



Claudia Detsch

# It's all about jobs

Investing in Europe's workers and qualifications for a competitive clean economy

**EUROPA**

## EUROPA

### FES Just Climate

FES Just Climate acts as a think tank about current and coming trends, and a policy advisor in ongoing debates. We support FES offices and their partners in shaping the industrial revolution of our times.

Further information on the project can be found here:

<https://justclimate.fes.de/>

### Friedrich-Ebert-Stiftung

The Friedrich-Ebert-Stiftung (FES) is the oldest political foundation in Germany with a rich tradition dating back to its foundation in 1925. Today, it remains loyal to the legacy of its namesake and campaigns for the core ideas and values of social democracy: freedom, justice and solidarity. It has a close connection to social democracy and free trade unions.

FES promotes the advancement of social democracy, in particular by:

- Political educational work to strengthen civil society
- Think Tanks
- International cooperation with our international network of offices in more than 100 countries
- Support for talented young people
- Maintaining the collective memory of social democracy with archives, libraries and more.

### About the author

**Claudia Detsch** is the director of the FES Competence Centre for Climate and Social Justice. Previously, she was editor-in-chief of the IPS Journal in Berlin and editor of the Buenos Aires-based journal Nueva Sociedad. From 2008 to 2012, she headed the FES office in Ecuador and the Foundation's regional energy and climate project in Latin America. She is a sociologist and studied in Hamburg and Barcelona.

Collaboration, interviews and research: Maximilian Herzog, Sarah Lösel, Andrii Makarenko, Julian Parodi, Stephan Thalhoffer, Steffen Verheyen

**Claudia Detsch**

# It's all about jobs

Investing in Europe's workers and qualifications  
for a competitive clean economy

<b>INTRODUCTION</b>	<b>2</b>
<b>I FORECASTS OF CHANGES IN LABOUR MARKETS AND SKILLS</b>	<b>4</b>
What are "green jobs"?	4
General labour market trends in Europe	6
Employment effects of the climate-neutral transition	6
Renewable energy sector overview	7
Employment effects in selected energy sectors	7
Coal	7
Hydrogen	8
Circular economy	8
Steel sector	9
Automotive sector	9
Construction sector	10
Shortage of skilled workers as the bottleneck of the energy transition	12
The double transition: digitalisation as a factor in climate-neutral transformation	12
Chemical industry	12
Electricians	13
<b>II THE VIEW OF EMPLOYEES AND LABOUR MARKET EXPERTS ON THE CLIMATE-NEUTRAL TRANSITION</b>	<b>14</b>
Clarifying political framework conditions	14
Strengthening trade unions in times of change	14
Shaping European industrial policy together	15
Avoiding labour market segmentation	16
Increasing women's power in the energy transition	17
Establishing social dialogue as a pull factor	17
Investing in education and training	18
Making companies more responsible, reaching out to SMEs	18
Best practice examples	20
<b>SUMMARY AND CONCLUSIONS</b>	<b>22</b>
Abbreviations	25
References	26

# INTRODUCTION

Europe is at the beginning of a massive structural change. The effects of increasing climate change are already becoming apparent. There is widespread social consensus that a climate-neutral transformation of the economy and society is necessary. Yet, the conditions for a successful transformation in Europe are challenging. Europe does not have energy self-sufficiency, and it has no prospects to achieve it in the foreseeable future, unlike its main competitors. Moreover, the Russian attack on Ukraine and its consequences have increased the prices of energy; natural gas as a transitional fuel for the transformation is no longer as readily available as it was.

The energy transition towards renewables and green hydrogen must be accelerated accordingly. However, this acceleration cannot be ramped up without limitations. There is a lack of efficient administrative processes, for example in planning and tendering, as well as a lack of financial resources, technological components and essential raw materials. And there is an increasing shortage of adequately qualified professionals.

Europe's competitiveness has not historically been based on low electricity prices. Other regions have long had comparative advantages in this area. So far, Europe has been able to compensate for this disadvantage through other factors. These include a good infrastructure, a high-quality research and science landscape, and skilled workers. Europe must ensure that it does not fall behind in these areas. This would have an impact on international competitiveness, labour markets, state coffers and ultimately also on prosperity and democratic stability.

Accordingly, the labour market and employment, including education and training, must be at the centre of political and public attention. The choices we make now will determine prosperity and security in Europe in the coming decades. At the same time, these questions are closely intertwined with fundamental decisions concerning the future of Europe as an economic and industrial location. Here as well, fundamental decisions of immense proportions are at stake.

Trade unions and industry associations are worried about competitiveness and job retention in domestic production. Concern regarding companies and even entire industries relocating, combined with the fear of not having access to

sustainable, climate-neutral technologies, is driving the resurgence of structural and industrial policy in Europe. However, financial resources are limited.

How much is Europe willing to invest to maintain or rebuild key industrial sectors in the region, both as quickly and as climate-neutral as possible? Should the European industrial architecture be more strongly adapted to the potentials of the individual Member States? Should energy-intensive production be relocated within Europe or should it be newly established in order to prevent it from migrating to other regions? Or is it enough to focus on sufficiently diversified supply relationships, while selectively promoting sectors with comparative advantages, such as cutting-edge technology? Or does Europe want to – and is it able to – establish the mass production of climate-neutral key technologies for its domestic market and the world market? So far, this debate has not been conducted strategically, neither in Brussels nor in the Member States, let alone *among* the Member States.

However, European labour markets depend heavily on the outcome of such debates and the industrial and structural policy decisions based on them. The same applies to reforms in employment policies. A study like this one can only provide limited information about the European labour market in 2030 or 2050. It can show scenarios, clarify forecasts and provide important indications. Whichever industrial policy path Europe decides to take, the effects on jobs and employment will be massive. But whether the desired industrial policy paths can realistically be taken at all depends on the availability of sufficiently qualified and motivated employees.

The climate-neutral transformation and its effects on the labour market and employment has been discussed for some time, generating some controversy. Depending on the orientation and affiliation to certain sectors, there have been warnings of massive job losses in particularly affected sectors in the past, contrasted with references to true “green” job miracles in the future.

The second level of this structural change, however has received little attention so far. It is not only a question of “old” jobs disappearing, for example in the coal industry, or of new jobs in battery production. The restructuring will change the requirements profile for a large number of jobs;

the majority of jobs will stay, but new knowledge and skills will be demanded. The actors involved must sufficiently prepare themselves for this.

In the first part of this study, we want to outline the current status of employment in relevant sectors affected the most by the restructuring, as well as possible future development paths. We equally want to shed light on the effects on the labour market and employment in general. Precise projections are scarce for many sectors. It is also clear that data, if issued by industry associations, must often be viewed in their specific perspective. Associations for climate-neutral technologies generally assume favourable scenarios and, accordingly, predict positive employment developments. This is logical and understandable because they call for favourable political and financial framework conditions and, based on this, hold out on the prospect of a positive performance in the labour market.

By contrast, industries put under pressure by the restructuring are more likely to emphasise the feared loss of jobs in order to underpin the demand for corresponding protection or adjustment measures.

The comparable and general nature of the figures is limited due to the different sectoral coverage, time horizons and political expansion scenarios in the documents analysed. Therefore, in the second part, qualitative interviews are used to discuss assessments of the current and expected future labour market situation, as well as strategy-building processes for climate-neutral transformation. Semi-structured interviews were conducted with a total of 45 trade unionists and labour market experts in 18 European countries.

Based on the secondary analysis and the contents of the interviews, recommendations are formulated in the last part.



# FORECASTS OF CHANGES IN LABOUR MARKETS AND SKILLS

## WHAT ARE “GREEN JOBS”?

In order to quantify developments in labour market figures in individual sectors, as well as future qualification needs, it is first worth taking a closer look at the term “green jobs”. Different definitions are circulating; what they have in common is that they distinguish between entirely new occupational profiles and those that have to adapt to the needs of the green transition.

The United Nations Environment Programme (UNEP) first defines green jobs in very general terms as “positions in agriculture, manufacturing, construction, installation, and maintenance, as well as scientific and technical, administrative, and service-related activities, that contribute substantially to preserving or restoring environmental quality.” (UNEP 2008, 35f.). According to the International Labour Organization (ILO), these jobs contribute to efficient consumption of energy and raw materials, limit greenhouse gas emissions, minimise waste and pollution, protect and restore ecosystems, and help adapt to climate change. Green jobs are not only found in emerging sectors such as renewable energy and energy efficiency. Jobs in traditional sectors such as manufacturing or construction also fall under this description, depending on their orientation (ILO 2016). Some existing jobs will also be in greater demand in the future due to the transition to a climate-neutral economy; corresponding additional qualifications will be necessary here to varying degrees. Jobs in administration or the financial sector contribute indirectly to the green transition; as in other contexts, qualifications may need to adapt to this. Finally, “brown jobs” must also be considered: jobs in sectors that will become redundant in the future. The most prominent example is the coal miner. Closely connected to this is the question of how existing qualifications can continue to be used and transferred to other sectors or how new ones can be acquired.

According to the ILO definition, “green” jobs must also be “decent”. This reference to the quality of jobs also emerges from the Paris Agreement: signatory countries must “[...] [take] into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities [...]” (United Nations [UN] 2016, 2).

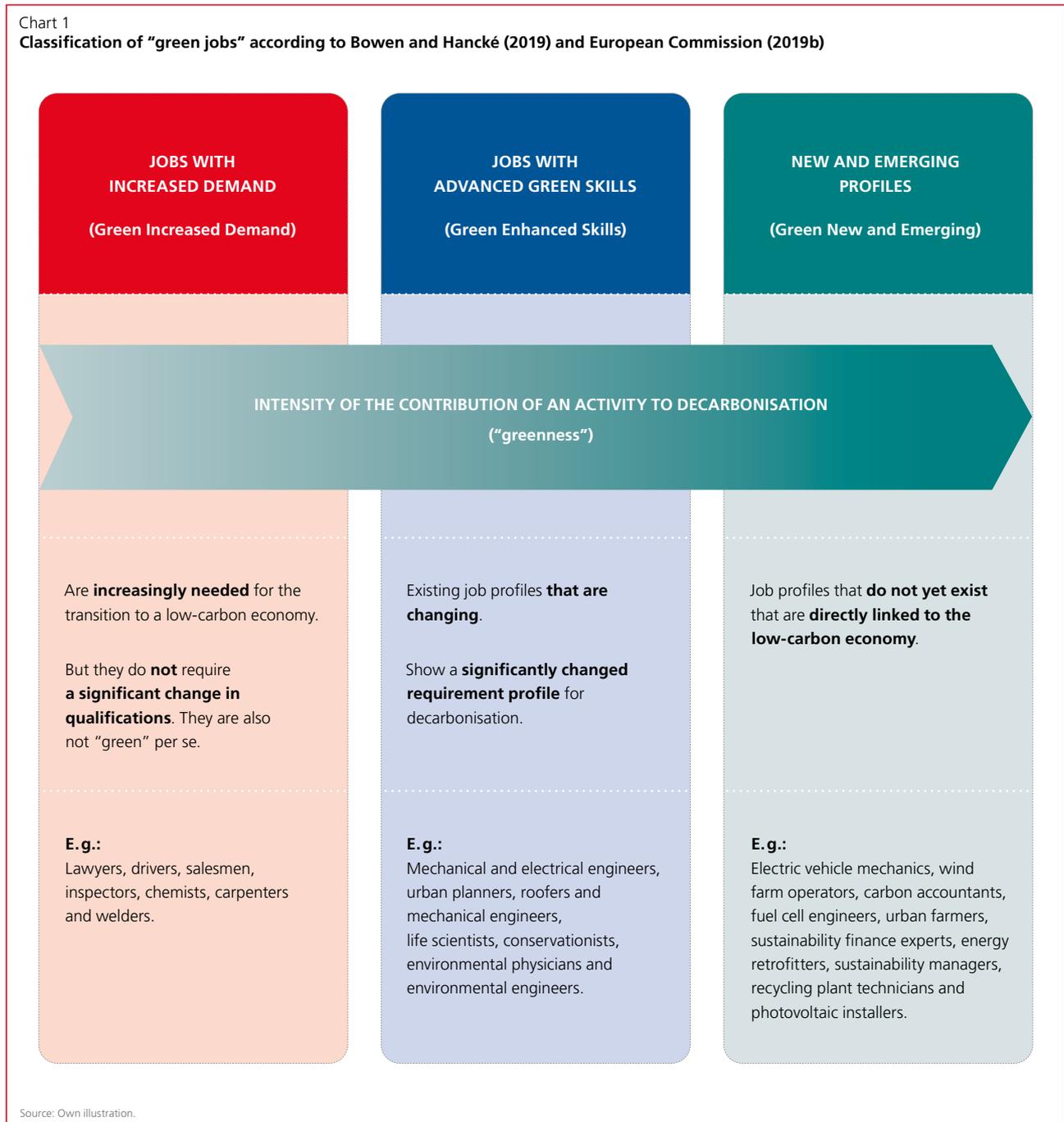
The European Commission uses a classification for a more specific definition of green jobs, which was introduced by

Bowen and Hancké (2019). This classification is based on the work of the Occupational Information Network (O\*NET) of the US Department of Labour, which determines the intensity of the relationship of green jobs to the decarbonisation of the economy (“the greenness of a job”) for all existing job profiles. The underlying job profiles correspond to the International Standard Classification of Occupations (ISCO), so they are also applicable to Europe. Chart 1 below provides an overview of the typology, consisting of three key profiles relevant to the development of the decarbonised economy: jobs with increased demand, jobs with enhanced green skills, and new and emerging job profiles.

Researchers working on the Green Jobs Now project on behalf of Lightcast and WorkingNation (Sedeberg, Markow, Joel 2023) came to similar conclusions. They identified four types of green jobs with different requirements in the low-carbon economy. The first three are congruent with the O\*NET classification, with the addition of the category “potentially green jobs”:

- “Core Green Jobs” are jobs that are created as part of the transition to a green economy and contribute directly to the preservation of the environment. Examples are solar engineers and energy efficiency specialists.
- “Green Enabled Jobs” are occupations that are not directly linked to the low-carbon economy, but where there is a growing demand for green skills. These include heating and air conditioning installers who introduce new, more energy-efficient products, or mechanics who develop such new systems.
- “Green Enabling Jobs” do not necessarily require environmental skills; however, they are located in companies related to the low-carbon economy, such as marketing managers for a solar company.
- “Potential Green Jobs” are jobs that currently have little connection to the low-carbon economy but may require green skills in the future. Examples are maintenance technicians and engineers.

The European Foundation for the Improvement of Living and Working Conditions (Eurofound) estimates that the greening of the European economy has little or no impact on 62% of the current jobs. 15% currently fall into the cat-



egory of jobs with increased demand and 14% into the category of jobs with enhanced green skills. 9% of jobs have new or emerging profiles (Contreras 2023).

The European Commission's Employment and Social Report (2019b) also specifically points to the change in skill requirements. In all three job categories (increased green demand, enhanced green skills and new green profiles), skills requirements have increased significantly in recent years; however, this is primarily the case in the medium and high skill levels. In the low-skill sector, the requirements have fallen (European Commission 2019b). If the European Green Deal's implementation is reinforced, it is expected that the trend will intensify. On the one hand, this will affect the demand for corresponding qualification offers. On the other hand, it raises the question of: i) whether activities with a low level

of qualification are increasingly being pushed out of the labour market by automation and digitalisation, ii) whether a response would be necessary through qualification measures or iii) whether, conversely, target groups with a low level of qualification that have been distant from the labour market could be led back to the labour market through this segment.

According to a study by the consultancy firm McKinsey (2020), up to 17.7 million workers in the EU will need to be trained or retrained for the transition to a low-carbon economy by 2050. 12.2 million of these are jobs that will change due to the climate-neutral transition and will require training. 3.4 million are for newly created green jobs and 2.1 million are for retraining workers whose jobs will become redundant (McKinsey 2020).

## GENERAL LABOUR MARKET TRENDS IN EUROPE

In mid-2023, the employment rate of 20-64-year-olds in Europe was 75.7% and the unemployment rate was at 5.9%. This is a historic high and low, respectively. At the same time, the number of job vacancies has risen significantly from around 2% before the onset of the Covid-19 pandemic to just under 3% now. This represents a continuously increasing trend at least since 2013 (1.2%) (Eurostat 2023). Thus, the shortage of skilled workers is worsening. The occupations with the greatest skills shortages in Europe vary from country to country. However, overall, the shortage of qualified applicants is very widespread in the fields of software, healthcare, construction, engineering, nursing and teaching (European Labour Authority 2022). According to the World Economic Forum's *Future of Jobs Report* (2023), the most in-demand jobs in Europe include highly skilled profiles such as data analysts, AI specialists, software developers and programmers, and digital marketing specialists (World Economic Forum 2023). The European Centre for the Development of Vocational Training (Cedefop) points out that jobs are becoming increasingly skills-intensive (Cedefop 2023). Accordingly, the major problems in the European labour market include skills shortages, growing demands due to automation and, especially, the demographic development.

In line with the overall picture of high employment rates, youth unemployment has also recently fallen to just under 14% and the share of young people neither in employment nor in education or training was also at a low of 11.7% in 2022 (Eurostat 2023). Nevertheless, these figures at the age of entry into the labour market are considered clearly too high. In some countries, including Spain, Italy, Greece or Romania, they are also much more pronounced.

The lower (full-time) employment rates of women are also a hurdle for future development, as is the lower labour force participation of people with low levels of education. The proportion of women working part-time is highest in Europe in the Netherlands, Austria and Germany and is three to four times higher than for men (Statista 2023).

## EMPLOYMENT EFFECTS OF THE CLIMATE-NEUTRAL TRANSITION

Various studies are looking at the employment effects of the climate-neutral transition. These studies can only be collated into a precise overall picture to a limited extent, as the framework conditions of the underlying scenarios differ. For example, the development of the labour market depends on external influences such as geopolitical developments, on the one hand, and political decisions within Europe, on the other. The debate on how these industrial and structural policy directions should be set in the coming years is only just gaining momentum. The answers, however, will have a massive impact on the labour market in Europe, as well as the job profiles and the requirements for education and training. Conversely, whether the course of decarbonisation

can be set as intended will depend on the developments in the labour and training markets.

Since the Covid-19 pandemic and the Russian war in Ukraine disrupted supply chains and imports, a purely market-based approach no longer seems justifiable, even in the European Union. So far, EU internal market and competition rules have been poorly compatible with state intervention, whether through market control or subsidies. However, security of supply and sovereignty have now asserted themselves as key political goals beyond emergency measures. At the same time, public financial resources for state subsidies and guidance are limited, not least because of the consequences of the pandemic and the war.

In the investment-intensive transformation to climate neutrality, the European states must therefore now decide which key industrial sectors they want to retain or build up. Do we need our European solar industry for diversified supply chains, when in the meantime considerable capacities are also being built up outside China in various economies such as the USA and India? Or should the EU, with its excellent research capacities, serve high-tech areas and leave mass production to economies with lower energy costs? Should such specialisation take place everywhere in Europe or rather with a regional focus? Is it possible and desirable to better adapt Europe's industrial architecture to the potentials of the individual Member States, at least in energy production, while ensuring the greatest possible autonomy in various sectors? So far, such a debate is not being conducted strategically either in Brussels or in – or even between – the individual Member States. For as long as these decisions are not made and strategically underpinned, statements on the labour market and strategies of the relevant institutions will remain imprecise.

Other factors complicate reliable predictions about the labour market and qualifications. For example, the projections consider different sectors; in addition, sometimes only direct jobs are looked at, while other times indirect jobs are also included. The energy transition is also defined in different ways, for example in terms of the expansion paths of renewable energies or the extent of electrification of transport. In addition, the job growth rates can shift over time. Therefore, the forecasts naturally differ from one another. However, one trend can be clearly discerned: overall, there will be neither a massive job slump nor a job miracle in Europe as a result of the climate-neutral transformation, but there will be slight increases.

For Europe, a study commissioned by the Hong Kong and Shanghai Banking Corporation (HSBC) projects that 9 million new jobs will be created and 6 million lost by 2040, a net increase of 3 million jobs (Vivid Economics 2021). McKinsey (McKinsey 2020) arrives at a stronger trend, but by 2050: under a low-carbon transition, 11 million jobs would be created and 5 million lost, a net gain of 6 million.

The majority of other studies assume a slight net increase in jobs, as stated by the Joint Research Centre of the European Commission (Joint Research Centre 2021b). Measures leading to the targeted 55% reduction of greenhouse gas

emissions in the EU by 2030 could have a “moderately positive effect on the total number of jobs” (Joint Research Centre 2021b, iv). Neither the promise of a “green” jobs miracle nor the spectre of large-scale job losses as a result of decarbonisation are therefore accurate according to these projections.

## RENEWABLE ENERGY SECTOR OVERVIEW

According to the International Renewable Energy Agency (IRENA), about 13.7 million people were directly and indirectly employed in the renewable energy sector worldwide in 2022 (IRENA and ILO 2023). The International Energy Agency (IEA) puts the number of people directly employed in low-carbon power generation (including nuclear power) at 7.8 million in 2021, which is now half of all people directly employed in the energy industry (IEA 2022).

The IEA forecasts that between 2022 and 2030, 13 million additional workers will be employed in renewable energy and related sectors worldwide (IEA 2022). IRENA and ILO estimate a figure almost twice as large in their joint annual report on employment in the renewable sector. They assume that the number of jobs in the renewable energy sector will grow exponentially in the coming decades, in parallel with the sector’s turnover. They expect global employment in the renewables sector to grow by more than 25.5 million jobs between 2022 and 2030, which would translate into about 38.2 million jobs by 2030. By 2030, another 74.2 million people could also be employed in energy efficiency, electric vehicles, energy systems/flexibility and hydrogen. More than half of the employment is concentrated in the Asia-Pacific region. China alone has an overall share of 41% and leads globally with about 56% of solar energy jobs and 48% of wind energy jobs (IRENA and ILO 2023).

## EMPLOYMENT EFFECTS IN SELECTED ENERGY SECTORS

### Wind

Currently, Europe’s wind industry provides a good 400,000 jobs (IRENA and ILO 2023). WindEurope (2022) estimates that the EU will add about 20 GW of wind capacity per year between 2023 and 2027 (30 GW per year would be needed to meet climate targets). The most recent available employment forecast for the sector comes from WindEurope in 2017, which projected 716,000 jobs for the entire wind industry in a scenario with an assumed annual addition of 17 GW between 2017 and 2030. Based on this calculation, at least 400,000 new jobs will be created by 2030.

According to WindEurope’s forecasts, Germany will be Europe’s largest wind market owing to the expected output of the onshore market in the next five years (19.7 GW) and the increasing offshore installations (5.4 GW). However, Germany is also an impressive example of how much geo-economic decisions in other parts of the world (especially China) and its own industrial policy choices can massively influence ac-

tual development. The production of wind turbines and components has collapsed massively in Germany since 2017 and companies have disappeared from the market. As a result, employment figures are also almost 40% below those of 2016; in 2020, around 100,000 people were still employed in the onshore and offshore industries. This decline in employment is also associated with losses of relevant qualifications, which are now becoming painfully apparent given the shortage of skilled workers (Hans-Böckler-Stiftung 2023).

On the other hand, employment in the service and maintenance sector, a field with traditionally demanding working conditions, has increased. In the future, the upcycling and recycling of older plants is likely to gain enormously in importance, as they are necessary given the scarcity of raw materials and the requirements of the circular economy (Hans-Böckler-Stiftung 2023).

### Solar energy

The solar sector is very dynamic with regard to rollout and therefore also employment. In its Solar Energy Strategy 2022, the EU Commission, with reference to the *EU Solar Jobs Report* (2021) by SolarPower Europe, puts the industry’s workforce at 357,000 direct and indirect jobs in 2020 (European Commission 2022). IRENA estimates current employment in the solar sector in Europe at 540,000 in 2022 (IRENA and ILO 2023). According to the latest SolarPower Europe report, direct and indirect employment in the solar sector together amounted to 648,000 full-time equivalents in 2022. Of this, 84% was in plant construction, 8% in operation and maintenance, 7% in manufacturing and 1% in dismantling and recycling (SolarPower Europe 2023). In a middle-of-the-road scenario, employment would continue to grow to 1.2 million in total by 2027. The fields of activity will increasingly shift within the sector from manufacturing and construction towards maintenance and recycling. Finally, by 2050, decommissioning or recycling of PV systems will account for a significant part of employment in the solar panels and PV systems sector (SolarPower Europe 2022).

### COAL

In some sectors, the climate-neutral transition will lead to job losses, as is the case in the coal industry. For decades, the coal sector was one of the most important factors in European energy production and a major employer. The sector experienced a sharp decline in employment as early as the early 2000s. For the current level of employment, recent studies (European Court of Auditors 2022) draw on figures from the Joint Research Centre of the European Commission. According to these, around 159,000 people were employed directly in coal mining, 49,000 in coal-fired power plants and an estimated 1,300,000 along the supply chain (Joint Research Centre, 2021a), making a total of around 3,400,000 people employed in the coal sector across Europe. Most jobs are in Poland, Germany, the Czech Republic, Romania and Bulgaria.

With the planned phase-out of coal for energy production, employment in this sector will continue to shrink. Since the timing of the coal phase-out is the subject of ongoing debates (mostly envisaged for after 2030 in coal-intensive countries), different projections exist depending on the scenario. The Joint Research Centre expects very different figures for direct job losses by 2030, depending on the scenario. Based on the current National Energy and Climate Plans of the Member States, it calculates a decline of 54,000 direct jobs by 2030. With a scenario based on the ten-year network development plans (TYNDP) of the European Transmission System Operators, on the other hand, the Joint Research Centre calculates an almost twice as high decline of 112,000 direct jobs (Joint Research Centre 2021a). Furthermore, a strong reduction of the remaining jobs is to be expected after 2030 in the course of further decarbonisation.

The example of the coal sector is a good illustration of a fundamental challenge posed by the climate-neutral transition: The newly created jobs in the renewable and clean-tech sectors are decentralised to various locations and not necessarily under comparable working and wage conditions. In contrast, the job losses due to the end of coal production and use are concentrated in certain regions. This is exemplified in Germany and France in a study by the DFBEW (2021). A study by the World Wildlife Fund (WWF 2021) confirms this characteristic for the Eastern and South-Eastern European coal regions. At the same time, it points out that more jobs can be created in these countries through the climate-neutral transformation than will be lost.

Such new jobs can also be located in the industrial regions affected by structural change. This requires a forward-looking industrial policy and concerted action by local players. In Germany, trade unionists also assess the employment effects as balanced to positive. But here too, the challenge is that many of the newly created jobs in clean-tech sectors are less well paid than those in traditional sectors such as the coal industry (Anhelm, Erich, Tuttlies et al. 2020). In addition, union density is generally much lower in the new sectors, which is a burden for trade unions. In any case, it will depend on the extent to which, in addition to the loss of jobs, the corresponding skills become obsolete or how adaptable they already are in other industrial sectors or can become it through further training.

## HYDROGEN

Green hydrogen is considered the key to a climate-neutral energy economy and industry. Currently, its use is limited to a few industrial and chemical sectors. In an increasingly climate-neutral economy, its potential lies primarily in applications that cannot be electrified. In the long term, hydrogen is likely to be used primarily in the chemical industry, the steel industry, aviation, shipping and parts of heavy goods transport. There are different forecasts and scenarios on the question of what quantities of hydrogen can be produced in Europe itself and how much will have to be imported in the

future. In this context as well, the actual expansion path depends heavily on political decisions and regulatory framework conditions.

However, the question of the manufacture and job potentials of hydrogen extends beyond the production of hydrogen itself; there is also great employment potential in mechanical and plant engineering, research and development, logistics, and the transport and storage of hydrogen. A good example is Germany, where the conditions for the production of green hydrogen are less favourable than in other industrialised countries. But German manufacturers are world market leaders in the production of electrolyzers, which are needed to produce hydrogen.

To forecast the employment effects, a study by Navigant Consulting (2019) for the European Commission is based on a scenario in which gas from renewables is also used for transport and peak demand in heating and electricity generation. It forecasts almost 1 million direct and indirect jobs for the green hydrogen economy in Europe by the time zero emissions are achieved in 2050. In contrast, the Hydrogen Roadmap Europe assumes that by 2030, more than one million new jobs will be created in the hydrogen economy as a whole. Half of these will be in the production of manufacturing plants and the expansion of infrastructure. By 2050, as many as 5.4 million jobs are forecast (Fuel Cells and Hydrogen 2 Joint Undertaking 2019).

The increase in employment will be concentrated in public research institutions and the manufacturing industry. Here, an increased demand for engineers and technicians is predicted. The demand for specialists will also increase in the construction industry and its upstream sectors. Accordingly, there are already warnings that the worsening shortage of skilled workers could delay the ramp-up and negate the employment effects. There are calls for strategic planning and an attractive design of education and training that are also interlinked at the European level. In the hydrogen sector, too, it can be assumed that the employment effects will begin to be felt unevenly from region to region. Regions with lower production costs for renewable energy are likely to benefit. Previous centres of heavy and basic industry will be more intensively affected by structural change (Steege, Helmrich, Maier et al. 2022).

## CIRCULAR ECONOMY

According to a study prepared for the European Commission (2018), the transition to a more circular economy could lead to an increase in employment of around 650,000 to 700,000 jobs between 2018 and 2030. The majority of these jobs would be in the waste management sector (European Commission 2018). This finding again shows how different policy approaches affect the development of industries and the labour market. The models for the circular economy currently still focus strongly on waste management. But there is also great development potential in the repair of goods and the extraction of metals and minerals from higher-value products. These have not been pursued

intensively enough so far; however, they have a great environmental impact and expansion potential for industry and the labour market.

## STEEL SECTOR

A look at the steel sector illustrates both the challenges and the opportunities of the climate-neutral transition. It is clear that in this sector in particular, actual development is closely linked to industrial and structural policy decisions. The debate on the future viability of the European steel sector exemplifies the overarching decisions that Europe has to make in the immediate future.

The steel sector currently provides over 330,000 direct jobs and 2.67 million indirect jobs in the EU. Steel production in the EU is concentrated in a handful of countries. Germany produced 26% of EU steel in 2020, followed by Italy (15%), France (8%) and Spain (8%) (European Research Executive Agency 2022). The steel sector is often at the centre of the debate on making European economies carbon-neutral. The switch to green steel production, based on the use of green hydrogen, is seen as the key to reducing CO<sub>2</sub> emissions. This primarily involves the introduction of environmentally sustainable methods such as direct reduction using hydrogen and electric arc furnaces powered by renewable energy sources. Until now, steel production has been based primarily on coal and other fossil fuels. At the same time, the transformation is cost-intensive. Accordingly, the impact on the labour market will also be significant; both challenges and opportunities are associated with this transformation.

The lack of forecasts on employment development in the course of decarbonisation of the sector indicates that predictions are difficult to make. The Green Steel for Europe Consortium (2021) alone drafts six development scenarios for the steel sector in Europe, but without addressing employment effects. Nevertheless, the different assumptions underlying the scenarios make it obvious on which factors the sector depends. These include in particular the availability and, correspondingly, the prices of green electricity and green hydrogen, but also the development of CCS and CCU technologies, as well as the availability of other raw materials such as ore and iron scrap.

In order to provide new employment opportunities for people in this structural change, opportunities for further training in green steel production or in other sectors will be crucial. The shift to low-carbon steel production can at the same time create an increased demand for labour, such as for the development and construction of the new plants and for the operation and maintenance of the new technologies. The number of jobs related to hydrogen-based reduction processes, electric arc furnace operation and renewable energy infrastructure is expected to increase, provided that national governments choose to support the transition with industrial policy.

In research and development, new production processes mean that there is an increased need for scientists and engineers, for example in the fields of materials science, metal-

lurgy and environmental science. The shift to carbon-neutral steel production will have an impact on the entire supply chain. Manufacturers of renewable energy equipment, hydrogen production technologies and the processing of sustainable raw materials could see increased demand, which should lead to employment growth in these sectors. IT professionals are also likely to be in greater demand due to growing automation and data analytics requirements (European Commission 2020a).

## AUTOMOTIVE SECTOR

The automotive sector will undergo major upheavals. From 2035, no new cars with combustion engines are to be sold in the EU. Ernst and Young estimate that, by that time, there will already be 130 million electric cars on Europe's roads (Colle, Micallef, and Horstead 2022). This transition has implications for production and jobs in the automotive sector. On the one hand, the production of individual components of e-cars is significantly less labour-intensive. This applies in particular to the powertrain (Bauer, Riedel, Herrmann 2020). On the other hand, the qualification profiles of employees differ considerably between combustion engines and electric cars. In addition, forecasts assume a strong specialisation of individual countries. It can be expected that the production of electric cars in Europe will be more concentrated in countries such as Germany, France or the UK. One indication of this is that battery cell production is planned for these countries and the final assembly of electric vehicles usually takes place close to battery production. This also speaks for the expansion of the production of batteries and, as a result, of e-cars in locations with cheaply available low-emission energy, such as Norway, Sweden or Spain (McKinsey 2021).

The four Visegrad countries (Czech Republic, Hungary, Poland and Slovakia) currently assemble one-fifth of the cars sold in the EU. They are expected to specialise in the recycling and reuse of internal combustion cars in the future (Pavlinek 2023). In fact, the decommissioning and partial recycling of internal combustion vehicles will require thousands of workers in the coming years. One pioneer is Renault, which has transformed its plant in Flins, where more than 20,000 workers were employed in the 1970s, into a "refractory". The company trains workers there to repair and decommission old combustion cars. This includes recycling the materials contained in the batteries, such as nickel, manganese and cobalt (Béziat 2021). As EU standards for the recyclability of vehicles and the recovery of the raw materials they contain continue to rise, it is expected that the relevant skills will continue to be needed even after the combustion engine becomes obsolete.

However, forecasts on the future demand for jobs in the expanded automotive sector are difficult to make, as development depends heavily on industrial and energy policies. A study by Agora Verkehrswende and Boston Consulting Group on the German automotive sector underlines this (Agora Verkehrswende 2021). In 2023, the sector will directly and indirectly provide a total of around 1.7 million jobs in

Germany. The authors assume a targeted settlement of new industries and sufficient education and training of employees. Based on this, they forecast massive shifts, but a constant number of jobs overall. By 2030, around 205,000 jobs will be added in Germany to manufacturers and suppliers, in energy infrastructure and energy production, as well as in mechanical and plant engineering. Among suppliers of powertrain-independent components alone, the growth would amount to 95,000 jobs; these are battery manufacturers in particular. The prerequisite, however, is that the demand for battery cells would be met primarily through production in Germany. Within associated industries such as energy infrastructure, 110,000 jobs would be created, for example in the maintenance of the necessary infrastructure such as charging stations. In the energy sector itself, further jobs would be created by the expansion of renewables necessary for electrification, as the labour intensity is higher than for fossil power plants.

In contrast, in traditional areas such as the classic production of automobile bodies and the maintenance and supply of combustion engines, about 180,000 jobs will be lost in Germany by 2030. Of these, 70,000 jobs would be lost at the car manufacturers themselves due to higher automation and the reduction of components. In the powertrain-focused suppliers, another 95,000 jobs would be lost; in the maintenance industry, another 15,000 jobs.

According to the study, about half of the jobs in the German automotive industry would remain constant despite the conversion to electric mobility. Other jobs in the automotive industry can be retained through retraining. Of these, 500,000 employees could remain in the same company and job with slightly different requirements, flanked by in-service training. 190,000 workers would have to change jobs within the industry, with a considerable need for retraining. 70,000 employees, on the other hand, would have to change to a new job or another industry sector.

Without giving more detailed figures for Germany, Director of the Centre Automotive Research in Duisburg, Ferdinand Dudenhöffer, explains, “If you add the new jobs in battery production, in the digital sector and in the charging infrastructure, the positive net effects will be greater than the negative ones” (NTV 2022).

For Europe, Cedefop forecasts relatively small net positive changes for employees in the motor vehicle sector by 2030 due to the implementation of the European Green Deal. It projects a net increase of 23,000 jobs (Cedefop 2021). It further states that employment will start to decline around 2040 as learning effects and digitalisation accelerate. A study commissioned by the supplier industry is much more pessimistic, predicting more than 200,000 new jobs in the European e-vehicle sector by 2035, but at the same time a loss of around 450,000 jobs in the combustion segment (European Association of Automotive Suppliers [CLEPA] 2021). In addition, only about half of the required qualifications are transferable from combustion engine to e-technology. The entire production chain around batteries, but also the electronic powertrain, connectivity, charging infrastruc-

ture, manufacturing, safety and drive components require intensive retraining for employees previously working in traditional production. Unlike other sectors, the skills gap is wider in the automotive sector (Vivid Economics 2021). Even when natural fluctuation and early retirement programmes are taken into account, many workers will continue to be in need of upskilling.

For battery production, a study by EIT RawMaterials and Fraunhofer forecasts around 135 direct and 850–900 indirect jobs per GWh (Thielmann, Neef, Hettesheimer et al. 2021). By 2030, demand for batteries is expected to reach 400–1000 GWh, which would mean about 50,000–135,000 jobs in battery production and another 340,000–900,000 in supplier industries. The European Commission, on the other hand, expects that a boom in the battery sector, not least in the context of the European Battery Alliance, will create 3 to 4 million new jobs by 2025 (Šeščovič 2021), including electrochemists, process engineers and recycling experts.

These strongly diverging figures can be attributed to differences in the inclusion of indirectly affected sectors. In addition, the number of employees depends strongly on the extent to which independent European battery production is ultimately established and on the relationship between domestic production and imports. Moreover, batteries will not only be important for the automotive sector. Decentralised and flexible energy grids – vital in the era of renewables – need stationary storage systems, which essentially include batteries.

## CONSTRUCTION SECTOR

The construction sector plays a key role in the energy transition. A large number of workers are needed, on the one hand, for the construction of renewable infrastructure and various clean-tech facilities and, on the other hand, for the comprehensive energy refurbishment of existing buildings. IRENA assumes that in the course of the energy transition, the construction sector will experience the strongest growth in the labour force. Accordingly, around 4 million new jobs will be needed worldwide by 2030 for the construction of new plants (IRENA and ILO 2021). In Europe, differences between individual countries become apparent: Poland and Bulgaria are expected to lose construction jobs, while Germany and Denmark will gain some (Stehrer 2022). An EU study estimates that the renovation of existing buildings will create 160,000 additional jobs by 2030 (Joint Research Centre 2021b). A McKinsey study projects an increase in direct employment in the construction sector of 500,000 by 2030 and 1.1 million by 2050 (McKinsey 2020).

The European Federation of Building Trades Unions examines various scenarios within the framework of the European targets for building renovation until 2030 and comes up with almost 460,000 to 1.5 million additional jobs needed. Taking into account retirements by 2030, a total of 2.8 million jobs need to be filled in the construction sector (Mella and Werna 2023).

Table 1

## Overview of job increases and decreases

Sector	Direct employment	Indirect employment	Total*	Time horizon	Source		
Worldwide, Renewable	7,800,000		13,700,000	2022 (current situation)	IRENA & ILO 2023		
			+ 13,000,000	2030 (announced pledges scenario)	IEA 2022		
			+ 25,500,000	2030	IRENA & ILO 2023		
Worldwide, Energy Efficiency, Electric Vehicles, Energy Systems/Flexibility and Hydrogen (worldwide)			74,200,000	2030	IRENA & ILO 2023		
Europe, Net Zero total			+ 11,000,000	2050	McKinsey 2020		
			- 5,000,000	2050	McKinsey 2020		
Europe, Green transition (transport, construction, energy production, supply chains, land use)			+ 9,000,000	2040	Vivid Economics 2021		
			- 6,000,000	2040	Vivid Economics 2021		
Wind (Europe)			406,000	2022 (current situation)	IRENA & ILO 2023		
			300,000	2017 (current situation)	WindEurope 2017		
			716,000	2030	WindEurope 2017		
Solar (Europe)			540,000	2022 (current situation)	IRENA & ILO 2023		
			648,000	2022 (current situation)	SolarPower Europe 2023		
			1,200,000	2027 (medium ambitious scenario)	SolarPower Europe 2022		
Coal (Europe)	208,000	130,000	338,000	2021 (current situation)	Joint Research Centre 2021a		
	- 54,000			2030 (NECP scenario)	Joint Research Centre 2021a		
	- 112,000			2030 (TYNDP scenario)	Joint Research Centre 2021a		
Hydrogen (Europe)			308,000	659,000	967,000	2050	Navigant Consulting 2019
					1,000,000	2030	Hydrogen Roadmap Europe (Fuel Cells and Hydrogen 2 Joint Undertaking) 2019
					5,400,000	2050	Hydrogen Roadmap Europe (Fuel Cells and Hydrogen 2 Joint Undertaking) 2019
Circular Economy (Europe)			+ 650,000 to + 700,000	2030	European Commission 2018		
Steel (Europe)	330,000	2,670,000	3,000,000	2022 (current situation)	European Research Executive Agency 2022		
Automotive (Europe)			+ 200,000	2035 (e-vehicles)	CLEPA 2021		
			- 450,000	2035 (combustion segment)	CLEPA 2021		
			+ 23,000	2030 (Green Deal, net plus)	Cedefop 2021		
Automotive sector (Germany)			1,700,000	2023 (current situation)	Agora Transport Transition 2021		
			+ 205,000	2030 (e-mobility, manufacturing, supply, energy production...)	Agora Transport Transition 2021		
			- 180,000	2030 (traditional motor vehicle construction)	Agora Transport Transition 2021		
Battery sector (Europe)	50,000 to 135,000	340,000 to 900,000	390,000 to 1,035,000	2030	Eit RawMaterials, Fraunhofer 2021		
			3-4 m	2025	EU Commission (Šeřčovič M.) 2021		
Construction sector (Europe)			+ 160,000	2030	Joint Research Centre 2021b		
			+ 460,000	2030	EFBWW 2023		
			+ 500,000	2030	McKinsey 2020		
			+ 1,500,000	2030	Cedefop 2021		
			- 180,000	2030	Cambridge Econometrics et al. 2018		

Source: Own representation.

\* Figures without a sign are the net total number of jobs (full-time equivalents as a rule). The + and - indicate the projected increases or losses.

Other studies, however, assume job losses due to increasingly modular construction techniques. Estimates range from 70,000 fewer jobs in construction between 2015 and 2050 (Černý, Bruckner, Weinzettel et al. 2021) and up to 180,000 fewer jobs between 2015 and 2030 (Cambridge Econometrics, Trinomics and ICF 2018). Employment is expected to peak around 2040 when most existing buildings will have been refurbished and renewable energy generation and transport electrification infrastructure will have been completed (Meijer, Visscher, Nieboer et al. 2012).

So far, there are few incentives for recycling construction and demolition waste. Construction and demolition waste accounts for 35% of all waste generated in the EU (Eurostat 2020) and thus offers great potential for the sector-specific circular economy. Construction workers need to increase their knowledge of the reuse and recycling of industrial/construction waste as the circular economy develops (European Commission 2019a). Cedefop estimates that about 3 to 4 million construction workers, including carpenters, bricklayers and technicians, need to be trained and educated on energy efficiency (Cedefop 2021).

## SHORTAGE OF SKILLED WORKERS AS THE BOTTLENECK OF THE ENERGY TRANSITION

The impact of the climate-neutral transformation on employment will vary widely - not only between Member States but also between individual regions within Member States (Joint Research Centre 2021b; Vandenbussche 2021). At the same time, Europe is already suffering from an increasing shortage of skilled workers, which according to a variety of forecasts will worsen in the coming years (Allenbach-Ammann 2022). As early as in 2008 and 2011, the UN-EP and ILO reported that there was a shortage of engineers, electricians and technicians in all sectors of renewable energy (UNEP 2008; ILO 2011). This shortage of skilled workers threatens to become a stumbling block for the European economy and especially for industry, thus also jeopardising the success of the climate-neutral transformation. While other sectors such as healthcare and hospitality also suffer from a shortage of skilled workers, from a climate-neutral perspective, the shortage in STEM professions (mathematics, information technology, natural sciences and technology), including trades, is particularly relevant (European Labour Authority 2022). This is because there is a great need for STEM professionals with higher qualifications in all renewable energy sectors. In wind power and solar energy, they account for between 21% and 31% of all workers needed in these sectors. In addition, there are between 52% and 91% technical, less highly qualified workers (plant mechanics for sanitary, heating and air conditioning technology, plumbers and construction workers). The rest is distributed among non-technical and administrative activities (IRENA and ILO 2021).

In the solar sector, for example, there is a shortage of civil, mechanical and electrical engineers, as well as tradespeople who install solar energy systems (Malin, Jansen

and Kutz 2022). The shortage of electricians is particularly critical, as this qualification requires at least three years of training.

In order to keep pace with the challenges of environmental and digital transformation, seize the opportunities that arise and ultimately fulfil the promise of “leaving no one behind”, the development of core skills must receive more policy attention. The ILO points out that “[s]kills development for green jobs also serves as a ‘buffer’ against the effects of transitory disruptions and emerging challenges while economies are greening. The transition to a greener future is happening; but it requires a coordinated policy approach to make it just and inclusive” (ILO 2019, p.2). As jobs change, workers must also be supported to adapt to new circumstances and ultimately learn new skills (Friedrich-Ebert-Stiftung 2022). These transitions “are already having an impact on the organisation of economic and social life” (Stehrer 2022, p.33). As a result, the demand for education and training in the workforce in Europe is increasing significantly (Czako 2022).

## THE DOUBLE TRANSITION: DIGITALISATION AS A FACTOR IN CLIMATE-NEUTRAL TRANSFORMATION

Digitalisation and decarbonisation are the two megatrends of the present and they are closely linked. Both are fundamentally changing production processes. Depending on its design, digitalisation can become another driver of climate change due to its enormous energy consumption. But it can also play an important role in decarbonisation through a wide range of digitally supported smart technologies, for example in transport, buildings or production. According to the European Commission's Joint Research Centre, digital technologies have the potential to reduce greenhouse gas emissions in Europe by 15% to 20% (Joint Research Centre 2022). This double transition is also changing the world of work and thus the demands on employees. The transition to a climate-neutral economy makes the digital skills of employees increasingly important. To illustrate this, here are two examples from the skilled trades and industry.

### CHEMICAL INDUSTRY

The chemical industry has been increasingly digitalised since the 1990s. According to a study by the Hans Böckler Foundation (Baumhauer, Beutnagel, Meyer et al. 2021), this has not led to job losses. However, job profiles have changed. While skilled workers in the chemical industry hardly have to do any physical work, skills for digital applications such as data analysis are becoming increasingly important. The decarbonisation of the chemical industry reinforces the importance of digital technologies in the chemical industry. For example, a digital product passport enables chemicals to be recycled; experiments simulated by algorithms reduce the consumption of resources compared with experiments carried out in the laboratory.

## ELECTRICIANS

In the skilled trades sector as well, digital skills are becoming increasingly important for employees in the course of the energy transition and the move away from fossil technologies. Electricians will play a vital role in this, as the widespread electrification of transport and heat supply will increase the demand for electricity, for example through heat pumps or charging stations for e-cars. Since the electricity supply will fluctuate more strongly due to the increasing share of renewable energies in the electricity mix, it will also become important to make electricity consumption more flexible. This will increase demand for *smart home systems*, which can digitally control the electricity demand of households. The installation of these systems requires complex digital skills, which require the training and further education of electricians and other tradespeople.

II

# THE VIEW OF EMPLOYEES AND LABOUR MARKET EXPERTS ON THE CLIMATE-NEUTRAL TRANSITION

How do workers themselves and labour market experts view the changes in jobs, employment and qualification in the face of the climate-neutral transformation? We conducted a series of background interviews on this question. Qualitative interviews were conducted in 18 European countries with experts from 19 national trade union organisations, 17 research institutions, one ministry and one industry association. They provided first-hand practical information on key challenges and reform areas, as well as tried and tested solutions. The key tasks and proposals mentioned in the interviews are summarised here.

## CLARIFYING POLITICAL FRAMEWORK CONDITIONS

Europe’s companies and their employees, whether transnational corporations or small and medium-sized enterprises, are suffering from the current planning uncertainty. For years, the climate-neutral transformation of national economies was not pursued consistently enough, for example in the expansion of the necessary electricity grids. Accelerated by the Russian invasion of Ukraine and the resulting consequences for European energy and industrial policy, things

**The lack of coherent strategies for climate-neutral restructuring and the resulting planning uncertainty make it difficult for trade unions and companies to forecast future labour demand and necessary retraining.**

are now very busy in the parliaments and ministries of many capitals, not least in Brussels. Numerous adjusting screws are being turned, and numerous agreements and legislative initiatives are being negotiated at the same time. Various funding pots are available, but tapping into them is usually time-consuming. It is understandable that the different procedures, initiatives and funds are perceived as chaotic. For businesses, it makes the situation very confusing. A lack of planning security is poison for investments. This also applies to the education and training of employees. Who would

want to invest in new employees if they don't know whether there will still be production at the site next year? At the same time, this makes such companies unattractive for job seekers. Companies whose economic future in Europe seems uncertain have a very bad chance of finding qualified apprentices and employees. Planning security is the key to securing employment. The framework conditions for the energy and industrial transition must be reliably clarified, and the programmes and subsidies must be more accessible and harmonised.

Governmental changes also play a role in the lack of planning security for companies and employees, as well as trade unions given the specific ideological bias of governing parties. The trade union representatives interviewed fear a change in political strategy should forces come to power whose strategic DNA includes the denial of climate change or its direct effects. For a clearer picture of qualification and labour market requirements, there needs to be more stability in the policy framework in the transition to a low-carbon economy without “boom and bust”. There are already great uncertainties due to geopolitical and trade developments and the great dependence on a few suppliers for raw materials and components. At the very least, economic actors need clarity about the framework conditions in their own country or in the European Union. Only then can the demand for skills be soundly assessed, and the actors in the labour market can prepare themselves accordingly. Moreover, it is easier to generate investments if the risks seem manageable. Accordingly, trade unions and employers both demand a defined roadmap for the energy transition with resilient plans. The labour market does not change on its own; it follows the foreseeable economic development. As long as long-term economic incentives and clear legal frameworks are lacking, the actors involved will hardly be able to set the appropriate course.

## STRENGTHENING TRADE UNIONS IN TIMES OF CHANGE

How do trade unions view the current restructuring? To give a rough idea: in the Nordic countries, the possibilities of raising their profile in global competition are emphasised far more than possible losses. The liberal culture in the labour market, known as “flexicurity”, is probably the reason for this; the labour market is flexible with strong social security

at the same time. Job changes are much less associated with scare and fear of relegation than in other parts of Europe; accordingly, the potential loss of jobs is not at the forefront of the debate.

**Scepticism towards the European Green Deal leads to little strategic debate around labour market development and changing job profiles and skills.**

In Eastern Europe, on the other hand, the discussion about the green transition is burdened with a number of problems. For one thing, the people of Eastern Europe have experienced a radical transformation of their economic system in their recent past. The results are not only viewed positively but also associated with losses and uncertainty. At the same time, there is scepticism and even rejection of state planning and intervention due to the historical legacy. Accordingly, a state-controlled green transition process is met with scepticism. In addition, climate policy is partly seen in the region as something imposed by Brussels or Berlin. The European Green Deal agenda is criticised as technically and socially unbalanced.

In view of the shortage of supply and the rise in prices since the Russian attack on Ukraine, trade unions in Eastern Europe are also currently pleading for a pause, or at least a slowdown, in legislation around the European Green Deal. In any case, this agenda is hardly perceived as something of their own; instead, it is widely seen as wanted and initiated by “Brussels”. However, the low level of reflection on the contents and the upcoming implementation steps also weakens the strategic debate around the development of the labour market and the change of job profiles and skills. Without this debate, though, it will be difficult for trade unions to bring their own reform proposals into the public and political debate.

The centre-left governments of Spain and Portugal emphasise the need for a common European industrial policy; this is also the case among trade union actors. On the one hand, this is because both countries themselves have potential in the production of green electricity and green hydrogen. They are also in the direct neighbourhood of North African countries such as Morocco, which are also seen as having a strong role in the production of green energy and hydrogen. Accordingly, the Iberian Peninsula is suitable as a location for manufacturing capacities in the clean-tech sector, such as battery production.

Overall, however, there is still a widespread lack of clarity among many trade unions as to what consequences the transition will have for them or their members and the employees working in the respective sector. This is also due to the lack of comprehensive political direction and strategies or a public dialogue on this. Moreover, even within the industry, there is often no uniform starting point. Some indus-

tries, such as battery production, are being built up from scratch. Other existing industries have to adapt and transform. Last but not least, digitalisation is leading to massive changes in the qualifications and number of employees working in specific industries.

It is a well-known problem for trade unions, but one that is now becoming more serious as decarbonisation progresses: the level of trade union representation is high, especially in sectors that are losing importance, such as coal mining, or sectors at least that are coming under massive pressure, such as the automotive sector. In addition, the jobs there are well paid compared to other sectors and are correspondingly at-

**The level of trade union representation is particularly high in sectors that are losing importance, such as coal mining, or are at least coming under massive pressure, such as the automotive sector.**

tractive for workers. The renewable sector, on the other hand, is considered a difficult terrain for trade unions. This is partly for structural reasons: many wind or solar energy companies, for example, are much smaller and their workers are therefore more difficult for trade unions to recruit and organise. In addition, they are often far less open or even hostile to union organising efforts. Interestingly, this is the case even in subsidiaries of companies from traditionally unionised countries. A Danish company in the wind sector, for example, does not automatically appear union-friendly in Germany. The growing presence of Asian companies in the European clean-tech sector is also making it increasingly difficult for trade unions to operate, including attacks on workers’ rights such as the exercise of trade union activities.

## SHAPING EUROPEAN INDUSTRIAL POLICY TOGETHER

The public debates in Germany and France – and even in Brussels – might give the impression that the revival of industrial policy is a general pan-European trend. Driven by the US *Inflation Reduction Act* and similar support programmes in other large economies, the EU Commission is also focusing on structural and industrial policy in a way that would have been unthinkable until recently. However, a pan-European trend or a pan-European commitment to industrial policy has not yet been observed.

In the Eastern European Member States and also in Northern Europe, the strategic focus is instead on attracting foreign direct investment. In general, many smaller Member States fear that industrial policy measures primarily favour the large economically and financially strong neighbours Germany and France and could thus lead to distortions in the European internal market.

Moreover, even in those countries where industrial policy is now high on the agenda (again), there are complaints about a lack of sound, concrete longer-term strategies. This was also the case among our interviewees. The resulting planning uncertainty makes it difficult for trade unions and companies to forecast future qualification needs and necessary retraining. The demands from both camps for a stable planning and financial framework are correspondingly strong. Both have a significant impact on the development of companies and business models and thus on jobs in demand and their requirement profile. One example is the recent dispute over the design of the German heating law. The initially envisaged far-reaching ban on the installation of new gas boilers led to a run on heat pumps, but the lack of sufficiently trained installers was perceived as a bottleneck. The industry switched its production. As the public debate continued, the bill was watered down. A slump in heat pump sales followed. Such developments make it difficult to build up capacity in the longer term, which is often accompanied by a massive need for retraining. Ideally, training should be started before conversions begin on a significant scale.

**A pan-European commitment to industrial policy cannot yet be observed. Many Member States fear that industrial policy measures primarily favour Germany and France.**

The inclusion of trade unions is also not sufficiently developed in the countries concerned. In France, for example, trade unionists report a high level of political attention to industrial policy, central consultation and numerous political committees on the subject. However, they complain that trade unions are hardly heard and that there is no translation of strategies into the breadth and depth of the regions and industrial and company structures. They therefore attest to the fact that the strategies have so far been largely ineffective.

Most of the experts we interviewed advocate for stronger Europe-wide coordination to manage the transition to a climate-neutral economy and to create European networks for regional competitive supply chains in sensitive sectors. Such European public-private partnerships and alliances would be promising in key areas of the climate-neutral transition. However, they require a stronger commitment from Member States. Moreover, the projects would need to go beyond pooling knowledge.

Triggered by the disastrous consequences of disrupted supply chains during the Coronavirus crisis and alarmed by the possibility of growing geopolitical tensions and consequent blackmailing, there is also increased debate in Europe about re-shoring, i.e. the relocation of key industries back to Europe. However, this seems to be more of a discourse pattern at EU level and only in some Member States. In many small-

er countries and again in Eastern Europe, the interests are different. Among other things, trade unions are less concerned with the possible industrial and labour market policy opportunities of relocating production branches that once migrated for cost reasons. Rather, they are concerned with the urgent question of how industries such as steel and aluminium, which are threatened by high energy prices, can be kept in their countries or how the domestic automotive industry can remain competitive.

## **AVOIDING LABOUR MARKET SEGMENTATION**

The shortage of skilled workers is affecting the whole of Europe. It leads to bottlenecks and backlogs in the economy, delays key reforms such as the climate-neutral transformation and, for some countries such as Germany, it even massively clouds the forecasts for long-term economic development and competitiveness. Even in countries with comparatively high unemployment rates like Spain and Italy, there is a shortage of qualified workers in key areas.

In some countries, the shortage of skilled workers is fuelled not only by demographic change but also by the brain drain, and the migration of young and qualified people in particular, mostly to neighbouring EU countries. A labour market policy in Northern and Western Europe that relies primarily on the constant influx of Eastern European skilled and temporary workers is likely to quickly reach its limits here. From an energy and climate policy perspective, as well as for reasons of European cohesion, continued migration from Southern and Eastern Europe is also undesirable, because buildings must be renovated and infrastructure renewed there too.

**The shortage of skilled labour is affecting the whole of Europe. It threatens climate-neutral restructuring and competitiveness.**

Parallel to the shortage of skilled workers, trade unions complain about the lack of strategies for the long-term unemployed. They urge that those affected must be offered significantly better qualification opportunities in order to integrate them into the labour market while countering the shortage of labour. At the same time, companies complain about a lack of sufficient qualifications among school leavers or the long-term unemployed. This is likely to hinder the rapid deployment of unemployed people in occupations experiencing shortages even more in the future. Major efforts are needed here in view of the increasing demands especially for digital skills in numerous occupations. The close connection to the education sector is obvious.

Trade unions point to the dangers of further regional division within many countries. This is partly the danger of the continued migration of young and well-educated people

to urban centres where both industrial manufacturing and scientific institutions as well as start-ups are concentrated. But continued structural change is also seen here as a possible source of increasing deindustrialisation with the corresponding relocation of jobs. Such a development can only be countered with an ambitious structural policy. In the southern Member States in particular, reference is also made to the economic risks posed by the consequences of climate change. These increase the uncertainty for the labour market and job prospects in the affected regions.

Conservative to right-wing populist governments and decision-makers are fundamentally subject to ideologically motivated self-limitation, not least when it comes to labour markets and transformation. Since they propagate a traditional image of the family, they rely on high birth rates and actively hinder the stronger representation of women in the labour market through relevant tax and social policies. In doing so, however, they simultaneously hinder the expansion of the working population. Since they are also generally critical of the influx of migrants, there is a lack of potential employees. This is a problem for the labour market in general, as well as for the development of a competitive clean-tech industry.

## INCREASING WOMEN'S POWER IN THE ENERGY TRANSITION

Female employees are underrepresented in the energy and industry sector; this is even more the case if administrative activities are discounted (Giner-Reichel et al. 2023). At the same time, there is a shortage of skilled workers across Europe, which even threatens to torpedo the implementation of the energy transition. The awareness of the difficult situation in the labour market and the potential role of women was very pronounced throughout Europe among our inter-

**The expansion of the domestic labour pool is crucial. The focus here is on increasing the labour market participation of women. Among other things, this requires a more progressive education policy and more attractive working conditions.**

viewees, both in the trade unions and among experts from research institutes. At the same time, it is clearly difficult to formulate concrete recommendations or practical solutions. Many interviewees emphasise that the environment for female employees must be made more attractive as a matter of priority. Positive role models are also seen as key. At the same time, there is a certain resignation in the face of the fact that stereotypical patterns in career choices prove to be surprisingly resistant.

The environmental turn in the industry must become mainstream and be reflected in labour market policy. Legal regulations and requirements must be examined to see whether they are inconsistent with employment policy goals. Given the lack of skilled workers and the low employment rate of women in the relevant sectors, tax or social policy regulations should not continue to be applied if they make full employment unattractive for women.

## ESTABLISHING SOCIAL DIALOGUE AS A PULL FACTOR

There are widespread complaints about a weakening of social dialogue – even in the countries that are traditionally considered the most progressive in this respect throughout Europe. On the one hand, this is connected to the current shift to the right. Liberal, conservative and right-wing populist parties still widely follow a neoliberal narrative that sees social and trade union rights as obstacles to increased competitiveness for companies. On the other hand, this conviction stands in stark contradiction to the declared goals and principles of the European Union.

The devaluation of social dialogue also contradicts company practice, as it is particularly evident with regard to employment and qualification. Many companies recognise the expertise and practical approach of works councils and trade unions in shaping industrial change.

**In the growing competition for qualified and motivated employees, employers will have to present attractive offers. Consequently, companies can also benefit from an expansion of employees' social rights.**

However, even in countries or regions with progressive governments, trade unions complain that they are not sufficiently included in the development of general or sectoral transformation plans. Unlike environmental organisations or think tanks, they are not perceived as natural consultation partners or advisors in this massive transformation process.

In principle, trade unions and their European umbrella organisations call for linking public procurement with compliance with high social standards, as well as social dialogue and collective bargaining autonomy and coverage. Especially in the renewable and clean-tech sector, this would be a strong lever for improving social standards, as companies in these sectors are often critical of trade unions. At the same time, companies could also benefit from an expansion of workers' social rights. In the growing competition for qualified and motivated employees, employers will have to present attractive offers.

## INVESTING IN EDUCATION AND TRAINING

The experiences of the trade unionists with employers interviewed vary in the area of education and training. Despite the historically anchored social dialogue in many places, many employers show little willingness to promote further education and lifelong learning for their employees to the necessary extent. Instead, they rely on the immigration of the necessary skilled workers or shift the responsibility for a sufficiently qualified pool of workers to the state. A common complaint was that companies are shirking their responsibility to provide training, development and qualifications. At the same time, segmentation is occurring because large international corporations in particular offer their own extensive in-house qualification programmes and thus hardly rely on (deficient) public programmes, especially in Central and Eastern Europe. This can run counter to a transformation of the labour market as a whole, as companies are primarily oriented towards their own needs and act less out of an interest in contributing to overall development. Smaller companies with limited training opportunities fear the disadvantages of attracting qualified employees.

In Sweden and Denmark, retraining and changing jobs are considered comparatively common. So far, this has no particular connection with the green transition but is common practice in the labour market (see “Flexicurity” above).

**Despite the great importance of skilled trades for the implementation of the energy transition, interest in these professions is declining. In addition to the state, the companies themselves are called upon to facilitate image gains.**

In future, training and further education must also target groups that are more difficult to win over. It is not enough to address only those who are already interested and convinced or to win over those who are already well qualified for further training. It is necessary to open up much broader new target groups for job profiles in the clean-tech and renewable sectors. This also includes people who may not yet have a proven affinity with technology, IT, practical craftsmanship and the natural sciences. There are some promising flagship activities that could be of interest to other countries as best practices. However, it is crucial to massively expand these activities. So far, the number of people trained has been rather low, which does not meet the increased demand.

In general, even in countries with a proven and established apprenticeship system such as Germany and Austria, the number of apprenticeship contracts is decreasing (Federal Statistical Office 2023). Training must be made more attractive by all actors. This applies not only in terms of pay and

working conditions but also and especially in terms of social values and image. Many countries report that non-university education is considered a second choice, an option only for those who have not made it to university. In countries in Eastern and Central Europe, university education also promises the possibility of seeking work in countries with higher wages. There are isolated examples, for example in Lithuania, where the renaming of educational institutions and training courses has had a positive counter-effect.

**Many employers show little willingness to promote further training and lifelong learning for their employees. They rely on immigration or see the state as having a duty to provide a sufficiently qualified pool of labour.**

It is not yet widely apparent that the high importance of trades in implementing the energy transition in practice is changing the image. Companies themselves, in addition to the state, are called upon in particular here. Large-scale image campaigns can be an important building block and convey a commitment to a diverse workforce. However, as long as women or people with a migration background still frequently report stereotypes and difficult conditions in everyday working life in practice, such campaigns will remain largely ineffective. Better reconciliation of family and work is also necessary to break the existing gender bias. Incidentally, this does not only apply to trades, but to the energy sector as a whole.

Many of the interviewees clearly pointed out where work needs to be done in the education sector. In fact, it is not possible to meet the growing challenges of a green and digital transition without massive investments and adjustments in the education sector. Incidentally, this is not only about improving the teaching of STEM skills. Rather, it is also about breaking through the one-sided focus on high school graduation and university studies. The majority of the experts interviewed also pled for a stronger anchoring of social-environmental competencies in the curricula. This also seems indispensable for the implementation of mainstreaming as mentioned above.

## MAKING COMPANIES MORE RESPONSIBLE, REACHING OUT TO SMEs

Decarbonisation is already in full swing for many companies in Europe, albeit accompanied by numerous hurdles and uncertainties. For many small and medium-sized enterprises (SMEs), however, the environmental transition is a major challenge. This does not only refer to technological and financial aspects. The lack of skilled workers or the resulting intensified competition for motivated and well-trained minds, as well as the need for continuous

training of their own staff, overwhelms many SMEs. In conjunction with the advancing need for digitisation, where transnational corporations also perform much better than many SMEs, this trend threatens to put SMEs in a much worse competitive position. Large companies handle much of the digitisation and further training of their workforce independently, out of their own economic interest; SMEs are left behind because they lack such opportunities. Government or European Union programmes such as funds or targeted training offers are also more accessible to large companies with specialist human resources departments.

At the same time, many SMEs also seem to still lack awareness of how prevalent the topic has become, on the one hand, and how urgent it is to take up specific further training offers, on the other. Often they have no knowledge of the opportunities they could take advantage of for their employees. In addition, SMEs naturally have limited possibilities for compensation: an employee tied up for months in further training creates vulnerable gaps, especially in view of the existing shortage of skilled workers, even if the qualifications acquired strengthen the company in the long term. From the employee's point of view, it is of course much more attractive – and essential for the acceptance of lifelong learning that such training takes place during regular working hours and not after work.

**The environmental transition poses a major challenge for many smaller companies. The shortage of skilled labour and the competition for the best brains, as well as the need for continuous training of their own workforce, are overwhelming many SMEs.**

Trade unions are aware of the danger of this development. Many SMEs will not be able to manage the technological changeover to climate-neutral production or the further qualification of their workforce on their own. This, however, could massively impair their competitiveness and even jeopardise their continued existence. As they are responsible for 50% of commercial value added in the EU and two-thirds of jobs in the private sector (European Parliament 2023), the economic and social risks of such a development are immediately apparent.

Trade unions emphasise the importance of proactive, outreach offers, for example by employment agencies and business associations, with regard to SMEs. It is not enough to set up further training offers and wait until SMEs discover them for themselves. In the interest of business development, their involvement must be solicited and made possible through financial and organisational support. What seems even more important than financial support is to provide easy access to information and practical guidance.

The Austrian Environmental Foundation is repeatedly cited as a relevant model (see best practice examples below). This is a cooperation of the Austrian Ministry of the Environment, the Ministry of Labour, the Austrian Trade Union Federation (ÖGB) and the Federal Economic Chamber. However, with a budget of 10 million euros and 1,000 retraining projects within 3 years, both scope and reach are so far rather limited, as representatives of the ÖGB note.

However, it is precisely the labour shortage that makes companies reluctant to train employees. There is concern that such qualified employees will then look elsewhere in the labour market and change employers. Particularly in Central and Eastern Europe, the fear of a brain drain has a negative effect on the motivation of employers to provide further training.

**In Central and Eastern Europe, the fear of a brain drain is having a negative impact on employers' motivation to provide further training.**

The greatest comparative advantage for Eastern and Central Europe still lies in their comparatively low labour costs. However, this not only has a negative impact on the willingness to strategically plan labour market and qualification measures; the drafting of a national and European industrial policy oriented towards higher-ranking value creation is not on the agenda either.

At the same time, trade unions and the experts interviewed both emphasised that companies must take much more responsibility for the education and training of their employees. Currently, this responsibility is often shifted to the state. However, it would be important and productive to dovetail the different levels. The state must set favourable framework conditions, coordinate and simplify programmes, and align social and education policy accordingly. However, it cannot release companies from their responsibility to support a well-trained and motivated workforce.

This is a challenging situation for trade unions. In view of the shortage of skilled workers, there is a trend towards lowering qualification standards. Workers are increasingly trained only with a specific activity or product in mind, such as a particular heat pump or solar panel. This rudimentary training can be done in a few weeks. It is certainly suitable for quickly counteracting a shortage of suitable skilled workers in certain sectors. At the same time, there is a danger that workers here do not receive solid training and professional qualifications that put them in a good negotiating position in the labour market. There is a risk of a continued career as an unskilled worker and a further segmentation of the labour market overall.

## BEST PRACTICE EXAMPLES

All in all, the yield of best practice examples during our talks was not abundant. But this need not discourage us. We are still largely at the beginning of the far-reaching change that the climate-neutral transition and digitalisation will bring. Moreover, the hope of one size fits all blueprints that can be used at will in various places is tempting, but unrealistic. So even with the examples mentioned, it can primarily be a matter of suggestions and points of orientation.

However, what the best practice approaches mentioned by the interviewees have in common is that they point to constructive cooperation between various stakeholders at local level. This is not only true for traditional issues of fair transition that arise directly from structural change. Here it has long been known that the interaction of diverse actors at local level is most likely to lead to socially accepted outcomes that are respected by the affected workers. But also, for the establishment of new industries, it is key that economic, social and political actors, civil society and educational institutions get together for concerted action.

In the discussions, some particularly dynamic regions of Central and Eastern Europe were mentioned as examples in this sense: Ostrava in the Czech Republic, Győr in Hungary and Trnava in Slovakia. In these regions, proactive cooperation between businesses, universities or research institutions and political decision-makers at municipal or regional level is leading to noticeable progress, for example in terms of subsidies, where start-ups are located, the formation of production clusters and investments in infrastructure. This shows that joint action by such actors increases the chances of success in retaining companies and skilled workers in a particular region.

sible if the training company is located more than 50 km from the place of residence. German language skills are required at level B1. Currently, about 250 people are enrolled with the foundation.

<https://www.aufleb.at/umweltstiftung/>

<https://www.oegb.at/themen/arbeitsmarkt/arbeitsmarktpolitik/umweltstiftung-bildet-1-000-arbeitslose-fuer-oeko-jobs-aus>

## SWEDEN – STUDENT FINANCE FOR TRANSITION AND RETRAINING

The Swedish Student Finance Board aims to promote and facilitate the professional development and re-training of employees through financial assistance to study. It is aimed at employees between 27 and 62 years old, with at least eight years of work experience. The focus on bottleneck occupations helps to reduce shortages and promote employment in key areas. The project has been running since October 2022. The grant replaces up to 80% of the previous income up to about €2500. An additional loan of up to about €1170 per month can be granted. In total, the support can be claimed for a maximum of 44 weeks (two semesters) for full-time studies. In the case of part-time studies (e.g. 50%), the period of entitlement can be extended to 88 weeks. So far, 40,000 people have applied and 3,000 have received support.

<https://www.csn.se/languages/english/student-finance-for-transition-and-retraining.html>

## AUSTRIA – ENVIRONMENTAL FOUNDATION

The goal of the Environmental Foundation is to train 1,000 people in a reduced training period (3–12 months) for an unfilled job in a climate-relevant field. €10 million have been made available for this purpose between April 2022 and April 2025. The foundation is supported by AUFLEB GmbH, an institution founded in 1995 by the Austrian Federation of Trade Unions (ÖGB) and the Austrian Federal Economic Chamber (WKÖ). The foundation's training courses focus on various fields, including waste and resource management, green mobility, energy production and distribution, building services engineering, skilled agricultural and forestry occupations, as well as occupations in the fields of education, counselling and lifestyle. In addition to the livelihood support provided by the Public Employment Service (AMS), a training subsidy of at least €200 is paid by the training company. In addition, a mobility package including allowances for relocation costs, housing and travel costs of up to €17,000 for the entire training period is pos-

## DENMARK – MUNICIPAL SCHOOL AND CAREER GUIDANCE

The Danish guidance system offers comprehensive and easily accessible support for young people, including those who have left the formal education system. It includes a variety of counselling services, including individual and group counselling, as well as introductory courses and bridge programmes to provide students with insights into different education, training and career options. The programme is proactive. The 60 counselling centres are required by law to contact and offer support at least twice a year to young people up to 19 years of age who have dropped out of formal education. This approach aims to address and resolve problems in education at an early stage. In this way, 90% of all young people are expected to complete a youth education programme before their 25th birthday by 2030.

<https://www.euroguidance.eu/guidance-system-in-denmark>

<https://www.oecd.org/denmark/2088292.pdf>

<https://pilotfeasibilitystudies.biomedcentral.com/articles/10.1186/s40814-022-01174-1>

## FRANCE – TRANSCO, OPMQ & ONEMEV

### Transitions collectives (Transco)

The Transco transition mechanism was established in cooperation between the Ministry of Labour, social partners, local administrations and training institutions. The aim is to facilitate and simplify vocational transitions. Specifically, Transco offers retraining for a period of up to 24 months. Workers can try out different potential jobs and undertake retraining. During the training, workers continue to receive their salary from their employer. The remuneration, including social security contributions, is then reimbursed to the company by the competent authority; whether this is 100% or only partially depends on various factors (Ministère du travail, du plein emploi et de l'insertion, n.d.). The programme is financed by the national fund for vocational training, with up to €500 million available. After the training/retraining, some participants look for new jobs or work for the same employer in a new position that matches the skills acquired. However, Transco does not focus specifically on changing job profiles as a result of the climate-neutral transformation.

<https://travail-emploi.gouv.fr/actualites/l-actualite-du-ministere/article/france-relance-lancement-officiel-du-dispositif-transitions-collectives>

### OPMQ

The Sectoral Observatories on Occupations and Qualifications (OPMQ) is a focal point for social partners to get an overview of the development of occupations and qualifications (Delanoë, Quintero, Vallette-Wursthén 2020). Based on this information, adjustments can be made to the training design. These have now developed into real strategic support agencies. In the dialogue between the social partners and the observatories, needs for retraining and additional qualifications are identified across sectors, which also comes into play in the context of the digital and green transition.

<https://www.cereq.fr/sites/default/files/2020-12/Bref398--web.pdf>

### ONEMEV

With a special focus on the context of the green transition, the French National Observatory for Jobs and Occupations in the Green Economy (ONEMEV) enables a better understanding of future employment and qualification needs. To this end, the ONEMEV produces regional forecasts and statistics on occupational and educational requirements in the context of the green transition. The Observatory is composed of representatives from the Ministry of Ecology and Environment, the National Statistics Office, public employment services and research institutions.

<https://www.ecologie.gouv.fr/observatoire-national-des-emplois-et-metiers-leconomie-verte>

## ESTONIA – OSKA

The Estonian initiative OSKA makes forecasts over five to ten years based on quantitative and qualitative analyses and highlights changes in the labour market and job profiles (OSKA Methodology n.d.). The focus is on the exchange between employers and educational institutions. A cooperative platform is used to identify and analyse necessary adjustments in the education sector and new training opportunities. In this way, all relevant stakeholders are to be involved.

<https://oska.kutsekoda.ee/en/oska-management-methodology/oska-methodology/>

# SUMMARY AND CONCLUSIONS

## THE PRIMARY CHALLENGES

The development of a climate-neutral economy is accompanied by fundamental upheavals in the labour markets. Jobs will be lost in and around CO<sub>2</sub>-intensive sectors, while the demand for labour will increase in the transforming sectors and in the development of new industries. Without a sufficiently skilled workforce, the desired transformation cannot be achieved. The evaluated forecasts show that in the overall balance, slight job increases can be expected until 2050. In practice, however, many workers will have to become qualified and trained for new profiles – either to continue working in their current field or to find employment in a related or new sector.

Three aspects are particularly challenging.

- **Firstly**, the demand for different qualifications and profiles fluctuates over time during the restructuring phase. In addition, the need for qualifications is generally increasing in most occupational sectors, among other things due to increasing automation and digitalisation, but also due to rising legal and regulatory requirements. There is already a shortage of qualified professionals to meet this demand.
- **Secondly**, a large number of very different sectors are affected by the changes, from the energy industry, traditional industry and production, mobility and agriculture to services, finance and administrations that support the green transition. New skills are needed in all these sectors.
- **Thirdly**, the change is not only focused on certain regions. It is affecting the whole of Europe. This is expected to lead to shifts within Europe. Locations with favourable conditions for renewable power generation, such as coasts or sunny regions, will become much more competitive and attract energy-intensive industries. Labour markets will also respond accordingly.

The core challenge is to **steer and coordinate** these three dimensions with **stable, predictable political frameworks throughout Europe**. Without sufficient predictability, the various responsible actors in the labour market, education and training sector will not be able to sufficiently prepare for the demand for jobs and profiles.

## ASSESSMENT OF THE OVERALL SITUATION

- One of the key messages of our interview series is that: in order to have a clear picture of the emerging needs, there needs to be more stability in the policy and regulatory frameworks for the transition to a low-carbon economy. Planning security was clearly prioritised by trade unions and experts alike as the key to securing employment. **Accordingly, concepts for the energy and industrial transition with resilient roadmaps must be defined.** The regulatory framework must be reliably clarified, and programmes and subsidies must be made more accessible and harmonised.
- The **opportunities for restructuring** are assessed differently by the actors concerned, especially the trade unions, depending on the country. In the **Nordic countries**, the opportunities for raising their profile in global competition are emphasised far more than possible losses. In **Central and Eastern Europe**, on the other hand, there is a historical burden in this respect: on the one hand, with a mistrust of state-directed economic processes; on the other hand, with disappointments or uncertainties in the last major transformation not long ago. Moreover, climate policy in the region is sometimes seen as being imposed from outside. In **southern European countries** like Spain, on the other hand, the potential of renewable energy production and the development of clean-tech sectors are viewed with optimism, at least in the progressive camp.
- Decarbonisation is already in full swing for many corporations in Europe, albeit accompanied by numerous hurdles and uncertainties. For many small and medium-sized enterprises (SMEs), however, the environmental transition is a major challenge.
- Fundamentally, the **concern about cannibalisation in the competition for labour** is expressed in many ways: firstly, in the sense of brain drain between countries and regions, from east to west and north; secondly, between rural areas and urban centres; thirdly, between SMEs and international corporations.
- The energy and raw materials crisis has led to a revival of the structural and industrial policy debate in Europe. But especially in Central and Eastern Europe, trade un-

ions are less concerned with possible new industrial policy opportunities in renewables or clean tech. They are often more concerned with the pressing question of how existing domestic industries can remain competitive. They fear a **regional divide in which large industrialised countries would win the race through industrial policy support**. The concern about unequal potentials, for example in the area of state aid, is also widely shared by smaller Member States.

- Most of the experts we interviewed advocate for **stronger Europe-wide coordination** to manage the transition to a climate-neutral economy and to create European networks for regional competitive supply chains in sensitive sectors.
- For trade unions, the well-known dilemma of the **level of union representation** remains. It is particularly high in those sectors that are under pressure from restructuring, such as coal or the automotive sector. In addition, these sectors are well paid compared with other sectors, making them attractive for workers. The **renewable sector, on the other hand, is considered difficult terrain for trade unions in this respect**.

## ASSESSMENT OF THE LABOUR MARKET SITUATION

- **The shortage of skilled workers is affecting the whole of Europe.** It leads to bottlenecks and backlogs in the economy, delays key reforms such as the climate-neutral transformation, and for some countries such as Germany, it even massively clouds the forecasts for long-term economic development and competitiveness.
- **Female employees are underrepresented in the energy and industry sector;** the awareness of this is very pronounced throughout Europe among our interviewees, both in the trade unions and among experts from the research institutes. They emphasise that **the environment for female employees must be made more attractive as a matter of priority**. In addition, **positive role models** are seen as the key, as stereotypical occupational patterns have so far proved surprisingly resistant.
- Parallel to the shortage of skilled workers, the trade unions complain about the **lack of strategies for the long-term unemployed**. They insist that those affected must be offered much better qualification opportunities in order to integrate them into the labour market and that the solution to the shortage of skilled workers is not seen in immigration alone.
- In principle, the environmental transformation in the industry must become mainstream, also in labour market policy. Legal regulations and requirements must be examined to see whether they serve employment policy goals.

## EDUCATION AND TRAINING

- Trade unions as well as the experts interviewed emphasised that **companies are increasingly shifting the responsibility for education and training to the state**. The most promising approach would be an interlocking approach: the state sets favourable framework conditions and aligns social and education policy accordingly. Companies highlight needs, develop programmes in coordination with public actors and offer incentives to the workforce. Moreover, the challenges of the green and digital transition can only be met through **adjustment and massive investments in the education sector**.
- Large companies address digitalisation and training independently out of their own interest. SMEs, on the other hand, seem to lack awareness of the prevalent nature of the topic on the one hand, as well as knowledge and practical possibilities of using specific training offers on the other. It would be necessary to develop proactive outreach offers, for example by employment agencies and business associations.
- The shortage of skilled workers necessitates reaching out to individuals beyond the already interested and convinced, or the highly qualified, for the profiles needed. We must also attract employees with no prior inclination towards **technology, IT, craftsmanship, and the natural sciences** to job roles in the clean-tech and renewable sectors.
- **There is also a need for re-skilling at the management level.** This is where the processes of restructuring are initiated and planned; however, there is often a lack of relevant knowledge about the requirements due to the environmental transformation.
- Apprenticeships must be made more attractive by all actors. This applies to **pay, working conditions and especially social values and image**.

## SOCIAL DIALOGUE

- There are widespread complaints about a fundamental **weakening of social dialogue** even in those countries that are traditionally considered the most progressive in this respect throughout Europe. Trade unions are also not sufficiently involved in the development of general or sectoral transformation plans. Where governments use civil society groups to form strategies, environmental organisations or think tanks are often consulted more than trade unions as advisors on the socio-ecological transition.
- Companies should be aware that they benefit from the **expansion of social rights** of the workforce. In the growing competition for qualified and motivated employees, employers must present attractive offers and working conditions.

- A stronger **link between public procurement and compliance with high social standards** as well as social dialogue, and collective bargaining autonomy and coverage is a powerful lever for improving social standards that has not been sufficiently used so far. This also applies to sectors that are more critical of trade unions, which could thus become more attractive for skilled workers.
- In **tripartite sector-specific transformation councils**, employers' organisations, trade unions and the public sector can come together for regional and supra-regional strategy dialogues, strengthen regional industry clusters and jointly pursue ambitious approaches to structural policy, including the necessary social, housing and infrastructure policies. Experience shows that these formats deliver realistic and socially and locally accepted results.

## ABBREVIATIONS

<b>CCS</b>	Carbon capture and storage
<b>CCU</b>	Carbon capture and utilisation
<b>CEDEFOP</b>	European Centre for the Development of Vocational Training
<b>CLEPA</b>	European Association of Automotive Suppliers
<b>DFBEW</b>	Franco-German Office for the Energy Transition
<b>Eurofound</b>	European Foundation for the Improvement of Living and Working Conditions
<b>HSBC</b>	Hong Kong and Shanghai Banking Corporation
<b>IEA</b>	International Energy Agency
<b>ILO</b>	International Labour Organization
<b>IRENA</b>	International Renewable Energy Agency
<b>ISCO</b>	International Standard Classification of Occupations
<b>O*NET</b>	Occupational Information Network
<b>SME</b>	Small and medium sized enterprise
<b>TYNDP</b>	Ten-Year Network Development Plans
<b>UN</b>	United Nations
<b>UNEP</b>	United Nations Environment Programme
<b>WWF</b>	World Wildlife Fund

## REFERENCES

- Agora Verkehrswende** (2021): Autojobs unter Strom. Wie Elektrifizierung und weitere Trends die automobilen Arbeitswelt bis 2030 verändern werden und was das für die Politik bedeutet. Berlin. [https://www.agora-verkehrswende.de/fileadmin/Projekte/2021/BCG-Jobstudie/64\\_Jobeffekte.pdf](https://www.agora-verkehrswende.de/fileadmin/Projekte/2021/BCG-Jobstudie/64_Jobeffekte.pdf)
- Allenbach-Ammann, Janos** (2022): Labour shortages felt all over Europe EURACTIV. <https://www.euractiv.com/section/politics/news/labour-shortages-felt-all-over-europe/>
- Anhelm, Fritz Erich; and Iris Tuttlies** (2020): Strukturwandel der Energiewende – Konversionsstrategien in der deutschen Energiewirtschaft Hans Böckler Stiftung. [https://www.boeckler.de/de/faust-detail.htm?sync\\_id=HBS-007624](https://www.boeckler.de/de/faust-detail.htm?sync_id=HBS-007624)
- Aufleb GmbH** (n. d.): Umweltstiftung: Klima – Jobs – Ihre Qualifikation für eine nachhaltige sichere Berufslaufbahn. <https://www.aufleb.at/umweltstiftung/>
- Bauer, Wilhelm; Oliver Riedel; Florian Hermann; Wolfgang Beinbauer; Daniel Bormann, Michael ertwig; Jessica Mack, Thomas Potinecke; Claus-Peter Praeg, an Peter Rally** (2020): Auswirkungen von Elektromobilität und Digitalisierung auf die Qualität und Quantität der Beschäftigung bei Volkswagen Stuttgart Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO. <https://publica-rest.fraunhofer.de/server/api/core/bitstreams/c024ab94-b0c0-4fd8-a69f-902aa9bfc9cd/content>
- Baumhauer, Maren, Britta Beutnagel; Rita Meyer; and Kira Rempel** (2021): Lernort Betrieb 4.0 – Organisation, Subjekt und Bildungs Kooperation in der digitalen Transformation der Chemie-industrie Düsseldorf Hans Böckler Stiftung, Study Nr. 454, January 2021. [https://www.boeckler.de/de/faust-detail.htm?sync\\_id=9162](https://www.boeckler.de/de/faust-detail.htm?sync_id=9162)
- BDEW (Bundesverband der Energie- und Wasserwirtschaft)** (2020): Konjunkturimpulse der Energiewirtschaft – Methodik und Ergebnisse einer Input-Output-Analyse einschließlich regionaler Effekte. [https://www.bdew.de/media/documents/Stn\\_20201110\\_BDEW-Konjunkturimpulse.pdf](https://www.bdew.de/media/documents/Stn_20201110_BDEW-Konjunkturimpulse.pdf)
- Béziat, Eric** (2021): A l'usine Renault de Flins, la transition des salariés vers la ReFactory : « C'est la fin d'une époque » et une « deuxième jeunesse » Paris Le Monde. [https://www.lemonde.fr/economie/article/2021/12/04/a-l-usine-renault-de-flins-la-transition-des-salaries-vers-la-refactory-c-est-la-fin-d-une-epoque-et-une-deuxieme-jeunesse\\_6104721\\_3234.html](https://www.lemonde.fr/economie/article/2021/12/04/a-l-usine-renault-de-flins-la-transition-des-salaries-vers-la-refactory-c-est-la-fin-d-une-epoque-et-une-deuxieme-jeunesse_6104721_3234.html)
- BMW i (Bundesministerium für Wirtschaft und Energie)** (2021): Die Energie der Zukunft – 8. Monitoring-Bericht zur Energiewende – Berichtsjahre 2018 und 2019. [https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/achter-monitoring-bericht-energie-der-zukunft.pdf?\\_\\_blob=publicationFile&v=32](https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/achter-monitoring-bericht-energie-der-zukunft.pdf?__blob=publicationFile&v=32)
- Bowen, Alex; and Bob Hancké** (2019): The Social Dimensions of 'Greening the Economy' Brussels European Commission, DG Employment, Social Affairs and Inclusion. <https://op.europa.eu/o/opportal-service/download-handler?identifizier=24c67b4c-3293-11ea-ba6e-01aa75ed71a1&format=pdf&language=en&productionSystem=cellar&part=>
- BusinessEurope** (2021): Greening the economy: Employment and skills aspects. [https://www.bussinesseurope.eu/sites/buseur/files/media/reports\\_and\\_studies/2021-10-15\\_employment\\_and\\_skills\\_aspects\\_of\\_greening\\_-\\_final.pdf](https://www.bussinesseurope.eu/sites/buseur/files/media/reports_and_studies/2021-10-15_employment_and_skills_aspects_of_greening_-_final.pdf)
- Cedefop** (2021): The green employment and skills transformation: Insights from a European Green Deal skills forecast scenario. Luxembourg Publications Office of the European Union. [https://www.cedefop.europa.eu/files/4206\\_en.pdf](https://www.cedefop.europa.eu/files/4206_en.pdf)
- Cedefop** (2023): Skills in transition: The way to 2035 Luxembourg Publications Office of the European Union. [https://www.cedefop.europa.eu/files/4213\\_en.pdf](https://www.cedefop.europa.eu/files/4213_en.pdf)
- Černý, Martin; Martin Bruckner; Jan Weinzettel; Kirsten Wiebe; Christian Kimmich; Christian Kerschner; and Klaus Hubacek** (2021): Employment effects of the renewable energy transition in the electricity sector Brussels ETUI. <https://www.etui.org/sites/default/files/2021-12/Employment%20effects%20of%20the%20renewable%20energy%20transition%20in%20the%20electricity%20sector-An%20input-output%20approach-2021.pdf>
- Colle, Serge; Paul Micallef; and Andrew Horstead** (2022): As eMobility accelerates, can utilities move EVs into the fast lane? Ernst and Young. [https://www.ey.com/en\\_gl/energy-resources/as-emobility-accelerates-can-utilities-move-evs-into-the-fast-lane](https://www.ey.com/en_gl/energy-resources/as-emobility-accelerates-can-utilities-move-evs-into-the-fast-lane)
- Contreras, Rodriguez** (2023): Towards a fair green transition: Implications for employment relations and working conditions Eurofound. <https://www.eurofound.europa.eu/en/resources/presentation/2023/towards-fair-green-transition-implications-employment-relations-and>
- Costanzo, Giuseppe; Guy Brindley; and Phil Cole** (2022): Wind energy in Europe 2022 Statistics and the outlook for 2023–2027. WindEurope. <https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2022-statistics-and-the-outlook-for-2023-2027/>
- Czako, Veronica** (2022): Skills for the green energy transition Petten European Commission. [https://www.researchgate.net/profile/Veronika-Czako-2/publication/365870615\\_Skills\\_for\\_the\\_Clean\\_Energy\\_Transition/links/63875d6c78f94b73a0ba50c3/Skills-for-the-Clean-Energy-Transition.pdf](https://www.researchgate.net/profile/Veronika-Czako-2/publication/365870615_Skills_for_the_Clean_Energy_Transition/links/63875d6c78f94b73a0ba50c3/Skills-for-the-Clean-Energy-Transition.pdf)
- Delanoë, Anne; Nathalie Quintero; and Aline Valette-Wursthen** (2020): Observatoires prospectifs des métiers et des qualifications, l'âge de la maturité Céreq and Bulletin de Recherches Emploi Formation. <https://www.cereq.fr/sites/default/files/2020-12/Bref398--web.pdf>
- DFBEW (Deutsch-französisches Büro für die Energiewende)** (2021): Beschäftigungseffekte der Energiewende: Bisherige Entwicklung und Zukunftsperspektiven. <https://energie-fr-de.eu/de/gesellschaft-umweltwirtschaft/aktuelles/leser/hintergrundpapier-zu-den-beschaeftigungseffekten-der-energie-wende.html>
- Euroäischer Rechnungshof** (2022): EU- Förderung für Kohleregionen: Begrenzte Ausrichtung auf den sozioökonomischen und energiewirtschaftlichen Übergang. [https://www.eca.europa.eu/Lists/ECADocuments/SR22\\_22/SR\\_coal\\_regions\\_DE.pdf](https://www.eca.europa.eu/Lists/ECADocuments/SR22_22/SR_coal_regions_DE.pdf)
- Euroguidance** (n. d.): Guidance system in Denmark. <https://euroguidance.eu/guidance-system-in-denmark>
- European Association of Automotive Suppliers (CLEPA)** (2021): Electric vehicle transition impact assessment report 2020 – 2040: A quantitative forecast of employment trends at automotive suppliers in Europe. <https://clepa.eu/wp-content/uploads/2021/12/Electric-Vehicle-Transition-Impact-Report-2020-2040.pdf>
- European Commission** (2019a): European Construction Sector Observatory – Trend Paper – EU construction sector: in transition towards a circular economy. <https://ec.europa.eu/docsroom/documents/34904/attachments/1/translations/en/renditions/native>
- European Commission** (2019b): Employment and Social Developments in Europe 2019 Luxembourg Publications Office of the European Union. <https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8219>
- European Commission** (2018): Impacts of circular economy policies on the labour market: Final report and annexes Publications Office of the European Union. <http://trinomics.eu/wp-content/uploads/2018/07/Impacts-of-circular-economy-on-policies-on-the-labour-market.pdf>
- European Commission** (2020a): European vision on steel-related skills and supporting actions to solve the skills gap today and tomorrow in Europe Brussels Publications Office of the European Union. <https://data.europa.eu/doi/10.2826/2092>
- European Labour Authority** (2022): EURES Report on labour shortages and surpluses 2022 Luxembourg Publications Office of the European Union. <https://www.ela.europa.eu/sites/default/files/2023-03/eures-labour-shortages-report-2022.pdf>
- European Labour Authority** (2021): Report on labour shortages and surpluses Bratislava. <https://www.ela.europa.eu/sites/default/files/2021-12/2021%20Labour%20shortages%20%20surpluses%20report.pdf>
- European Parliament** (2023): Fact sheets on the European Union, Small and medium-sized enterprises. <https://www.europarl.europa.eu/factsheets/en/sheet/63/kleine-und-mittlere-unternehmen>

- European Research Executive Agency: Iacob, Nadina; Hien Vu; Francesca Cecchin; Cristian Stroia** (2022): Climate-neutral steelmaking in Europe: Decarbonisation pathways, investment needs, policy conditions, and recommendations Luxembourg Publications Office of the European Union. <https://op.europa.eu/en/publication-detail/-/publication/89cda1b2-b169-11ec-83e1-01aa75ed71a1/language-en/format-PDF/source-254269180>
- Eurostat** (2020): Energy, transport and environment statistics Luxembourg Publications Office of the European Union. <https://ec.europa.eu/eurostat/documents/3217494/11478276/KS-DK-20-001-EN-N.pdf>
- Eurostat** (2023): Labour market. [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Labour\\_market](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Labour_market)
- Friedrich-Ebert-Stiftung** (2022): The Jobs of Our Future. <https://justclimate.fes.de/e/jobs-future-energy-digital-transition-skills-labour>
- Fuel Cells and Hydrogen 2 Joint Undertaking** (2019): Hydrogen roadmap Europe: A sustainable pathway for the European energy transition Luxembourg Publications Office of the European Union. <https://op.europa.eu/o/portal-service/download-handler?identifier=0817d60d-332f-11e9-8d04-01aa75ed71a1&format=pdf&language=en&production-System=cellar&part>
- Giner-Reichel Irene and van Veldhuizen Maria** (2023): Europe's energy transition: Women's power in solving the labour bottleneck Bonn Friedrich-Ebert-Stiftung. <http://library.fes.de/pdf-files/bueros/bruessel/20418.pdf>
- Green Steel for Europe Consortium** (2021): Decarbonisation Pathways 2030 and 2050. <https://www.estep.eu/assets/Uploads/D1.7-Decarbonisation-Pathways-2030-and-2050.pdf>
- Høy, Theresa Victoria; Andreas Jørgensen; Susan Andersen; Christina Bjørk Petersen; Maja Baeksgaard Jørgensen; Morten Grønbaek; Sengül Sari; Laila Ottesen; Gro Inge Lemcke Hansen; and Teresa Holmberg** (2022): The development of a health-promoting employment intervention with physical activity for young people Not in Education, Employment or Training (NEET): NEXT STEP—on the path to education and job. <https://pilotfeasibilitystudies.biomedcentral.com/articles/10.1186/s40814-022-01174-1>
- International Energy Agency: Chen, Olivia; Daniel Wetzel; Ashley Acker; Justina Bodláková; Yannick Monschauer; and Jeremy Moorhouse** (2022): World energy employment report. <https://iea.blob.core.windows.net/assets/a0432c97-14af-4fc7-b3bf-c409fb7e4ab8/WorldEnergyEmployment.pdf>
- International Labour Organisation** (2011): Skills and Occupational Needs in Renewable Energy Geneva. [https://www.ilo.org/wcmsp5/groups/public/@ed\\_emp/@ifp\\_skills/documents/publication/wcms\\_166823.pdf](https://www.ilo.org/wcmsp5/groups/public/@ed_emp/@ifp_skills/documents/publication/wcms_166823.pdf)
- International Labour Organisation** (2016): What is a green job ?. [https://www.ilo.org/global/topics/green-jobs/news/WCMS\\_220248/lang-en/index.htm](https://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang-en/index.htm)
- International Labour Organisation** (2019): Skills for a greener future: Challenges and enabling factors to achieve a just transition Geneva. [https://www.ilo.org/wcmsp5/groups/public/---ed\\_emp/documents/publication/wcms\\_731957.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_731957.pdf)
- IRENA und ILO** (2021): Renewable energy and jobs: Annual review 2021 International Renewable Energy Agency, Abu Dhabi and International Labour Organization, Geneva. <https://www.irena.org/publications/2021/Oct/Renewable-Energy-and-Jobs-Annual-Review-2021>
- IRENA und ILO** (2023): Renewable energy and jobs: Annual review 2023 International Renewable Energy Agency, Abu Dhabi and International Labour Organization, Geneva. <https://www.irena.org/Publications/2023/Sep/Renewable-energy-and-jobs-Annual-review-2023>
- Joint Research Centre** (2022): 5 digital solutions for a greener Europe Luxembourg European Commission. [https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/5-digital-solutions-greener-europe-2022-07-05\\_en](https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/5-digital-solutions-greener-europe-2022-07-05_en)
- Joint Research Centre: Alves Dias, Patricia; Andrea Conte; Konstantinos Kanellopoulos; Zoi Kapetaki; Giovanni Mandras; Hrvoje Medarac; Wouter Nijs; Pablo Ruiz Castello; Julian Somers; and Dalius Tarvydas** (2021a): Recent trends in EU coal, peat, and oil shale regions Luxembourg Publications Office of the European Union. <https://publications.jrc.ec.europa.eu/repository/handle/JRC123508>
- Joint Research Centre: Asikainen, Tommi; Abdelfeteh Bitat; Erica Bol; Veronika Czako; Alain Marmier; Stefan Muench; Ingrida Murauskaite-Bull; Fabiana Scapolo; and Eckhard Stoermer** (2018b): The future of jobs is green Luxembourg Joint Research Centre, European Commission. <https://publications.jrc.ec.europa.eu/repository/handle/JRC126047>
- Ludwig, Thorsten; Stefan Timm; Stephan Cordes; and Filiz Schwieger** (2023): Branchenanalyse Windindustrie: Perspektiven vor dem Hintergrund von Globalisierung, Energiewende und Digitalisierung Hans Böckler Stiftung. [https://www.boeckler.de/pdf/HBS-008564/p\\_fofoe\\_WP\\_273\\_2023.pdf](https://www.boeckler.de/pdf/HBS-008564/p_fofoe_WP_273_2023.pdf)
- Malin, Lydia; Anika Jansen; and Vico Kutz** (2022): Studie 03/2022: Energie aus Wind und Sonne – Welche Fachkräfte brauchen wir? Köln Kompetenzzentrum Fachkräftesicherung. <https://www.kofa.de/media/Publikationen/Studien/Solar-und-Windenergie.pdf>
- McKinsey: Cornet, Andreas; Patrick Hertzke; Russell Hensley; Ruth Heuss; Timo Möller; Patrick Schaufuss; Stephanie Schenk; Andreas Tschiesner; and Karsten von Laufenberg** (2021): Why the automotive future is electric. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/why-the-automotive-future-is-electric>
- McKinsey: D'Aprile, Paolo; Hauke Engel; Godart van Gendt; Stefan Helmcke; Solveigh Hieronimus; Tomas Naulé; Dickon Pinner; Daan Walter; Maaïke Witteveen** (2020): Net-Zero Europe: Decarbonization pathways and socioeconomic implications. <https://www.mckinsey.com/~media/mckinsey/business%20functions/sustainability/our%20insights/how%20the%20european%20union%20could%20achieve%20net%20zero%20emissions%20at%20net%20zero%20cost/net-zero-europe-vf.pdf>
- Meijer, Frits; Henk Visscher; Nico Nieboer; Robert Kroese** (2012): Jobs Creation Through Energy Renovation of the Housing Stock Neujobs Working Paper D14.2. [https://conference.iza.org/conference\\_files/neujobs\\_2014/4.pdf](https://conference.iza.org/conference_files/neujobs_2014/4.pdf)
- Mella, Andrés; and Edmundo Werna** (2023): Skills and Quality Jobs in Construction ITUC Just Transition Centre, and EFBWW. [https://www.ituc-csi.org/IMG/pdf/230630\\_-\\_jtc\\_study\\_report\\_may\\_2023.pdf](https://www.ituc-csi.org/IMG/pdf/230630_-_jtc_study_report_may_2023.pdf)
- Ministère du travail, du plein emploi, et de l'insertion** (n. d.): Transitions collectives (Transco): Dépliant pour les employeurs. [https://travail-emploi.gouv.fr/IMG/pdf/employeurs\\_transitions\\_collectives.pdf](https://travail-emploi.gouv.fr/IMG/pdf/employeurs_transitions_collectives.pdf)
- Navigant Consulting** (2019): Gas for Climate – Job creation by scaling up renewable gas in Europe Utrecht. <https://gasforclimate2050.eu/wp-content/uploads/2020/03/Navigant-Gas-for-Climate-Job-creation-by-scaling-up-renewable-gas-in-Europe.pdf>
- NTV** (2022): So kann die deutsche Autoindustrie die Kurve kriegen. <https://www.n-tv.de/wirtschaft/So-kann-die-deutsche-Autoindustrie-die-Kurve-kriegen-article23704130.html>
- OECD** (2002): OECD review of career guidance policies. <https://www.oecd.org/denmark/2088292.pdf>
- OSKA** (n. d.): OSKA Methodology. <https://oska.kutsekoda.ee/en/oska-management-methodology/oska-methodology/>
- Ostermayer, Max** (2019): Jobwende – Effekte der Energiewende auf Arbeit und Beschäftigung Friedrich-Ebert-Stiftung. <http://library.fes.de/pdf-files/fes/15696-20210201.pdf>
- Österreichischer Gewerkschaftsbund** (n. d.): Arbeitsmarkt: Umweltstiftung bildet 1.000 Arbeitslose für Öko-Jobs aus. <https://www.oegb.at/themen/arbeitsmarkt/arbeitsmarktpolitik/umweltstiftung-bildet-1-000-arbeitslose-fuer-oeko-jobs-aus>
- Pavlinek, Petr** (2023): Transition of the automotive industry towards electric vehicle production in the east European integrated periphery Empirica 50, 35–73 (2023). <https://doi.org/10.1007/s10663-022-09554-9>
- Pestel, Nico** (2019): Employment effects of green energy policies IZA World of Labor. <https://wol.iza.org/articles/employment-effects-of-green-energy-policies/long>
- Sedeberg, Rachel; Will Markow; and Joel Simon** (2023): Green jobs now WorkingNation. [https://workingnation.com/wp-content/uploads/2023/08/WorkingNation\\_Lightcast\\_GreenJobsNow\\_August2023.pdf](https://workingnation.com/wp-content/uploads/2023/08/WorkingNation_Lightcast_GreenJobsNow_August2023.pdf)

**Šefčovič, Maroš** (2021): Speech by Vice-President Šefčovič at the press conference following the 5th high-level meeting of the European Battery Alliance. [https://ec.europa.eu/commission/presscorner/detail/en/speech\\_21\\_1142](https://ec.europa.eu/commission/presscorner/detail/en/speech_21_1142)

**SolarPower Europe** (2022): EU solar jobs report 2022: Addressing the solar skills challenge. [https://api.solarpowereurope.org/uploads/SPE\\_EU\\_Solar\\_Jobs\\_Report\\_September\\_2022\\_5925da42fc.pdf](https://api.solarpowereurope.org/uploads/SPE_EU_Solar_Jobs_Report_September_2022_5925da42fc.pdf)

**SolarPower Europe** (2023): EU solar jobs report 2023. <https://www.solarpowereurope.org/insights/thematic-reports/eu-solar-jobs-report-2023-1>

**Statistisches Bundesamt** (2023): Duale Berufsausbildung: Zahl neuer Ausbildungsverträge stagniert 2022 auf niedrigem Niveau. [https://www.destatis.de/DE/Presse/Pressemitteilungen/2023/08/PD23\\_333\\_212.html](https://www.destatis.de/DE/Presse/Pressemitteilungen/2023/08/PD23_333_212.html)

**Statista** (2023): Europäische Union: Anteil der Teilzeitbeschäftigung an der Gesamtbeschäftigung in den Mitgliedstaaten. <https://de.statista.com/statistik/daten/studie/1098738/umfrage/anteil-der-teilzeitbeschaeftigung-in-den-eu-laendern/>

**Steeg, Stefanie; Robert Helmrich; Tobias Maier; Jan Philipp Schroer; Anke Mönnig; Marc Ingo Wolter; Christian Schneemann; and Gerd Zika** (2022): Die Wasserstoffwirtschaft in Deutschland: Folgen für Arbeitsmarkt und Bildungssystem Bonn Bundesinstitut für Berufsbildung. <https://bibb-dspace.bibb.de/rest/bitstreams/ce79dfe2-3a9b-4af2-8dce-556016b5ed6d/retrieve>

**Stehrer, Robert** (2022): Short- and medium-term sectoral employment forecasts 2021–2027 Brussels ETUI. <https://www.etui.org/sites/default/files/2022-10/Short-%20and%20medium-term%20sectoral%20employment%20forecasts%202021%E2%80%932027-2022.pdf>

**Swedish board of student finance (CSN)** (n.d.): Student finance for transition and retraining. <https://www.csn.se/languages/english/student-finance-for-transition-and-retraining.html>

**Thielmann, Axel; Christoph Neef; Tim Hettesheimer; Katharina Ahlbrecht; and Sandra Ebert** (2021): Future Expert Needs in the Battery Sector EIT RawMaterials, Fraunhofer. <https://eitrawmaterials.eu/wp-content/uploads/2021/03/EIT-RawMaterials-Fraunhofer-Report-Battery-Expert-Needs-March-2021.pdf>

**Umweltbundesamt** (2021): Beschäftigung und Umweltschutz. <https://www.umweltbundesamt.de/daten/umwelt-wirtschaft/beschaeftigung-umweltschutz#aktuelle-ergebnisse-und-entwicklung-im-zeitablauf>

**UNEP** (2008): Green jobs: Towards decent work in a sustainable, low-carbon world Nairobi, Kenya. [https://www.ilo.org/wcmsp5/groups/public/-/-ed\\_emp/-/-emp\\_ent/documents/publication/wcms\\_158727.pdf](https://www.ilo.org/wcmsp5/groups/public/-/-ed_emp/-/-emp_ent/documents/publication/wcms_158727.pdf)

**United Nations** (2016): Paris agreement. [https://unfccc.int/sites/default/files/english\\_paris\\_agreement.pdf](https://unfccc.int/sites/default/files/english_paris_agreement.pdf)

**Vandenbussche, Thijs** (2021): A Just Energy Transition, Tapping into a century of ideas Brussels, Bonn Friedrich-Ebert-Stiftung and European Policy Centre. <https://library.fes.de/pdf-files/id/18669.pdf>

**Vivid Economics** (2021): Skills for the Low Carbon Transition HSBC Centre for Sustainable Finance. <https://www.sustainablefinance.hsbc.com/-/media/gbm/sustainable/attachments/green-skills.pdf>

**World Economic Forum** (2023): Future of jobs report 2023 – Insight report. [https://www3.weforum.org/docs/WEF\\_Future\\_of\\_Jobs\\_2023.pdf](https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf)

**WWF (World Wide Fund for Nature)** (2021): Europe's Coal Regions: Boosting employment, environment, economy through 'just transition'. [https://wwfeu.awsassets.panda.org/downloads/eu\\_coal\\_regions\\_\\_\\_boosting\\_employment\\_\\_economy\\_\\_environment\\_through\\_\\_just\\_transition\\_.pdf](https://wwfeu.awsassets.panda.org/downloads/eu_coal_regions___boosting_employment__economy__environment_through__just_transition_.pdf)

## IMPRINT

© 2023

**Friedrich-Ebert-Stiftung e. V.**

Godesberger Allee 149

53175 Bonn

Germany

Email: [info@fes.de](mailto:info@fes.de)

Issuing Department:

Competence Centre for Climate and Social Justice | FES Just Climate

Cours St Michel 30e | 1040 Brussels | Belgium

<https://justclimate.fes.de/>

Responsible for this publication in the FES:

Claudia Detsch, Director of FES Just Climate

[Claudia.Detsch@fes.de](mailto:Claudia.Detsch@fes.de)

Editor: Stephan Thalhofer, Policy Advisor, FES Just Climate

Orders/Contact: [justclimate@fes.de](mailto:justclimate@fes.de)

**ISBN 978-3-98628-346-9**

The views expressed in this publication are not necessarily those of the Friedrich-Ebert-Stiftung (FES). Commercial use of media published by the FES is not permitted without the written consent of the FES. Publications by the FES may not be used for electioneering purposes.

Design/Typesetting: [pertext](http://pertext.de), Berlin | [www.pertext.de](http://www.pertext.de)

Cover Illustration: Barbara Huber | [www.cc-construct.de](http://www.cc-construct.de)

