RESEARCH REPORT

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Working conditions and sustainable work

Job quality side of climate change

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Eurofound

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Executive summary

Introduction

Climate change will have a profound impact not only on living conditions but also on Europe's labour markets, working conditions and job quality. To understand the implications of climate change for working life, it is important to distinguish between its direct impact and the impact of climate change policies.

This report aims to contribute to the discussion by examining national-level research and debate on the impact of climate change and environmental degradation on job quality, in particular in occupations likely to be impacted by greening.

Policy context

EU policies on climate change are not new, but policy ambitions and mitigation policies aimed at reducing greenhouse gas emissions have significantly ramped up and are combined with financial investment to support a green transition and growth strategy. The European Union has committed to a series of targets and linked policy measures under the European Green Deal, adopted in 2019. They seek to transform the EU into a modern, resource-efficient and competitive economy based on the binding target of achieving carbon neutrality by 2050. As an intermediate step, the EU has raised its 2030 climate ambition, committing to cutting emissions by at least 55% by 2030 under the Fit for 55 package. To align legislation with these ambitions, a new European Climate Law entered into force in July 2021. The regulation strengthens emission reduction targets for buildings, transport, agriculture, waste management, and small and medium-sized enterprises, and requires the restructuring of the car industry and energy sector to meet climate targets, among other things. The European Green Deal will absorb one-third of the €1.8 trillion investment from the NextGenerationEU recovery package.

To support the European Green Deal's objective of ensuring that no one is left behind, in 2020 the European Commission introduced the Just Transition Mechanism. Its aim is to support the regions and people worst affected by the transition to climate neutrality, with financial aid of €19.2 billion to be allocated between 2021 and 2027 to policy interventions aimed at supporting employment and the diversification of the local economy. The European Commission has emphasised the importance of social dialogue in designing and implementing these measures.

Given the huge impact of climate change and climate change policy on society, the economy and the labour market, related considerations are increasingly mainstreamed into other EU policies, such as industrial policy, research frameworks, education and skills strategies and indeed the European Pillar of Social Rights, which has a key role to play in supporting the transition through education, employment, and safe and healthy work environments.

Key findings

- Climate change impacts, such as rising temperatures, increased air pollution and greater frequency of extreme weather events, have demonstrable negative effects on workers' job quality and productivity. They make work harder. At particular risk are workers who spend a lot of time outdoors (for instance, in agriculture, fisheries, forestry, horticulture, construction and tourism) and those working with heat-generating machinery. Workers in the emergency services are also directly impacted by adverse weather events such as wildfires and floods.
- Employment in these sectors is dominated by men and high numbers of seasonal, migrant and self-employed workers, who tend to lack legislative protection and often have lower levels of trade union organisation and workplace representation.
- Many of these sectors also face change because working methods need to be adapted, which may reduce job security and require training, retraining or job transition.
- Climate change policies (and mitigation policies in particular) are set to contribute to sectoral and occupational shifts, particularly in sectors contributing the most to greenhouse gas emissions. Analysis of European Working Conditions Telephone Survey data confirms that high shares of the workforces in these sectors are in occupations that are likely to be impacted by the green transition. Overall, 40% of workers in the EU are in occupations that will be directly impacted by the green transition.
- In terms of job quality, jobs that are likely to experience greater demand (crop growers,

carpenters and insulation workers) tend to have higher job demands (such as physical risks and physical demands) while lacking job resources (such as social support, autonomy and access to training). New and emerging jobs (for example buyers, policy planning managers and wastewater engineers) show the most positive balance of demands and resources, and enhanced skills jobs (construction managers, meteorologist and electrical engineering technicians) are more in line with European average job quality.

- The balance of occupational change, resulting in new job profiles, greater demand or new skills requirements, varies across sectors. The implications for job quality will be determined not only by the precise task profile of individual jobs (including exposure to climate change risks) and workplace practices but also by measures taken to address the impacts of climate change and how the green transition is implemented at all levels.
- While greened occupations embody the lifelong learning efforts that will support the transition, companies are also engaging in actions and workplace practices that support decarbonisation. The involvement of workers in the development and implementation of these practices can enrich job quality.

Policy pointers

- Research on the effects of climate change on workers and workplaces is still patchy. More knowledge and solutions are needed to reduce the risks to workers.
- There is no level playing field in the EU in relation to the protection of workers from risks directly associated with climate change. National-level provisions on working in heat vary significantly.
- Decarbonisation processes impact many sectors, going beyond energy production and heavy industry. Workers in the most affected sectors should receive priority support for skills renewal and job transitions. Additionally, a more detailed analysis of the implications for other sectors is necessary, along with providing support for these companies and their employees.
- More attention should be paid to the job quality implications of the green transition, and more systematic research is required. Monitoring of the quality of greened jobs and those most exposed to climate change risks (often the same jobs) is needed as climate change is a dynamic process. Policy measures should aim to level up job quality.
- The development of industrial strategies and related skills forecasting and the design of relevant training developed with social partners will be vital, particularly if skills and labour shortages are to be prevented from limiting progress towards decarbonisation.

Introduction

Together with demographic change, digitalisation and globalisation, climate change and environmental degradation are key megatrends affecting living conditions and employment and working conditions worldwide. Job quality plays a major role in supporting the quality of working life, and also the performance of companies (Eurofound, 2022) and the labour market (European Commission, 2023). Job quality is determined by characteristics of work and employment that have a proven causal relationship with health and well-being, as demonstrated by high-quality epidemiological studies. It is multidimensional, relating to the working environment and the physical demands of work, the social environment, working time, job security and career prospects, work intensity and task discretion, organisational policies, and intrinsic job features.

While EU policies related to climate change are not new, recent years have seen a significant increase in EU policy ambitions and mitigation policies aimed at reducing greenhouse gas (GHG) emissions. These policies have been combined with substantial financial investment to support a green transition and growth strategy. This report contributes to the policy debate by examining national-level research and debate on the impact of climate change and environmental degradation on job quality.

- The first chapter sets the scene for the analysis of climate change and job quality.
- The second chapter discusses climate change risks, both physical and psychosocial.
- The third chapter considers job quality in the sectors with the highest GHG emissions. These sectors are undergoing a high level of change, as they are exposed to climate change risks but are also involved in mitigating the effects of climate change.
- The fourth chapter discusses the issue of green workplace behaviours.
- The fifth chapter examines the extent and variety of policy discussions on addressing the impacts of climate change on people's work and job quality.
- The sixth chapter outlines the conclusions and policy recommendations from this report.

The report is based on a comparative analysis of the 28 national contributions provided by the Network of Eurofound Correspondents (Annex 1) to a questionnaire and on a statistical analysis of European Working Conditions Telephone Survey (EWCTS) data. These analyses are complemented by a comprehensive literature review. The report adds to existing Eurofound research on the topic, in particular the conceptual framework on the impact of climate change and climate policies on living conditions, working conditions, employment and social dialogue (Eurofound, 2023a).

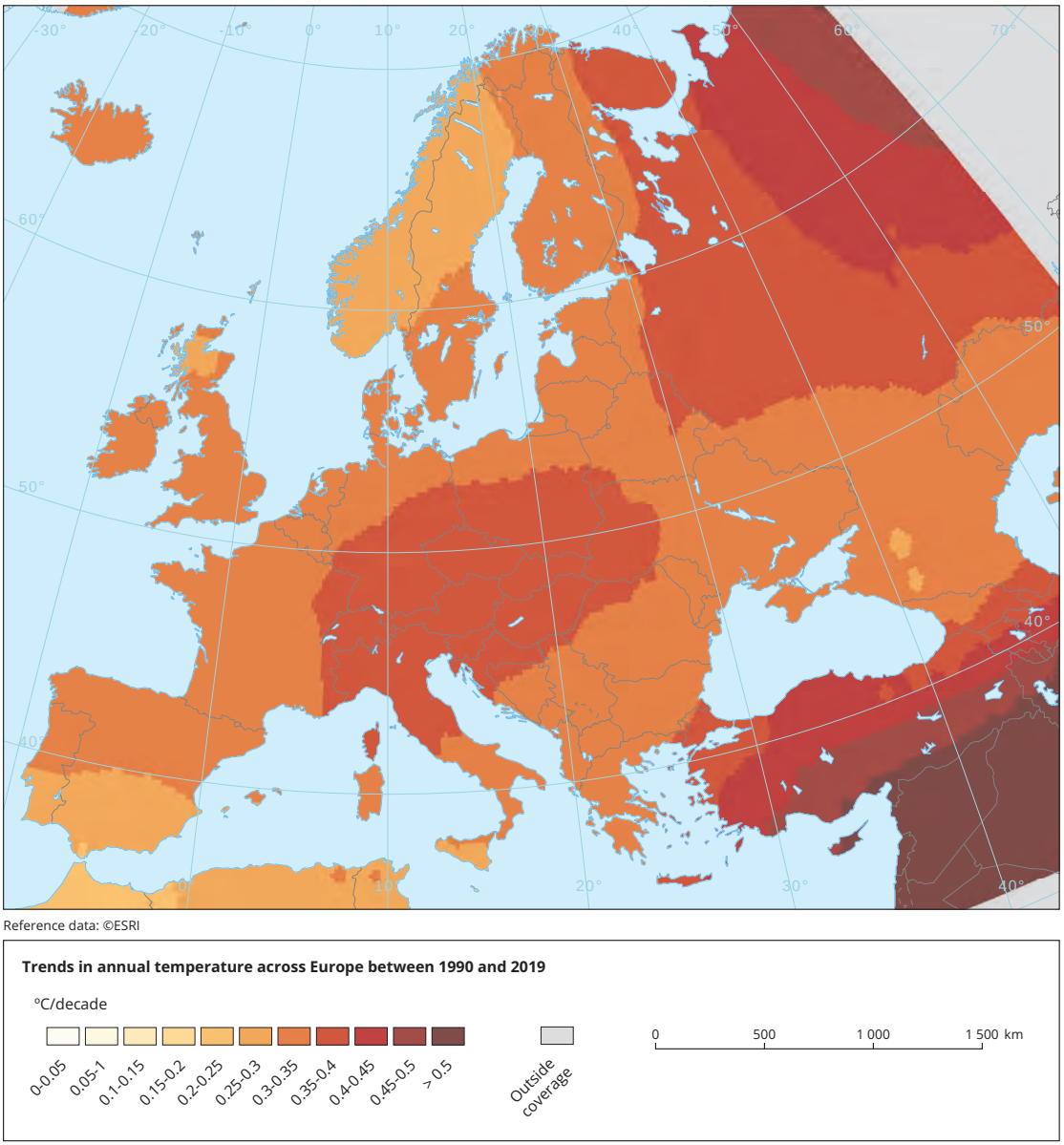
1 Climate change and job quality

This chapter introduces the issues of climate change and environmental degradation in Europe, including job quality, greening of tasks, and the green transition and job quality. It identifies sectors of interest and discusses the relationships between climate change, climate policies and job quality.

Climate change and climate policies

According to the Intergovernmental Panel on Climate Change (IPCC), global warming – that is, the increase in surface (and ocean) temperatures and the concomitant increased concentration of atmospheric carbon dioxide (CO_2) – has already resulted in rapid and widespread changes in the atmosphere, ocean, cryosphere and biosphere, with an increase in climate hazards. According to the World Meteorological Organization (WMO) report *State of the Climate in Europe 2022*, 'Europe is the fastest-warming of all the WMO regions, warming twice as much as the global average since the 1980s' (WMO, 2023). This trend is illustrated in Figure 1. Climate change has reduced food security and water security.

Figure 1: Trends in annual temperature across Europe, 1990–2019



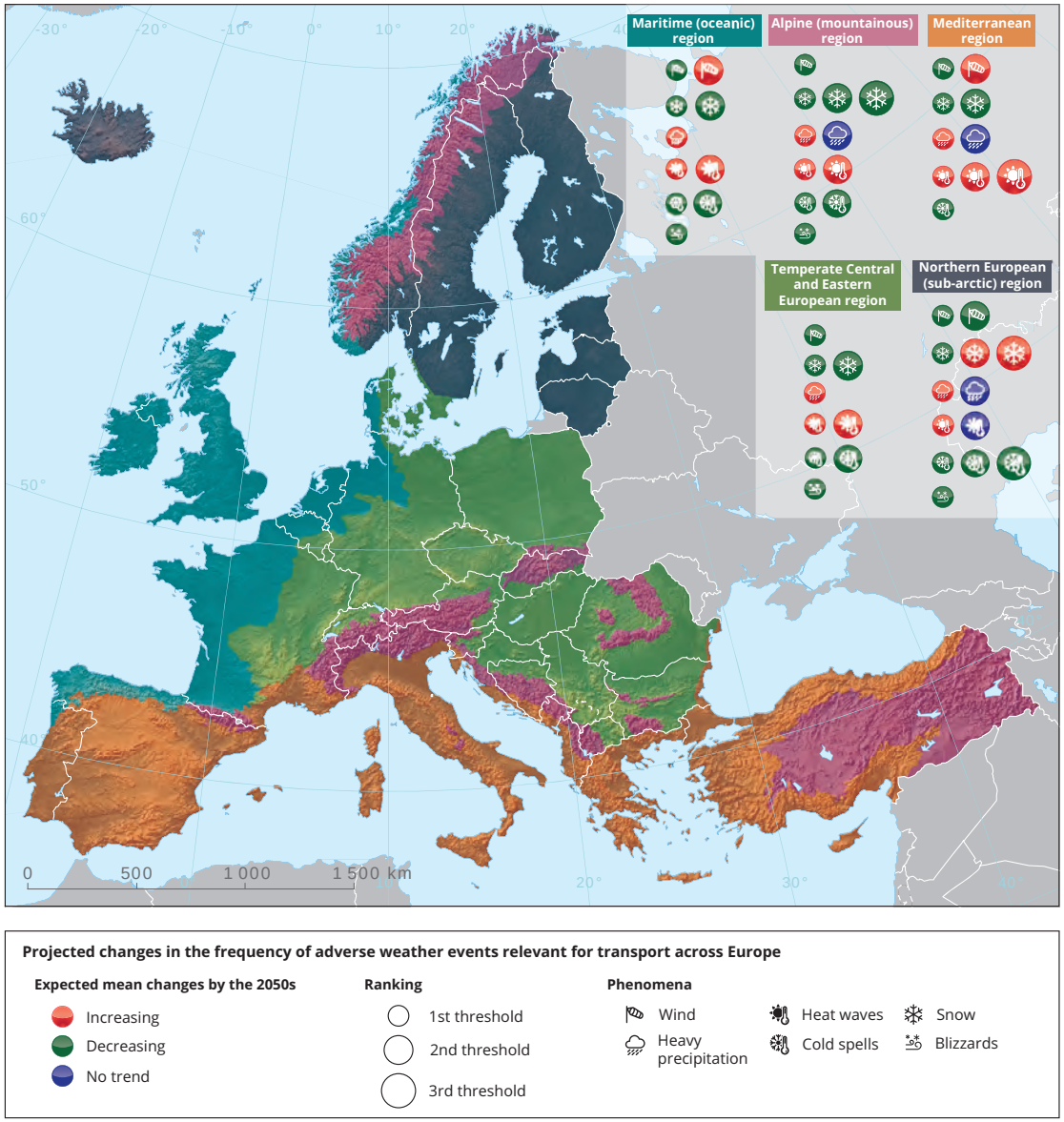
Reference data: ©ESRI

Source: *EEA, 2020*

Individual livelihoods have been affected through, for example, the destruction of homes and infrastructure, loss of property and income, and the impacts on human health and food security, resulting in adverse effects on gender and social equity. Extremes of heat have intensified in cities, and urban infrastructure – including transport, water, sanitation and energy systems – has been compromised by extreme and slow-onset events, with resulting economic losses, disruption to services and negative impacts on well-being.

Warming in Europe is expected to continue to increase faster than the global mean. Largely negative impacts are projected for southern regions (for instance, increased cooling needs and water demand, losses in agricultural production and water scarcity), and some short-term benefits are anticipated in the north (for example, increased crop yields and forest growth). The numbers of deaths and people at risk of heat stress will increase. At the same time, extreme weather events such as fire and flooding are predicted to become more frequent and will increase risks to people, businesses and infrastructure (Figure 2). European cities are hotspots for multiple risks of increasing temperatures and extreme heat, floods and droughts.

Figure 2: Projected changes by 2050 in the frequency of adverse weather events relevant for transport across Europe



Source: *EEA, 2020*

In terms of climate change policies, this report refers to two types.

Climate change adaptation policies are policies dealing with the expected impacts of climate change and involve taking practical actions to manage risks, protect communities and strengthen the resilience of the economy. Examples of climate change adaptation policies directly relevant to the world of work are the introduction of agro-ecological principles and practices, sustainable forest management, sustainable aquaculture, improved cropland management, and the development of green infrastructure and ecosystem services. Indirect adaptation actions include practices to improve water use efficiency.

Climate change mitigation policies aim to change how we live, move, consume and produce with a view to reducing and/or eliminating the production of harmful GHGs. Systemic change is needed to achieve deep emission reductions and transformative action. Systems transitions include the deployment of low-emissions technology, improved cropland management, and sociocultural and behavioural changes. Mitigation actions directly relevant to the world of work include the development of renewable energy, the improvement of sustainable forest management practices, the use of efficient building materials and energy efficiency. There can be positive synergies between adaptation and mitigation actions.

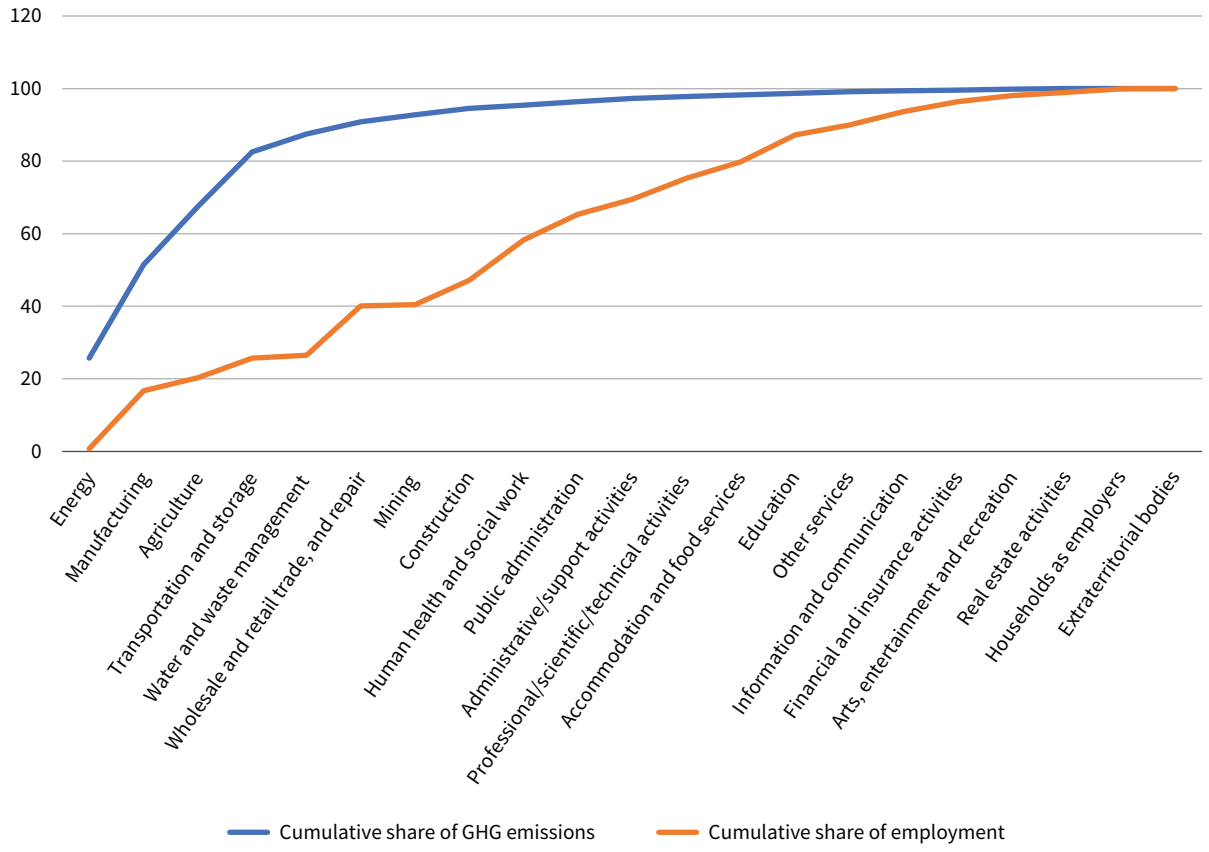
Climate change and climate change policymaking are dynamic processes. Workers may be subject to the mental health impacts of climate change in general; these may also interact with work-related hazards. Deep, rapid and sustained mitigation and adaptation strategies would deliver many co-benefits, especially for air quality and health (IPCC, 2023).

Employment and greenhouse gas emissions

Eurostat statistics for the European Green Deal show that GHG emissions per employed person have been in decline in the EU since 2010. This has resulted from decreasing GHG emissions and increasing employment in the region. In 2020, 13.6 tonnes of GHGs were emitted by every employed person in the EU, the lowest value on record and 4.4 tonnes less compared to 2010 (Eurostat, 2022). Despite this positive outlook, not all sectors of activity produce the same amount of GHG emissions or employ similar shares of people.

Figure 3 ranks broad economic activity sectors by their share of total GHG emissions in 2022. The heaviest

Figure 3: Cumulative GHG emissions and employment by economic sector of activity, EU27, 2022 (%)



Note: *The blue curve shows the cumulative share of total GHG emissions by the industries from the left to the right, while the orange line shows the cumulative share of employment.*
Source: *Eurostat, European Union Labour Force Survey, employed population over 15 years old [lfsa_egan2], and air emissions accounts, greenhouse gases [env_ac_ainah_r2]*

GHG-emitting sector is on the left-hand side and the sector that emits the least is on the right-hand side. The sector with the largest share of GHG emissions in 2022 – electricity, gas, steam and air conditioning – accounts for 26% of emissions but less than 1% of employment in the EU. The graph shows that the largest emitters of GHGs in the EU account for a relatively small proportion of the total employment in the region: the sectors to the left of (and including) water supply and waste management produce 88% of the EU's total GHG emissions but employ only 27% of the EU workforce.

Job quality

Job quality is determined by characteristics of work and employment that have a proven causal relationship – either positive or negative – with health and well-being. Job quality is multidimensional.

The EWCTS data provide insight into how the different aspects of work that contribute to job quality are distributed across the working population. This framework for analysis, created using a methodology developed by the Organisation for Economic Co-operation and Development (OECD, 2017), identifies six job quality dimensions, each of which involves job demands, with associated psychological and physiological costs, and/or job resources, which support workers' well-being (Bakker and Demerouti, 2007).

- **The physical and social environment** refers to the features of the physical space in which work is undertaken and the relationships between workers in the workplace.
- **Job tasks** refers to the conditions under which workers carry out their tasks, including work intensity, and task discretion and autonomy.
- **Organisational characteristics** refers to opportunities for workers to be part of decision-making processes at work, including practices that enable employees to be involved in decision-making concerning their work. This dimension includes one demand, relevant only to self-employed workers, which is dependence, as measured by a lack of freedom to make important decisions on how to run the business and recruit staff.
- **Working time arrangements** refers to how working time is organised, including unsocial work schedules and the working time flexibility available to workers.
- **Job prospects** refers to opportunities to advance in one's career, job insecurity – the risk of losing one's job – and opportunities to develop skills through training.
- **Intrinsic job features** refers to opportunities for self-development and to contribute to a goal in line with personal values.

The demands and resources associated with each job quality dimension, as measured by the EWCTS data, are summarised in Table 1.

According to data from the European Working Conditions Survey (EWCS) series, job quality is associated with the quality of working life and therefore with health and well-being; with engagement (feeling full of energy at work, being enthusiastic about one's job and feeling that time flies when working), trust and cooperation in the workplace; with ability to make ends meet; and with work–life balance. Good job quality supports sustainable work over the life course.

Table 1: Dimensions of job quality and corresponding job demands and resources

Dimensions	Job demands	Job resources
Physical and social environment	Physical risks (for example, exposure to chemicals and noise)	Social support
	Physical demands (for example, lifting and carrying heavy loads)	
	Intimidation and discrimination	
Job tasks	Work intensity (high speed and tight deadlines)	Task discretion and autonomy
Organisational characteristics	Dependence (self-employed only)	Organisational participation and workplace voice
Working time arrangements	Unsocial work schedules	Flexibility of working hours
Job prospects	Perceptions of job insecurity	Training and learning opportunities
		Career advancement
Intrinsic job features		Intrinsic rewards
		Opportunities for self-realisation

Source: *Eurofound, 2022*

It also supports the performance of the labour market: most occupations experiencing persistent labour shortages have lower job quality (European Commission, 2023). Job quality supports an inclusive labour market and the engagement in work of various groups of workers.

Greening occupations

The green transition will lead to the development of new occupations, some of which do not even exist yet. In many cases, it will transform existing occupations, requiring different skills to be learned and developed. Some existing occupations are needed to 'make and build' the transition, leading to increased demand for these occupations, without significant transformation of their skill sets. Other occupations will be less impacted or not impacted at all by the green transition; tasks will not change but job content may be informed by the transition (for example, in the education sector).

This approach focusing on greening of tasks contrasts with approaches focusing on green jobs and makes it possible to map the transformative processes affecting occupations as the tasks required in them change.

According to Dierdorff et al:

> *The 'greening' of occupations refers to the extent to which green economy activities and technologies increase the demand for existing occupations, shape the work and worker requirements needed for occupational performance, or generate unique work and worker requirements.*
>
> (Dierdorff et al, 2009, p. 11)

This approach was taken using the Occupational Information Network (O*NET) database, maintained by the United States Department of Labor. The O*NET occupational classifications identify jobs as being directly or indirectly green, depending on whether they explicitly contain 'green' tasks. This approach allows four 'greening occupational groups' to be distinguished based on the likely impact of the greening of the economy, as set out in Table 2. The application of O*NET classification, using the International Standard Classification of Occupations (ISCO), enabled, in turn, the identification of these groups of jobs in the EWCTS.

According to the EWCTS, in 2021, 37% of workers in the EU were in occupations that the green transition will probably directly impact. About 9% of workers were in

Table 2: Impact of the greening of the economy on occupational groups

Occupational group	Description
Small or no impact	Occupations that will see little or no impact of greening.
New and emerging	New and emerging occupations that do not exist in ISCO-08 and are currently classified under one of the existing codes. *The impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, which results in the generation of a new occupation …. This new occupation could be entirely novel or 'born' from an existing occupation* (Dierdorff et al, 2009) Examples of occupations: green policy planning managers, renewable energy engineers.
Enhanced skills	Existing occupations that will potentially require changes in tasks, skills and knowledge as a result of the transition to a carbon-neutral economy. *The impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing … occupation. This impact may or may not result in an increase in employment demand for the occupation. The essential purposes of the occupation remain the same, but tasks, skills, knowledge, and external elements, such as credentials, have been altered* (Dierdorff et al, 2009) Examples of occupations: house builders, roofers, motor vehicle technicians.
Increased demand	Existing occupations that will not require changes in tasks, skills and knowledge but will potentially see an increase in demand due to the transition to a carbon-neutral economy. *The impact of green economy activities and technologies is an increase in the employment demand for an existing occupation. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change, but the tasks themselves do not* (Dierdorff et al, 2009) Examples of occupations: electrical and mechanical engineers, electrical line installers and repairers, field crop and vegetable growers.

Source: *Authors' elaboration, based on Dierdorff et al, 2009*

occupations that will see new or emerging jobs arising from the green transition, while 14% were in occupations that will probably require enhanced skills as a result of greening, and 15% were in occupations likely to see an increase in demand due to the transition.

The jobs in the occupations likely to be impacted by the green transition are performed mostly by men (75%). These jobs represent only 20% of all female workers but encompass half of the male working population in the EU, clearly indicating that the scale of the impact of the green transition will be different for men and women.

The distribution of workers according to the potential impact of greening by sector confirms that the green transition will predominantly affect those working in sectors with larger stakes in the greening process, indicated by their level of GHG emissions.

Green transition and job quality

Table 3 shows how the different types of occupations impacted by the green transition compare with the EU average in terms of workers' exposure to job demands.

Workers in new and emerging occupations are much less exposed than those in the other types to physical risks and physical demands, whereas those in increased demand occupations are particularly likely to be exposed to such risks and demands. This suggests that policy should be targeted towards reducing the level of physical demands and physical risks in increased demand occupations and that developments in this area should be monitored.

Workers in increased demand occupations are indeed more exposed to physical demands. About half of workers in increased demand occupations (49.7%) and 38.8% of those in enhanced skills occupations report carrying or moving heavy loads at work, which is a much larger proportion than the EU workforce average (35.3%).

However, work intensity is an issue for large shares of workers in all the occupations likely to be impacted by the green transition: 47% of those working in increased demand occupations, 52% of those in enhanced skills occupations and 54% of those in new and emerging occupations report frequently working to very tight deadlines, while 45%, 49% and 51% report frequently working at very high speeds, respectively. This is problematic, given the association between high levels of exposure to demands of this kind and health problems such as cardiovascular diseases and musculoskeletal disorders, and also depression.

Perceived job insecurity is reported by nearly one-quarter of workers in increased demand occupations, which is slightly higher than average (21%) and higher than the shares of workers perceiving their jobs as insecure in new and emerging occupations.

Table 3: Job demands of greening occupational groups compared with the EU workforce average

Occupational group	Physical risk	Physical demands	Intimidation and discrimination	Work intensity	Dependence*	Unsocial work schedules	Perceived job insecurity
Small or no greening impact							
New and emerging							
Enhanced skills							
Increased demand							

Note: ** Self-employed only. The red bars represent demands that are above average, whereas the blue bars represent demands that are below average.*
Source: *EWCTS, 2021*

Table 4: Job resources of greening occupational groups compared with the EU workforce average

Occupational group	Social support	Task discretion and autonomy	Organisational participation and workplace voice	Flexibility in working hours	Training and learning opportunities	Intrinsic rewards	Career advancement	Opportunities for self-realisation
Small or no greening impact								
New and emerging								
Enhanced skills								
Increased demand								

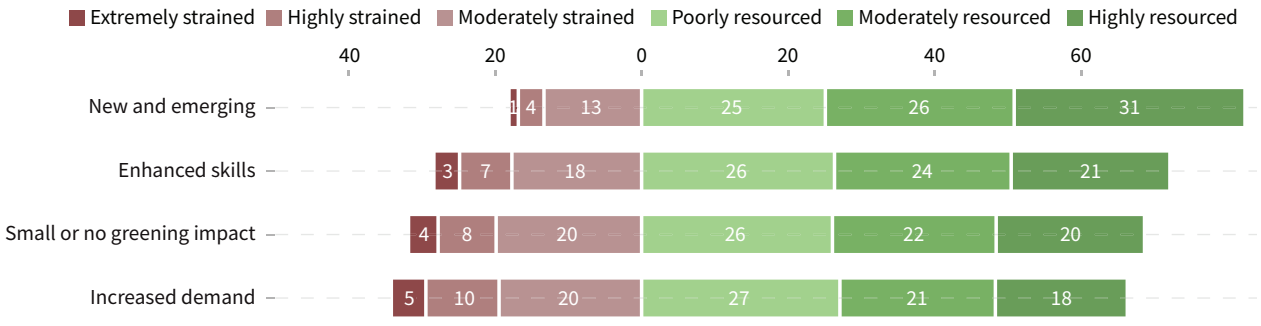
Note: *The red bars represent resources that are below average, whereas the blue bars represent resources that are above average.*
Source: *EWCTS, 2021*

Table 4 shows how the different types of occupation compare in relation to workers' access to job resources, indicating that workers in new and emerging and enhanced skills occupations tend to be better resourced than workers in increased demand occupations and those in occupations with a small or no greening impact. Workers in increased demand occupations appear, again, to be particularly disadvantaged. They fare worse in terms of social support (provided by co-workers and managers), task discretion and autonomy, organisational participation and workplace voice, and intrinsic rewards. Only 45% reported undergoing training paid for by their employers (or paid for by themselves if self-employed) during the 12 months prior to the survey, which is comparatively less than the 54% of workers in new and emerging occupations. They would benefit from initiatives or policy action aimed at developing their autonomy and organisational voice and enhancing their working time flexibility, as well as company practices promoting social support and intrinsic rewards.

Using the data on job demands and resources, Eurofound constructed an index for measuring job quality. In simple terms, a job is described as 'strained' when the demands exceed the resources available to the workers and 'resourced' when the resources surpass the job demands. Workers in strained jobs are at risk of poorer health and well-being, not only in the short term but also in the medium and long term (Eurofound, 2022). Based on this index, workers are grouped into six categories: extremely strained, highly strained, moderately strained, poorly resourced, moderately resourced and highly resourced.

Figure 4 shows the distribution of strained and resourced jobs across the occupational groups likely to be impacted by the green transition. What is striking is that a much lower share of workers in new and emerging occupations are in strained jobs compared to the other occupations, while workers in increased demand occupations fare the worst. This reflects the fact that new and emerging jobs are better than average in terms of job demands and job resources, while increased demand occupations are worse than average.

Figure 4: Job quality index, by greening occupational group, EU27 (%)



Source: *EWCTS, 2021*

These results show that, all in all, the impact of the green transition in terms of job quality (and contribution to decent work for all) will be mixed. On the one hand, it will result in the creation of more jobs of the new and emerging type, which will contribute to an overall improvement in job quality compared with the current situation. On the other hand, this positive contribution may be counterbalanced by below-average job quality in increased demand jobs.

Summary

Climate change has significantly contributed to environmental degradation in Europe, which in turn has affected the health of the population and that of some workforces, as well as modifying some working conditions, making work more difficult to carry out for some workers. Workers may be subject to both the (mental) health consequences of climate change and work-related hazards.

The green transition will predominantly affect those working in sectors with larger stakes in the greening process, as indicated by their level of GHG emissions. For instance, the electricity, gas, steam and air conditioning sector had the largest share of GHG emissions in 2022, accounting for 26% of emissions but less than 1% of employment in the EU workforce.

The jobs in the occupations likely to be impacted by the green transition are performed mostly by men (75%). These jobs represent only 20% of all female workers but half of the male workforce in the EU. This disparity clearly indicates that the scale of the impact of the green transition will be different for men and women.

Workers in new and emerging occupations face less exposure to physical risks and physical demands than those in the other types of occupations. Conversely, those in increased demand occupations are particularly likely to face such risks and demands. This suggests that policy should be targeted towards reducing the level of physical demands and physical risks in increased demand occupations and that developments in this area should be monitored.

A much lower share of workers in new and emerging occupations are in strained jobs compared to other occupations, while workers in increased demand occupations fare the worst. This reflects the fact that new and emerging jobs are better than average in terms of job demands and job resources, while increased demand occupations are worse than average.

2 Climate-related hazards at work

Environmental degradation is associated with changes in the working environment, including exposure to heat and air pollution, ultraviolet (UV) radiation, extreme weather events, and communicable vector-borne diseases and expanded vector habitats. It is also associated with changes that impact on natural resources in the work environment (Schulte and Chun, 2009; Adam-Poupart et al, 2013; Schulte et al, 2016). Such changes also lead to an increase in psychosocial risks, for example linked to fear of employment loss and increased insecurity. Climate mitigation policies lead to profound occupational change and are also associated with an increase in psychosocial risks. They can also lead to increased exposure to physical risks, for example those present in emerging industries, such as wind turbine energy generation. This shows how much climate change and climate policies will profoundly impact job quality.

This chapter first discusses the effects of increased ambient temperatures and heatwaves and considers other climate-related hazards. It then moves from the issue of physical risks to cover psychosocial risks, and concludes by looking at gender divides and identifying the vulnerable groups most exposed to risks.

Increased ambient temperatures and heatwaves

According to information provided by the Network of Eurofound Correspondents, the risks associated with increased temperatures and an increased incidence of heatwaves are the most widely recognised of all climate change hazards; recent heatwaves in Europe have contributed to heightened interest in this threat. Based on a two-year research project carried out between 2019 and 2021, heatwaves are recognised in Czechia as the most significant threat to workers (Danihelka, 2021). Climate change-induced degradation causes increased exposure of workers to heat.

Overview

The frequency and severity of heatwaves is going to increase as a result of climate change. This will intensify the risk of workers experiencing heat stress, which is a major concern for worker populations, working both indoors and outdoors. The negative health impact is greater in cases of high air humidity.

Extreme cases of heat stress result in heat exhaustion or heatstroke, which require urgent medical treatment. Extreme heat exposure is linked to chronic kidney disease.

Heat exposure also increases the risk of work accidents caused by fatigue and reduced vigilance. Research from the European Trade Union Institute shows that at above 30°C the risk of workplace accidents increases by 5–7%. When temperatures exceed 38°C, this risk increases by 10–15% (ETUI, 2021). The negative impact of heat increases as the number of 'tropical nights' (when the temperature does not fall below 20°C and buildings do not have time to cool down) increases, as heat also disrupts sleep and rest.

In France, several deaths caused by hyperthermia in the workplace were identified during the 2003 and 2006 heatwaves. A substantial proportion of heat-related fatalities occur during the worker's first day on the job, which emphasises the importance of acclimatisation. Wearing protective equipment can also aggravate the effect of heat on certain groups of workers. In addition, warm, wet skin promotes the absorption of chemicals.

Heat exposure makes performing work activities more strenuous and difficult: it increases physical discomfort, reduces manual dexterity and affects cognitive performance, visual motor capacities, short-term memory and vigilance (Anses, 2018). It alters workers' emotional state (leading to irritability or anger) and can aggravate tensions within an organisation or with the public, and it is therefore ultimately likely to increase psychosocial risks at work. Extreme heat is also associated with decreased labour productivity.

Outdoor workers, such as those employed in construction, agriculture, fishing, tourism and municipal services, are most exposed. Other industries in which workers are exposed to heat include mining, transport (drivers), waste materials management, postal services and firefighting services. Industries involving indoor activities that expose workers to the risk of excessive heat are the glass, ceramic, brick and rubber fabrication industries; foundries; the canning and textile industries; and laundries, kitchens and warehouses.

Healthcare workers, particularly those in the emergency services, are also at increased risk due to an increase in the number of patients. Difficulty in maintaining an appropriate temperature in hospital buildings may further increase the risk of heat exposure, according to the Hungarian correspondent.

Populations disproportionately affected by heat stress include foreign-born workers, particularly because many work outdoors, in working premises not environmentally controlled or exposed to heat (such as warehouses and kitchens) and in industries such as agriculture and construction. A Croatian study found that low- and middle-income workers are more

vulnerable to the effects and costs of the green transition and that workers in different income brackets will not be equally able to protect themselves from the heat because of differences in quality of housing. This could compound the negative impact of heat for people who are also exposed to heat at work.

At the individual level, heat tolerance seems to diminish from about 45 years of age. Overweight workers, workers with certain health problems, workers taking certain medications and pregnant workers are more vulnerable and more likely to develop problems following excessive heat exposure.

European highlights

An increasing number of people will be working in hot environments in the coming years, with the associated adverse effects on (public) health and productivity. One in three people frequently working in hot environments experiences symptoms, including hyperthermia, syncope, reduced kidney function, dehydration and neurological dysfunction (report of the technical working group in Greece in 2021). Working in a hot environment has a negative effect on productivity, and this leads to significant negative effects on the economy and public health. The effects are strongest in industries that rely on manual labour, but the effects spread across all sectors of the economy, as they affect primary sector productivity.

More people are working from home, often with poorer ventilation than in the employer's premises.

A cross-sectional study was carried out on heatwaves in Brnik (Slovenia) and Larisa (Greece) over the period 1981–2017 in order to establish how environmental changes were affecting workers (Pogačar et al, 2019). The study produced the following key results for Slovenian participants who worked outdoors: 50.9% of participants spent one-third to two-thirds of their working time outside and 49.1% worked outside for between two-thirds and all of their working time. Some 30.6% of all participants reported chronic diseases. Ninety-four per cent of participants stated that the impact of heat stress on their work was not negligible and that it had a significant impact on their productivity (71%) and their well-being (74%). In terms of symptoms, participants reported thirst (82%), excessive sweating (85%), tiredness (62%), exhaustion (62%) and headaches (53%). Thirteen per cent of participants reported that they did not see any options to reduce their own exposure. Around 60% of participants stated that their employer had not given them guidance on working during a heatwave.

The research also covers economic analysis of the impact of increased temperatures. The impact of climate change and warming in Italy affects both the number of hours worked (labour supply) and the efficiency of workers during their working hours (labour productivity) (Spano et al, 2020).

In the agriculture, construction, service and industrial sectors in Italy, there was a 79.9% decline in potential hours of labour in 2019 compared with a 1990–1994 baseline. Total employment in Italy is expected to decline by 1.2% under a low-emissions scenario and by 3.1% under a medium-emissions scenario.

The productivity of office workers is also expected to decline due to an increase in the error rate in performing work activities and a decrease in work efficiency, which may be countered to some extent by workers taking safety breaks (Pogačar et al, 2019).

Other negative impacts reported include overheating of servers and other IT equipment, reduced airfreight cargo (weight limit on take-off), cases of warped railway tracks and fires at railway facilities (Ministry of the Environment of Poland, 2013; Government of Luxembourg, 2018).

To measure the trend in extreme temperatures in Italy, researchers in one study used the Monitoring Agricultural Resources (MARS) database developed by the European Commission's Joint Research Centre (Alpino et al, 2022). The researchers measured the incidence of extreme temperatures in each year by counting the number of days when the maximum temperature exceeded 30°C. This temperature threshold is supported by a series of studies that show that the individual productivity of workers falls sharply above this level (see, for example, Bauer et al, 2022).

The number of days with extreme temperatures has increased significantly in Italy, from just over 20 days in the early 1990s to almost 40 days in recent years (Alpino et al, 2022). Increased temperatures are expected to have direct consequences for companies: reduced productivity, increased production costs, increased absences from work due to illness, heatwaves or risks and damage related to floods. These impacts will be felt by companies in the south in particular, which is the region most affected by climate change, and above all by small and medium-sized companies, which are the majority in Italy.

Practices on adaptation to heat that impact on job quality

In a few cases, national correspondents were able to provide examples of adaptations to heat that have impacted other job quality dimensions.

Research has found that workers in occupations vulnerable to increased heat risk have poorer job quality and working conditions due to rising heat levels; this calls for decreasing their workload for the first few days of a hot period to enable them to get used to the high temperatures, managing activities so that workers can do tasks better suited to the heat and providing training on the prevention of heat-related illness (Magasinet Arbejdsmiljø, 2022). As more workers are exposed to high temperatures, and temperatures

continue to increase, awareness-raising activities and the dissemination of good practices should be encouraged.

It is possible to design win–win practices in terms of climate adaptation and job quality. To minimise the loss of working hours, the Dutch association of construction and infrastructure companies, Bouwend Nederland, advises its members to invest in on-site facilities, alternative construction methods and changing employee behaviour (Bouwend Nederland, 2022). Investing in on-site facilities may include providing good shelter, such as a construction tent. These can provide more workable days, which makes meeting work schedules more feasible. Choosing new construction methods can also make the construction process less dependent on weather conditions and less hazardous, for example, modular construction. These new methods reduce working time on outdoor construction sites, which makes the construction process less sensitive to weather conditions. Managing extreme weather more effectively can also be achieved through behavioural change among employees, for example better awareness of safe working practices and the importance of drinking water regularly and taking breaks. Construction companies may also introduce a tropical schedule on days of extreme heat. It is also recommended that companies create an open working atmosphere, in which employees feel able to identify or report areas for improvement (Bouwend Nederland, 2022).

Climatic conditions in greenhouses have changed as a result of pressure to become more energy efficient (Pekkeriet and Splinter, 2020). New knowledge and insights have led to developments in cultivation that put the needs of the plant first and not those of the grower or employee. Research has shown that plants appear to be able to cope well with higher temperatures that do not feel comfortable for humans, as long as humidity is sufficiently high. This leads to denser and more vegetative crops and higher production and energy efficiency. In greenhouse horticulture, moving towards circular production is more environmentally friendly, and the quality of the product and the reliability of delivery improve significantly. For employees, however, it has the following consequences:

- temperatures 4–5°C warmer in the greenhouse, especially in summer
- 10–20% higher humidity in the greenhouse, with reduced air movement
- a denser crop, making it more difficult to manoeuvre in the greenhouse
- unnatural colours due to LED lighting, making work more difficult and unpleasant and thus more strenuous (this is an example of a maladaptive climate mitigation practice from the perspective of job quality)

Bauer et al (2022) found that heatwaves can lead to overheated indoor workplaces if no air conditioning is in place. Air conditioning relies on (high) energy consumption; this is an example of a possible conflict between climate change adaptation practices and job quality measures, as this preventive measure designed to improve job quality (cooling of the workplace) is associated with a negative impact on climate change (through increased emissions).

These examples confirm the need to devise and systematically assess climate change policies with a focus on the long term and job quality policies; preserving nature and workers' health should go hand in hand in a sustainable climate change agenda.

Other climate-related hazards

This section examines air pollution, exposure to UV radiation, communicable vector-borne diseases and expanded vector habitats, changes in the work environment and extreme weather events. Increased exposure to these risks arises mostly as a result of climate degradation.

Air pollution

Climate change affects the level of air pollutants and other GHGs, as well as the level and distribution of pollens and other aeroallergens.

Changes in weather patterns (temperature, wind and precipitation) can increase the severity and frequency of air pollution episodes, while growing energy demands increase the emission of certain pollutants. Forest fires increase the concentration of smoke in the air.

Air pollution-related diseases include respiratory disease, allergic disorders, and asthma and other chronic lung conditions. Exposure to ozone and other air pollutants has been associated with cardiovascular and respiratory diseases.

The combination of high temperatures and added heat load through physical exertion increases breathing frequency and, thereby, total intake of air pollutants.

Measures to protect workers include less exposure by reducing time outdoors, rotating tasks and workers, restricting work during periods of severe air pollution episodes and using personal protective equipment.

Air pollution impairs cognitive ability, increases fatigue and reduces mental readiness, causing more accidents at work. A pioneering study in Italy examined the causal effects of air pollution on accidents at work and concluded that they increase by an estimated 14% given a decrease in the air quality index used in the study of one standard deviation, which would equal 2% more accidents arising from a 10% reduction in air quality as measured by the index (Alpino et al, 2022).

Eurofound's Spanish correspondent highlighted concerns about other forms of pollution, such as water pollution and contaminated soils.

Outdoor workers are the most exposed to the risks of air pollution, while firefighters are also very much at risk, and workers cycling to work can also be affected.

Exposure to UV radiation

Exposure to UV radiation has been associated with the development of skin cancers, cataracts, eye infections and disturbed immune function.

A number of individual factors can increase the incidence and severity of these effects, such as white skin, skin that does not tan and taking certain medications.

Workers working outdoors, especially during the hours when the sun is at its most intense, are the most exposed.

Communicable vector-borne diseases and expanded vector habitats

Higher temperatures change incubation rates, transmission seasons and geographical distributions of vector insects (ticks and mosquitoes) and disease-carrying animals. Rises in temperature also facilitate the introduction of new pathogens or disease vectors to livestock.

Exposure to water-borne and food-borne pathogens can occur via contaminated drinking water (from human waste or agricultural run-off), seafood (due to natural microbial hazards or toxins) and fresh produce (grown or processed with contaminated water).

Water-borne pathogens are associated with serious health conditions, including hepatic, lymphatic, neurological and endocrinological diseases.

Mosquito-borne diseases include West Nile virus, dengue and malaria. Tick-borne diseases include Lyme disease. As vegetation zones shift northwards, this in turn impacts the geographical distribution of pests and vectoral diseases. Of these, tick-borne encephalitis and Lyme disease, as well as the rodent-borne Puumala virus, are of particular concern in Finland.

Outdoor workers are at risk of biological hazards (such as venomous animals and insects, and poisonous plants) and vector-borne diseases (such as malaria and Lyme disease).

Emergency responders and healthcare workers are at risk of various infectious diseases (such as vector-, water-, food- and airborne diseases).

The potential impact of climate change and other factors may require increased pesticide and herbicide use, which could potentially increase workers' exposure to these toxicants.

Changes in the work environment

Environmental degradation also affects natural resources, the built environment and the efficiency of key infrastructure.

Changes in natural resources: These changes will have an impact on agriculture, fishing, forestry and related sectors, with expected drops in revenue, production and number of jobs. The locations where crops have traditionally been grown are moving. Land that has never supported crops is being purchased in anticipation of a future opportunity to grow crops. This may result in a need for workers to be located in more remote areas where infrastructure is lacking. In addition, traditional agricultural areas will need to transition to other crops or otherwise adapt. The main risk for workers is job insecurity. The acquisition of new skills would help workers adapt. This may not be enough, and the development of forms of work organisation that facilitate the introduction of new practices and support effective access to training would support the development of successful strategies.

Changes in the built environment: High temperatures increase the need for climate-controlled buildings. Occupants of buildings (particularly workplaces) with air conditioning have higher rates of building-related ill-health symptoms than occupants of naturally ventilated buildings. Workers in poorly ventilated buildings, those who are exposed to industrial chemicals in the workplace and those who work in polluted areas are at risk of tight building syndrome.[1]

In Finland, the warmer climate and increased rainfall and humidity are posing new challenges for buildings and building standards. The conditions increase the risk of moisture and microbial damage to buildings, which in turn affects the indoor air conditions for those living and working in the buildings. Mould growth as a result of excessive moisture or poor building maintenance represents an indoor and outdoor air hazard for workers.

Efficiency and safety of key infrastructure: Network services such as energy distribution, roads and transport, and telecommunications systems could experience breakdowns, thus increasing workers' risk of exposure and vulnerability to changes in work environments and new hazards. Buildings and infrastructure may be vulnerable to climate change due

1 The US Environmental Protection Agency describes tight building syndrome as occurring where building occupants experience acute health and comfort effects linked to time spent in a building, without a specific illness or cause being identified.

to their design (if, for example, they have low resilience to storms) or location (for instance, in areas prone to floods, landslides or avalanches).

Extreme weather events

According to IPCC predictions, extreme weather events such as floods, landslides, storms, droughts and wildfires will continue to become more frequent and intense (Figure 2 in Chapter 1).

Extreme weather events have multiple effects on health, such as death, injuries, communicable diseases, malnutrition and mental health disorders.

An increase in both the frequency and intensity of extreme weather events may cause extensive damage to infrastructure and buildings. Service networks such as power, roads and transport may fail, increasing workers' risk of exposure to disaster-related damage and hazards. As a result of disruption to infrastructure, workers could be put in new or unfamiliar circumstances, leading to a potentially high risk of traumatic injury. In disruption scenarios where citizens face severely restricted mobility, electric power, food and shelter, various workers may be at increased risk of violence.

Flood clean-up work is associated with exposure to multiple hazards that are often unknown. Often, relief workers are provided with temporary accommodation, experience isolation from their close relatives and tend to work long hours. Overwork, disaster relief work that interferes with their personal lives, the loss of family members or their homes and economic instability could increase the risk of adverse mental health outcomes, including depression and suicidal ideation. Emergency workers and municipal services workers are at high risk, and their work may require them to engage with hazards.

Firefighters, police officers and relief workers are also exposed to mental stressors, including the recovery of bodies, crowd control, assault, and injury to a family member, with possible impacts on their mental health, such as post-traumatic stress disorder and depression. In many countries, firefighters include both employees and volunteers.

Workers may also be more exposed to the risk of lightning and may accelerate their work, resulting in risks to their safety, prior to storms setting in.

In many cases, workers operating in areas hit by extreme weather conditions will experience income loss.

In contrast to the previously mentioned risks, extreme weather events affect the general population and all workers in many different and unpredictable ways. Managing emergencies forms part of the duties of those in many occupations; it will become more important than ever to ensure that workers are indeed prepared and trained for emergency situations.

Increases in the frequency and intensity of extreme weather events and floods and the destruction and damage of infrastructure and buildings negatively impact economic activity and employment. An Italian study calculated that firms located in municipalities affected by landslides or floods recorded on average a 4.8% higher probability of bankruptcy than firms in municipalities not affected (Clò et al, 2022). The effect is concentrated on micro- and small businesses, with medium-sized and large businesses largely unaffected. With regard to the performance of the surviving companies, in the three years following a shock, revenues and employee numbers were on average 4.2% and 1.9% lower, respectively, than in a counterfactual scenario of no landslides or floods. The decline in turnover occurs from the year in which the adverse event occurs and the decline in the number of employees from the following year. The effects continue in the years thereafter and are absorbed after about four to five years. The negative impact is concentrated on smaller companies and on the construction and service sectors, probably because a large part of their activity relies on the physical accessibility of the workplace.

'Loss and damage' refers to the residual negative effects that occur when adaptation and mitigation efforts are not sufficient to avert climate change impacts (IPCC, 2022). Loss and damage are already occurring in Europe, primarily as a result of major natural disasters such as floods and heatwaves. They will increasingly occur as a result of slow-onset events, including sea level rise, glacier retreat and increases in average temperature (Pill, 2021).

Increased exposure to psychosocial hazards

Psychosocial risks arise from insecurity linked to environmental degradation but also from occupational change linked to climate mitigation policies.

Job insecurity

Job insecurity can arise as a result of climate degradation, when the yields of agricultural products decline; as a result of adaptation policies, when there is pressure to close certain industries (such as coal mining); or as a result of mitigation policies, as new skills are needed to work in the same industry.

Epidemiological studies have shown an association between job insecurity and adverse health outcomes (cardiovascular diseases and musculoskeletal disorders) (see, for example, Niedhammer et al, 2021).

Phasing out fossil fuels has a direct impact on workers in the industries dealing with these energy sources, as well as on the workers in surrounding communities who depend on those industries.

Job insecurity takes on an even more dramatic dimension when it affects citizens in already fragile communities with high unemployment rates and low gross domestic product per capita, where it is not possible to imagine autonomous professional retraining or migratory possibilities (Alpino et al, 2022).

Financial insecurity

Increased financial risks are also noted among owners of forestry and farms and their employees in Latvia (Bērziņa et al, 2016). Decreases in yield are noted to have an impact on the earnings of workers and to increase the risk of working poverty. For example, the harvest of vegetables in Lithuania in 2017 was the lowest since 2012; consequently, only 24% of horticulture farms had an income above the poverty threshold that year (Dabkienė, 2020). The Italian correspondent raised the issue of the frequent lack of insurance available to exposed industries such as agriculture.

Other forms of insecurity

Other forms of insecurity at work are linked to an increase in physical and mental health problems.

Workers can experience a profound sense of vulnerability at work when changes are so numerous that they can no longer rely on their professional experience and knowledge but instead have to rely on their capacity to adapt to their new circumstances at work (Linhart, 2012). Intense and fast-tracked change can be very challenging and can affect workers' well-being.

The Estonian correspondent identified risks linked to the lack of a secure supply of electricity and fuel, and a lack of supply of food products, for example in agriculture, where animals need food (Sammul et al, 2015).

Another form of insecurity identified in Italian research relates to the anticipated 'tipping points' in agriculture due to slow-onset phenomena (such as rising temperatures) (Alpino et al, 2022). Examining three important agricultural products, the study notes that the relationship between yield and temperature is non-linear: it is positive up to a given threshold (around 28°C for cereals and 32°C for vines) and negative beyond. The estimates, combined with climate projections, imply that the average effect on the national territory in 2030 will be almost zero or positive for all three crops. However, it is plausible that further temperature increases expected in subsequent decades (or earlier, should the climate projections used turn out to be too optimistic) will lead to a negative effect overall.

Management of change

The experience of organisational restructuring, whether workers lose their jobs or not, is a difficult time in people's working lives that could jeopardise their relationships with co-workers. Deterioration in the health status of workers can happen during the period of job loss anticipation that precedes actual organisational restructuring; it is also reported by so-called labour market survivors.

Eurofound research has identified that restructuring is associated with increased work intensity and exposure to adverse social behaviours but also a higher incidence of learning and cognitively rich work (Eurofound, 2018). The good quality of information and consultation of workers during the process and a high perceived level of fairness in the workplace are key to mitigating negative impacts on the health and well-being of employees and company performance. The quality of the restructuring process is a critical element in supporting the transition.

Increased workload

This issue was highlighted in relation to healthcare workers; climate change will lead to an increase in the number of patients with chronic conditions (for example, conditions linked to pollution), or acute ones in the case of heatwaves or extreme weather events.

Ethical demands

Psychosocial risks include ethical conflicts. In these instances, workers can experience a conflict between their personal values and the expectations or beliefs that exist in their work. Such conflicts may lead to moral distress and can pose a threat to retaining workers. According to a French working conditions survey in 2019, 7% of respondents answered 'always' or 'often' to the question 'Do you believe your work has a negative impact on the environment?' and 24% answered 'sometimes' (Coutrot and Perez, 2022). Both blue- and white-collar workers reported carrying out such work. When considering the working conditions of workers experiencing ethical conflicts, blue-collar workers emerge as a group who are exposed to smoke and fumes (such as welding or exhaust fumes), lack social support from their colleagues, report little task autonomy and report fear while carrying out their work. In addition, white-collar workers also report not being able to carry out work that is useful and of good quality. Workers answering positively that their work has a negative impact on the environment are at increased risk of not being able to work in their current job by the time they are 60 years of age (in other words, their work is not sustainable).

Lack of adequate training

As workers adapt to climate change risks and their tasks are greened, they will need to be trained. The range of climate-related skills that need to be acquired is wide; they cover technical skills and softer skills. They should also include skills in multiparty governance to manage 'the commons' (Ostrom, 2015) – that is, to manage companies in their local ecosystems so that they can deliver social, economic and sustainable performance.

The issue of retraining also needs to be considered in the context of local labour markets. In Poland, a survey aimed to assess how workers in the coal-mining sector in Silesia, where coal mines are being closed, could be reallocated to other industrial sectors in the area that are experiencing persistent labour shortages (Sokolowski et al, 2021). A survey among miners suggests that most respondents felt confident about finding a job within the energy sector or other sectors, capitalising on their existing mining-specific skills (Frankowski and Mazurkiewicz, 2020). However, the report indicates that the skills of certain groups of employees may not be transferable to other industries, such as young workers, workers with low levels of education and workers in companies and sectors closely related to mining.

A similar issue was mentioned by the Spanish correspondent, concerning regional policies aimed at diversifying economic activity, which need to cover within-sector changes (for instance, changes in crops or the development of new tourism activities) but also address changes in the types of industries within regions and support, for example, the development of economic industries that are less climate sensitive.

Vulnerable groups and gender

Groups at risk

Immigrant workers and workers of lower socioeconomic status are frequently employed in high-risk occupations (such as agriculture, construction, transport and emergency work) that are often subject to climate change (Schulte et al, 2016). They are also overrepresented in low-wage sectors, such as the waste management sector, which plays a major role in mitigation policies (VÚBP, 2019).

Overall, the literature demonstrates that migrant workers face a combination of risk factors, including seasonality of jobs, lack of decision-making autonomy, differences in their treatment on the job and extreme work conditions (Schulte et al, 2016), as well as limited access to resources (such as food, discretionary funds and healthcare) at home and work, which can also affect their ability to deal with work-related injuries or illnesses.

Boromisa (2022) reports that individuals working in the informal economy, seasonal and casual workers, the self-employed and workers in microenterprises and small enterprises are the most affected by climate risks.

Gender matters

Bauer et al (2022) conclude that more research is needed with regard to climate change and gender, as clinical studies undertaken so far often worked with male volunteers for testing. Therefore, not much is known about the risks for women.

Climate change mitigation policy in Lithuania has been analysed from the gender equality perspective (Malinauskaitė, 2016). The author identified that women are underrepresented in, or excluded from, decision-making and implementing climate policy. The Gender Equality Index indicates that Lithuanian women have less free time than men, that their input in the care sector is not accounted for, that they have a weaker bargaining position in the labour market due to family commitments and that they earn less on average. Men, on the other hand, suffer from being overworked, are more likely to fall into substance abuse and have a shorter life span than women. This means that climate policy measures that affect employment opportunities, income, health and other aspects have different effects on men and women.

Division of labour along gender lines also determines how men and women are affected: if a policy measure, for example a requirement to sort household waste, increases the workload in the domestic sphere, women bear the larger effects. If, on the other hand, a climate policy increases costs and the workload in the male-dominated economic sector, men experience greater direct effects.

Employer bias was deemed to be the main barrier faced by women in finding employment in green jobs (44.4%) (Marmara, 2022). When it comes to men, upskilling and reskilling were deemed to be the main barriers to finding employment in green jobs (54.8%).

Summary

This chapter has shown how working outside and working in the emergency services increase exposure to climate change risks. It has highlighted how certain industries and occupations, such as agriculture, construction, energy, municipal services, tourism and healthcare, are more impacted by climate change and climate policies than others. It has shown that climate change risks and policies are linked to an increase in physical risks and also to an increase in psychosocial risks, which are likely to impact negatively on people's health.

Increases in temperature lead to a lowering of job quality – as work is harder – as well as a decrease in productivity. Other climate change risks include air pollution, exposure to UV radiation and extreme weather events, and are the result of climate change and climate change policies. Psychosocial risks, including job and financial insecurity, increased workload and lack of adequate training, arise in the context of environmental degradation and occupational change linked to climate mitigation policies.

This chapter has highlighted how some groups of workers are more exposed than others, such as migrant workers and low-wage workers, and it has identified important gender gaps in research and policymaking that need to be addressed.

3 Job quality in sectors most impacted by climate change and climate policies

This chapter will examine job quality in the sectors most directly impacted by climate change and climate policies. Sectors were selected based on their level of emissions, greening of tasks and exposure to climate change risks.

Using research from the Member States and Norway, for each sector a section of the chapter provides information on specific aspects of climate change vulnerability and potential for mitigating the impact of climate change; examines trends in greening of occupations; and describes the main job quality challenges. In the case of the energy sector in particular, the relevant section looks at risks arising in the new and emerging areas of the sector, since new technologies require employers and workers to anticipate, recognise and manage known hazards in new contexts.

Connecting data on greening of tasks with data on job quality makes it possible to assess the proportion of greened jobs that are of good quality. This aligns, to a certain extent, with the International Labour Organization taxonomy of green jobs, which defines green jobs as those at the intersection of three dimensions: employment in the production of green products and services, employment in environmentally friendly processes, and decent jobs. These sectoral vignettes illustrate the multiple ways climate change and climate change policies, and their potential transformative power, impact jobs and job quality. The vignettes also show the importance of sectoral analysis to capture future changes.

Energy

The energy sector is much discussed in relation to climate change and decarbonisation.

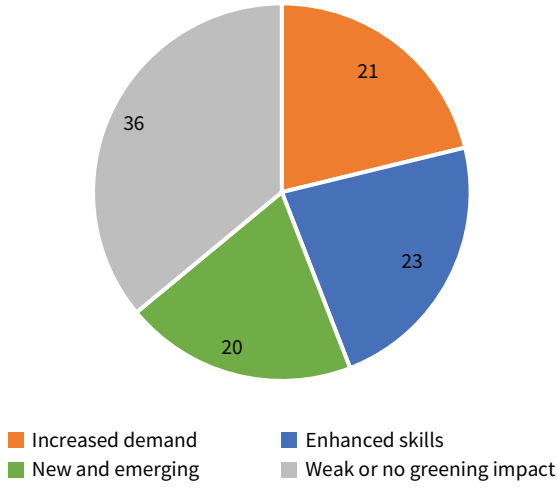
Although renewable and clean energy accounts for a growing share of Europe's energy needs, for most of our energy we depend on fossil fuel combustion, which releases air pollutants and GHGs. In 2022, energy production accounted for 26% of the EU's GHG emissions. Like agriculture, energy is both part of the 'problem' and the solution. From a job quality perspective, renewable and clean energy fall under the climate change hazard of 'new industries with new risks'. At the same time, many jobs are at risk in fossil fuel industries, leading to the need to cater for and retrain workers involved in these industries that are closing, which can also impact activity across the whole regional economic ecosystem.

Moreover, quality of life depends on a reliable supply of energy at an affordable price. In the case of extreme weather events, industry, transport, services, cooking, heating, lighting, payment systems and access to the internet will all be negatively affected. Higher temperatures, humidity and dust deposits on insulators also increase the risk of systems failure. The following key infrastructure types were identified as being particularly vulnerable to the climate change impacts identified: electricity generation plants, overhead electricity transmission and distribution lines, underground cables and stations, large wind farms, and gas pipelines and substations. Secondary impacts on other infrastructure, staff, customers and the economy were also identified. Proposed adaptation actions and measures would therefore be expected to reduce the vulnerability and increase the resilience of energy systems.

Greening of occupations

According to the EWCTS 2021, the majority of workers in the electricity, gas, steam and air conditioning supply sector (64%) are in occupations that are likely to be impacted by greening. About 20% are in new and emerging occupations, 21% are in increased demand occupations and 23% are in enhanced skills occupations that will possibly require changes in tasks, skills and knowledge as a result of greening (Figure 5).

Figure 5: Shares of electricity, gas, steam and air conditioning supply in occupations likely to be impacted by greening (%)



Note: *Electricity, gas, steam and air-conditioning supply, NACE Rev 2.0, Section D, Division 35.*
Source: *EWCTS, 2021*

New industry, new companies, new risks

New industry: Occupational risks in renewable and clean energy

According to Schulte et al (2016), in the wind energy generation industry, manufacturers of wind turbines are exposed to hazards similar to those in the automobile and aerospace industries. These hazards are primarily exposure to epoxy-based resins, glass-reinforced plastic and noise. Installation and maintenance of wind turbines is associated with working in confined spaces, electrical risks and falls from height, potentially exacerbated by the unpredictability of wind gusts (Freiberg et al, 2018). The risks are several times more numerous in offshore wind farms, which have the potential to become extremely dangerous places to work, with turbines in deep water, further away from the coast at the mercy of extreme weather events. Other risks include isolation, delays in emergency care for life-threatening injuries and the potential for longer work shifts (Mette et al, 2018).

According to the Norwegian correspondent, the most serious injuries observed while working with wind power occur during the transport of people, at residential facilities and on installation vessels on the wind turbine itself.

Manufacturing solar energy materials, construction, maintenance and demolition also present various hazards that are recognised in the construction and manufacturing sector. However, working with both solar electric and solar hot water equipment is associated with risks not present in other construction trades; for example, exposure to sunlight creates stored energy. Manufacturing photovoltaic materials also involves a variety of different materials, most of which are potentially toxic or hazardous. Furthermore, several physical and electrical hazards are associated with the installation and maintenance of photovoltaic systems, including falls and manual handling concerns, as well as heat stress.

New types of fuel (such as hydrogen, biomass, biogas and biodiesel) bring specific risks of fire or explosion during their production, storage or transport. Storing and handling biomass exposes workers to physical risks, chemical and biological risks, and fire and explosion risks.

There are also health hazards associated with other renewable energy industries, such as hydroelectric power.

Health hazards associated with the nuclear power industry vary across the industry. Occupational deaths can occur as a result of exposure at the mining, milling and generation stages. Routine radiation exposure during generation, decommissioning, reprocessing and low- and high-level waste disposal, and as a result of accidents, can be the source of injury or illness.

New companies

The production and supply of renewable energy sources are decentralised, and, as a result of that, new, smaller companies may enter the sector without always having the necessary work safety culture set-up. In new workplaces where rules and routines are not yet established, this could result in increased exposure of workers to on-the-job risks. However, new industries can learn a lot from well-established industries. For instance, the Global Offshore Wind Health and Safety Organisation (known as G+) has chosen to use the app ‘Toolbox’, which is traditionally used in the oil and gas industry. Toolbox is designed for sharing experiences and exchanging information between companies. According to the Norwegian correspondent, the tool enables users to search for work processes and retrieve information that sheds light on specific problem areas. This raises the issue of whether the job quality system in which these new companies operate is sustainable. Sustainability in this sense would support the development of work practices that increase job quality.

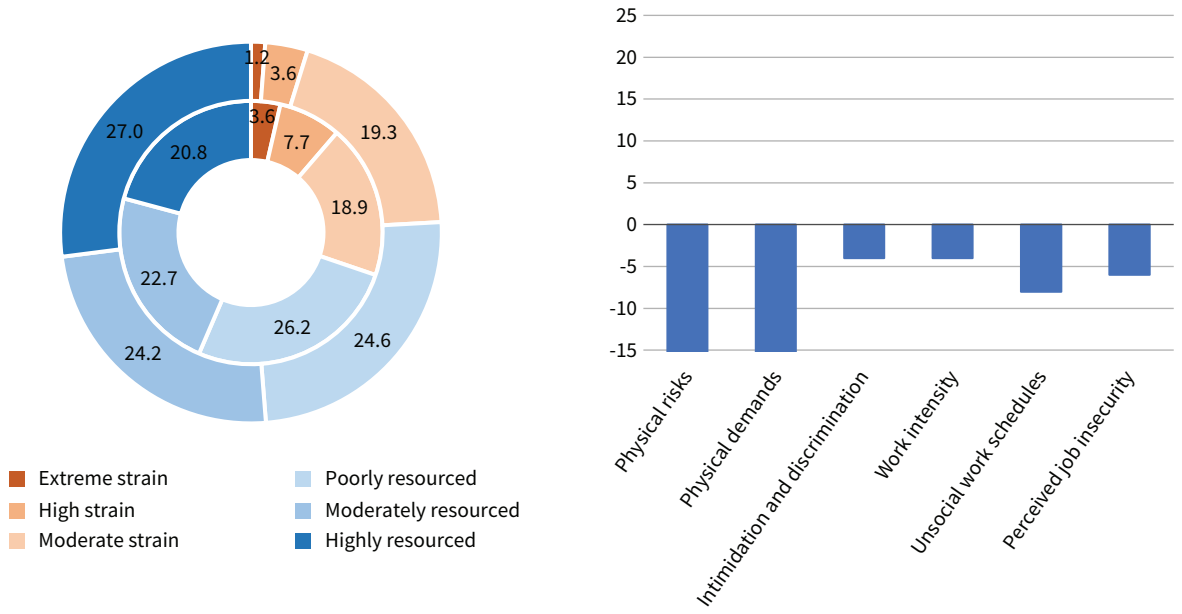
New jobs

While it is anticipated that the renewable energy will create new jobs, there are also concerns, for example as described in Romania’s National Strategy for Green Job Creation 2018–2025, that this will lead to labour shortages in occupations with skills that are relevant to energy efficiency and the use of renewable energy, such as: construction electrician and plumber; insulator; carpenter/carpentry fitter; and installer of solar thermal systems, solar photovoltaic systems, geothermal systems, biomass thermal power plants and heat pumps.

Job quality

In terms of job quality, according to the EWCTS, the electricity, gas and steam sector fares better than the EU average, with ‘only’ 24% of its workers in strained jobs. In fact, the sector performs better than the EU average in all job demand dimensions, in particular in terms of physical risks and physical demands (Figure 6).

Figure 6: Job quality (left) and job demands (right) – Electricity, gas, steam and air-conditioning supply versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Electricity, gas, steam and air-conditioning supply, NACE Rev 2.0, Section D, Division 35.*
Source: *EWCTS, 2021*

The sector also fares relatively well in most job resource dimensions, only falling behind the EU average in terms of opportunities for self-realisation.

In terms of work sustainability, the energy sector presents a relatively better situation than most sectors and the EU average (see Eurofound, 2015, 2021, 2022). It has relatively fewer workers reporting difficulty in making ends meet (18.4%), fewer workers declaring that their health and safety is being put at risk because of work (27.3%), and fewer workers reporting physical and/or emotional exhaustion and being at risk of burnout (29.2%). On the downside, compared with others, this sector presents one of the smallest shares of workers with high levels of engagement (feeling full of energy at work, being enthusiastic about one's job and feeling that time flies when working).

Monsef and Wendland (2022) investigated the characteristics of workers who indicated that their work was related to renewable energies and/or who worked in 34 economic activities included in the EU Taxonomy Regulation.[2] They found that the workers under consideration performed routine tasks less often. Instead, their jobs were characterised by the need to learn new tasks and improve existing procedures.

These workers also worked more often under pressure to meet deadlines and perform well, but they were less likely to perceive these pressures as a burden. When it came to their working environment, around every second worker stated that new machines or plants had been introduced at their workplace within the last two years. Some 41% confirmed that new manufacturing or process technologies had been introduced during the same period, and the same share also confirmed that new products and materials played a role in their jobs.

Against this background, it is not surprising that around half of workers in the sector reported that they had been required to increase their professional knowledge; this compares with 45% of all employees in the EU. In line with their fast-changing working environment, renewable energy workers indicated that further training was of major importance in their current job: 64% of these workers indicated that they had participated in training within the last two years (in comparison with 59% of all workers in the EU). Finally, Monsef and Klein (2023) found in another report that the monthly wage of an employee working in a sector covered by the Taxonomy Regulation is (on average) €500 higher than that of an employee in a sector not covered by it.

2 The Taxonomy Regulation includes assessment criteria to identify economic activities that can make a substantial contribution to the European Green Deal.

Manufacturing

Although manufacturing is one of the sectors with the largest GHG emissions, there are important differences in terms of working conditions and job quality between the different sectors within manufacturing. Here the focus is on the manufacture of motor vehicles and the manufacture of food and beverages, as two contrasting sectors that are impacted by climate policies.

Plants and production sites will need to adapt to rising temperatures. Many mitigation policies focus on mobility and are likely to impact on the type of car produced as well as the production process. A further concern expressed by national contributors is the risk of suppliers of combustion energy cars losing their clients and going out of business as 'parent companies' restructure their supply chains (Gažo and Smith, 2022).

Greening of occupations

According to the EWCTS 2021, the majority of workers in the motor vehicle manufacturing sector (71%) are in occupations likely to be impacted by greening. About 17% are in new and emerging occupations, 34% are in increased demand occupations and 21% are in enhanced skills occupations that will possibly require changes in tasks, skills and knowledge as a result of greening. In contrast, most workers in food and beverage manufacturing are not in occupations likely to be impacted by the green transition (40%). About 8% are in new and emerging occupations, 12% in enhanced skills occupations and 20% in occupations that may see demand increase due to greening (Figure 7).

Job quality

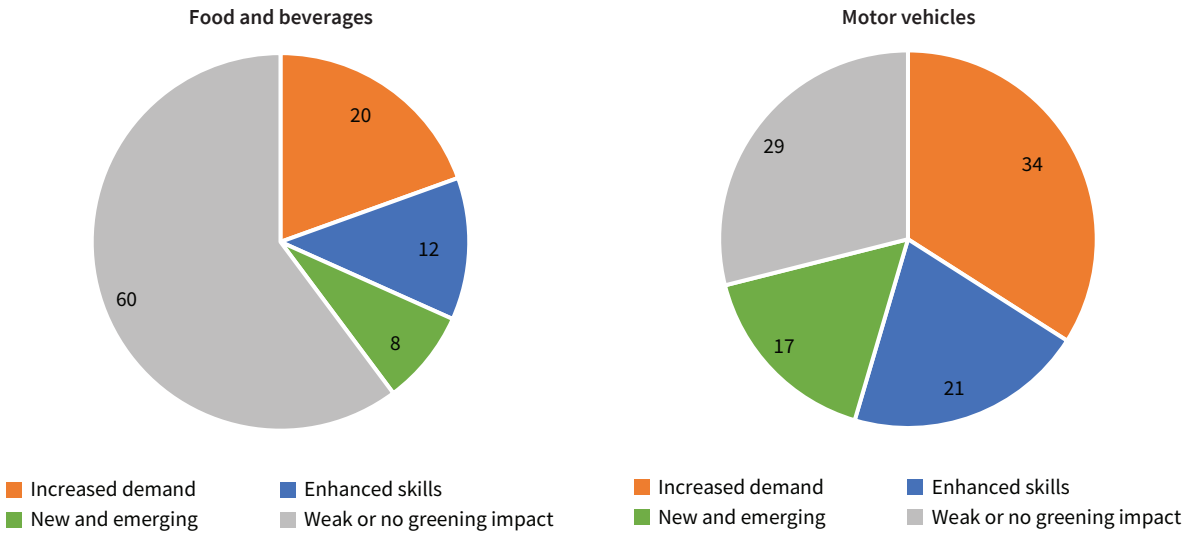
The motor vehicle manufacturing sector is on a par with the EU average in terms of job quality: 30% of workers are in strained jobs, with job demands surpassing the job resources at their disposal (Figure 8). In most of the job demand dimensions captured by the EWCTS, the sector does not differ much from the EU averages. However, it shows slightly better results in terms of physical demands and a relatively lower level of perceived job insecurity.

The food and beverage manufacturing sector has a relatively large share of workers in strained jobs: more than one-third (37%) are in jobs where the job demands surpass the job resources in the workplace. This is mostly due to greater physical risks and physical demands and, to a smaller extent, unsocial work schedules.

Task discretion and autonomy, along with training and learning opportunities, are the two dimensions of job resources in which food and beverage manufacturing fares worse than the EU average. In terms of job resources, motor vehicle manufacturing fares better than average in terms of training and learning opportunities and social support.

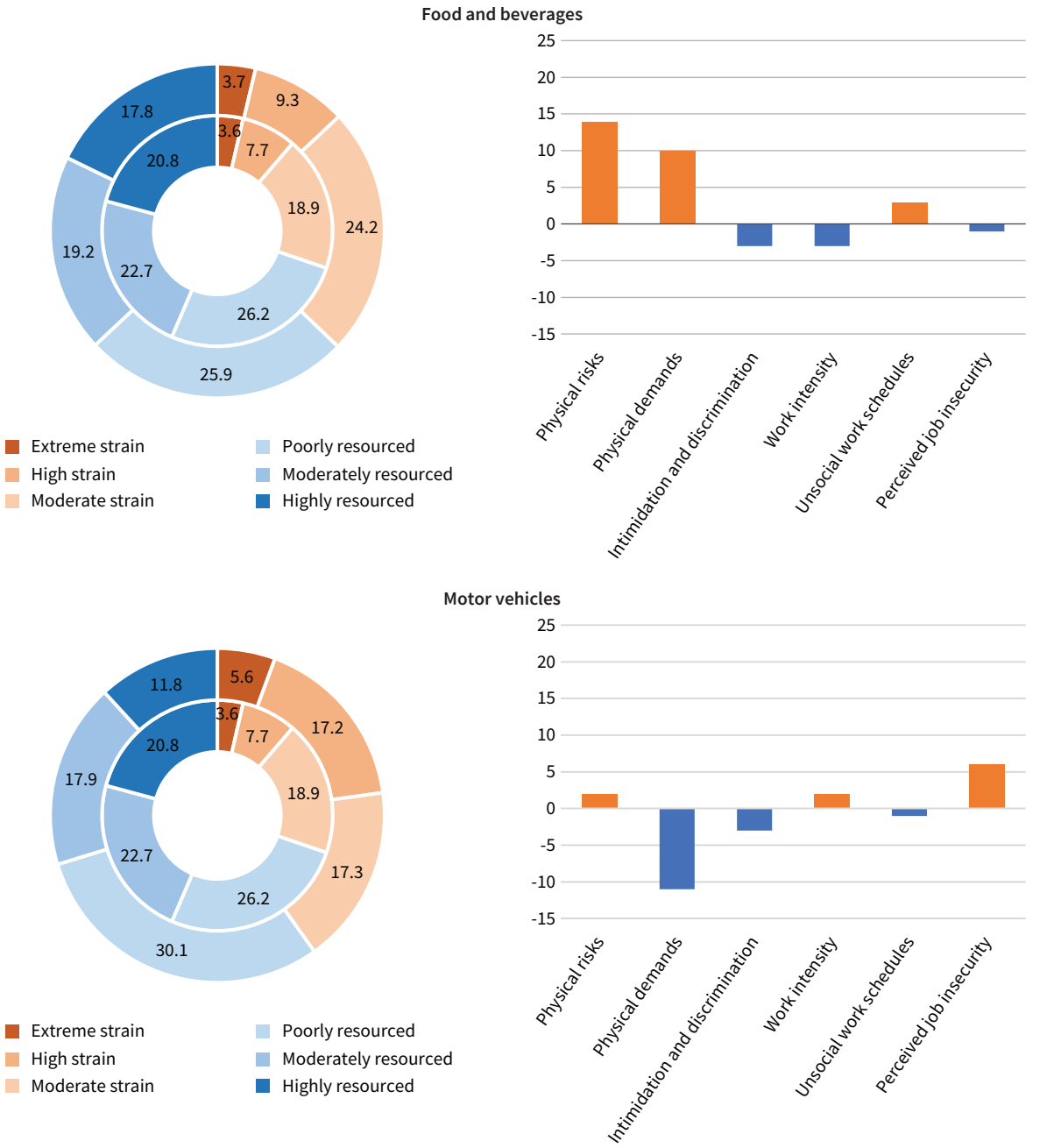
Motor vehicle manufacturing also fares better than food and beverage manufacturing in terms of work sustainability. Although the latter presents a better than average situation regarding the share of workers reporting having their health and safety put at risk by their work and reporting exhaustion, the work sustainability of food and beverage manufacturing is

Figure 7: Shares of workers in the manufacturing of food and beverages and motor vehicle manufacturing sectors in occupations likely to be impacted by greening (%)



Note: *Manufacturing of food and beverages, NACE Rev 2.0, Section C, Divisions 10 (Food products) and 11 (Beverages). Manufacturing of motor vehicles, NACE Rev 2.0, Section C, Manufacturing, Division 29.*
Source: *EWCTS, 2021*

Figure 8: Job quality (left) and job demands (right) – Food and beverages and motor vehicle manufacturing sector versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Manufacturing of food and beverages, NACE Rev 2.0, Section C, Divisions 10 (Food products) and 11 (Beverages). Manufacturing of motor vehicles, NACE Rev 2.0, Section C, Manufacturing, Division 29.*
Source: *EWCTS, 2021*

weakened by one of the lowest levels of engagement (30% of workers in the sector show a low level of engagement) and a relatively large share of workers reporting difficulties in making ends meet (32%). In contrast, motor vehicle manufacturing has one of the smallest shares of workers reporting difficulties making ends meet (19%), one of the smallest shares of workers reporting that their health and safety is being put at risk because of work (30%) and a comparatively small share of workers reporting exhaustion (37%). However, the sector presents one of the lowest engagements levels, with around 34% of workers reporting a low level of engagement, compared with 24% of EU workers.

Agriculture

The relationship between agriculture and climate change is a complex one.

On the one hand, agriculture is identified in most countries as a sector critically impacted by climate change. As indicated in the previous chapter, agricultural workers are highly exposed to climate change hazards and their job quality is expected to decline due to climate change.

At the same time, the food system is one of Europe's major systems of production and consumption, and, according to the European Environment Agency (EEA), it is responsible for over one-fifth of all environmental and climate impacts (EEA, 2024). Changes to the way work is carried out (including greening in occupations) will be key in supporting decarbonisation. The way changes are implemented, and skills developed, will be critical for the future job quality of workers employed in the sector.

While the main function of the food system is to satisfy the basic human need for food, sustainable food systems also maintain ecosystem health and contribute to social well-being. With climate change, yields will become less predictable and are likely to decrease, which will increase financial insecurity and the need for farmers to adapt their practices to the new environmental conditions. At the same time, policies that support the development of new functions for agriculture (for instance, tourism) will help mitigate the negative impact of climate change.

Consideration should also be given to the system in which agriculture is operating. For example, investments in infrastructure (such as embankment or irrigation systems or water reservoirs) will be key to supporting the adjustment of the sector and will have an impact on the conditions under which agricultural work is being carried out. This is likely to increase the number of changes experienced by workers and companies as a result of climate change.

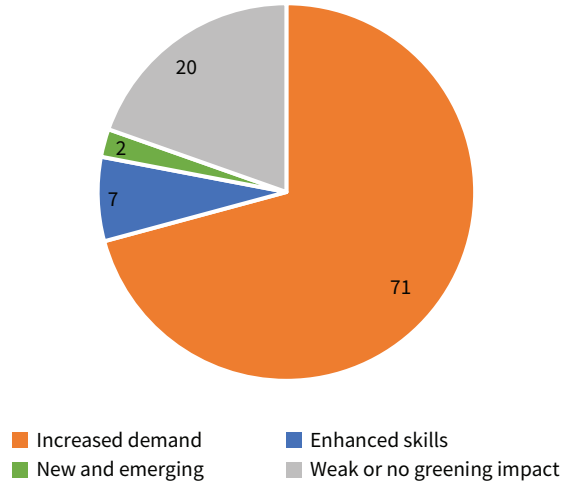
Finally, the quality of adaptation practices and the risks associated with maladaptive practices need to be considered. Maladaptive practices, such as the increased usage of chemical pesticides due to declining yields, could increase exposure to dangerous substances and impact the quality of the food produced. Multiple hazards may also intensify such risks, for example when hotter conditions reduce willingness to wear appropriate personal protective equipment while handling pesticides, thereby further increasing exposure.

In a similar vein, breeders may resort to more indoor housing of animals in order to limit the effects of heat on them. This could lead to the development of new diseases in animals while increasing the risk of zoonotic diseases. Breeders may also find themselves obliged to use more biocides and veterinary medicines, thereby increasing the cost of livestock raising and the potential health risks associated with the use of such chemical products. An adaptation strategy in this case might lead to increased risks for workers' health and well-being. The long-distance transport of animals for human consumption could also require more night work on the part of truck drivers as they seek to avoid driving during periods of intense heat. In the fishing industry, climate change could also have unforeseeable effects on fish production (variety and quantity), favouring fishing at new sites or in more remote areas. In addition, fishing in harsher weather conditions could become a more frequent occurrence (Adam-Poupart et al, 2013).

Greening of occupations

Agriculture (including forestry and fisheries) is a sector characterised by large shares of workers in occupations likely to be impacted by greening. Very few workers (2%) are in new and emerging occupations, or in enhanced skills occupations (7%); a majority (71%), however, are in occupations likely to see an increase in demand due to greening (Figure 9). An example of a new occupation is the green sector of aquaponics,[3] which combines different kinds of knowledge and skills, creates new types and combinations of professions that did not exist before and entails fewer health and safety risks than traditional agriculture (VÚBP, 2019). There are concerns about the job quality of agricultural workers being negatively impacted by climate change, while

Figure 9: Shares of agricultural workers in occupations likely to be impacted by greening (%)



Note: *Agriculture, NACE Rev 2.0, Section A, Agriculture, forestry and fisheries, Divisions 1 (Crop and animal production, hunting and related service activities), 2 (Forestry and logging) and 3 (Fishing and aquaculture).*
Source: *EWCTS, 2021*

3 A food production system that couples aquaculture (raising aquatic animals such as fish, crayfish, snails or prawns in tanks) with hydroponics (cultivating plants in water).

seasonal employment may increase and become less predictable, and there are also concerns that reduced job quality will lead to a fall in employment and labour shortages.

The issue of skills has been raised in a few countries: for example in Croatia, where research by Horvatinčić et al (2016) shows that, for farmers, there is a need for modern agricultural knowledge in order to achieve green development standards and enhance the quality of jobs. This includes improving agricultural competitiveness, the protection and sustainable use of the environment, the quality of agricultural production and the marketing of agricultural products. Education programmes will need to be implemented in a context in which many farmers are older and self-employed, and this will call for innovative ways to support and incentivise participation in lifelong learning.

Job quality

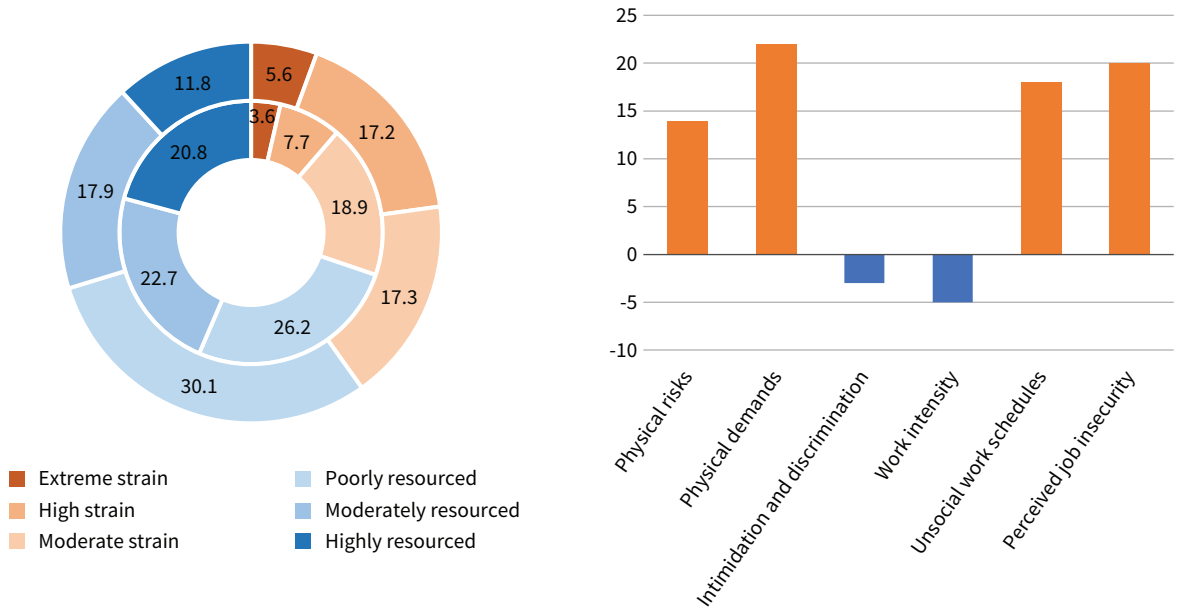
In terms of job quality, agriculture is a sector in which the share of workers in strained jobs is larger than the EU average and most of the other sectors of activity. Overall, 40% of workers in agriculture, forestry and fisheries are in strained jobs, in which job demands surpass job resources (Figure 10).

Agriculture is a sector in which workers tend to be more exposed to physical risks, physical demands, unsocial work schedules and perceived job insecurity than the EU average. At the same time, in terms of job resources, workers in agriculture tend to present better than average opportunities for self-realisation but worse than average social support, task discretion and autonomy, and training and learning opportunities.

In terms of work sustainability, agriculture presents a relatively grim situation in comparison with the EU as a whole (see Eurofound, 2015, 2021, 2022). Despite the comparatively large share of workers reporting a high level of engagement, many report difficulty in making ends meet (51%). At the same time, a considerable share report that their health and safety is being put at risk because of work (46%), while more than half report physical and/or emotional exhaustion and being at risk of burnout (53%).

The diversity of business models in the agriculture sector and their impact on economic conditions is discussed in the literature. The differences between more intensive agriculture (agro-industry) and more regenerative practices are acknowledged in some of the work identified (French, Slovenian and Spanish contributions). Job quality and sustainable work practices differ considerably within the sector according to the type of agriculture carried out. Research on changes in production mode from agro-industry to organic farming modes shows the difficulties of working with less pesticides and different crops, the lifelong learning efforts and the necessary development of professional experience. The duration of the transition (it takes a number of years to be granted an organic certification label) is also a factor to consider. Finally, such a transition can have a profound impact on the professional identity of the farmer.

Figure 10: Job quality (left) and job demands (right) – Agriculture sector versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Agriculture, NACE Rev 2.0, Section A, Agriculture, forestry and fisheries, Divisions 1 (Crop and animal production, hunting and related service activities), 2 (Forestry and logging) and 3 (Fishing and aquaculture).*
Source: *EWCTS, 2021*

The issue of environmental, social and economic sustainability in the agriculture sector is discussed in most countries. For example, in Lithuania, the strategic importance of agriculture is acknowledged as a priority in the national climate change plan (Government of the Republic of Lithuania, 2021). However, in most cases, the concrete impacts on working conditions and job quality are not mentioned or discussed. It is clear that in-depth studies about the sector are needed and that changes in the sector should be monitored and discussed (Adam-Poupart et al, 2013).

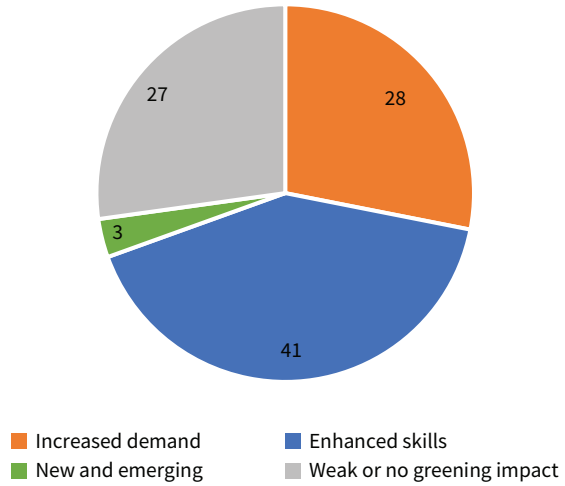
Transport

Transport contributes to about a quarter of the EU's GHG emissions. Despite a shift towards electric vehicles, most vehicles in the EU rely on petrol and diesel. Changes in the mobility practices of people and goods will play a strong role in shaping future development in the sector.

Greening of occupations

According to the EWCTS data, the majority of transport workers are in occupations likely to be impacted by greening. Few (3%) are in new and emerging occupations, while many (28%) are in increased demand occupations and enhanced skills occupations (41%) (Figure 11). Employment in public transport is expected to grow along with investments in the sector. Rail freight and passenger transport are likely to be an important source of skilled and secure employment. The growing demand for bicycle rental companies, car-sharing management and biogas stations is expected to create jobs.

Figure 11: Shares of transport workers in occupations likely to be impacted by greening (%)

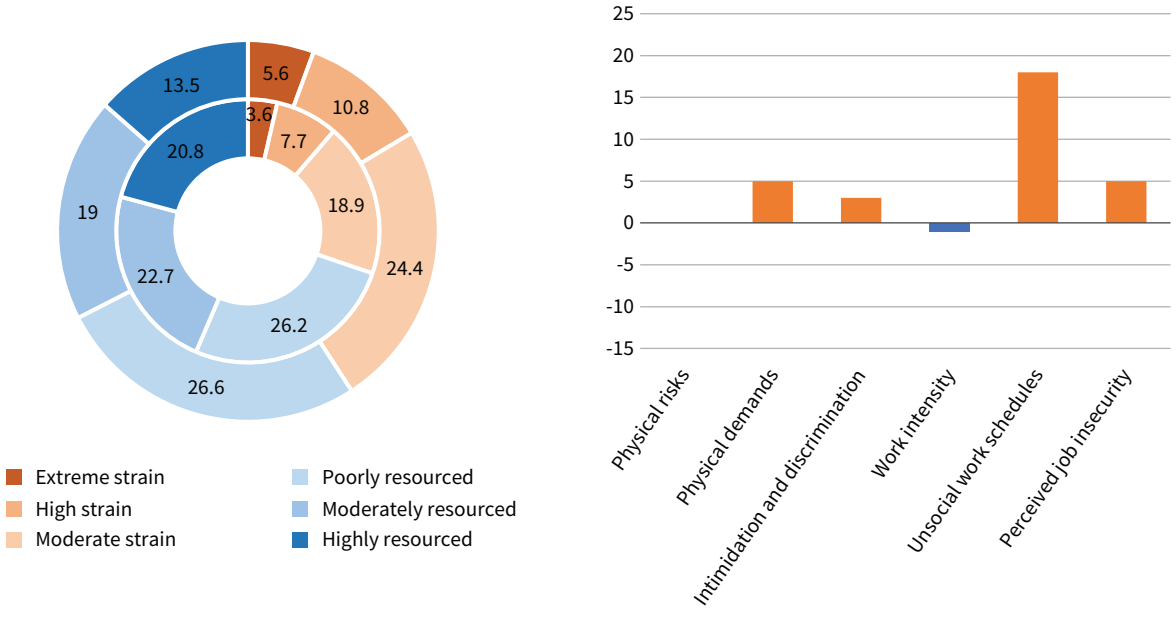


Note: *Transport, NACE Rev 2.0, Section H, Transportation and storage, Divisions 49 (Land transport and transport via pipelines), 50 (Water transport) and 51 (Air transport).*
Source: *EWCTS, 2021*

Job quality

Transport workers present a poorer picture in terms of job quality than the EU as a whole: about 41% of transport workers are in strained jobs compared to 30% in the EU (Figure 12). This results from slightly worse than average physical demands and perceived job insecurity, and much greater than average exposure to unsocial work schedules. At the same time, the sector has access to less than average job resources that are considered important: task discretion and autonomy, and organisational participation and workplace voice.

Figure 12: Job quality (left) and job demands (right) – Transport sector versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Transport, NACE Rev 2.0, Section H, Transportation and storage, Divisions 49 (Land transport and transport via pipelines), 50 (Water transport) and 51 (Air transport).*
Source: *EWCTS, 2021*

When it comes to work sustainability, transport workers are on a par with the EU average in terms of engagement (43% show high engagement) and risk of burnout (38% report physical and/or emotional exhaustion), but fare worse in terms of their health and safety being at risk because of work (a very large share at 50%) and making ends meet (with 34% reporting difficulty).

Extreme weather conditions and heat have a direct impact on the conditions in which bus, coach and truck drivers live and work, with a direct and negative impact on the quality of their rest and quality of life (as noted by the correspondents from Denmark and Greece).

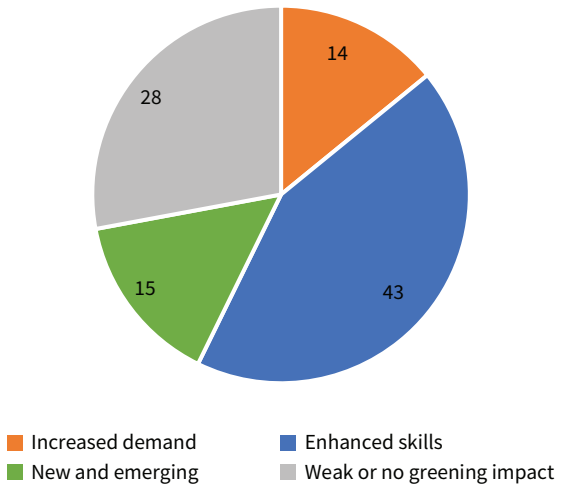
Water supply and waste management

Water supply and waste management are also crucial industries in addressing climate change, playing a key role in our ecosystem stewardship. Water scarcity in Europe has been identified as a key risk in the IPCC 2022 report.

Greening of occupations

The majority of workers in the water supply, sewage and waste management sector (72%) are in occupations likely to be impacted by greening. About 15% are in new and emerging occupations, 14% are in increased demand occupations and 43%, the largest group, are in enhanced skills occupations that will potentially require changes in tasks, skills and knowledge as a result of the transition to a carbon-neutral economy (Figure 13).

Figure 13: Shares of water supply and waste management workers in occupations likely to be impacted by greening (%)



Note: *Water supply and waste management, NACE Rev 2.0, Section E, Water supply, sewerage, waste management and remediation, Divisions 36 (Water collection, treatment and supply), 37 (Sewerage), 38 (Waste collection, treatment and disposal activities; materials recovery) and 39 (Remediation activities and other waste management services).*
Source: *EWCTS, 2021*

The potential for new jobs in the industry is acknowledged in many countries. The heterogeneity of the sector is well acknowledged, ranging from traditional (such as mechanical biological treatment) plants that rely mostly on human operators to more modern, automated plants where the bulk of the work is carried out by automated sorting equipment and robots. The fragmentation of the sector, together with the evolution of manufactured products and therefore of waste resources (for example, the emergence of the solar panel sector), developments in waste collection and sorting and treatment technologies, and the increase in household sorting, calls for the monitoring of health risks and job quality in the sector, as it is expected to undergo considerable and increasing changes in the future.

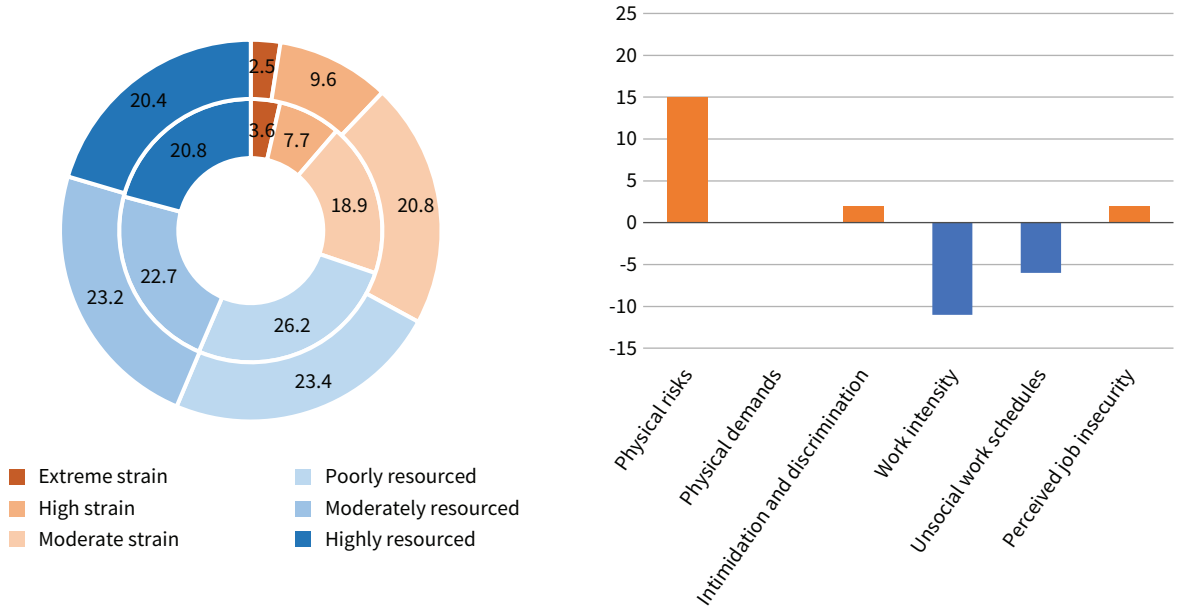
Job quality

This sector fares slightly worse than the EU average in terms of job quality, with 33% of its workers in strained jobs (Figure 14). The sector performs worse than average in terms of all job demand dimensions, in particular in terms of physical risks and physical demands. Organisational participation and workplace voice is a job resource lacking in this sector compared with the EU average.

The wide variety of waste and the processes used for their management may lead to very diverse occupational exposure. In addition to exposure to chemical and biological risks, workers in the sector are likely to be exposed to multiple risks such as noise, mechanical vibrations, repetitive movements, tiring positions, exposure to high and low temperatures, psychosocial risks (lack of recognition, external violence) as well as risks associated with the use of specific work equipment (machinery and vehicles). The sector is still marked by a high number of accidents: in the sector of waste collection, treatment and disposal activity in Czechia, the ratio of injuries is the highest of any sector (2.37 recorded cases of incapacity to work due to work-related accidents per 100 insured people, compared with the Czech average of 0.98) (VÚBP, 2019). The Danish government's action plan for circular economy calls for a '... change in design practices, increased traceability and better waste sorting ... to ensure secondary raw materials of high quality and without harmful chemicals' (Ministry of Environment of Denmark, 2021).

Another risk results from the low level of qualifications required to work in the sector and the low wages, which, in many cases, lead to the employment of migrant workers, who may, however, be insufficiently informed about the possible dangers arising from the work due to the language barrier. The issue of low wages in the waste collection and recycling sector has also been discussed, for example in Malta (Rizzo, 2011).

Figure 14: Job quality (left) and job demands (right) – Water supply and waste treatment versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Water supply and waste management, NACE Rev 2.0, Section E, Water supply, sewerage, waste management and remediation, Divisions 36 (Water collection, treatment and supply), 37 (Sewerage), 38 (Waste collection, treatment and disposal activities; materials recovery) and 39 (Remediation activities and other waste management services).*
Source: *EWCTS, 2021*

A study on recycling discusses the invisibilisation of women involved in the recycling of plastic packaging in waste sorting centres (Rochart and Benayoun, 2022). Companies invest in more efficient but expensive machinery, and, in order to pay back the investment on the new technology, the work of machine operators intensifies, leading to an increase in turnover in a local labour market that is already limited. This example highlights the need to integrate the human factor when introducing new technology in the workplace.

In terms of work sustainability, this sector has a relatively high level of worker engagement (46% show high engagement) and one of the lowest shares of workers reporting physical and/or emotional exhaustion (31%). However, the sector has a relatively large share of workers reporting difficulty in making ends meet (31%) and reporting that their health and safety is being put at risk because of work (44%).

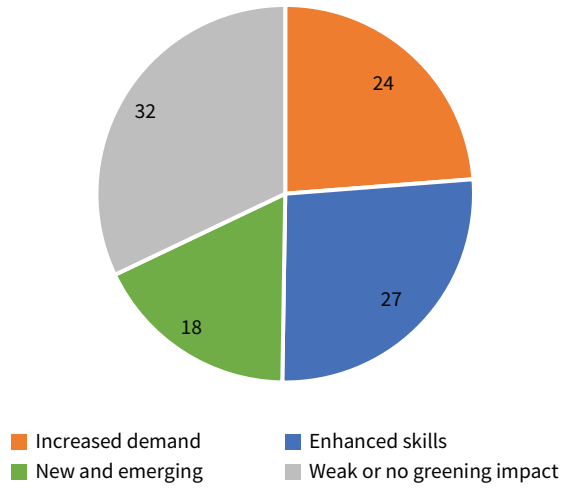
Construction

Construction has been identified as one of the sectors most exposed to climate change risks, and extreme weather events in particular (for example, due to working outdoors); it is also a sector that will play a major role in the context of the green transition, as the built environment accounts for about 50% of all extracted materials and the sector is responsible for over 35% of the EU's total waste generation. It is anticipated that more efficient use of materials could significantly reduce the sector's GHG emissions. The workforce should increase its skills and knowledge related to building zero-carbon buildings and renovating older buildings. The sector will also be key in supporting a fair and just transition for people who live in housing with low thermal efficiency.

Greening of occupations

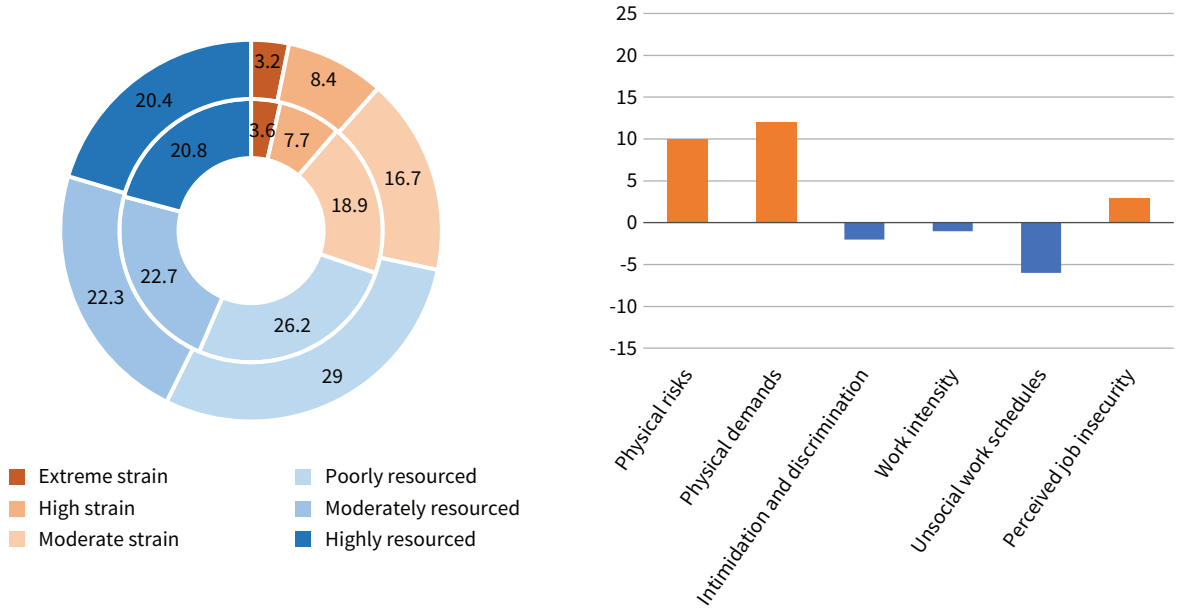
The call for greening in construction is clearly illustrated by the EWCTS data: most of those working in the sector (68%) are in occupations likely to be impacted by the green transition. About 18% are in new and emerging occupations, 24% in occupations that will probably see demand increase due to greening and 27% in enhanced skills occupations (Figure 15).

Figure 15: Shares of construction workers in occupations likely to be impacted by greening (%)



Note: *Construction, NACE Rev 2.0, Section F, Construction, Divisions 41 (Construction of buildings), 42 (Civil engineering) and 43 (Specialised construction activities).*
Source: *EWCTS, 2021*

Figure 16: Job quality (left) and job demands (right) – Construction versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Construction, NACE Rev 2.0, Section F, Construction, Divisions 41 (Construction of buildings), 42 (Civil engineering) and 43 (Specialised construction activities).*
Source: *EWCTS, 2021*

Job quality

In terms of job quality, construction presents a picture similar to the EU average: about 28% of its workers are in strained jobs (Figure 16). Physical risks and physical demands are more prominent than average, but career advancement and opportunities for self-realisation are two salient aspects of job resources that are better than average in this sector.

In terms of work sustainability, the construction sector has relatively high levels of engagement but a slightly larger than average share of workers who have difficulties making ends meet. At the same time, the share of workers in construction reporting exhaustion (physical, emotional, or both: 41%) is on a par with the EU average, while the share of those reporting having their health and safety put at risk because of work (39%) is slightly higher than the EU average (34%).

Seasonality in employment is expected to decrease in Estonia due to climate warming and as a result job insecurity is likely to be reduced (Sammul et al, 2015). A number of contributions highlight the high level of claims for some form of compensation in the sector and postulate that this could increase, as some work situations, such as working on major infrastructure projects, carry a higher than average risk of work accidents.

Many contributions mention that the construction sector, which involves particularly labour-intensive work, faces the challenge of improving the quality of jobs, which continues to be low. At the same time, the sector should concentrate on providing workers with training and qualification opportunities that allow them to contribute to the transition; it is suggested in a number of countries that the additional learning required to adapt should also deal with opportunities to improve working conditions.

Hospitals

This is a sector much discussed in the context of climate change because of its essential nature (as noted in the European Pillar of Social Rights), because it is likely to be impacted by climate change, given the number of patients is likely to increase, and because it can help in the adaptation to climate change through prevention. This sector is very much under pressure already (see Eurofound, 2023b).

These are some of the ways the hospitals and care sector is impacted by climate change and adaptation measures.

- An increase in the number of patients (and potentially workload) during, for example, episodes of heatwave, flood or forest fire and a predicted increase in patients due to an increase in pollution, vector-borne diseases and so on. As heatwaves take place mostly during summer, it is expected that this might affect workers' work–life balance (for instance, they may be unable to take leave).
- The infrastructure of hospitals may not be 'heat efficient', and concerns have been expressed in some countries that high temperatures in hospitals and residential services will increase the morbidity and mortality of patients; this would probably increase workload and ethical conflicts (if workers feel unable to carry out their work well) and workers themselves will be affected by the heat.

A survey by the National Public Health Centre in Hungary in 2015 showed that ensuring an appropriate temperature inside hospital buildings has become increasingly difficult due to extreme heat (Páldy et al, 2018). Deaths in hospitals were three times the number of deaths in homes during heatwaves.

- Finally, hospital and care workers are asked to play a preventative role to support and educate the general public in adapting to and managing climate change hazards, again leading to new demands for workers, but also probably an increase in intrinsic motivation.

Greening of occupations

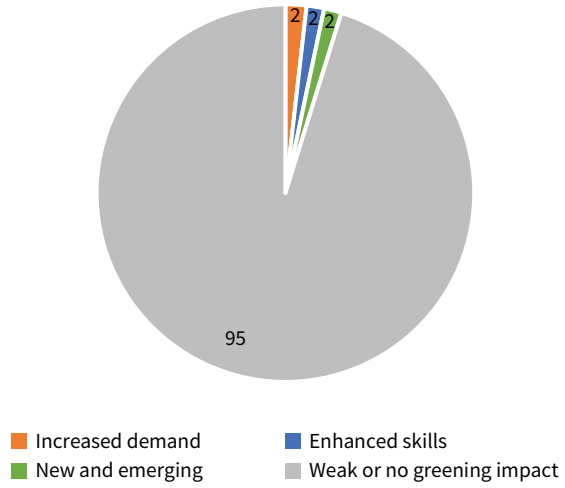
Only a tiny share of workers in the human health services sector (6%) are in occupations likely to be impacted by the green transition (Figure 17). About 2% are in new and emerging occupations, 2% in occupations that will probably see demand increase due to greening and 2% in enhanced skills occupations.

Job quality

This is a sector characterised by worse than average records in most aspects of job demands – especially physical risks and demands – to which is added little task discretion and autonomy and a lack of flexibility of working hours in terms of job resources. Overall, 47% of workers in the sector are in strained jobs (Figure 18).

In terms of work sustainability, this sector presents a mixed picture, with some concerning features in terms of consequences for workers' health and well-being.

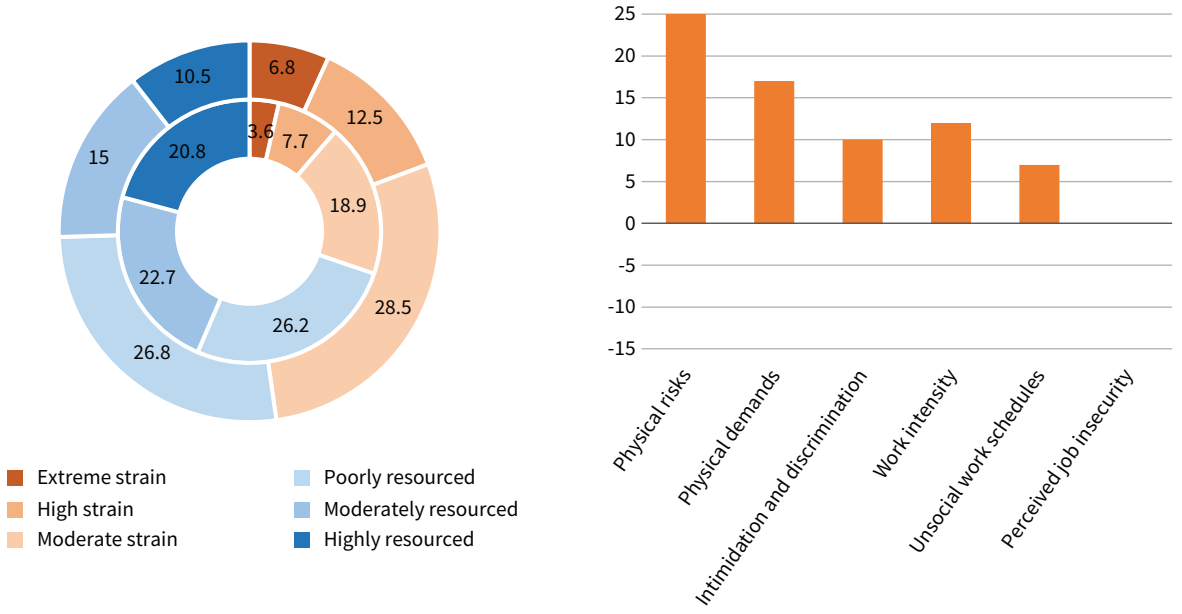
Figure 17: Shares of hospital and care workers in occupations likely to be impacted by greening (%)



Note: *Hospitals, NACE Rev 2.0, Section Q, Human Health and Social Work Activities, Division 86 (Human health activities).*
Source: *EWCTS, 2021*

On the one hand, this sector is characterised by a relatively small share of workers who have difficulty making ends meet (20%), and level of engagement is on a par with the EU average (43% of workers show high engagement). On the other hand, it is the sector with the largest share of workers reporting having their health and safety put at risk because of work (52%) as well as the largest share of workers reporting physical and/or emotional exhaustion and therefore being at risk of burnout (55%).

Figure 18: Job quality (left) and job demands (right) – Hospital sector versus EU27 average (%)



Note: *On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Hospitals, NACE Rev 2.0, Section Q, Human Health and Social Work Activities, Division 86 (Human health activities).*
Source: *EWCTS, 2021*

Tourism

Tourism is a sector much discussed in relation to climate change hazards, as it is expected that tourism offers will be affected and it is suggested that it may offer job opportunities for workers who might have lost their jobs or part of their activity due to climate change. Research alludes to the adaptation of tourism offers to fit with the changing climate while supporting sustainable tourism practices.

For instance, in Estonia it is considered that climate change will create more opportunities, while in Austria, Cyprus or Greece, for example, tourism will become more difficult, as temperatures in the summer will be too hot and/or water scarcity will increase competition between tourism and other economic sectors. The rise in water level in certain coastal regions could also destroy beaches or damage tourism facilities and infrastructure, leading to job insecurity.

Greening of occupations

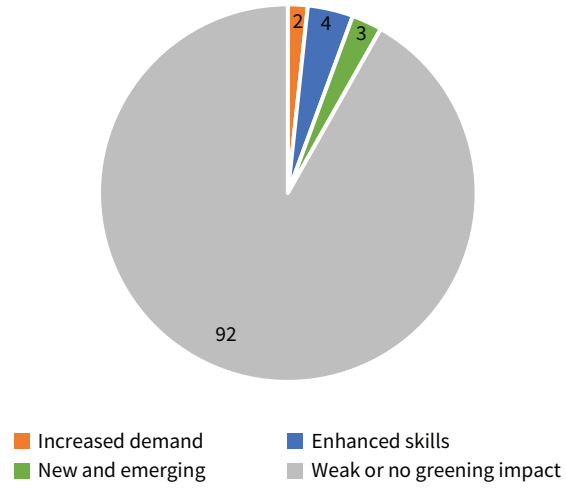
Very few workers in Horeca (the hotel, restaurant and catering sector, used as a proxy for the tourism industry) are in occupations likely to be impacted by the green transition (9%). About 3% are in new and emerging occupations, 2% in occupations that will probably see demand increase due to greening and 4% in enhanced skills occupations (Figure 19).

Job quality

This is a sector scoring worse than average on most job demands and with poorer training and learning opportunities and task discretion and autonomy, resulting in a relatively poorer job quality than the EU average: 38% of its workers are in strained jobs (Figure 20).

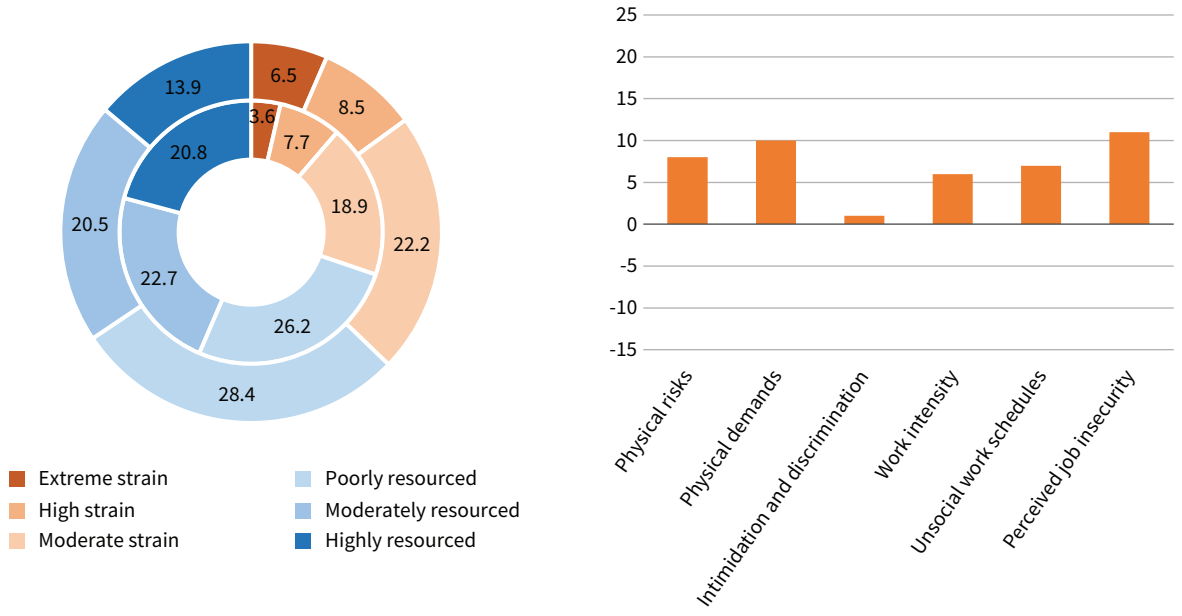
Workers in Horeca have a relatively high level of engagement (44% show high engagement) and are less likely to report having their health and safety put at risk because of work (33%). However, this sector has a very large share of workers reporting difficulty in making ends meet (40%) as well as a large share of workers reporting physical and/or emotional exhaustion and being at risk of burnout (48%).

Figure 19: Shares of Horeca workers in occupations likely to be impacted by greening (%)



Note: *Horeca (the hotel, restaurant and catering sector, used as a proxy for the tourism industry). Tourism, NACE Rev 2.0, Section I, Accommodation and food service activities, Divisions 55 (accommodation) and 56 (Food and beverage service activities).*
Source: *EWCTS, 2021*

Figure 20: Job quality (left) and job demands (right) – Horeca versus EU27 average (%)



Note: *Horeca (the hotel, restaurant and catering sector, used as a proxy for the tourism industry). On the left, the inner circle is the distribution of the job quality index in the EU27 on average. Tourism, NACE Rev 2.0, Section I, Accommodation and food service activities, Divisions 55 (accommodation) and 56 (Food and beverage service activities).*
Source: *EWCTS, 2021*

Summary

The sectors most directly impacted by climate change and climate policies include energy, manufacturing, agriculture, transport, water supply and waste management, construction, hospitals and care, and tourism. This chapter has examined job quality in these sectors, based on their level of emissions, greening of tasks and exposure to climate change risks. Most of these sectors play an important role in sustaining the population.

Workers in these sectors are under considerable pressure to adapt to new greened tasks, but, in some cases, they also have to work in more arduous circumstances. This calls for close monitoring of the changes and their impact on workers' job quality, companies and other organisations to help identify practices that support climate change policies, job quality and the well-being of workers, and the performance of companies.

4 Green behaviours and practices at work

The previous chapter examined the industries most exposed to climate change risks and climate change policies. This chapter examines how workplaces and workers engage in the green transition in their work. This is an emerging area of research, and the evidence is patchy. The following topics were identified in the literature and research: workers involvement in green workplace behaviours, meaningful work and the green transition, workplaces practices that support the transition, and the ecological transition as an opportunity to reinvent work.

The extent to which the organisations in which workers are employed are high-involvement organisations (see Eurofound, 2020) is likely to play a key role in workplace efforts to adapt to climate change. Finally, some of the literature supports some reconceptualisation of work in light of the transition.

Green workplace behaviours

Green behaviours are 'scalable actions and behaviours that employees engage in that are linked with and contribute to or detract from environmental sustainability' (Ones and Dilchert, 2012). They are diverse in their nature; examples of green behaviours contributing to environmental sustainability are provided in Table 5 (Francoeur et al, 2021).

Table 5: Categories of green workplace behaviours

Category	Behaviours
Conserving	Recycling, reusing, reducing use, repurposing
Avoiding harm	Preventing and reducing pollution, monitoring environmental impact, strengthening ecosystems
Transforming	Choosing responsible alternatives, changing how work is done, creating sustainable products and services, embracing innovation for sustainability
Influencing others	Educating and training for sustainability; encouraging and supporting others
Taking initiative	Initiating programmes and policies, lobbying and activism, putting environmental interests first

Source: *Francoeur et al, 2021*

Further elaboration on these behaviours is important to understand their impact on job quality. Are these behaviours linked to job tasks, and, if so, to what extent? This distinction matters: if they are part of job tasks, workers are required to engage in such behaviour; however, if they are outside of their tasks, such behaviour is discretionary. Are these green behaviours individual or collective practices in the workplace? Do workers have a direct or indirect influence on the environment? Direct influence means that employees engage concretely in green practices, for instance employees who avoid printing any documents or print on both sides of paper. Indirect influence involves an intermediary stage whereby employees and management are encouraged to adopt green behaviours. These behaviours can have multiple consequences: they can increase workload, change task requirements, support ethical coherence, be a source of additional recognition for workers and support their engagement in work, depending on the local context in which work is performed. Companies can support these behaviours through adopting policies on training and work organisation practices.

However, it is difficult to quantify at the individual worker level the impact that engaging in such behaviours has on job quality and also on sustainability trajectories; this is a gap that a recent Finnish survey has started to address (Moilanen and Toikka, 2023). This representative survey of employees was designed to broadly capture green transition-relevant changes in working life. The survey covers the following areas: workplace sustainability, employers' sustainable actions, work organisations' sustainability actions, sustainability skills training, sustainable work environment, own sustainable actions, awareness of new occupational safety and health risks, preparedness for hot working conditions, climate change-related worries and opportunities, and sustainability values. At the time of writing this report, only preliminary results were available. Most employees in Finland do not perceive the organisations in which they work as sustainable, and actions to hasten the transition to sustainability are scarce. Based on employees' experiences, training on sustainability is not yet common and neither are collaborative climate actions. In fossil-intensive sectors such as energy and construction, however, training on sustainability is more frequent and employees' perceptions of the sustainability of their workplace are more positive.

The survey results highlight the key role of work organisation and communities at work in supporting change and in the development of sustainability actions.

Rochart and Benayoun (2022) report on a collective of workers, employees in the large French companies Axa, EDF and Michelin, who are acting to change their companies from the inside, with actions at three levels: awareness raising and training on climate change; promotion of more virtuous behaviours, such as having a vegetarian canteen and the use of bikes and soft mobility; and limiting air travel. The ultimate aim is to change the company strategy and adapt the business model. The study reports that, while the first two levels receive support from both the workforce and management, it is very difficult to implement action at the third level. The study also reports that, for these workers, these actions and efforts are supplementary evening or weekend work that is not part of their contracted working time. In some cases, actions such as these have been a first step before engaging more actively with a trade union.

An example of a different way of working is provided by the Écoles de la Transition Écologique (Écoles ETRE) in France, where carpenters in training are taught to first look at the stock of wood that they have and can recycle before preparing their orders, rather than starting from scratch. This is similar to low-tech engineering, which advocates the design of simple objects that are useful, sustainable and accessible. This illustrates how new work practices will encourage different competences and skills of workers and might profoundly impact their job quality and experience of work.

A Portuguese study demonstrates that green/environmental human resource practices positively affect green behaviours, environmental performance and affective commitment (Dias, 2022).

It was not possible to identify much research in this field. The development of a research programme combining a quantitative survey with case studies would be a useful tool to map the greening of workplaces and monitor job quality changes during the process.

Meaningful work and the green transition

A significant proportion of workers are looking for work that is good for the environment. According to the Lithuanian contribution, 44% of Lithuanian people take climate change into consideration when job hunting; 56% of people aged 15–29 and 47% of people aged 30–34. A speech given by a group of eight graduates from AgroParisTech (a leading French university teaching agronomy) called on fellow students to boycott jobs that entail participating in the 'ongoing social and ecological devastation' and highlighted the strong attraction of having a job with a purpose, a job aligned with your personal values. According to Coutrot and Perez (2022), meaningful work is made up of three dimensions: ethical coherence, social utility and being allowed to grow and develop. Meaningful work is a job resource and supports motivation and engagement. It has a strong positive link with well-being. Rochart and Benayoun (2022) report on the benefits to workers at a luxury fashion house, in terms of their engagement and sense that their work is meaningful, brought by the *loi anti-gaspillage pour une économie circulaire* (a law on preventing waste for a circular economy that came into force at the beginning of 2022), which bans the destruction of unsold goods. Climate quitting (leaving a job for environmental reasons) illustrates the impact of this value.

New data are being collected through the EWCS that will enable the relationship between the subjective attachment of workers to work that is good for the natural environment and job quality to be assessed.

Workplace practices that support the transition

Several working practices have been identified by the Network of Eurofound Correspondents that could support the green transition, such as an increase in telework and a reduction in working time, including the development of the four-day week. They rely on the use of digital technologies to support the green transition in most instances.

Employer and business organisations state that the world of work will have to change, too – and become more flexible with regard to working times and places (BDA et al, 2021).

The Finnish Institute of Occupational Health (FIOH) suggests that the green economy will rely heavily on telework and the workforce being spread out across the country (FIOH, 2020). This is linked to the expectation that the green economy will rely on a sharing economy, which requires collaborative networks and digital platforms. The circular and sharing economy also requires localised business models. Businesses will offer product use rather than the product itself. The circular/sharing/platform economy also requires digital skills. A digital twin[4] enables some maintenance work to be carried out from anywhere and limits the need for the physical presence of a technician at the machine location.

4 A digital twin is a virtual representation of an object or system designed to accurately reflect a physical object.

FIOH also envisages that the green economy will be characterised by a high theoretical expertise and/or a high level of manual skills in maintenance, repair and remanufacturing services. Often both are required, as the people conducting these jobs require knowledge of both old and new products and materials.

In an event organised by the Austrian Economic Chamber (WKÖ) on working life in the face of climate change in October 2022, the examples of good practices in companies provided included 'smart working time models' to address the immediate consequences of the climate crisis in the workplace (especially heat), a general reduction in working time, but only if it does not lead to compressed working time, and a call for the development of social protection systems and social infrastructure to provide access to essential goods and services fit for addressing the challenges of climate change. Danish and Austrian research suggests there is evidence that a shorter working week may lead to a decline in ecological footprint. The Austrian Trade Union Federation (ÖGB) has called for the right to a four-day week. From a degrowth perspective, working time reduction should achieve three objectives: sharing employment, reducing throughput and liberating time.

The literature reminds us, however, that digital activities are neither energy-neutral nor carbon-free, and rebound effects may diminish the expected impact of such changes. This calls for complementing these types of measures with cultural changes in organisations.

Effective greening measures are most likely to be achieved where there is a high quality of deliberation in the workplace. Finally, the ecological transition can be seen as an opportunity to reinvent work and improve job quality.

Involvement of workers in the ecological transition

Many national contributions (Ireland and Austria, for example) acknowledge that the challenges brought by adaptation to and mitigation of climate change are enormous and call for the development of work practices that facilitate collaboration, joint problem-solving, and conflict avoidance and resolution; in this respect, the involvement of works councils and the workforce is key.

Workers play a role in sustainability transitions. Moilanen and Alasoini (2023) state:

> *Workers can contribute to more sustainable production modes in industries in their daily work practices; some may even be able to influence other actors, such as collaborators or citizens, to engage in more sustainable conduct. However ... workers can be constrained by their collaborators or work organisations, whose actions externally shape their work practices, and this external influence can hinder the shift toward sustainable work practices.*

The quality of internal deliberation is essential to support the changes called for by the transition. Clot (2016) refers to the scandal at Volkswagen over pollution emission tests and the salmonella-infected milk scandal at the French company Lactalis to demonstrate that the absence of quality internal deliberations on work well done and the 'garroting' of conflicts have had profound ecological, economic and social effects that have extended beyond companies' walls. As new practices are put in place to green tasks and to adapt companies to climate change, workers' expertise will be challenged; in this context, it will be more important than ever to support, through work organisation and workplace policies, practices that support workers in developing expertise in their new tasks. The creation of a new role in companies, that of a 'professional referent', or elected workers who can facilitate the dialogue between workers and management on the criteria definition of professional and good-quality work, has been suggested. Without a shared appreciation of quality work and a full appreciation of the actual conditions in which work is performed, there is a risk of (ethical) conflicts arising over work not done well, with an increased risk to mental health and a negative impact extending beyond the workplace.

Prior research has shown that the involvement of workers in the development and implementation of new work organisation practices supports better change management practices.

The EWCTS data show that 33% of employees work in forms of work organisation that offer a high degree of involvement, in which they experience both a high level of task discretion and a high degree of organisational participation. This form of work organisation is associated with the take-up of innovation.

Ecological transition as an opportunity to reinvent work

Full decoupling of economic growth and resource consumption may not be possible. The EEA states:

> *If there are limits to economic growth and to the current trajectory (i.e. 'plan A'), plan B to achieve sustainability is to innovate lifestyles, communities and societies that consume less and yet are attractive to everybody and not only individuals with an environmental, spiritual or ideological interest.*
>
> (EEA, 2021)

This would entail challenging current thinking about work. Further analysis in this regard goes beyond the scope of this report.

However, applying the principles examined in this chapter, it is suggested that developing sustainable work practices will be essential to mitigating the ecological crisis and that the following pillars might play a part in that: providing decent employment; ensuring that essential workers can use their skills and grow them while they work; ensuring autonomy and that workers are involved in changes in their work and its organisation; and insisting that work makes a meaningful contribution to the ecological transition.

Summary

Workers have the ability to engage in green behaviours at work. They can do so as individual workers or through collective practices in the workplace. The extent to which they are engaged in such behaviours depends on the forms of work organisation. A significant proportion of workers are looking for work that is good for the environment, as it is often perceived as meaningful work. The ecological transition can be seen as an opportunity to reinvent work and improve job quality.

Telework, working time reduction and the introduction of the four-day working week have been viewed as work practices that support decarbonisation.

5 Policy discussions

When assessing the level of policy debate and policy discussion on job quality, it is possible to distinguish between discussions on the direct impact of climate change and on the implications of climate change policy. There has been some debate about the implications of climate change impacts, specifically increased frequency of extreme temperatures and adverse weather conditions such as storms and floods, for job quality. Occupational safety and health (OSH) concerns about working in heat have intensified in recent years and have triggered policy action on the part of different stakeholders at the EU and national levels. The impact of the increasing frequency of extreme weather events has also prompted discussions about the working conditions and remuneration of emergency service workers and firefighters in particular. These policy emphases are particularly evident in southern European countries following the experience of more extreme heatwaves and large-scale, prolonged and devastating wildfires in recent years, but they are also increasingly present in central European countries as average temperatures rise and fires and floods become more frequent. Little emphasis was found in the policy debate at the EU Member State level on the implications of environmental degradation linked to climate change for employment and working conditions (for example, in the agriculture, forestry and aquaculture sectors).

When debating the impact of climate change policy, a distinction can be drawn between the implications of adaptation, mitigation and compensation/just transition policies (Eurofound, 2023a).[5] The focus of national policy debates is largely on the implications of mitigation and just transition policies. Specifically with regard to the push for decarbonisation at the regional, sectoral and occupational levels, the question of the attention paid to job quality aspects is more complex. On the surface, discussions primarily focus on the overall employment and social implications of the carbon-neutral transition and how these should be addressed. Inevitably, this policy focus is particularly evident in the countries and regions most impacted by the move away from coal or peat-fired power and those reliant on carbon-intensive heavy industry. Although just transition plans frequently mention the importance of creating quality new employment for affected workers, assessments of the pay and working conditions of such new jobs and explicit policies to ensure the creation of quality employment are generally missing from these plans. In the policy discourse it is generally assumed and implied that new green jobs will be of higher quality, without much evidence presented on whether this is actually the case.

The emphasis in policy discussions is on the need for accurate skills forecasting, the regular adjustment of training curricula, and the delivery of relevant training for new or adjusted occupational profiles for unemployed individuals and workers impacted by restructuring and potential job loss. This discussion often also addresses sectors, occupations and skill areas where labour shortages are currently in evidence and where a lack of supply of workers with the appropriate skills could hamper the achievement of climate targets (Eurofound, 2023c).

Among the most frequently mentioned issues directly linked to working conditions in green jobs is the need to understand OSH issues arising in growing occupations, for example, in waste recycling, the installation of more energy-efficient or alternative power sources and the use of battery technologies in vehicles.

Finally, in a number of countries, the climate change debate, coupled with the experience of the COVID-19 pandemic, has triggered a more fundamental assessment of current underlying economic models and parameters. On the one hand, this has led to a greater emphasis on investment in the circular economy, and on the other hand, it has led to rethinking the balance between work and private life, as exemplified by the growing discussions around the four-day working week and/or potential working time reductions.

This chapter provides an overview of these policy discussions at the Member State level.

Impact of climate change

As shown in the preceding chapters, climate change and environmental degradation can directly impact employment, working conditions and job quality. This is perhaps most evident in its implications for land and sea use through agriculture and aquaculture, but it also impacts on the productivity of inputs to economic activity (OECD, 2015). The impacts on the feasibility of certain types of agricultural, horticultural and forestry production and fisheries may not only lead to job losses in these and associated sectors but also change the

5 Eurofound (2023a) uses the term ‘compensation’ policies for any policies implemented mitigating the impact of climate change policies on workers and communities, such as retraining or job-to-job transition measures. The term ‘just transition’ policies was not used here; instead a broader term that was not directly associated with the EU’s just transition policies and fund was chosen. However, the types of policy approaches covered are similar and hence we use the term ‘just transition’ policies for the remainder of this report.

organisation of work and therefore job quality. Changes in sectoral and occupational make-up as a result of the direct impact of climate change can change the balance of the overall quality of jobs and working conditions. However, this is not a subject currently high on the agenda in the policy debate.

While loss of productivity through health impacts was previously seen as a more marginal phenomenon in Europe, increasing and prolonged heatwaves are now recognised as having an impact in EU countries. This – and the impact of the rising incidence and scale of wildfires and adverse weather events such as floods – has also triggered further discussions on the working conditions of emergency service workers.

Identifying and addressing new OSH risks

Key debates on the OSH risks associated with climate change relate to the risks associated with working in heat and the identification of potential new OSH risks linked to the development of new job profiles or tasks.

Working in heat

Although there is no specific legislation on maximum or minimum workplace temperatures at the EU level, the EU OSH Framework Directive (Directive 89/391/EEC) makes employers responsible for the health and safety of their workers and requires them to carry out risk assessments and take preventive measures to either eliminate or minimise risks. Two directives based on the OSH Framework Directive – Directive 92/57/EEC on temporary or mobile construction sites and the Workplace Directive (Directive 89/654/EEC) – make reference to temperature and state that the temperature in rooms containing workstations must be adequate for human beings and have regard to the working methods in use and the physical demands placed on workers. In 2023, the European Agency for Safety and Health at Work published guidance for workplaces on heat at work. The document elaborates on the short-term health risks associated with working at high temperatures, such as heat stroke and heat exhaustion, as well as the longer-term risks, including an increase in accidents. The guidance summarises existing legislation and mitigating measures (EU-OSHA, 2023).

Despite the existence of this EU legislation, which needs to be transposed at the national level, a number of trade unions at the EU and national levels have called for more specific regulations.

At the national level, concerns over working in heat have also been raised by occupational health insurance bodies and social security institutions. The issue has also been addressed in some collective agreements.

A survey of European Trade Union Confederation (ETUC) affiliates carried out in the context of the adoption of its resolution on the need for EU action to protect workers at high temperatures (see ETUC, 2018) found that only a few EU countries have legislation going beyond the need for risk assessment included in the EU OSH Framework Directive and specifically aimed at keeping workers safe during heatwaves, with temperature limits varying between countries, for outdoor and indoor work and for work involving different physical workloads. For example, in Belgium, the limit is 29°C for light physical work, 26°C for moderately physical work, 22°C for heavy physical work and 18°C for very heavy physical work. In Hungary, a temperature of 31°C is allowed for sedentary and light physical work, 29°C for moderately physical work and 27°C for heavy physical work. In addition, work organisation measures (such as changes to rest periods) must be taken if workplace temperatures exceed 24°C, and hydration must be provided. In Spain, the maximum temperature for sedentary work is 27°C and for light work is 25°C. However, these limits do not apply to all types of work and all workers. In Latvia, work involving no or limited physical effort can be carried out in temperatures between 20°C and 28°C, moderate handling of loads can be performed in temperatures between 16°C and 27°C, and heavy work is limited to temperatures between 16°C and 27°C. In Lithuania, the National Action Plan for Public Health and Heat Prevention 2016–2020 was adopted in 2015. The Institute of Hygiene published a guidance document on preventive measures for heat exposure in the workplace in 2018. In Latvia, information has been disseminated on the rights of workers in hot weather, with different acceptable air temperatures in place depending on the nature of the work being performed (Lvportals.lv, 2020). In Cyprus, the labour code describes in detail the measures that must be taken to protect workers from thermal stress. Employers are required to record temperature and humidity and the measures taken to prevent and reduce thermal stress.

Given these variations in provisions at the national level, in December 2018, the ETUC adopted the abovementioned resolution. It calls on the Commission to introduce a legislative instrument that recognises the increased risk to workers of working in high temperatures and refers to WHO recommendations that indicate people work best at temperatures between 16°C and 24°C.

Social partners at the national level have also taken action relating to the impact of heat stress. In Spain, evidence of excess mortality in the workplace has received significant attention. In the agriculture sector, changes to work schedules have already been implemented to avoid working in the hours of highest sun exposure. Collective agreements in the construction sector contain provisions regarding working in high temperatures. Trade unions (for example the General Union of Workers (UGT) and the Workers' Commissions (CCOO)) and the National Institute for Health and Safety at Work (INSST) have organised events focusing on new work-related health risks linked to climate change (CCOO, 2019; INSST, 2022; UGT, 2022).

The impact of high temperatures on workers' health is also high on the agenda in Italy. The two Italian social security institutions, the National Institute for Social Security (INPS) and the National Institute for Insurance against Accidents at Work (INAIL), issued a joint press release in the summer of 2022 supporting workers and companies struggling with record temperatures. As well as the direct impact of heat stress, they also raised the issue of the increased risk of accidents at work during such periods. From a policy perspective, in cases when work is suspended due to temperatures reaching beyond 35°C, companies can participate in a job retention scheme (the Ordinary Wage Guarantee Fund (CIGO)), which ensures that workers' salaries continue to be paid.

In Germany, advice for employees on their rights during heatwaves and suitable measures to ensure workplace health and safety both indoors and outdoors during such periods are provided by trade unions (see, for example, IG Metall, 2022; ver.di, 2022) and accident and occupational liability insurers. Similar information is also provided by chambers of commerce and crafts.

In a number of other countries, including Austria, Croatia, Malta, Poland and Slovenia, trade unions – sometimes in collaboration with other bodies – have called for further legislative or policy action and organised awareness-raising campaigns, as well as research on the prevalence of working in heat and workplace mitigation measures.

In Austria, the ÖGB adopted a policy paper on climate policy from a workers' perspective in 2021. Among other things, this paper calls for the updating of regulations to protect workers from sunstroke, heat stroke, sunburn and skin cancer. The trade union confederation demands that employers should be obliged to take appropriate measures as soon as the room temperature exceeds 25°C. Organisational and technical measures should be prioritised over individual measures. Such organisational measures could include improving ventilation, using cooling or air conditioning equipment, enhancing thermal insulation, addressing ingress of heat through windows, reducing thermal load arising from equipment, relaxing clothing regulations and providing refreshments. For outdoor work, shading and cooling of workplaces is also recommended for temperatures above 25°C, with a mandatory cessation of outdoor work to come into force above 32°C. Heavy physical work outdoors must be stopped during ozone alerts (ÖGB, 2022).

In Croatia, trade unions are also calling for further action to protect workers from the impact of more frequent heatwaves, particularly in sectors such as agriculture and construction, but also in tourism. Many of these sectors are already suffering from shortages of labour. Among the solutions suggested are more flexible work schedules.

In Poland, the Independent Self-governing Trade Union Solidarity (NSZZ Solidarność) organised a conference on OSH in high temperatures in 2019, with a specific focus on work in heavy industry. Conference participants pointed out that clarification of the regulations on working at high temperatures is needed, as currently the only regulation is an obligation to provide drinking water to employees when the temperature exceeds 28°C. In 2022, NSZZ Solidarność asked the Minister for Family and Social Policy to initiate changes to policy on working conditions and extremely high temperatures.

The limited discussion in Malta on the issue of climate change and its impact on employment and working conditions also focuses on heat stress and the potential for increased workloads for firefighters and other emergency service workers.

Social partners in Slovenia participated with other national actors and similar organisations from other countries in the HEAT-SHIELD project, which sought to assess awareness of rules and gather information from workplaces on current practices related to working in heat. The results showed a high share of workers working under such conditions. Nine per cent of respondents said that the temperature can be up to 25°C, 15% stated up to 28°C, 21% stated up to 30°C, 27% stated up to 35°C, 18% stated up to 40°C and 10% stated that the temperature can be above 40°C. When asked what their employers provide them with, 56% said air conditioning, 24% free drinks, 18% more frequent breaks and 16% a cooler room. Some 16% said that they did not have any such measures in their workplace, and only 2% had the option of interrupting work in extremely high temperatures. The results showed that 54% of participants felt less productive, the same percentage had heat-stress symptoms (such as headaches and nausea), 34% had difficulties maintaining concentration, 26% reported dehydration and 21% had fainted. In conclusion, 73% of respondents stated that their employer is not doing enough and almost half (45%) stated that their employer does not listen to the employee representative. Work jointly carried out by the social partners as part of the HEAT-SHIELD project also showed that heat-related work stoppages were required for 1.5% of working hours.

The need to enforce regulations has been emphasised in Hungary, where the work, health and safety inspectorate conducted targeted checks in the construction sector in 2022, with a specific focus on extreme heat conditions, to ensure that existing provisions are observed with regard to rest periods and access to hydration.

OSH risks linked to new jobs and tasks

As well as emphasising the importance of ongoing training, skills development, job security and worker participation in the green transition, the Danish Trade Union Confederation (FH) points to the importance of understanding and addressing (new) health and safety risks in green occupations, including, for example, exposure to harmful chemicals in waste recycling and risks of accidents when installing solar panels and wind turbines (FH, 2020). The Danish government's Action Plan for Circular Economy addresses the issue of harmful chemicals in waste recycling and the construction industry as part of its circular economy strategy, calling for safe processes and minimising the use of harmful secondary raw materials (Ministry of Environment of Denmark, 2021).

The Union of Autonomous Trade Unions of Croatia (SSSH) undertook an analysis of the effects of the green transition on workplaces and trade union activities in the municipal waste management sector to raise awareness of new ways of working, new requirements and new risks.

FIOH carried out a survey in 2022, which, among other things, assessed the extent to which risk assessment tools were being used to manage climate change-related risks. The findings show that in 51 out of 115 organisations, such monitoring tools were not being used for this purpose. Out of 118 respondents answering questions about competence-building needs in climate-related occupational safety risks, 47 stated that they would welcome general and basic training related to climate change, 23 mentioned a need to learn how to identify climate change-related safety risks, and 11 mentioned a need to get sector-/occupation-specific information about risks. Eight respondents requested more training regarding preparing for extreme weather conditions and the related psychological stress.

Concerns about 'new' risks have also been raised at the company level, with trade unions in a Hungarian battery plant expressing concerns to management about the level of nickel exposure experienced by workers.

Working conditions of emergency service workers

The prevalence of heatwaves in recent summers is demonstrated by the fact that measures regarding the working conditions of firefighters and other emergency service workers are not limited to the south of Europe. For instance, following the outbreak of the largest fire in the modern history of Czechia in the summer of 2022, involving more than 6,000 professional and volunteer firefighters, the policy focus was on their working conditions. In addition to the provision of funds for extraordinary rewards for participating firefighters and police officers, the salaries of members of the security forces, including firefighters, were increased in connection with this event and also to take into account growing security challenges. Funds were also released for additional equipment for fire brigades.

Following the forest fires experienced in France in 2022, the Fédération nationale des sapeurs-pompiers de France (FNSPS) issued a number of demands linked to the capacity of the fire service to respond to such emergencies, including considerations regarding working hours and working conditions, such as the need to anticipate systematic relief or rest phases after 12 hours of fighting, in order to meet European standards and ensure optimal working conditions.

In Austria, the ÖGB has demanded that, in the case of work necessary for the maintenance of public infrastructure, such as that done by rescue services, fire brigades or security services, a maximum working time limit of eight hours per day be imposed and more paid breaks be provided (ÖGB, 2020).

Impact of climate change policies

Eurofound (2023a) emphasises that policies on climate change can have far-reaching consequences for working conditions and job quality, not only because of the implications of sectoral, occupational and task shifts on the different indicators of job quality. They may also imply the adjustment of existing business models and the emergence of new ones, new managerial approaches and changes in commuting behaviour and the associated implications for other dimensions, such as work–life balance. These implications are likely to impinge unequally on workers in different sectors and occupations and on workers with different types of contracts and with different characteristics (such as age, gender, ethnic background and skills level), as demonstrated above. While mitigation policies are likely to affect job prospects, job security, earnings and training requirements as a result of the required job shifts in the sectors most affected by these approaches, adaptation policies – on the face of it – are more likely to give rise to increased labour demand, new and additional training requirements and changes in business models. However, these impacts will depend on the mix of policies and the precise nature of each policy, the sectors/occupations/tasks affected in terms of decline, growth or task change, and the availability, quality and effectiveness of any associated just transition measures.

Since assessments of the impact of climate change policy on the precise sectoral, occupational and task make-up of jobs (and associated job quality) are largely lacking at the national level, it is perhaps not surprising that the policy debate has primarily focused on the impact of decarbonisation policies on employment and training and retraining requirements. While the need to support new business models – including the circular economy – is being debated and policy strategies are

being developed, there is, generally speaking, no explicit debate on the impact of climate change policy on job quality. As mentioned above, although a number of just transition plans highlight the need to create quality jobs, it is largely simply assumed – rather than demonstrated with evidence – that the new jobs created will be of higher quality.

The following section discusses the two main (interlinked) fields of policy discussion: the need to forecast and provide training for emerging green and greening jobs, and the requirement to retrain workers impacted by decarbonisation policies linked to the EU's targets and support measures, not least the European Green Deal and the Recovery and Resilience Facility.

Initial and ongoing training for green and greening jobs

As mentioned above, job quality is set to be indirectly impacted by climate change policy as a result of sectoral, occupational and task shifts in existing and newly created jobs. An agreed clear definition of what constitutes a green job or greening task is currently lacking (Eurofound, 2023c); however, there is a clear necessity – recognised by policymakers in many countries – to assess and monitor occupational and task shifts, forecast future requirements and ensure that new skills and qualifications are developed and integrated into initial and ongoing training curricula.

Skills forecasting and adjustments to curricula

Different methodologies and processes for skills forecasting are in place in different Member States, with Cedefop at the EU level contributing to this process of skills foresight. National systems vary in terms of approach, frequency, involvement of different stakeholders, methods for integrating findings into curricula and the offer of vocational and tertiary education places. In the context of its work on labour shortages, Eurofound has reported on efforts, particularly in the construction sector (but also beyond), to assess new skills requirements and implement new curricula suitable for meeting the demand for new green construction and retrofitting existing homes (Eurofound, 2023a). Greater emphasis has been placed by such forecasting systems on the skills needs of the green and digital transition. For example, since 2015, Estonia has had a system of labour market monitoring and skills forecasting (named OSKA) in place, and several sectoral reports are published each year to predict workforce and skills needs. In 2021, an overview of skills needs for the digital and green transition was published that emphasises that, as well as developing new occupational profiles, such skills would be needed in all sectors and occupations in future (Kaelep et al, 2021). These reports provide inputs to curriculum development, career counselling and funding for education and training, including via the public employment service and the Estonian Unemployment Insurance Fund.

Delivery of training to the unemployed

As well as making changes to education curricula, numerous countries are making efforts to prioritise the delivery of active labour market policy measures (such as training and work placement), focusing on the delivery of skills for green jobs, in some cases with the involvement of social partners. Such initiatives are further driven by the fact that labour shortages currently exist in a number of relevant sectors. Job quality is not explicitly mentioned as part of these discussions.

In Austria, the peak-level social partner organisations established a new re-employment scheme (a work foundation) with specific emphasis on education and employment in climate-related jobs. The so-called inplacement foundation (which offers a specific qualification in a dual training system with subsequent fully insured employment) is implemented by the public employment service and the federal ministries for labour and the economy and for climate action, the environment, energy, mobility, innovation and technology, in close cooperation with companies where there is a high demand for climate-related jobs in the fields of resource management, green mobility, energy and building technology, agriculture and forestry, and education. In total, €10 million has been invested in order to provide 1,000 unemployed people with mostly low-level qualifications with specific know-how, but the scheme also supports individuals who have already completed an apprenticeship or upper secondary education. The measure is set to run for three years and aims to create new opportunities for unemployed people in rapidly growing sectors and to future-proof jobs with financial security. The scheme is also aimed at easing the shortage of skilled workers in areas in which the need for skilled personnel is expected to further increase due to the energy transition, including within the framework of Austria's Klimaaktiv action plan, which focuses on the retrofitting of homes as well as a sustainable transport strategy (Eurofound, 2023c).

Given the emphasis in public policy in many Member States on reducing energy demand and emissions through ensuring a more energy-efficient building stock utilising renewable energy sources (both in new builds and through retrofitting existing stock), the construction sector has often been at the forefront of assessing future skills and labour force needs and the development of new curricula. At the transnational level, this has been supported through the EU BUILD UP Skills programme, implemented through specific initiatives at the national level. For instance, the Bulgarian Construction Chamber started a new project, BUILD UP Skills Bulgaria 2023, in October 2022 after completing its predecessor programme, BUILD UP Skills

Bulgaria 2020. The project aims to increase the knowledge and skills of construction professionals and workers in order to build zero-carbon buildings in line with the expected amendments to the directives on energy efficiency (European Commission, 2021a), energy performance of buildings (European Commission, 2021b) and renewable energy sources (European Commission, 2021c) under the Fit for 55 legislative package. The project ran for 18 months and included a national mapping and in-depth analysis of working conditions, labour and skills needs and best practices in climate-neutral construction delivery.

The shortage of skilled staff in Germany, which has been a key factor in the labour market policy debate in the country for a number of years, also extends to (new) skills profiles required in the context of the green transition. The Federal Ministry of Labour and Social Affairs published its revised skilled labour strategy in 2022. The strategy highlights that a skilled labour shortage exists in several trades and technical professions that are important for dealing with the impact of climate change and that such demand is likely to keep rising, requiring specific efforts in the updating of education and vocational curricula and ongoing training delivery (BMAS, 2022). The Confederation of German Employers' Associations (BDA) emphasises the need for a joint effort between the government, its agencies, employees and employers to ensure initial and ongoing qualifications are fit to manage the demands of the twin transition (BDA et al, 2021).

Labour shortages in sectors involved in the green transition are also at the heart of social partner concerns in the Netherlands and France. Unions emphasise the importance of improving working conditions in order to attract workers to sectors such as construction and waste management. They also criticise the lack of (retraining and other) support for workers impacted by company reorganisation in the context of the green transition. In their view, companies favour the recruitment of new, cheaper staff over transferred and retrained workers. Strong union involvement is therefore considered to be critical to the achievement of a fair transition (FNV, 2021).

In France, unions such as the French Democratic Confederation of Labour (CFDT) are arguing for the subject of employment and skills to be addressed at the strategic planning level in the same way that decarbonisation is, and not just as an afterthought or consequence of this policy. The union has set up a network on ecological transition at the confederal level involving representatives from different sectors. Studies show that 300 collective agreements include 'green clauses', demonstrating that trade unions have been mobilising on these issues for a number of years. At the policy level, the 2018–2022 Skills Investment Plan makes funds available to workers who qualify with respect to the green transition. The Climate and Resilience Law (Loi No. 2021-1104) contains a section on 'adapting employment to the ecological transition'. Among other things, this provides social and economic committees at the company level with new competences and resources in order to achieve ecological transition.

In Italy, unions have expressed concern about job losses, greater geographical divergence and lack of public and private investment in retraining. Employers, on the other hand, have called for more investment to support the implementation of green technologies and the strengthening of employment services to include green skills in training pathways. The 'jobs versus the environment' discussion remains alive in this debate.

As indicated above, in many countries, public employment services are tailoring their active labour market policies and training offers to the needs of the twin transition, focusing on the provision of training and work experience in relevant sectors and occupations. This is the focus of the debate in Luxembourg, where social partners do not consider the country to be at significant risk of job losses as a result of decarbonisation. The emphasis is instead on ensuring the continued skilling and upskilling of the workforce to meet the changing skills needs resulting from the green transition.

Portugal's National Energy and Climate Plan 2021–2030 anticipates, among other things, the promotion of vocational training in the energy efficiency sector (related to services, industry, energy generation and transport). The goal is to promote new strands of training to develop specialised technicians in the sector of energy efficiency and renewable energy and specialists in the field of green construction. The plan also includes anticipatory actions to prevent negative job impacts linked to decarbonisation.

Slovenia's public employment service is implementing a project supported by the climate change fund that aims to fund 200 unemployed individuals to be trained to enter green jobs. Employment subsidies will be provided to employers recruiting and supporting the training of such workers and subsequently providing them with permanent employment contracts.

Support for workers in the most impacted sectors and regions

Although in most countries social partners firmly support policy emphasis on the push towards a carbon-neutral economy to mitigate the threat posed by climate change and environmental degradation, in a number of countries some social partner organisations oppose the speed of the change and/or the detail of specific EU and national policy approaches. Such criticism primarily focuses on the negative implications of the nature or speed of change on employment. In these countries, which tend to be the most impacted

by the phasing out of coal-powered energy generation and the implications for heavy industry, the policy debate is often focused on the economic and employment implications of climate change policy, although this overarching debate is also taking place elsewhere.

For instance, Czech employers (more specifically, those represented by the Confederation of Industry of the Czech Republic (SPČR)) consider the climate goals set at the EU level to be too ambitious and unrealistic, and they demand that the country's degree of dependence on industrial sectors, which is particularly high, be taken into account during the transition to a green economy and that impact studies on the sectors in question be carried out before the relevant measures are introduced. In principle, trade unions share employers' concerns. In particular, the Trade Union of Agricultural and Alimentation Workers – Association of Free Trade Unions of the Czech Republic expresses a critical position towards EU plans to introduce the European Green Deal in agriculture due to concerns about the impact of its implementation.

In Slovakia, the debate on the green transition currently primarily focuses on the potentially negative impacts on employment in a country reliant on heavy industry. In Estonia, although supportive of the country's climate ambitions, sectoral social partners voiced criticism of the regional just transition plan for the Ida-Virumaa region, when, initially, only 60% of the funds were allocated to business development in the area. As a result of their feedback, 80% of resources are now dedicated to economic and entrepreneurship development, with the remaining 20% earmarked for investments in social, environmental and community-related activities. Social partners also called on the government to advance retraining opportunities for oil shale industry workers and to support the creation of jobs that pay a wage comparable to that earned in the oil shale industry (Eurofound, 2023d).

In a number of countries, trade unions have criticised delays in the adoption of territorial just transition plans as well as the perceived lack of focus on developing quality alternative employment strategies for those impacted by job losses. This is the case in Bulgaria.

The low level – or lack – of social partner involvement in the drafting of territorial just transition plans is also criticised in a number of countries. This specific issue is not covered here and is the subject of another Eurofound report (Eurofound, 2023d). Just to provide one example, in Finland, each sector has been tasked with creating a climate road map for carbon neutrality by 2035. The government programme states that the preparation of such road maps must be carried out on a tripartite basis. In its 2019 report on the impact of climate mitigation efforts on work and employees, the Central Organisation of Finnish Trade Unions (SAK) stated that it was positive that the government recognised the impacts climate change will have on working life and that a just transition was being prioritised. However, as employer organisations and business associations have taken the lead in the preparation of the sectoral road maps, SAK raises the importance of trade union consultation in order to ensure a just transition. In some sectors (for example, construction and transport), trade unions have been invited to participate in the preparation of the road maps by employer organisations, but this is not the case for all sectors.

In the debate on the reorientation of workers impacted by climate change policy – and just transition policies in particular – the importance of alternative job creation ensuring quality jobs is often mentioned. However, that such jobs will be of high quality is assumed rather than specific assessments or measures being presented to ensure this. In a limited number of countries, trade unions in particular have voiced specific demands that transition funding is limited to supporting organisations or measures that ensure the creation of jobs covered by collective agreements and respect for labour rights.

In both 2018 and 2021, the Greek National General Labour Agreement between the Greek General Confederation of Labour (GSEE) and employer organisations emphasised the importance of social partner participation in the preparation of just transition plans to ensure the retraining and redeployment of workers. The Economic and Social Council of Greece highlights the importance of paying attention to job quality as well as to overall employment and the quality of life impacts of the transition to a carbon-neutral economy. Greek unions have expressed concerns about what they perceive to be a rushed timetable for the transition from lignite mining in regions already impacted by high unemployment and a lack of consultation with and safeguarding of the workforce in the transition process (Liargovas et al, 2021). The GSEE, in its position on the national climate law, has stressed that respect for labour rights, protection of jobs and the creation of new, quality jobs should be at the heart of national climate change policy (GSEE, 2022). The Spanish national just transition strategy (Instituto para la Transición Justa, 2020) and just transition plans at the regional level also count among their goals the promotion of quality jobs. However, no specific policies are mentioned to create and sustain quality employment beyond the general emphasis on reskilling through active labour market policies and dual vocational training to provide new labour market entrants with the required skills for jobs in green sectors. Similarly, the Polish national just transition plan mentions the issue of job quality but does not provide any specific measures indicating how such quality in employment in the transition is to be ensured.

Several reports have been published suggesting solutions for workers affected by the phasing out of coal-fired power (see, for example, Szrop and Kierwa, 2018; Confederation Lewiatan, 2021; Sokolowski et al, 2021). All focus on reskilling, collaborating at the regional level and encouraging new business formation.

The German Trade Union Confederation (DGB) has long emphasised the need for green jobs to be 'good jobs' (DGB, 2012). It has called for the introduction of a 'transition fund', which would use government bonds to promote the introduction of new technologies for a climate-neutral economy. It states that such support should be granted only to companies ensuring co-determination and offering good pay and working conditions in line with collectively agreed standards, and job security (DGB, 2022). In line with existing practices in the context of significant restructuring, they have called for the use of regional tripartite transformation councils to ensure the transition is adequately planned and contributes to the retention or creation of good-quality jobs. The DGB has also called for co-determination rights of works councils to be broadened to ensure their participation in companies' climate protection efforts (DGB, 2022, 2023).

In 2019, the Irish government made a specific request to the National Economic and Social Council to identify steps that could be taken to address the vulnerability arising for workers, firms and sectors in relation to the transition to a low-carbon (and more digital and automated) future. The council highlighted the integral role of the state in implementing actions to achieve a high-quality jobs economy and proactively addressing employment vulnerability as part of a just transition. The council presented a framework of action to assist the state to manage the transition more effectively and fairly. It identified three drivers of a proactive, place-based response to vulnerability: delivering high-impact, targeted funding; continuous, pre-emptive workforce development; and building resilient enterprises. Particular emphasis has been placed on investing in the energy retrofitting of buildings, sustainable forestry and peatland restoration, and training the workforce to meet the demand for labour in relevant sectors. Nonetheless, the Services, Industrial, Professional and Technical Union (SIPTU) expressed concerns about existing climate change policies and highlighted the need for social partners to develop binding transition plans and strategies that offer new opportunities to employees and actively shape structural change (SIPTU, 2017). According to the Irish government:

> *[The Midlands region is the first in Ireland to] directly experience the negative impacts of the transition away from fossil fuels, with the ending of peat extraction for power generation, and this plan sets out a just transition implementation plan for this region. Under the national just transition fund, 56 projects in the Midlands region are being supported, with up to €22 million in committed grant funding until 2024, bringing €15 million in additional funding to the region and supporting an estimated 178 direct and 999 indirect jobs. The EU Just Transition Fund Programme will deliver an additional €169 million in investment to the region in the period to 2030.*
>
> (Government of Ireland, 2023)

There is a consensus that job quality and employment opportunities will improve with the emerging occupations and greened practices in the context of adaptation/mitigation and just transition policies.

The 2021 Portuguese Climate Framework Law (Law 98/2021) contains an article focusing on just transition, establishing that the state is to promote a just transition through the requalification of workers whose jobs are eliminated or significantly transformed by decarbonisation. It requires that the Economic and Social Council be consulted regarding the actions to be implemented. The territorial just transition plans for the most affected regions similarly emphasise retraining, together with support for entrepreneurship in line with the diversification of the economic base. Generally speaking, these measures do not include an explicit focus on job quality. The latter is at the heart of the campaign Jobs for the Climate (Empregos para o Clima). This campaign aims to create decent and socially useful jobs with fair working conditions. The campaign was launched in 2016 and has the support of the Climáximo association, with the involvement of several civil society organisations, such as trade unions (the General Confederation of Portuguese Workers (CGTP-IN) in particular), non-governmental organisations and environmental collectives. This national campaign is part of the Global Climate Jobs campaign that is in place in several countries. The campaign brings together the demands of the climate and labour movements by proposing massive public investment in the creation of jobs that meet the goals of decarbonisation, while ensuring good-quality jobs in terms of working conditions, health and safety and collective bargaining coverage. UGT also emphasises that green jobs should provide healthy, safe and decent working conditions and has called for an assessment of the risks arising in emerging sectors and tasks. The employer organisation the Confederation of Portuguese Business (CIP) has also spoken out in favour of ensuring a just transition through public support for retraining and redeployment and the close involvement of social partners in the formulation of relevant plans at the national, local and enterprise levels.

Climate change as a trigger for rethinking priorities

A number of examples were provided of policy debates linking the need to address the impact of climate change to the need for a broader reconsideration of economic and work–life balance policy strategies. While degrowth discussions remain politically marginal, effective circular economy strategies and their impact on managerial approaches and broader skills needs are becoming more mainstream, with many countries developing circular economy strategies and providing support for companies and non-governmental organisations in this sphere. Here, also, the main focus is on the impact on employment and the job creation potential within sectors rather than the quality of such jobs (beyond assumptions that it creates more 'sustainable' and 'meaningful' employment).

Remote working, reduced hours and the four-day week

In France, the debate on the need for climate change adaptation has reinvigorated interest in the four-day working week, with proposals from the Citizens' Climate Convention to reduce working hours to 28 hours per week without sacrificing pay. The reduction of working hours, without loss of pay, is proposed as a way of moving towards this new model.

In Ireland, there has also been increasing policy discussion around changing traditional modes of working in a way that would positively impact the environment and people's well-being. This includes discussions on the four-day working week and the right to request remote working.

Summary

Policy discussions at the national level regarding the impact of climate change and climate change policies on the labour market primarily focus on two areas: the implications of working in heat and the employment effects of the green transition on workers in carbon-intensive industries and the energy sector. Currently, there is no uniform approach to regulating work in heat, and support for workers affected by the energy transition occurs in a limited number of sectors. A clear assessment of the impact of climate change and climate change policies on the job quality of workers across different sectors is needed. Present strategies for creating green jobs assume they will be high quality, but evidence to support this claim is lacking.

6 Conclusions

Climate change will profoundly impact labour markets, working conditions and job quality, but research evidence remains patchy. The information presented in this report demonstrates the profound impact that climate change is set to have not only on our living conditions but also on Europe's labour markets, working conditions and job quality. Despite this, its implications, particularly for working conditions and job quality, are less researched and less well understood than is the case for other megatrends such as digitalisation and population ageing. This could be due to the more recent nature of the active policy debate in this area, resulting from the more dramatic evidence of the impact of climate change on the planet experienced in recent years. Another reason could be the complexity of the interactions of climate change and climate change adaptation, mitigation and just transition policies with other socioeconomic and political trends. Many workers will be more exposed to climate risks than the general population because their job is to work in situations where they are exposed to climate risks. Many workers will have their jobs and tasks profoundly changed by climate change and climate policies. A comprehensive research agenda should be developed, and changes will need to be monitored over time, as climate change is a dynamic process.

Some sectors, occupations and groups of workers are likely to be impacted more than others. The available literature, data from the EWCTS and contributions from the Network of Eurofound Correspondents do, nonetheless, provide some insights into the direct impact of climate change, as well as the impact of climate change policies, on job quality in different sectors, occupations and groups of workers. This demonstrates that, although efforts to green workplaces are likely to have some implications for the way we work across the board, some sectors and occupations – and as a result certain groups of workers – are likely to be impacted more and thus deserve more policy attention. An analysis based on EWCTS data shows that close to 40% of workers in the EU are in occupations that will be directly impacted by the green transition, either because of increased demand (15%) or the need for enhanced skills (14%) or because of the emergence of new occupational profiles (9%). These occupations are highly gendered, with more than 75% of impacted occupations being male dominated. New and emerging jobs show the most positive balance of low job demands and high resources, demonstrating the importance of policy support for the creation of more such jobs. Jobs that are likely to experience increased demand have higher job demands (such as physical risks and physical demands), while lacking job resources (such as social support, autonomy and access to training). Efforts should be made to improve the quality of these jobs and reduce the risks associated with them, particularly because they are also at a higher risk of climate change impacts, and, without action, the quality of these jobs will deteriorate.

One of the implications of climate change for jobs that has become evident following the heatwaves, flooding and widespread wildfires in recent years is a renewed emphasis on the valorisation of emergency service workers, their capacity to deal with increasing demand, their job quality and financial compensation packages. Many emergency workers are volunteers. Many workers will be exposed to the consequences of extreme weather events, as was the case with the recent flooding in Germany and the north of France. Providing temporary support to workers during periods of crisis will also be necessary.

The direct impact of climate change on job quality goes beyond exposure to heat. The implications for workers of direct climate change impacts such as rising temperatures, increased air pollution, greater exposure to UV radiation and higher frequency of extreme weather events are increasingly studied and have demonstrable impacts on physical and psychological health as well as productivity. At the greatest risk are workers in sectors and occupations characterised by a high degree of outdoor activity (for instance, agriculture, fisheries, forestry, horticulture, construction and tourism) and those working with heat-generating machinery. As well as being male dominated, these sectors have high shares of more vulnerable seasonal and migrant workers and self-employed people. These characteristics can serve to aggravate risk factors, as such workers may be less well protected by existing legislation and often have lower levels of trade union organisation and workplace representation.

Furthermore, many of these sectors face change as a direct impact of climate change because methods of production and service delivery need to be adapted to the implications of a warming environment and reduced biodiversity, which contributes to reduced job security and increased requirements for training, retraining or job transition (for example, due to a need to shift to producing different crops, to support effective access to training, to implement different methods of production or to adapt from outdoor tourism to a different type of activity).

The impact of measures to reduce the direct impact of climate change on workers can be positive or negative. Measures to reduce the direct impact of climate chance on workers could further impact working conditions and job quality negatively should they involve – for instance – moving to different shift patterns (more split shifts or more night work) or the use of new materials or chemicals to boost crop production. Other measures to reduce the risk of heat exposure, such as cooling technology – if not planned with sustainability in mind – could also serve to increase GHG emissions. Similarly, as demonstrated by the example of the horticulture sector in the Netherlands, efforts to reduce GHG emissions in production, while beneficial for the environment, can negatively impact working conditions and increase risks for workers. However, actions to limit the direct risks of climate change for workers can also contribute to positive change and improvements in job quality and address other issues in the labour market, such as labour shortages. For example, moving to more modular forms of construction can move some construction tasks indoors and make work processes less physical, and can therefore open up occupations to a more diverse workforce. Examples of such practices should be collected and disseminated.

Sectoral and occupational shifts will be significant in sectors contributing the most to GHG emissions, requiring participative just transition policies. Climate change adaptation policies can lead to increased demand in certain sectors and occupations. Climate change mitigation policies are set to contribute to significant sectoral shifts, particularly in the sectors contributing most to GHG emissions. Analysis of EWCTS data confirms that high shares of the workforces in some of these sectors are in occupations likely to be impacted by the green transition, either as a result of the emergence of new job profiles or because of increased overall demand or enhanced skills requirements. This is particularly true of the energy sector, in which the emphasis is on the transformation of the nature of energy supply (and conservation) and in which job quality is relatively high. Enhanced skills requirements, new and emerging jobs and increased demand are also likely to be implications for the construction and water and waste management sectors, where job quality is around or slightly below the EU average. Implications for the more diverse manufacturing sector are understandably more differentiated, and in agriculture, while there may be an increase in demand to sustain the security of food supplies, the implications for working conditions and GHG emissions are highly dependent on the nature of measures adopted to address the direct impact of climate change. In this sector, as well as in others likely to experience an increase in demand – particularly the public transport sector – job quality tends to be relatively low, however.

The implications of sectoral shifts for job quality and different groups of workers need to be better understood. While the analysis presented in this report provides a starting point to understanding the implications of climate change and climate change policy for job quality, more systematic research is required. As well as examining the occupational and task profile of growing versus declining occupations, research also needs to take into account the answers provided by companies and the nature of enterprise structures (and supply chains) in these companies, since these have demonstrable implications for the structure of employment contracts and employee voice.

Policies should move towards a level playing field in protecting workers from the adverse effects of climate change and supporting all impacted sectors. The risks posed by climate change are not new, but they are expected to grow in intensity and affect increasing numbers of workers. Despite the existence of EU-level framework regulations on OSH, no level playing field currently exists in relation to the protection of workers from risks directly associated with climate change. National-level provisions on working in heat vary significantly, and ongoing work is required to update regulations as new risks emerge linked to new materials and work processes.

The evidence shows that decarbonisation processes impact many sectors, going beyond energy production and heavy industry. While workers in these most impacted sectors should receive priority support for skills renewal and job-to-job transitions as certain forms of energy generation and production are phased out, more detailed analysis of the implications for other sectors is required, alongside the collaborative development of just transition policies to accompany mitigation strategies. In developing policies, more attention should be paid to the job quality implications of such transitions, and the aim should be to level up job quality, as envisaged by the European Pillar of Social Rights. The development of national and regional industrial strategies with associated ongoing skills forecasting and the design of relevant and experiential initial and ongoing training developed with the full participation of social partners have a critical role to play, particularly if skills and labour shortages are to be prevented from limiting progress towards decarbonisation. The analysis presented here has demonstrated that support for such new and emerging profiles can potentially positively impact job quality. Such holistic policy development also provides an opportunity to pay more attention to circular strategies and the improvement of living conditions as well as working conditions.

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Workers will experience the effects of climate change in many ways: job insecurity, changes to their work tasks and responsibilities, and changes in their workplaces that may involve different work practices and the development of new activities and products. Climate change risks are associated with increased exposure to hazards, leading to lower standards of job quality, productivity loss and greater job and work insecurity. Nearly half of workers in the EU will experience profound changes in their job tasks as economies adapt to climate change and climate mitigation strategies are implemented. In addition, work is likely to change as a result of company responses to climate change. These changes in work, while increasing the vulnerability of some workers, offer opportunities to improve some dimensions of job quality. This report outlines the complex relationship between job quality and climate change, including the implication of green tasks in selected sectors.

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