2030 and 30 per cent by 2050 (compared to a baseline).

The modelling also indicates that well designed and implemented climate policies can help improve how Europe manages these megatrends. When the best-case scenario is combined with 1.5 degree compatible decarbonisation policies, it improves employment projections, leading to a scenario of around 1 per cent growth in employment.[7] Yet policy makers must keep in mind that even though the labour market impacts of the low carbon transition are relatively minor, the aggregate figures hide substantial sectoral differences, and with major significance for particular communities or countries with a high dependence on a declining sector. Financial support and inclusive policies will be essential to ensure that the negative impacts of low carbon transition do not disproportionately disadvantage specific communities, or exacerbate the negative impacts of the other megatrends.

The employment and economic impacts associated with **technological change**, primarily developments in AI and automation, could lead to substantial job losses, reduced household income, and decreased consumption but at the same time improving productivity. These effects have the potential to polarise the labour force, driving inequality between workers. **Globalisation**, while smaller scale in impact, is also likely to drive significant economic inequality and polarisation within domestic labour markets – supporting job creation and benefitting some workers, while disadvantaging others.

Demographics add to the complexity and challenge of coping with other trends as the European workforce is shrinking and ageing, making it less flexible and putting pressure on public resources. The impacts associated with globalisation and resource scarcity are relatively minor in comparison. Finally, **resource security** and environmental sustainability create a source of volatility and change – both creating pressures that will undermine existing industries but also opportunities for new approaches.

To help illustrate both how the climate transition is likely to impact jobs, and the interaction of these concurrent transformational trends, this report features **five case studies** that examine the impact of selected megatrends on sectors that will play a key role in achieving climate neutrality by 2050: offshore wind in the UK, automotive manufacturing in Germany, coal mining in Romania, steel manufacturing in Sweden and agriculture in Spain. These demonstrate the potential impact of national and regional policy on the jobs and skills in relation to each sector.

Offshore wind in the UK has significant future employment potential (including as alternative employment for offshore oil and gas workers), with skills required across engineering, science and specific to the sector.

Technological change, including the shift to electric vehicles, implies significant changes and job losses in the **German automotive sector** and its supply chains. It may also lead to net employment gains in other sectors, including electricity, infrastructure development, services and manufacturing. Adapting to new technologies will be essential to maintain the competitiveness of the industry.

In the **Romanian power industry**, the renewable sectors can provide new opportunities for highly skilled engineers and technicians from the coal workforce (more than gas), but this will need to be bolstered by a focus on labour-intensive energy-efficiency programmes.

Decarbonised steel production in Sweden will generate a high demand for STEM graduates, and a shift towards digital skills and competences in new production methods. It takes place in the context of a shift towards the circular economy that will drive demand for expertise in resource efficiency, material reutilisation and recycling.

Similarly, to successfully exploit the opportunities offered by innovation in **agriculture in Spain**, farmers will need a multidisciplinary skillset, including the ability to control machinery as well as knowledge of informatics, robotics, meteorology, chemistry and biology. In ageing and shifting workforces this will be challenging and require attention.

The report finds that decarbonisation policies can help build a European labour market that is more resilient to economic change and sustainable, as long as these policies are sufficiently tailored to manage the types of negative impacts described above. The findings of this report can also inform governments who need to design and implement recovery plans in the face of Covid-19.

Policymakers have started to grasp the range and depth of actions they need to take, and the EU already has experience and initiatives it can build on. However, greater coherence and resolve is required – some instruments will need to be adapted and strengthened, key approaches should be joined up to exploit synergies and avoid fragmentation, and new policies will need to be developed through a strong social dialogue.

Our recommendations for policymakers are as follows:

1 Commit to the European Green Deal and a clear and managed transition to a climate neutral economy

Action to mitigate climate change is not optional. New jobs in the low and zero carbon economy can help to mitigate the otherwise negative impacts of technological change on the labour markets. The future of the European labour market will depend on the EU's ability to remain competitive at a global level and achieve leadership in growing international markets for the design, production, assembly and marketing of clean products.

2 Develop a comprehensive vision to scale up skills and adaptability

It will be critical to support the European workforce to be as adaptable as possible to a changing work environment. Learning skills and lifelong learning approaches will be key to this, especially given the ageing demographic. The other important area for both future competitiveness and the climate transition is digital skills. The EU should bring together a comprehensive vision across policy areas, potentially through the industrial strategy.

3 Establish an inclusive economy through a just transition framework

The economic impacts of change will not be evenly distributed. Policymakers will play an essential role in ensuring that businesses and workers that are negatively impacted by the low carbon transition and the other megatrends receive sufficient support though investment in reskilling, redeployment and economic diversification. Regions with a high dependence on a single declining sector (such as coal) should be a priority for support as should sectors likely to face disruption in the near future, such as the automotive industries and agriculture.

4 Define a shared European agenda for the future of work

EU and member state policymakers will need to show leadership by working with businesses, educational establishments and social partners to identify sectors that will thrive in the future, and what skills gaps and shortages there are likely to be. Working together they can develop a regulatory framework for the future of work, including educational and vocational training programmes to equip workers with the skills that are likely to be in demand in the future. The EU and its member states should seek to share guidance and best practice.

5 Implement green and equitable Covid-19 recovery plans, while urgently addressing which skills will be needed for the future

Recovery plans will need to address both public spending, and policies that can incentivise business investment. It is essential that these recovery plans also consider the broader impacts of the changes covered in this report, and that they are aligned with longer-term goals including climate neutrality.

Well-designed and implemented climate policies can help improve how Europe manages megatrends and offsets some negative impacts.

Introduction

In December 2019, European Commission President Ursula von der Leyen announced the European Green Deal, the new growth strategy for the EU, setting a pathway for at least EUR 1 trillion of investment over the next ten years and a just transition to a climate neutral economy by 2050. The Green Deal covers a set of new strategies and measures across energy, finance, industry, buildings, transport and agriculture, with additional plans to preserve biodiversity and to eliminate pollution.

Delivering the European Green Deal will require an unprecedented degree of cooperation across industry, research and government. Companies will need to alter their production processes and potentially change their business models. These changes will have implications for skills demand and regional and sectoral distribution of jobs. For example, energy efficiency improvements in the buildings sector will increase demand for skilled workers that are currently in short supply.

The policy-driven transition to a climate neutral Europe will need to take place within a context that is influenced by additional socio-economic–environmental dynamics taking place worldwide, known as megatrends. These developments are largely outside the control of the policymakers, although policies can be employed to harness the potential benefits and minimise any negative impacts. The megatrends covered in this report include **technological change** (including artificial intelligence, big data, and digitalisation), **demographic change**, **globalisation** and **resource scarcity**.

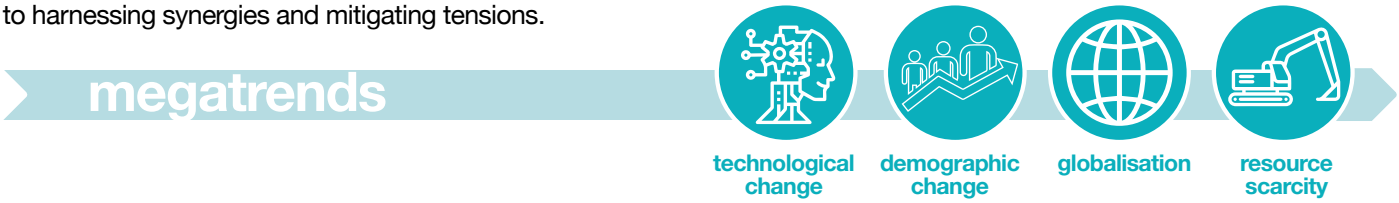
Although their exact impacts are highly uncertain, these megatrends are likely to impact the global economy, business and society, causing **major transformations in the labour market over the next 30 years. Understanding and engaging with these changes is vital to the scale, competitiveness and stability of the European economy.** Understanding the nature of the interactions between the most influential megatrends, and their impact on the effectiveness of climate policies, is key to harnessing synergies and mitigating tensions.

Many attempts to comprehensively estimate and forecast the labour market impacts of climate policy have so far focused on a specific dimension of the topic, such as the transition of the energy sector, circular economy, energy efficiency of buildings or the transport sector. However, these focused accounts – even when drawing on extensive amounts of high-quality research and data – do not explicitly consider the impact of other overlapping trends and therefore are largely unable to provide a sufficiently nuanced picture of the complex reality.

This report seeks to understand the implications for the European labour market of the transition to climate neutrality in the context of these broader changes, and to inform policy and business actions in response. It shows how climate action and the other megatrends may impact future labour markets, and how the megatrends may help or hinder the transition to climate neutral economy. It describes the four trends and their implications for jobs and skills in Europe, and documents a set of case studies that focus on specific sectors undergoing transition. Each sectoral case study is located in a specific country to allow us to explore the impact of local policy. Business stories also highlight how companies are dealing with this issue. A concluding section offers some high-level policy insights.

This report was developed with insights drawn from a technical working paper by Cambridge Econometrics.[8]

During the final stages of the drafting of this report, the global Covid-19 pandemic has presented an immediate and far-reaching disruption to European and global economies and labour markets. As the EU responds to the emergency and begins to lay plans for recovery, discussions have already begun on major stimulus packages and how they can be best aligned with Europe's long-term climate goals. The Covid-19 crisis may also highlight the need to develop mechanisms to respond and mitigate the negative impacts of the megatrends.



Section 1

The future of jobs and work
Trends and analysis

Technological innovation, global economic integration, demographic and generational shifts, and sustainability challenges are all radically altering global business models and economic activity. These megatrends will significantly affect the nature and sectoral distribution of employment and have already led to concerns about a global shortage of skilled labour, with the skills gap being considered a major issue by 78 per cent of executives.[9] Finding workers who possess the relevant skills has become problematic even for entry-level positions, and many business executives feel that new graduates are not adequately prepared for current or future work.

There are many uncertainties surrounding the overall impact of these megatrends, and it is important to understand the ways in which those impacts may be felt. In this section we highlight how they are likely to affect the number and nature of jobs, the implications for future skills demand, and the interaction between them and the transition to a climate neutral economy.

Impacts and interactions

The net zero carbon transition is often thought of as a major source of economic restructuring. However, recent modelling commissioned by the European Commission shows that, at aggregate level, the effects of the low carbon transition on gross domestic product (GDP) and employment might be a lot smaller than the impacts of megatrends that are going to occur regardless of policy development. The comparatively minor aggregate impacts of the low carbon transition also hide substantial sectoral differences, and careful policymaking is required to ensure that the negative impacts of the low carbon transition will not exacerbate the negative impacts of the megatrends.

The modelling, which was delivered by a consortium led by Cambridge Econometrics, considers the economic, employment and CO_2 impacts of four key megatrends (automation, globalisation, demographic changes and impacts of resource scarcity) that will take place simultaneously and will interact with the transition to a climate neutral economy.[7]

The modelling involved designing scenarios based on a range of possible outcomes for the four megatrends. For each megatrend, a 'middle-of-the-road' baseline case was constructed, followed by four alternative scenarios based on the uncertainties specific to each megatrend. In some alternative scenarios, accompanying government policies were included to mitigate negative effects and to maximise positive outcomes.

The scale of impacts from the different megatrends in 2050 varies widely, suggesting that:

- The employment and economic impacts associated with **technological change**, primarily developments in AI/automation, could lead to **substantial net employment losses**, **reduced household income**, and **decreased consumption and output**, resulting in **losses in GDP**.
- The impacts associated with **globalisation** and **resource scarcity** are relatively minor in comparison.
- There is a high variation in the least favourable and most favourable outcomes for **demographic change**. These results illustrate the crucial role that government policies play in determining educational and health outcomes.
- The **low carbon transition** scenario (which achieves emissions reductions compatible with the 1.5 degree pathways, without assuming any specific megatrend effects) shows positive outcomes for GDP and employment. These results indicate that decoupling emissions from economic growth and employment is possible in a well-designed policy framework.

Table 1: Highest and lowest economic impacts of each megatrend in (EU-27+UK) by 2050, percentage difference compared to baseline scenario

Percent difference from the reference case, 2050	GDP		EMPLOYMENT		CO_2 EMISSIONS	
	Low	High	Low	High	Low	High
Technological change	-8.0	-0.1	-23.2	-9.9	-5.9	-2.9
Globalisation	-0.1	2.2	0.0	0.7	-0.1	1.3
Demographic change	-10.0	10.6	-5.8	6.2	-4.2	4.0
Resource use	-0.3	0.6	0.1	0.1	-0.2	2.9
Low carbon transition		1.06		1.01		-74.1

Source: E3ME, Cambridge Econometrics. Compiled by authors from preliminary results that are to be published in the forthcoming Macroeconomics of the Energy Union: Policy Report for Modelling Megatrends *for the European Commission.*[7]

Note: The 'low' and 'high' values in Table 1 refer to the most favourable outcome (high) and the least favourable outcome (low) across the four scenarios for each megatrend. For the low carbon scenario, only one set of results is available.

The modelling also combines the various megatrends with the low carbon scenarios. The results show that low carbon policies operate relatively independently of what happens in the other megatrends, indicating that decoupling of emissions and economic growth, achieving a higher growth with lower production, is possible for the EU. In some cases, the low carbon transition may complement other changes and can contribute to offsetting certain other negative impacts.

Interactions across the megatrends arise through the impacts of each megatrend on the wider economy. This was also modelled in the analysis (through best-case and worst-case scenarios). The main findings are:

- **The best combination of scenarios is one in which smart regulation works with markets and technological change to create a dynamic economy that can adapt to the key challenges faced by society.** Compared to the reference case, the ideal outlook shows positive impacts on EU GDP, with an increase of 7.8 per cent by 2030 and 12.5 per cent by 2050. However, this is paired with a rather high effect on the workforce: while employment is relatively unaffected by 2030, it is reduced by 3.4 per cent by 2050.
- **The worst combination of scenarios shows a case in which technological change and other fast-moving developments create social problems that governments are not able to cope with, resulting in significant negative impacts.** Impact on the EU-27+UK GDP compared to the reference case reaches -3.9 per cent by 2030 and -17.1 per cent by 2050. Employment follows a similar pattern: decreasing by 9.5 per cent by 2030 and by 27.5 per cent by 2050.
- **Low carbon policies have a small positive impact of around 1 per cent in 2050 on GDP and employment in both the best and the worst case scenarios** (described above) compared to scenarios without the low carbon policies. These positive results arise from low carbon policies (due to restructuring the economy on a sectoral level) replacing some of the jobs lost to automation.

Overall, the modelling results suggest that a policy framework that supports the development of a flexible economy, able to adapt to change, is a fundamental determinant for success as multiple transitions inevitably take place.

Worst combination of scenarios

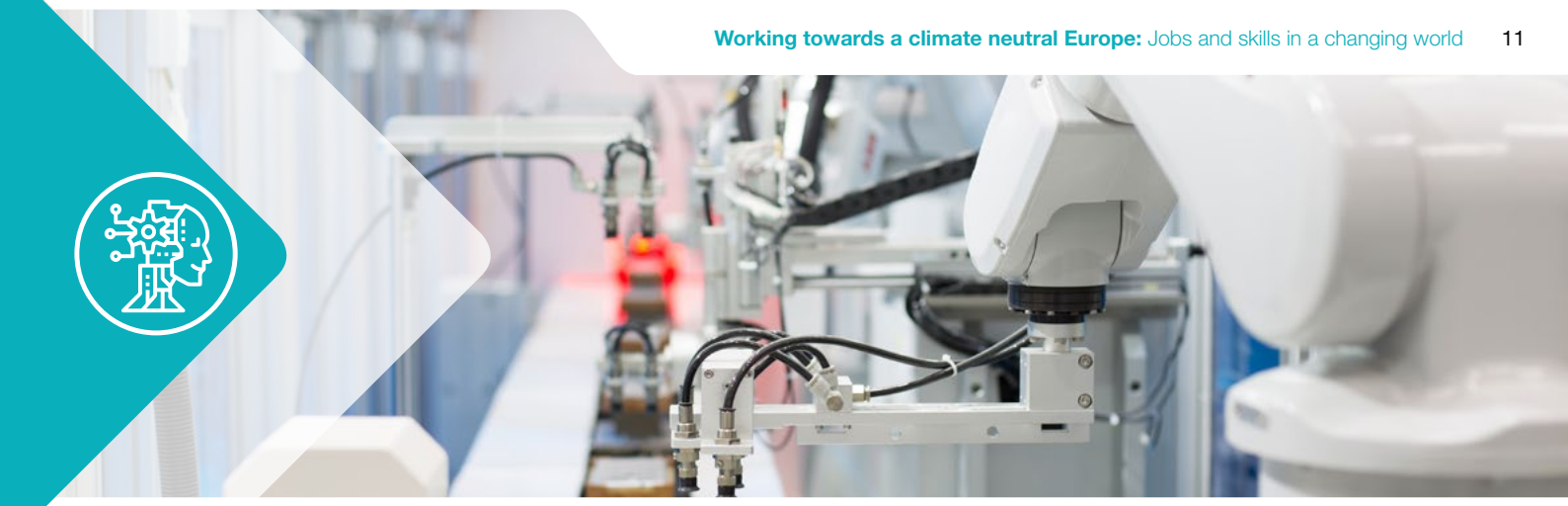
By 2030: Employment could decrease by 9.5 per cent.

By 2050 employment could decrease by 27.5 per cent.

Best combination of scenarios

By 2030, employment is relatively unaffected.

By 2050, employment could be reduced by 3.4 per cent.



Trend: automation and accelerating technological change

Rapid advances in technology, particularly in automation and AI, will most likely have a substantial impact on the labour market. Exponential advancements in computer science (better algorithms), computer power (more powerful processors) and availability of data (big data) have dramatically improved the capabilities of technology to perform an increasing number of tasks more efficiently than humans.[10] At the same time, these developments create a need for workers with a new set of skills.

Although the world of work has, for centuries, been constantly reshaped by technological progress,[11] the current wave of technological development has the *potential* to impact on a much wider range of tasks than before, across all sectors, and faster than before. If labour markets are not able to keep up with the speed of this change, the new technological advances could lead to increasing unemployment and inequality. On the other hand, society might be able to harness the potential of automation and AI in such a way that the benefits are shared across prosperous new societies that become characterised by high productivity and an abundance of free time. The final outcome is uncertain and depends on a number of factors discussed below.

Impacts

The automation of processes and tasks will have profound consequences for labour markets, productivity and income distribution.

1. **Displacement of workers.** Recent advances in technology, and particularly in AI, are now allowing machines to replace an increasing number of tasks that require *skills* that were previously only embodied in humans. Continuous advances in machine learning mean that more and more work is now easily undertaken by machines, while a decreasing share of workers have skills that are complementary to machines. However, workers skilled in non-linear reasoning in interaction with people, and in performing non-standardised tasks, will be less likely to be replaced by machines.

2. **Productivity gains.** The productivity of capital-driven processes can be enhanced considerably through the use of AI,[12] meaning that more capital-intensive sectors are generally estimated to see the greatest productivity gains from AI uptake. As such, AI will help to address some key challenges for Europe, such as low productivity growth and the impact of an ageing population.[10] Besides allowing the production of more output at a lower unit cost, automation could provide a balancing mechanism to the displacement effect:

   - Higher productivity increases the value of workers performing the non-automated tasks,[13] thus increasing the demand for skills that are complementary to automation.
   - Higher productivity will command higher wages for the non-displaced workers, who in turn will spend more, thus increasing demand and mitigating the loss of employment due to substitution.[14]
   - New technologies including the Internet of Things, big data, AI and robotisation have the potential to increase production and reduce greenhouse gas (GHG) emissions in various sectors (eg: automotive, industry, agriculture). For example, in the agricultural sector technological change has the potential to increase production more than land expansion and better protect and restore the land, water and biodiversity.

3. **The risk of an increase in inequality.** Higher inequality could emerge as a result of labour market dynamics, factor endowments and institutional factors:

   - **Labour market polarisation.** As employment grows in high-skill occupations and low-skill occupations, while decreasing in the middle,[7] it is possible that technological improvement will polarise the labour market between 'low-skill/low-pay' and 'high-skill/high-pay' workers.[15]
   - **Monopolisation due to the increased digitalisation of the economy.** In the digital economy a small set of 'superstar' firms are able to charge higher prices and extract monopoly rents,[16] for example through the exploitation of network effects. Such firms tend to have a low share of labour in their value added, which in turn lowers the share of labour in national income.[17]
   - **Inability to adapt.** Individuals with low levels of digital skills and so called 'learning skills' might find it difficult to adapt, especially if the educational system and lifelong learning training providers do not keep up with the pace of technological change.[18]
   - European institutions are aware of the challenge and opportunities posed by digitalisation and automation, but **public policies might struggle to compensate the losers** from the adoption of automation.[16]

Interaction with the climate transition

New technologies are fundamental in the transition towards a climate neutral economy, but the right policy framework will be needed to ensure net benefits. New technologies and AI could help curb emissions in a variety of ways, for example, by enhancing weather predictions to maximise the efficiency of wind turbines and solar panels;[19] improving traffic and route management; improving forecast of supply and demand, allowing a better scheduling of energy supply; and improving the energy efficiency of buildings.[20]

Microsoft and PwC estimate that **applying AI to environmental problems could curb emissions by 1.5–4 per cent by 2030.**[21] In terms of jobs, Eurofound[22] estimates that the investment in new technologies needed to achieve a low carbon economy will **expand employment for the EU-28 by 0.5 per cent in 2030**, compared to a baseline without such investment. This shows that the use of AI to curb emissions can result in net job creation provided that an adequate policy framework is put in place to ensure that the workforce acquires the necessary skills to use these technologies or benefit from them.

Technological change

Could lead to substantial net employment losses.

New low carbon technologies could expand employment for the EU-28 by 0.5 per cent in 2030.

Case Study

Smart buildings: a new opportunity

In order for Europe to achieve climate neutrality by 2050, approximately 97 per cent of buildings within the EU need to be renovated, redeveloped or upgraded – a significant labour intensive economic activity with major employment implications. EDGE is working to address this challenge by reusing and upcycling existing materials and utilising smart technology. Digitalisation enables EDGE to track, control and optimise all the different variables within the building, leading to significant increases in energy efficiency and space optimisation. These measures enable better performance and improved well-being among the users of the buildings, while also improving energy efficiency and reducing emissions from light, heating and cooling.

Credit: EDGE

Trend: globalisation

The term globalisation refers to the growing interdependence of national economies, cultures and populations caused by cross-border flows of goods, services, technology, investment and finance, people and information.[23] Globalisation has complex, politically charged effects and with unequal impacts between and within societies.

The wave of globalisation that started in the late 20th century has created a situation characterised by: the integration of production processes in global value chains (GVCs – where final products are the outcome of production activities executed in multiple countries); the rise of China as a global trade and manufacturing powerhouse; massive international flows of data; and increased global interlinkages which have made individual countries more vulnerable to negative events happening abroad, as seen in the coronavirus outbreak.

International trade is changing shape, with cross-border services growing 60 per cent faster than trade in goods in the period 2007 to 2017, and GVCs becoming more knowledge intensive and reliant on high-skill labour.[24] Recent years have also been characterised by **an increase in protectionism**, and it has been estimated that protectionism between China, the US and the EU could lower EU GDP by 1 per cent and employment by 0.3 per cent by 2030.[25] Furthermore, **global demand is shifting**, with developing economies increasing their share of global consumption.

The impact of the current pandemic is still to be seen. According to the WTO, world merchandise trade is set to fall by between 13 and 32% in 2020 due to Covid-19 before potentially recovering in 2021, depending on the duration of the outbreak and the effectiveness of the policy responses.[26]

Impacts

Global trade has been linked to economic growth and reduced poverty worldwide. Plentiful supply of low-skill labour has enabled developing countries to integrate into GVCs, while developed economies have specialised in more high-skill labour. Significant impacts are as follows:

1. **Improvements in global economic growth and reduced poverty have been linked to growth in global trade.** International trade can boost growth through mechanisms such as increased and more intense competition, economies of scale and innovation.

2. **International trade has facilitated job creation in developed economies.** In the EU, 36 million jobs (one in seven) were supported by exports to countries outside the EU in 2017. Two-thirds of these jobs are in services and are better paid than jobs in the rest of the economy.

3. **GVCs allow the exploitation of comparative advantages, but gains seem to be distributed unequally.** The positive effect of GVC participation[27] tends to be concentrated in upper-middle and high-income[28] countries, while the positive effect on low and lower-middle-income countries does not appear significant.

4. **Globalisation induces specialisation and labour market adjustments across countries, which benefit different kinds of workers.** In developed economies, such adjustments have resulted in increased demand for high-skill workers while routine tasks are offshored to other countries. Low-wage workers in developed economies are left to face large obstacles to labour mobility and may bear the greater share of the adjustment costs.[29]

5. **Globalisation affects workers through international competition, which can decrease employment and wages in sectors more exposed to import competition.** For example, Portuguese businesses seeking to export to the rest of Europe but in competition with Chinese businesses seeking the same markets saw employment decline.[30]

6. **Globalisation has reduced income inequality between countries globally while increasing inequality between individuals within countries.** However, national policies (eg progressive taxation and social transfer) might mitigate adverse distributional effects.[31]

7. **Globalisation has been accompanied by an increase in capital flows and financial linkages between countries, with consequences on the real economy.** For example, additional exposure to impacts like the 2008 global financial crisis.

Interaction with climate transition

Globalisation allows the reduction of emissions through technology transfer. International trade and foreign direct investments (FDI) lead to the transfer of knowledge and more carbon-efficient technologies from countries where the technology is often developed to other countries.

Less positively, the rise of GVCs has also resulted in an outsourcing of emissions by developed countries to developing ones. With parts of the supply chain outsourced, developed countries have been able to reduce emissions domestically at the expense of increased emissions in developing countries. However, there is evidence that such emissions transfers have been on a declining trend since 2006, and that the rate of decarbonisation of global trade now exceeds the rate of growth in trade value.

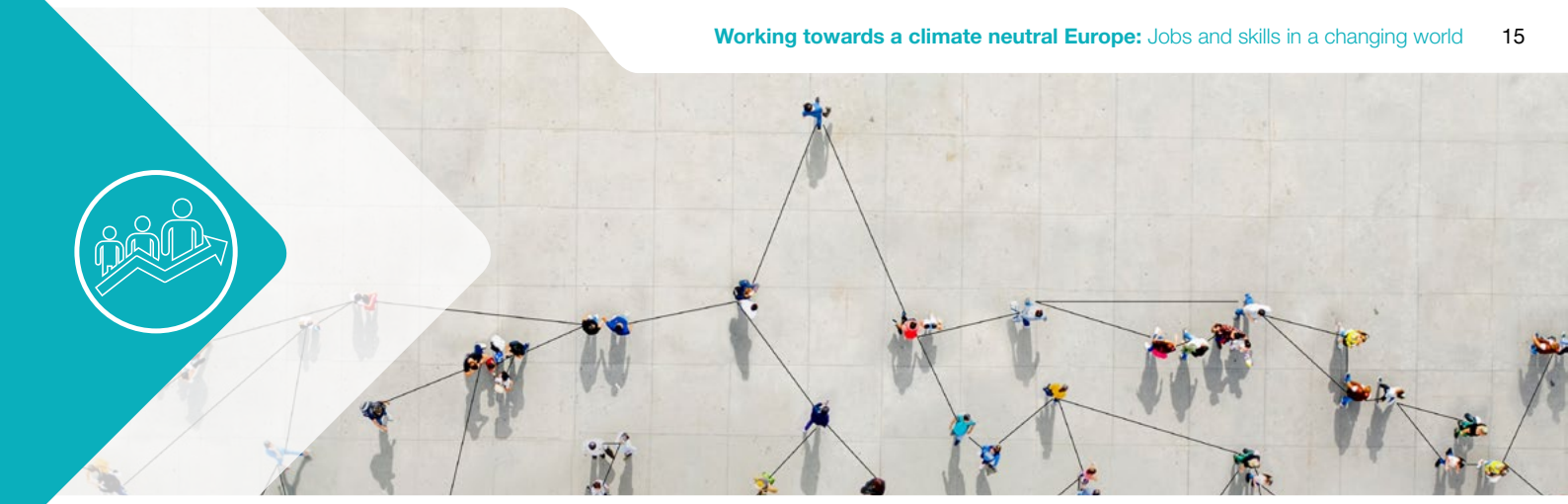
Overall, globalisation could help or hinder the transition to a climate neutral economy at the global scale, depending on which aspect of it will dominate. If globalisation and digitalisation increase trade intensity, then emissions could grow faster than would otherwise be the case. On the other hand, if companies bring manufacturing activities closer to their main markets and low-carbon innovations spread faster, then the world as a whole might become more energy-efficient.

Case Study

Brainport Eindhoven: innovation and training as an engine for economic growth

Brainport Eindhoven[32] was developed through a collaborative effort involving industry, research and government in response to the economic crisis in the 1990s, during which a third of all jobs in the Eindhoven region disappeared. The driving forces behind the Brainport were the establishment of Philips High Tech Campus[33] in 1998 and the 1996–2002 regional economic development strategy plan known as 'Stimulus', which facilitated the emergence of a knowledge economy across the Eindhoven region. The EUR 180 million funding under the 'Stimulus' plan accelerated mutual trust and cooperation between companies and resulted in 60 cluster projects and 400 other types of projects, the refurbishment and development of new industrial areas on a large scale, and the creation of 33,500 course places and 4,000 jobs. The success of the Brainport highlights the importance of innovation as an engine for economic growth and regional development during an economic transition, and the role of government in innovation and as an agent that can help facilitate private sector collaboration. Producing 44 per cent of all patent applications filed in the Netherlands and contributing EUR 2.5 billion in private research and development (R&D) spending, Eindhoven is now widely acknowledged as the high-tech capital of the Netherlands.

High Tech Campus Eindhoven (The Netherlands). Credit: Microtoerisme



Trend: demography

The ageing of the population is a worldwide phenomenon, although the speed and scale of this process varies widely across countries. Despite these regional differences, the trend is clear: the number of people aged 65 or more is going to increase both in absolute value and as a share of total population in all regions of the world.[34] This trend is the consequence of a combination of increasing life expectancy and decreasing fertility rates. As a consequence, old-age dependency ratios are projected to increase all over the world,[35] potentially shrinking the labour force and putting pressure on government finances.

In the EU-28, the population has reached 500 million and is ageing. The proportion of people aged 65 or more in the total population increased from 17 per cent in 2008 to 20 per cent in 2018, while the old-age dependency ratio increased from 28 per cent to 33 per cent in the same period.[36,37] In 2017, four million people migrated to one of the EU member states, out of which two million were not EU citizens. The immigrants were, on average, much younger than the resident population in the country of destination, with a median age of 28 years compared to 43 years for the EU-28. The ageing of the EU population is expected to continue in the 21st century, coupled with slower population growth.

Impacts

The ageing population has negative effects on GDP growth through two channels: first, as the number of retirees increases (in the absence of appropriate increases in the pension age), the number of workers relative to the population falls; second, workers beyond a certain age tend to work fewer hours and to be less productive.[38] Ageing also has profound consequences for labour markets, by altering the size and skill profile of the available labour force.

Key impacts and observations are as follows:

1. **An ageing workforce.** Within the European labour force, older cohorts are expected to increase in size while younger ones are expected to decline.[39] Older workers are less likely to be unemployed than younger workers, but take more time to re-enter employment if they do become unemployed. They are also harder to retrain and participate less in formal education and on-the-job training, and are less economically mobile (ie they are less likely to change occupation, sector of activity and region). Their skills are more likely to be outdated in the face of ongoing innovation. As such, the increasing age of the labour force might slow the speed of change following economic shocks[40] and improving older cohorts' productivity and flexibility through lifelong learning will be fundamental to effectively manage the labour market impacts of the different megatrends.
2. **Digital competences are scarce among older adults.** Among employed older adults, almost half are at risk of low-level digital skills, a share which increases to 70 per cent among the unemployed and 60 per cent among the economically inactive.[41] Conversely, younger cohorts in the EU-28 have higher-level digital skills than the older ones, resulting in an overall increase in digital skills among the workers as more young people enter the labour market.[42] This will increase productivity, which may partially counteract the negative effects of a smaller labour force and higher dependency ratio.[43]

3. **Pension systems might be strained by increasing retiree numbers.** The European labour force is projected to shrink, implying that a lower number of workers will have to provide for a higher number of older people, with consequences on the sustainability of public finances (in terms of pension and health spending). Old-age dependency ratios in the EU-28 have increased from 28 per cent in 2008 to 33 per cent in 2018 and are projected to reach 55 per cent by 2050.[44,45] These developments, if not counteracted by an increasing number of employed workers and/or productivity, will slow growth and reduce standards of living.
4. **The ageing of the population interacts with the increase in inequality, to create the risk of unequal ageing.** Inequalities in dimensions such as education, health, employment and earnings reinforce each other over the course of life,[46] with early-life factors being powerful predictors of financial well-being among older cohorts.[47]

In summary, to counteract negative impacts, an increase in productivity and employment is needed. Possible solutions are immigration to increase the size of the workforce, the adoption of automation to improve productivity, an increase in labour participation of older people and a more extensive implementation of adult learning to support flexibility.

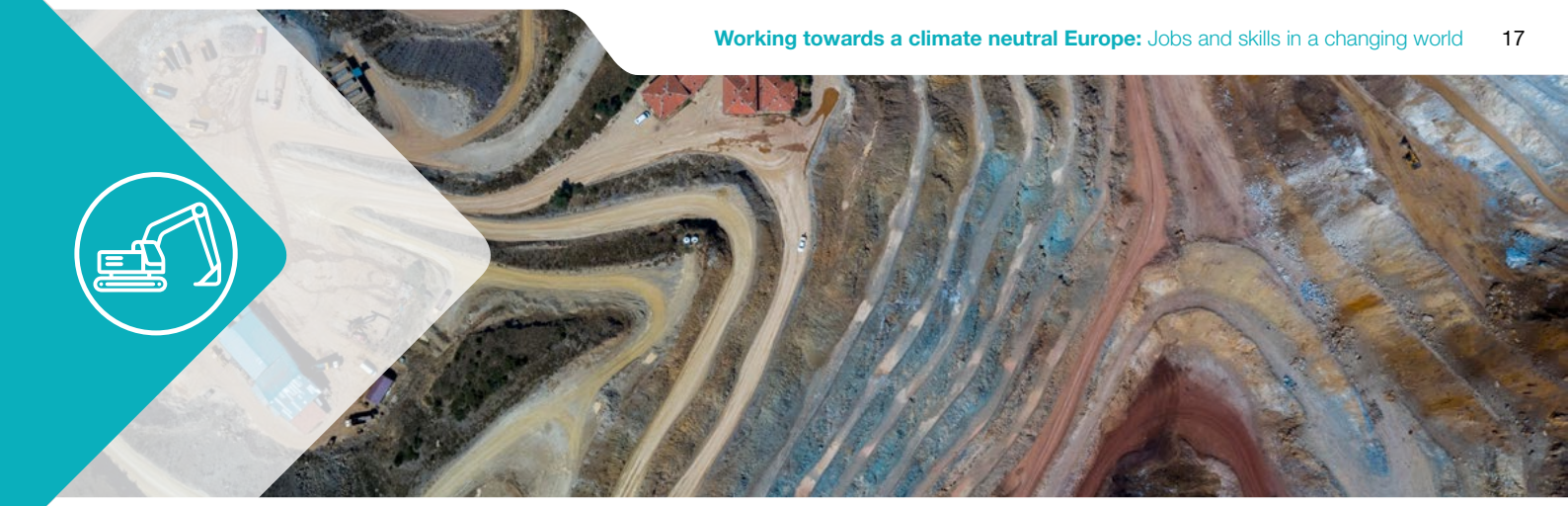
Interaction with climate transition

Demographic changes affect consumption patterns and energy use. On the one hand, slower population growth should reduce the growth in energy demand but, on the other hand, ageing and higher incomes might increase it. This is because the elderly in advanced economies have higher energy use than the younger population[48,49,50,51] and, consequently, induce higher emissions (mainly due to sensitivity to extreme weather and being late in adopting the latest, most energy-efficient, technologies).[52, 53] However, some studies suggest that current younger cohorts have higher energy consumption than previous generations and are expected to continue to demand more electricity at every stage of their lives. Necessary efforts to improve overall energy efficiency and decarbonise the energy supply, as set out in the Green Deal, should mitigate these issues.

Demographic change

Ageing has profound consequences for labour markets, by altering the size and skill profile of the available labour force.

Productivity can be improved through an increase in labour participation of older people and a more extensive implementation of adult learning to support flexibility.



Trend: resource scarcity

Global demand for materials and other resources, such as water, energy and land, has increased more than ten-fold from 1900.[54] Between 1970 and 2017, global extraction of materials more than tripled, while material demand per capita increased by 65 per cent.[55] Intense exploitation of global natural resources has already resulted in resource scarcity, with humanity consuming more ecological resources than the Earth is capable of regenerating. The 'Earth Overshoot Day' arrives sooner each year: it was 29 July in 2019, while it was 29 December in 1970.[55]

Global demand for goods and services is projected to increase further, fuelled by a growing population and improved living standards. However, resources are not infinite and are often geographically concentrated, and their extraction and exploitation has impacts in terms of GHG emissions and degradation of the environment. Addressing these issues will also influence economic outcomes and job creation.

Impacts

Global resource consumption is projected to increase in the coming decades, amidst heightened competition for scarce resources, pressure on agricultural systems and environmental risks. The adoption of the circular economy is one of the main solutions embraced by European policymakers to tackle these issues, and the European Commission has set out a pathway for decoupling economic growth from natural resource use through initiatives along the entire life cycle of products.[56] By promoting recycling and reuse of products, the circular economy is expected to increase aggregate employment in the EU-28. However, transitioning towards a sustainable economy is not without costs and many jobs will be lost in the process. Reskilling policies will be needed in order to allow a smoother transition from declining sectors (eg fossil fuels) towards growing sectors (eg renewable energy).

Key impacts are as follows:

1. **The overuse of natural resources has deep environmental consequences.** Biomass, metals, non-metallic minerals and fossil resources extraction and processing account for approximately 50 per cent of global GHG emissions.[57] They are also associated with increased pollution and biodiversity loss. These environmental impacts have clear and well-documented social and economic costs.

2. **As demand for natural resources increases, the outlook for supply is more uncertain.** Demand for key natural resources is increasing and projected to continue to do so. More food production will imply increase land use, and water demand is projected to increase by 55 per cent by 2050.[58] While global demand is projected to increase, it is uncertain if the same will apply to supply. Indeed, reserves of key materials (eg lithium, cobalt) are concentrated in a limited number of, often politically unstable, countries.

3. **Uncertainty over resource supply may increase volatility in commodity prices.** This represents a risk for economies heavily dependent on imported resources, such as Europe.[54]

4. **Tackling resource scarcity through the circular economy might have sizeable economic benefits.** By 2030, the transition to a more circular economy is expected to increase GDP in the EU-28 by 0.5 per

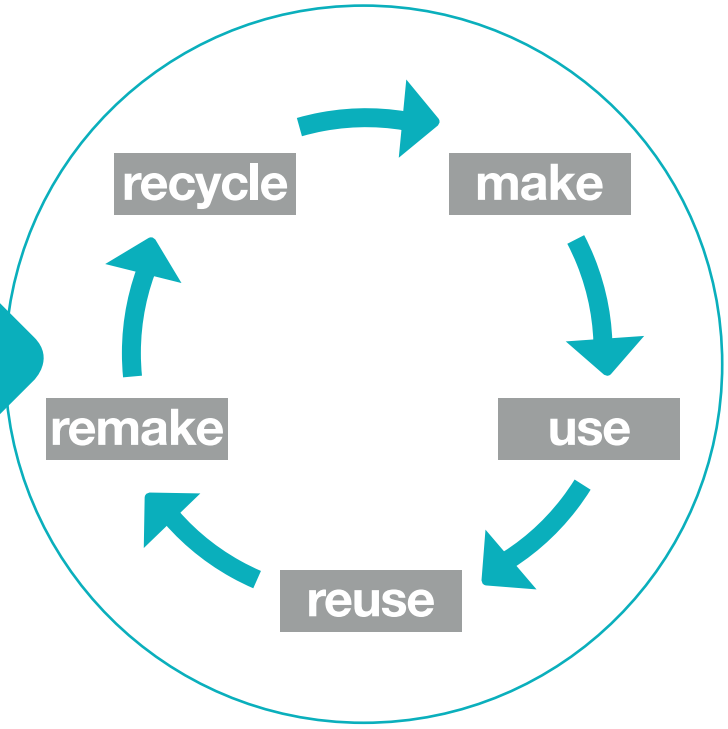
cent and create 700,000 (net) new jobs (taking into account job creation and shedding). The positive effect on economic activity is due to additional labour demand in recycling plants and repair services, and to the additional consumer demand generated by higher savings allowed by a more efficient use of resources. The sectoral composition of employment will change, with sectors producing and processing raw materials declining and the recycling and repairing sectors growing. Services and electricity sectors will also benefit from the transition, while electronics, machinery, automotive, accommodation and construction sectors will experience a decrease in employment.[59]

Interaction with climate transition

Lowering emissions stemming from the (over)exploitation of resources is a fundamental step towards the achievement of climate neutrality. A significant reduction in GHG emissions would be achieved by implementing the practices of the circular economy.[60] The European Commission's new Circular Economy Action Plan[61] demonstrates that the circular economy is fundamental to the transition towards a climate neutral economy, including through the reuse, remanufacturing and recycling of materials, while decoupling economic growth from resource use.

Conversely the geo-political impacts connected to resource scarcity and shifting patterns of resource use may challenge the project of building political consensus around common action towards climate neutrality and a more sustainable economy.

Tackling resource scarcity through circular economy might have sizeable economic benefits. By 2030, the transition to a more circular economy is expected to increase GDP in the EU-28 by 0.5 per cent and create 700,00 (net) new jobs (taking into account job creation and shedding).



Section 2

Sectors in change
Case Studies

UK offshore wind power generation

Increased electricity generation from renewable sources will be crucial for Europe to achieve climate neutrality by 2050. In the UK, strong government support for the offshore wind industry has enabled the sector to grow substantially over the past decade. Although the offshore wind industry is not yet a major employer, future potential employment is significant. Offshore wind may also provide alternative employment for offshore oil and gas workers as that industry contracts.

Overview

The UK is the global leader in the offshore wind power generation sector, with installed power generation capacity of 8.5 GW in 2019, a mature supply chain and world-class engineering expertise. In the UK, 8 per cent of national electricity is generated through offshore wind (up from 0.8 per cent in 2010).[62] In 2018, the sector employed an estimated 7,200 full-time equivalent (FTE) and generated £3.7 billion of turnover.[63]

In 2019, the UK government set out its ambition for the sector, including a target of 30 GW of total installed capacity (providing one-third of national electricity generation), and an aim to employ 27,000 highly skilled workers in the sector by 2030.[64] In support of the latter there are to be measures to develop new curricula and accreditation, and to facilitate job mobility between energy sectors (eg from oil and gas).

Interactions with megatrends

Automation could make operating wind farms more efficient and safer, but will need highly skilled individuals who are capable of deploying automated systems and analysing data, implying an upskilling of the current workforce and job creation rather than replacement. For example, technicians currently working offshore could be reskilled/upskilled to deploy robots from land and to analyse the wealth of data gathered from autonomous systems.[65]

Offshore wind is an example of a truly globalised sector, where ownership, components and expertise travel across borders. As a result of the legacy of sectors such as automotive and oil and gas, the UK has developed world-renowned expertise in the offshore energy domain. The country is currently the global sector leader for installed capacity and engineering expertise, and is exporting its products and services around the world.

In 2018–19, UK-based companies signed at least 317 offshore wind contracts in 15 countries, for a maximum contract value of £8.8 million and a total combined value per company up to £53 million, offering services such as blade transport and installation, cable protection systems, equipment and engineering expertise.[66] However, few wind farm owners and big suppliers are of British origin:[67] Ørsted (Danish), Vattenfall (Swedish) and E.ON (German) accounted for 64 per cent of UK market share in 2018.[68] Many smaller businesses are also foreign owned (eg the Polish JDR Cables, leader in the cable segment).

Implications for jobs and skills

A 2017 study by Cambridge Econometrics estimated that, by 2032, the UK offshore wind sector might provide 21,000 FTE jobs – more than doubling from current levels. Indirect and induced employment, such as jobs that are part of the supply chain to the sector or those, supported by the wages of workers in direct and indirect employment, like retail, could result in an additional 37,000 FTE positions, bringing the total number of jobs supported by the offshore wind sector to 58,000 FTE. Within the offshore wind sector, technical professionals is the prevalent occupation and most jobs are expected to be created in the North East of England and in the Humber region.[69]

Skills that will be crucial in the development of the offshore wind sector include: engineering and technical skills (mechanical, electrical and control & instrumentation, blade and turbine technicians, with an increased role of IT skills), scientists (with degrees in disciplines such as marine biology, geophysics, hydrography, oceanography) and offshore-specific skills (working in confined spaces, working at heights, team working, team living). The UK has traditionally been capable of producing a world-class offshore workforce employed mainly in the oil and gas sector, whose skills could be easily transferred to offshore wind.[70]

However, supplying the skilled workforce needed to meet the expansion of the sector might be challenging. It is estimated that the UK is already short of 20,000 engineering graduates per year for all sectoral demand. Moreover, attracting talent could be more challenging for small and medium-sized enterprises (SMEs) (which represent the bulk of the UK offshore wind sector) than it is for large companies.[71]

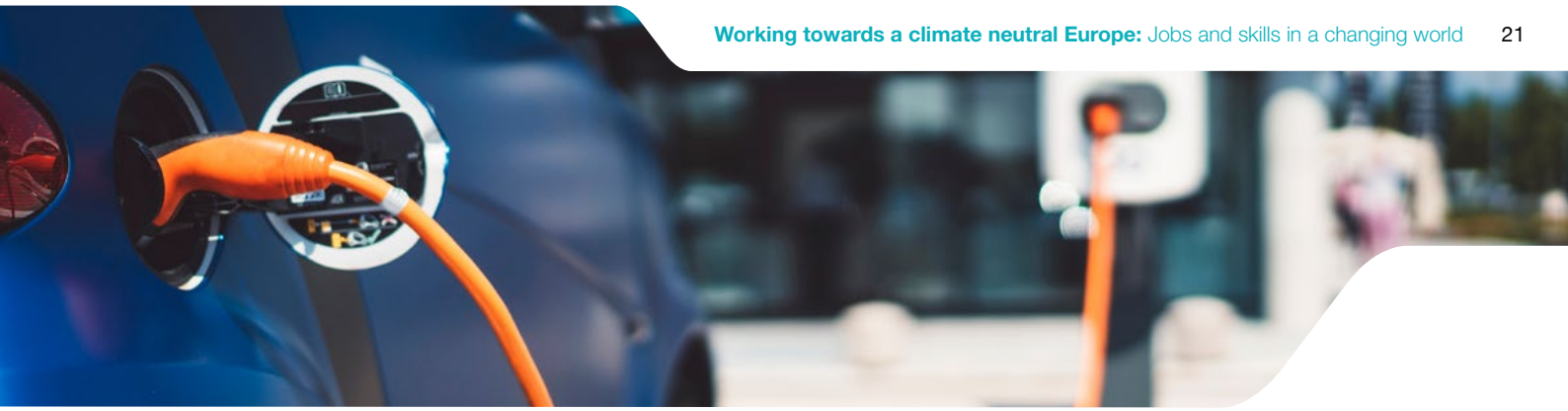
Case Study
How Iberdrola leads on offshore wind: a commitment to talent and skills development

For two decades, the Iberdrola Group has been supporting the clean energy transition. Its UK-based subsidiary company ScottishPower plays a key role within the Iberdrola Group in the provision of offshore wind-related training and talent-fostering at a global level.

In recent years, ScottishPower has worked actively to improve diversity in the workforce and to increase mobility between offshore renewables and extractive industries. For example, ScottishPower Renewables (SPR) is involved in the creation and development of training courses at the East of England Offshore Wind Skills Centre. As a part of their £55,000 donation, SPR sponsored ten places on an 'Offshore Wind Transition Course', which is aimed at individuals with previous experience in engineering and focuses on key elements such as working at height and Global Wind Organisation basic technical training. SPR also collaborates with the centre to ensure that the training meets the needs of the sector and can be adapted as the industry evolves. SPR staff members from the local operation and maintenance (O&M) facility regularly attend the college to provide career talks and interview training. One of the early success stories includes the recruitment of a local Lowestoft resident as a trainee balance of plant technician, following on from their successful completion of the funded transition into offshore wind training.

Top: Wikinger (350 MW) located in Germany

Bottom: East Anglia (714 MW in 2020, up to 1,200 MW by 2024) in the UK. Credit: Iberdrola



German automotive industry

The German automotive industry is an important sector both in terms of its economic impact and as a source of employment. The industry's supply chains stretch across many European and non-European countries, contributing to employment and economic development especially in Central and Eastern Europe. The sector faces numerous drivers of change, including pressure to be competitive and adopt the latest technologies. One key issue is the necessity to shift to zero emissions vehicles as part of the transition to climate neutrality.

Overview

The automotive industry is the largest industrial sector in Germany. In 2017, it generated almost EUR 500 billion of turnover (representing 27 per cent of national manufacturing turnover) and employed 866,000 people (representing 12 per cent of national manufacturing employment).[72]

However, developments such as lower export demand for German cars (due to competition from elsewhere), technological change and regulation of emissions are challenging the resilience of the sector.[73] In 2019, car production in Germany reached a 22-year low of 4.7 million cars, leading German car manufacturers to announce that tens of thousands of jobs are at risk. More recently, the coronavirus outbreak has added further uncertainty in the European automotive sector, with many carmakers including Volkswagen, Daimler, Fiat Chrysler Automobiles (FCA) and Renault shutting down factories as part of the measures to fight the virus.[74]

Worldwide, the automotive sector is preparing to phase out vehicles powered by internal combustion engines (ICE) and to switch to the production of electric vehicles**.** Many countries and cities, in Europe and elsewhere, have already adopted specific time schedules for the ban of ICE vehicles, and the topic is being discussed at the European level.[75,76] In recent years, European regulations on emissions from vehicles have been tightened, with a view of encouraging European carmakers to increase efforts into research, development and production of electric vehicles and hybrids, so they are better positioned to maintain market share. At the same time other connected innovation trends including the potential shift to autonomous vehicles and digital technologies changing travel patterns are disrupting the industry.

Interactions with megatrends

The German automotive industry is already highly automated. Germany is the fifth-largest market for robots in the world, with almost 27,000 industrial robots installed in 2018, most of them in the automotive sector.[77] Although robots do not seem to have directly displaced existing workers in Germany, they appear to have led to increased income inequality by increasing the earnings of high-skill workers and decreasing the earnings of low and medium-skill workers, particularly in machine-operating occupations.

Germany is the biggest car exporter in the world, accounting for 20 per cent of global car exports.[78] However, the German automotive manufacturing sector is highly vulnerable to the new production processes associated with the transition to electric vehicle production as well as growing competition from countries such as China. In particular, China is positioning itself as the global leader in the production of electric vehicles.

Implications for jobs and skills

Research suggests that the switch to electric vehicles will entail significant changes in the industry's labour market. Electric vehicles contain fewer parts than traditional ICEs and are faster to manufacture, resulting in lower demand for component parts (as many will become obsolete) and less work for assembly workers.[79,80,81]

Predictions regarding future employment impacts range dramatically depending on the specific assumptions made. One study indicates that German GDP could be 0.5 per cent higher compared to the baseline in 2030 because of investment in electric vehicles, with a potential net employment creation of approximately 145,000 jobs, primarily in construction, electricity, hydrogen, services and manufacturing.[79] However, regions where the automotive sector, including the production of components, constitutes a significant share of total employment, might be negatively affected.

Positive net figures conceal significant likely job losses in the sector, where estimates range from the loss of 400,000[82] jobs by 2030 to more moderate losses of approximately 75,000 to 100,000 jobs, primarily in engine and gearbox manufacturing.[83,84,79] There is already evidence of supply chain restructuring in Europe, with German manufacturers of components such as Bosch, Mahle and Schaeffler making redundancies because of lower employment needs connected to electric vehicle manufacturing.

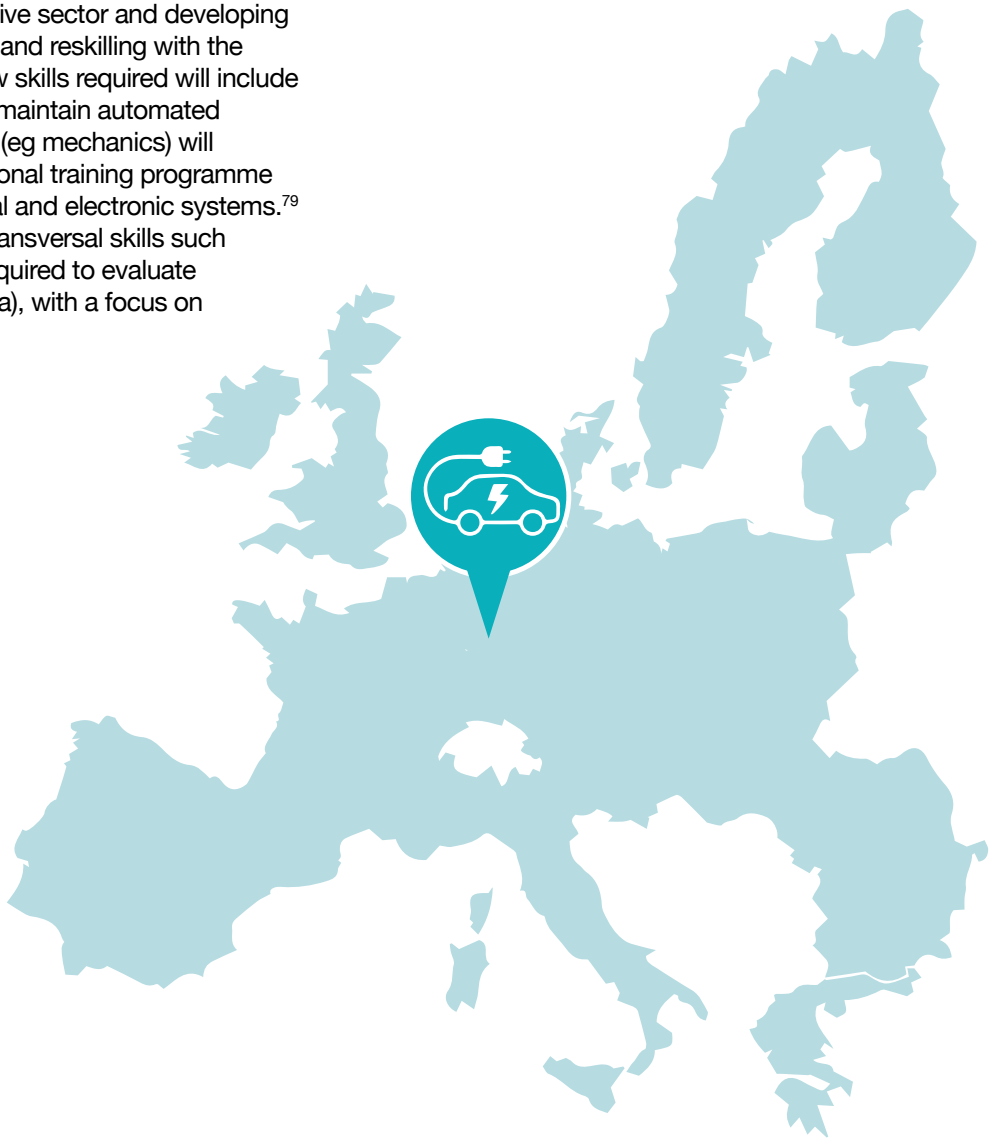
Despite these challenges, establishing domestic supply chains to produce electric vehicles will be fundamental to avoid further job losses stemming from a loss of international competitiveness: employment losses would be massive if the production of electric vehicles was to be completely seized by foreign competitors such as China, resulting in the potential end of the car manufacturing industry in Germany.

One key need to minimise job losses and the impact of change is active reskilling of workers where possible. Several pan-European projects[85] aim at understanding the future skills needs of the automotive sector and developing appropriate training for upskilling and reskilling with the involvement of the industry.[86] New skills required will include the ability to set up, operate and maintain automated systems. Machine tool operators (eg mechanics) will need to complete a formal vocational training programme focused on working with electrical and electronic systems.[79] There is also the need for more transversal skills such as social and intellectual skills (required to evaluate and organise information and data), with a focus on adaptability.[87]

Automotive manufacturing Germany

By 2030, 145,000 jobs could be created in different sectors due to investment in EVs.

Positive net figures conceal significant likely job losses in the sector, active reskilling of workers will be fundamental to minimise job losses.



Romania and European coal regions

For Europe to reach climate neutrality by 2050, the consumption of coal for energy generation needs to be phased out –ideally in the next ten years. Romania has a long-standing tradition of coal extraction and, although it has not set an official phase-out date for coal, the sector has been shrinking rapidly over the past 30 years. Beyond environmental pressures, inefficiencies of the coal mines and their dependence on state aid mean that much of the sector became uneconomical during the industrial restructuring in the 1990s. Many former coal mining regions were left with weak economies, an ageing population and high out-migration.

As part of the European Green Deal, disadvantaged regions that depend on coal mining for employment and economic activity are to receive support to help diversify their economies and to reskill workers. Reskilling and redeployment of former coal industry employees in the renewable energy sector could provide at least a partial solution. This approach has particular scope in countries such as Romania and Bulgaria that have a high cost-competitive potential for wind and solar energy generation. In Romania, the renewable energy sector has been successful, placing the country in a strong position to increase this sector as power generation changes.

Overview

In 2018, the Romanian coal sector employed 16,000 people, and is currently the third largest coal sector in terms of employment in the EU-28, after Poland and Germany.[88] This is down from around 171,000 workers in the hard coal sector in the 1990s.[89] Besides mining jobs, in 2015 it also provided 10,000 additional jobs through indirect employment.[90] Around 80 per cent of the coal sector workforce is represented by production and auxiliary staff, which include roles such as equipment operators, electricians and mechanics. The remaining coal mines in Romania show some of the lowest outputs per employee in Europe as well as being among the most polluting.[91]

Interactions with megatrends

Romania has a declining and ageing population and net negative migration. Between 2000 and 2018, total population in Romania decreased by 13 per cent, with an average of 0.5 per cent of the population leaving the country each year. The coal regions present a more extreme variation of the national picture: with some seeing population decreases of more than 20 per cent and an average net negative migration of 0.7 per cent per year.[92]

The economy based on coal mines had deep environmental consequences such as land deterioration, excessive land use and water pollution.[89] The phase-out of coal in Romania could be compensated by greater investment in renewable energy technologies. It is estimated that coal regions in Romania have a technical potential of 10–25 GW for wind and 20–80 GW for solar (ground-mounted) photovoltaics (PV). Offshore wind could also contribute with an additional capacity of 8 GW.[93] This could in principle transform the economic model of the coal regions away from mining into a more diversified and sustainable one.

The closure and conversion of coal mines into wind and solar PV farms could have several advantages, including the restoration of the environment; the recovery of extensive areas of land; a positive impact on the local economy through new employment and re-employment opportunities, especially in the construction phase; and better acceptance of renewable energy farms, which could be placed in closed mining sites instead of valuable land.[91]

Implications for jobs and skills

The European Green Deal clearly sets out the aim to phase out coal in Europe completely and build an energy sector based entirely on renewable and other low carbon sources.[94] Romania will be one of the beneficiaries of the European Commission's Just Transition Fund, which will allocate €7.5 billion to help regions impacted by the transition towards climate neutrality, including coal regions.[95]

The government is now expected to draw up regional plans for transition to a climate neutral economy, focusing on local economy diversification, reskilling of workers and ecological transformation of the areas previously used for coal and oil extraction.[96] This could also present a partial solution for energy poverty in Romania as it would encourage investment in energy efficiency.[97]

The phase-out of coal means that workers will have to adjust. For example, they will have to decide whether to search for an occupation in the same sector (eg mining of gold, silver, salt or copper, in which Romania is rich[98]) to update their skills to work in another sector, or to move

to other regions. For example, a coal industry worker could stay in the energy sector, with the same skills and in the same region as a power plant operator working in a biomass power plant, assuming some of the existing coal power plants were converted to biomass. At the other extreme, an industrial electrician could retrain to become a technician on a wind farm in another region.

The wind and solar industries demand highly skilled engineers and technicians, and have been identified as suitable redeployment options for coal workers through reskilling and upskilling.[89] However, some regions, such as Oltenia, are considering replacing the coal generation capacity with gas units, which tend to be less labour intensive to maintain and would therefore mean fewer employment opportunities than the development of renewables.[99,100]

Developing a local renewable energy sector could boost the local economy and provide considerable environmental and health benefits, especially if this is in conjunction with a long-term development plan. Although employment increases in wind and solar energy in the coal regions are currently not expected to be sufficient to substitute all coal-related jobs,[101] energy efficiency interventions could be capable of absorbing a significant proportion of the remaining workers.[93]

However, transitioning from a coal-based economy to one based on renewables will not be easy or quick. Interventions will need to be comprehensive and timely, to mitigate the risk of the current diversified and educated workforce leaving the region. There should be a focus on implementing training programmes, developing entrepreneurship and strengthening the role of universities and connectivity of the area.[102]

Romania and European coal regions

The coal sector is rapidly shrinking.

Developing a local renewable energy sector could boost the local economy.

Reskilling and redeployment of former coal industry employees in Romania and Bulgaria that have high cost-competitive potential for wind and solar energy generation could transform the economic model of coal regions into a more diversified and sustainable one.

Case Study
Transforming Bulgaria's Maritsa East region into the 'Energy Technology Valley of Southeast Europe'

The future plans for the Maritsa East (ME) region could see 240 km^2 of open cast lignite mines transformed into an economic zone that would combine clean energy generation technologies with industrial and R&D enterprises associated with the regional and global energy transition. The three key principles of the redevelopment proposal for ME include: (a) preserving the 3.3 GW power generation capacity of the region, using a combination of technologies including various renewable energy technologies, to protect Bulgaria's energy security; (b) preserving and increasing the number, quality and pay grade of employment in the region; and (c) retaining and increasing the economic output of the region. The redevelopment would also increase the number of high-skill jobs in the region and thus help reverse brain and youth drain, which are currently depleting the population.

Fossil-free steel in Sweden

Steel is used widely, with increasing global demand. At the same time, iron and steel production are responsible for approximately a quarter of global industrial CO_2 emissions. Following the adoption of the EU's 2050 climate neutrality target, the steel industry is under intense pressure to improve energy efficiency, recycle more and switch to low carbon production processes. In a capital-intensive industry characterised by path dependency and technological lock-ins, sustainability transitions are not straightforward. However, modelling shows that hydrogen-based production in conjunction with a move towards the recycling of scrap steel enables the industry to continue to produce high-quality steel as well as reduce emissions and maintain jobs in the sector.

Overview

Sweden's steel production accounts for 3 per cent of total European steel production[103] and around 2 per cent of Sweden's GDP.[104, 105] In 2018, the steel sector in Sweden employed 15,700 workers directly and 26,500 indirectly, and accounted for 4 per cent of Sweden's total exports of goods.[106] In response to foreign competitive pressures, Sweden has developed expertise in highly processed steel grades and niche-oriented products made of environmentally friendly steel.[106]

The Swedish government has committed to two major climate targets: 100 per cent renewable electricity generation by 2040 and a net zero carbon economy by 2045. These ambitious goals, together with the Fossil Free Sweden initiative, put pressure on all Swedish industries to decarbonise.

The commitment to develop fossil-free steel production is supported by both government and the industry, as demonstrated by the long-term plans of the country's largest incumbent iron and steel producers, LKAB (a state-owned mining company) and SSAB. SSAB operates Sweden's two remaining plants that use blast-iron furnaces[107] and are leading entrepreneurial activity and experimentation to decarbonise virgin steel production using hydrogen-based production methods, with the help of substantial financial support from the Swedish Energy Agency. For these companies, investing in innovation makes economic sense. At present, SSAB relies on imported coal to operate its blast furnaces, instead of using readily available, domestically generated, fossil-free electricity. Also, by taking the lead in the development and implementation of new technology, SSAB aims to enhance its competitiveness in the long term.[107]

Interactions with megatrends

Technological innovation will be essential for the competitiveness of the steel sector. The EU steel sector cannot compete globally on labour costs, and therefore needs to base its competitiveness on innovation, technology, quality and the abilities of a highly skilled workforce.[108]

Iron (from which steel is made) causes the highest climate impact among metals, due to the large volumes of steel produced yearly, its energy-intensive nature and the use of highly polluting coal in the blast furnaces for iron ore reduction to produce virgin steel. In 2017, the iron and steel industry produced about 6 per cent of global CO_2 emissions.[109] To address requires a number of strategies. On the demand side steel can be used more efficiently or alternatives can replace it. On the production side greater use of recycled steel and innovative production processes will be key. Recycling steel allows savings in terms of CO_2 emissions in the range of 62 per cent to 90 per cent compared to primary production.[110] However there will still be a need for new technologies for innovative steel production with significant reduced emissions. Alternative production methods are varied and include using hydrogen, biomass or electrolysis to reduce iron ore, changing the process to reduce the use of carbon and capturing the emissions generated.[108]

Implications for jobs and skills

The steel sector is often perceived by younger generations as involving low-skill, low-pay and less safe occupations.[111] However, the reality of the modern steel industry is different, with salaries comparable to other industrial jobs and highly automated, high-tech workplaces. There is a high demand for science, technology, engineering and maths (STEM) graduates in the sector, especially as the average age of workers in the steel industry is relatively high.

The ageing steel sector workforce has consequences in the flexibility of the workforce, and ease of adoption of new skills, such as digital skills. Older workers seem to be more resistant to change and to adopting more flexible approaches to tasks and responsibilities, although this attitude changes based on the roles covered.[111] The ageing

workforce also makes knowledge transfer more difficult. The low number of young entrants and the increasing age of steel workers creates a gap in knowledge transfer, with expert older workers retiring without being able to pass on their knowledge.[111]

Jobs linked with administrative functions will be the ones at greatest risk of automation. Production workers will still make up the majority of hiring in the steel sector but will perform different tasks and will require a varied and flexible skillset. Specialised technical skills and advanced technology skills will remain in demand. The knowledge of steelmaking processes and materials will remain fundamental, but the importance of digital skills will rise substantially, implying that workers will still need in-depth knowledge of tasks but won't be performing them. Green skills, such as understanding of environmental management and knowledge to support circular business models, are projected to become increasingly important. R&D expertise will be needed to lead research in sustainable steel and new production processes, while floor workers will need competences in resource efficiency, material reutilisation and recycling.[111]

For Sweden's and the EU's climate targets to be met, the steel industry needs to decarbonise. This means that the future jobs in the steel industry will be either in recycling-based steel or in new forms of steel production that are still exploratory, such as hydrogen-based technologies. Modelling by Cambridge Econometrics (E3ME, FTT:steel) indicates that a shift towards more hydrogen-based steel production in Sweden would enable a Swedish steel production increase without a negative impact on employment levels. This result is linked to the labour intensity of various production technologies and the availability of scrap steel: although hydrogen-based production is slightly less labour intensive than current fossil-based production, it is more labour intensive than recycling-based production and does not rely on the availability of scrap steel.

Case Study
Fossil-free steelmaking in Sweden

Under the HYBRIT joint venture, the Swedish firms SSAB, Vattenfall and LKAB are collaborating to develop a fossil-free hydrogen-based steelmaking process as an alternative to coal-based steelmaking by 2035. While the main objective is to reduce the environmental impact of steelmaking, the economic impacts are also important. With this new method of producing steel, CO_2 emissions generated from the steel industry could be eliminated, thus contributing to Sweden's goal of net zero emissions by 2045.[112] Construction of a pilot plant began in 2018, with EUR 52 million of assistance from the Swedish Energy Agency. The pilot phase should last until 2024, with a subsequent demonstration phase from 2025 to 2035.[113]

Credit: HYBRIT

Agriculture in Spain and Southern Europe

Agriculture remains a key sector both socially and economically. This case study focuses on the impact of changing climate on agriculture in Spain, and how new technologies could help the farmers adapt to climate change. Although it focuses on the Spanish context, many of the conclusions are applicable across various EU countries where the characteristics of the agricultural sector are similar to those in Spain, namely a large share of farms being run as small family businesses, an ageing workforce, population decline in rural areas, significant use of seasonal migrant labour and lack of educational opportunities resulting in a lower level of digital skills among rural populations.

Overview

Agriculture is one of the most important sectors of the Spanish economy. In 2017, agriculture accounted for 2.7 per cent of GDP (down from 3.9 per cent in 2000). Between 2000 and 2017, agricultural production in Spain grew by approximately 1.6 per cent per annum. During the same period (2000–17), employment in the sector declined slightly, from 882,000 workers employed (5.3 per cent share of employment) in 2000 to 750,000 workers (4 per cent of total employment) in 2017. The economic importance of the agro-industrial sector (including all activities linked with agriculture such as food processing, distribution etc) is even greater, accounting for 11 per cent of GDP and 14 per cent of total employment in Spain in 2016.[114]

In Spain, as well as many other parts of Europe, small-scale farmers are heavily reliant on EU subsidies and vulnerable to growing competition from non-EU countries. They are also dependent on a migrant workforce whose availability is vulnerable to disruption. The small size of farms, together with limited digital skills and access to further training, present financial and skills-related barriers to the adoption of new technologies that could improve resilience and productivity in unfavourable climatic and demographic conditions. In such contexts, strong support will be needed to enable farmers to embrace new technologies and alternative farming methods that will improve their ability to adapt to climate change and growing market pressures.

Interactions with megatrends

Technology is increasingly used in agriculture to enhance productivity while reducing the environmental impact and resource use stemming from agricultural activities. Technology can support farmers in facing challenges such as extreme weather, volatile prices, changes in consumer behaviour, natural disasters and diseases.[115]

Technology could have the potential to increase productivity and meet higher demand, while supporting adaptation to climate change. New technologies include the Internet of Things – ie the growing use of digitally connected devices (allowing greater monitoring capacity, efficiency and higher quality of products), robotics (to collect data about chemical and water use, and to select plants with better traits), AI (to support yield prediction, disease detection, weed detection, water management and soil management) and big data (to improve farm production practices and enhance the efficiency of the supply chain). Digitalisation of agriculture can help Spanish farmers to alleviate the negative effects of some major problems, such as water scarcity. Indeed, modern irrigation techniques are already widespread and make use of sensors, data processing and information analysis.

Spain is facing a problem of shrinking population in rural areas. Between 2000 and 2018, the rural population decreased by 10 per cent, while the total population increased by 15 per cent. Rural areas in Spain are also ageing: only 4 per cent of farm owners were less than 35 years of age in 2016, 14 per cent were 36–44, 51 per cent 45–64 and 31 per cent were over 65. These factors increase the importance of seasonal migrant labour. Ageing could pose a problem in terms of updating the skills of older workers in view of the deployment of digital technologies in agriculture.

Climate change will have a deep impact on agriculture. Rising temperatures and the increased likelihood of extreme weather events will affect crop yields. Spain already faces high risks of desertification due to the characteristic of its soil. Rising temperatures, lower volumes of precipitation and more frequent droughts and bushfires could put three million hectares of land at risk of desertification in the next 50 years, and by the end of this century, 80 per cent of Spain's territory could be at risk of desertification. To address environmental challenges in a high-impact sector, technological solutions capable of reducing emissions, optimising the use of fertilisers, and reducing the quantity of land, energy and water exploited will be fundamental.[114]

Implications for jobs and skills

In order to successfully exploit the solutions offered by technologies in agriculture, the workforce must be equipped with advanced technical skills and be capable of implementing and managing innovative systems. Therefore, in the future, farmers will need a multidisciplinary skillset, including the ability to control machinery as well as knowledge of informatics, robotics, meteorology, chemistry and biology.[114]

Various interventions are required to improve the digital skills of the agricultural labour force. Education in high-tech skills needs to be boosted, and a higher level of lifelong learning must be implemented to allow workers to keep up with the speed of technological change. Changing the professional profile of farmers to a more digital one could help attract younger workers. New forms of learning are also needed, such as virtual and blended learning (a mix of face-to-face and virtual learning), Massive Open Online Courses (MOOC) offered by universities and peer-to-peer learning. Forms of long-distance learning (eg based on smartphone apps) could be particularly useful for agricultural workers and small-scale farmers who may be unable to participate in costly and time-intensive traditional training formats.[116]

Rural areas require special attention in terms of education, since they show relatively high drop-out rates and relatively low tertiary education rates. Rural workers who wish to upskill or reskill face a double challenge: bridging the educational gap with the urban population while learning new skills which might not be readily available in the local educational system.[116]

The European Commission acknowledges the challenges faced by younger farmers and suggests a set of policies to support generational renewal such as: income support and investment support for young farmers; promoting cooperation and exchanges of assets and knowledge between older and younger workers; and promoting training and educational exchange in the field of agriculture.[117]

Case Study
Adapting to climate risks: how digital and AI skills can strengthen the resilience of wine-making in Spain

Grupo Bodegas Palacio 1894 is one of ACCIONA's business lines with more than 100 years producing and ageing quality wines in Spain in world-known regions, such as Rioja or Ribera del Duero. ACCIONA has a century of experience of a dynamic market and understands that vineyards are vulnerable to the growing challenges of a changing climate. ACCIONA's research and development unit is therefore collaborating with its winery business to test and adopt adaptation and mitigation technologies to address climate risks. Through the 'Aggregate Farming in the Cloud' (AFarCloud) project, the company is studying the application of cloud-based, sensor and drone technologies to monitor soil texture, moisture and water stress in its vineyards, and help promote precision viticulture management. Ultimately the project should increase efficiency and reduce farm labour costs and risks. In turn the development of such projects will provide new and more specialised job profiles.

Fruit picker selecting grapes in Spanish vineyard (Photo Credit: Grupo Bodegas Palacio 1894).

Section 3

Policy recommendations

In order to maintain and develop its economy, the EU will need to manage the effects of several megatrends (automation, demography, resource scarcity and globalisation) on the labour market. This need will be strengthened and its urgency increased due to the Covid-19 crisis, which will have profound implications for Europe's economy and society, and which will drive governments across the world to put in place stimulus and recovery plans. At the same time, the EU must continue to face up to the impacts of climate change and the imperative need to achieve climate neutrality – requiring a set of policies with significant social and employment impacts.

All these objectives can and should be combined: policies should be designed to harness the climate benefits of the megatrends and overcome some of the challenges they bring in a way that delivers a competitive, prosperous and socially just climate neutral economy with a thriving and resilient labour market. At the same time, as governments face up to the economic fallout of the pandemic and develop longer term plans for recovery, they should ensure that they are building back better – supporting economic activity with genuine long-term sustainability, aligned with the industries of the future and effective in addressing other concerns like the climate challenge.

Policymakers have started to grasp the range and depth of actions they need to take, and the EU already has experience and initiatives it can build on. However, greater coherence and resolve is required – some instruments will need to be adapted and strengthened, key approaches should be joined up to exploit synergies and avoid fragmentation, and new policies will need to be developed through a strong social dialogue.

At this moment, there is both opportunity and necessity for climate and environmental breakdown, economic damage, social inequalities and resilience to all be addressed together, if we are to build a stronger and more resilient European economy.

Our recommendations for policymakers are as follows:

1 Commit to the European Green Deal and a clear and managed transition to a climate neutral economy

The European Green Deal, with climate neutrality at its core, provides an opportunity for the EU to develop policies across a wide range of areas to help promote a reinvigorated and modernised labour market in the context of the megatrends and the task of addressing climate change. **Action to mitigate climate change is not optional**, and sensible, **well-managed approaches can have a positive impact** on the environment, economy and employment. But support will be required for workers, sectors and communities that are undermined by climate action and other megatrends to ensure the best economic and societal outcomes.

A transition to climate neutrality has **significant prospects for job creation** in a number of sectors, such as energy, transport and sustainable land management. Another key area is jobs linked to the **circular economy** which are already rapidly growing. Both the new European Commission Industrial Strategy and the Circular Economy Action Plan[61] aim to ensure that the EU instruments supporting skills and job creation also contribute to the acceleration to a circular economy. In order to achieve this, more must be done to identify the skills needed to fill circular economy related jobs and address gaps accordingly. Circularity should be integrated into education and training programmes to provide skilling and reskilling opportunities for workers.[118]

Finally, the future of the European labour market will depend on the EU's ability to remain competitive at a global level. Increasing the EU's know-how and entrepreneurial capacity in low carbon technologies and the circular economy will help **position Europe as a leader** in growing international markets for the design, production, assembly and marketing of clean products.

2 Develop a comprehensive vision to scale up skills and adaptability

The European workforce will cope better if they are supported to be as adaptable as possible to a changing work environment. **Learning skills** and lifelong learning approaches will be key to this. The other most important area will be **digital skills** as automation and digitalisation are likely to most significantly impact jobs and skills. Increasing efforts on digital skills is necessary to enable workers to harness the benefits of these technologies and adapt to the changes they bring. This report has identified some under-recognised priorities and challenges in this area, for example digital skills are in growing demand in sectors such as **agriculture**, where the ageing workforce and limited access to educational opportunities currently restrict their uptake. Generally **older workers**, who will comprise a growing part of the workforce, might need additional support in acquiring digital skills – policymakers have a key role in ensuring lifelong learning. Similarly, **smaller businesses** will often need additional investment and support. Finally, the **Covid-19** crisis has led to a massive requirement for digital infrastructure and skills, with children pursuing schooling online and teleworking, virtual meetings and webinars taking over. It is likely that teleworking and digital services will continue at much higher levels than before.[119]

Given that these skills are key for adaptability, it is important that initiatives in this field do not leave significant parts of the workforce behind. The EU also needs to avoid fragmentation of its initiatives and bring them together behind a **comprehensive vision**, potentially as part of the new Industrial Strategy, which addresses what digital skills need to be developed across various sectors to increase economic competitiveness, resilience and innovation in support of its climate neutrality goal.

3 Establish an inclusive economy through a just transition

The trends outlined in this report have great potential in terms of job creation, but they will also disrupt the economy and lead to job losses, a situation that will be exacerbated by the coronavirus crisis. Policymakers have an essential role to play in providing **support for businesses and workers that are negatively impacted**. Several case studies in this report indicate sectors that are contracting (energy generation from fossil fuels, car manufacturing based around the internal combustion engine), shedding jobs through productivity improvements (agriculture), or transforming in a way that will shift the required skill set (steel, agriculture). In each case existing jobs will be lost through the process of economic change but it is possible to **identify new employment opportunities** where workers will need to be supported to find new careers. Workers should be able to have access to decent jobs, that will increase their wellbeing and higher skilled jobs which will result in higher wages.

The geographic concentration of employment from an affected industry is a key concern. **Regions with a high dependence on a single declining sector (such as coal) should be a priority for support**, and more must be done to anticipate future disruptions in other sectors including the heavy industry and automotive sectors. **Transition plans, designed to help regions steer investments, will need to be consistent with the objective to achieve climate neutrality by 2050** and elaborated through close cooperation between regional governments, industry, investors and trade unions.

4 Define a shared European agenda for the future of work

To deliver sustainable economic development, policymakers will need to work with businesses to **identify and structure sectors that will thrive in the future**. Businesses can help identify skills gaps and shortages that policies could seek to address. For example, in Sweden, where they are focusing on fossil-free steel, the clear direction seems to be towards high-skill jobs in hydrogen-based steel production. This should not be limited to large-scale incumbent industries – in many sectors new businesses are emerging, such as those centred around renewable energy generation. As demonstrated in the offshore wind and coal case studies, such **new businesses** are often able to repurpose some of the skillsets of outgoing workers from declining sectors, or where automation is improving productivity and leading to declining labour demand. **Social partners** (such as trade unions), educational establishments, businesses and policymakers will also need to work together to deliver a regulatory framework for the future of work as well as educational and vocational training programmes. Companies and governments' forward-looking positioning on these themes will contribute to the risks and opportunities being incorporated into analysis by the financial industry. How strategies and operations are adjusted and delivered will impact equity and debt decisions at both business and national level.

European action depends on aligned implementation from its **member states**. Policies related to jobs and skills are mostly national competences, but the EU provides guidance to member states, including advice and analysis on socio-economic challenges and opportunities from the climate and energy transition.[120] National governments across Europe should seek to incorporate these lessons into their climate and social policies.

5 Implement green and equitable Covid-19 recovery plans, while urgently addressing which skills will be needed for the future

The Covid-19 pandemic and its response will inevitably lead to significant economic damage and loss of employment. Recovery plans will need to address both public spending and investment, and also put in place policies and funding instruments (for example from the European Investment Bank and the European Bank for Reconstruction and Development), that incentivise private investment to rebuild economic capacity in an environmentally sustainable way. Public spending can invest in **critical infrastructure** such as energy, transport and digital communications, support **innovation** and clean technologies and fund areas such as **health and social care**, **sustainable land management** and **energy efficiency programmes for buildings**. Sustainable finance principles including the EU Low Carbon Taxonomy should be used to encourage **long-term investment alignment with sustainability goals.** Other key policy options include **public procurement** to provide markets for innovative goods and services such as electric vehicles.

All of these are key areas for business investment, and essential areas to innovate to develop a competitive, climate neutral economy. Policy incentives, such as mandates, fiscal incentives and regulation should all be aligned to ensure private sector activity helps public finance go further. The right expenditure can deliver more jobs quickly. For example, energy efficiency developments are labour intensive and can result in significant job creation, although they will need to be accompanied by **targeted training**. As can be seen in the Romania case study, renovation of the building stock can also offer major opportunities in some of the most disadvantaged regions of Europe. On the other hand, where appropriate **companies receiving public support** should be required to align their investments with common goals such as climate action and resilience.

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