Impact of climate change on the quality of work

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1. Introduction

The study ‘Impact of climate change on the quality of work’ is focused on selected aspects of the impact of global warming on the quality of work in terms of health and safety, position on the labour market and competence of workers. The study covers the broad socio-economic context of the effects of climate change. The context is complemented by how the green economy transition can be ensured with regard to social justice, including the role of trade unions in this process.

The chapter ‘Socio-economic effects of climate change’ focuses on the context of climate change and economic activity in various sectors. It maps the effects on society in health, vulnerable population groups, employment and education. It describes the concept of green jobs and the manifestations of the transition to the green economy in employment and the labour market. It presents data and trends in the development of green jobs in the Czech Republic and the European Union.

The next part of the study, entitled ‘Quality of work in the context of green jobs’, deals with the risks that are emerging or gaining importance in connection with the expansion of green jobs. The study describes the risks of working in selected green sectors, such as wind energy, green building or energy storage. The chapter also deals with the specific topic of the impact of rising temperatures on the quality of work. The study presents data on the increasing number of summer and tropical days in the Czech Republic and describes the possibilities of adapting work processes so that high temperatures do not pose a threat to the health and safety of workers.

Chapter ‘Development of green competences as a way of ensuring the quality of work in a sustainable economy’ describes two key EU documents through which the European Union seeks to build the social pillar of the green transition. The first one is the ‘Proposal for a Council recommendation on ensuring a fair transition towards climate neutrality’. The second document focuses on the development of people’s competences needed to ensure the green transition, i.e. ‘Proposal for a Council recommendation on learning for environmental sustainability’.

Chapter ‘Attitudes, roles and activities of trade unions’ describes the relevant trade union agendas in the fair (just) transition at the macro and micro levels. The first of the levels represents, inter alia, the formulation of jobs and trade unions’ recommendations on the social dimension of just transition. The micro level is represented by specific activities of trade unions at local level. Examples of these activities are presented in the chapter and illustrated in the appendices to the study. Furthermore, the chapter describes the attitudes of employees to the need for climate action at the level of employers in which employees work or are interested in working.

2. Summary of main findings

Global warming is increasingly interfering with the functioning of human civilisation. Various risks increase with increasing temperature. Besides the threat to nature and territory, there are also increasing risks to entrepreneurship and to the everyday life of society. Trade unions perceive the risks and accept the need for a green transition of the economy so that it produces fewer greenhouse gases, switches to circular economy, protects natural resources and biodiversity. Trade unions as an active participant in social dialogue emphasise the **social pillar of the green transition** to make this process a **just** transition in which no one is left out. Trade unions try to eliminate the negative effects of the green transition on four areas of society: **health**, **vulnerable population groups**, **employment** and **education**.

Regarding occupational health and safety, it is important to monitor the new and increasing **risks associated with green jobs** (jobs that are crucial to ensure the green transition). Trade unions can focus on the risks to the quality of work identified in the areas of wind energy, green building, bioenergy, waste management and recycling, green transport, green manufacturing, robotics and automation, domestic and small-scale renewable energy, batteries and energy storage and energy transmission and distribution.

An increasingly important cross-cutting issue in health protection is the prevention of risks to work resulting from **high temperatures at work**. Trade unions in the Czech Republic can produce relevant information and manuals in this area for representatives of trade unions at the corporate level to raise awareness of appropriate measures for the prevention of risks of working in high temperatures. They can draw practical inspiration from the already available methodology of the Occupational Safety Research Institute and from manuals prepared by foreign trade unions, for example.

Trade unions pay increased attention to the **groups of workers** who are **most at risk** in the context of climate change. These include residents of low-income urban areas with poorly developed infrastructure, population groups with lower incomes and assets in general, women, the unemployed and socially marginalised, older generations of workers

and migrants. Agriculture, conventional energy, heavy industry and manufacturing, transport and construction can be identified as the **most vulnerable sectors** in terms of the effects of climate change on the workforce. In terms of employment, it is essential that some carbon-intensive sectors (e.g. coal mining, metallurgy, etc.) are actively subdued in favour of new, green sectors. Furthermore, some sectors of the economy are vulnerable due to their dependence on normal weather conditions. This can affect performance in sectors such as agriculture and tourism.

Finally, it is crucial in education that **public and private actors work together to develop and strengthen green competences** applicable in the transformed labour market. It is also important for trade unions at the European level that **employers** accept a key role in training, re-skilling and up-skilling of workers as part of the green transition. This will allow a **smooth transition** from one job to another when changing qualifications, without creating a period of unemployment. Green competence growth policies within the initial training should support the **adaptation of vocational education and training programmes towards green skills**. In addition to initial training, education policies must also pay adequate attention to the **education of adults, especially employees**. Green competences must be **particularised**.

According to European trade unions, it is further necessary to ensure procedures for **anticipating the necessary green skills** and an adequate **role of trade unions in forecasting** and developing **impact strategies** at **regional** and **sectoral level.** Similarly, it is important to **update job profiles and qualifications** according to the evolution of the green labour market. Trade unions require that there be a **guarantee of the right** to training, re-skilling and up-skilling of employees. **A special item in the national budget** should be earmarked for employee **skills verification** systems. Only seven countries in the EU have such a system; the Czech Republic is not among them.

In promoting sustainability in the corporate environment, trade unions can rely on the growing **interest of employees in the green agenda** of their employers. Potential employer's attitude to sustainability is important for approximately a quarter of job seekers

and the same share of employees (most often up to 34 years of age) think about changing employer and finding a job with an organisation with a better attitude to sustainability.

Trade unions can thus find new **impulses for** their **further development and securing their future in the green agenda.** At the micro level, trade unions are already engaged in **negotiating green clauses** in trade and investment agreements, establishing **trade unions** in **new sectors** (e.g. circular economy or solar energy) or in **joint initiatives** with environmental organisations in defining green programmes at the local level, e.g. to obtain sufficient funds for re-skilling. SEV (Siemens Energy Ventures) is an inspiring example of employee involvement in the green transition of the company, i.e. programmes led by Siemens Energy employees to develop opportunities for providing sustainable, reliable and affordable energy. Czech trade unions can also draw inspiration from other examples of good practice, such as the **guidance of the British Trades Union Congress (TUC)** on the issue of high working temperatures and on the issue of skin cancer and outdoor workers. These guidances are designed as a basic information tool used by representatives of trade unions in occupational safety and health.

3. Socio-economic effects of climate change

There are diverse, not always completely identical approaches to the typology of the effects of climate change. In addition to the impacts on nature and landscape, risks affecting economic activities and the quality of society are significant for trade unions. The study focuses in detail on economy (the effects of climate change on enterprises) and on the social context of climate change. Global warming affects the health of society, especially of vulnerable population groups. It also strongly affects education and employment. The green transition of various sectors of the economy significantly changes the labour market. New, so-called green jobs are being created and many traditional jobs are changing.

3.1. Impacts of climate change on business

The European Commission describes the negative impacts of climate change on business,[1] perceiving risks in the following areas:

- **Infrastructure and buildings**

The consequences of climate change relate to infrastructure and buildings primarily because of their long service life, high initial costs and key importance for the functioning of societies and the economy.

Buildings and infrastructure are at risk due to their structure (not strong enough to withstand storms) or location (e.g. in areas prone to floods, landslides or avalanches). Damage or decommissioning can occur as a result of changing weather conditions or extreme weather phenomena such as: rising sea levels, extreme rainfall and flooding, extremely low or high temperatures, heavy snowfall, strong winds, etc. For example, damage caused by rain and flooding in Slovenia (2023) caused total damage, including

[1]EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

houses and infrastructure, amounting to €5 billion. This corresponds to 1/3 of the Slovenian state budget or 8% of the Slovenian GDP.2

- **Energy**

Climate change already poses a threat to the energy system. This risk is expected to keep increasing. Climate change will lead to reduced heating demand in northern and northwestern Europe. It will significantly increase the demand for electricity needed for cooling in southern Europe, which may further increase the demand for electricity in the hot summer months.

More intense and more frequent heat waves will change energy supply and demand, often in opposite directions. Temperature rise and droughts may limit the availability of water for cooling in the production of thermal energy in the summer and the demand for air conditioning will grow.

Moreover, a great range and frequency of extreme weather phenomena will threaten physical energy infrastructure: overhead transmission and distribution lines, but also substations or transformers. Climate change also brings increased uncertainty in terms of weather conditions. This has a direct negative impact on renewable energy production in the long term. Examples are less sunshine and wind in usually warm and dry areas, affecting the growth of crops for producing energy from biomass.3

- **Agriculture**

Climate change negatively affects European agriculture due to increased temperatures, droughts, floods, pests, diseases or the declining health of land resources. This trend will extend throughout the 21st century. There will be significant losses in agricultural production (lower crop yields) and the loss of areas suitable for growing crops due to high

[2] EURACTIV. Flood damage in Slovenia estimated at €5 billion. Online. 2023. Dostupné z: https://www.euractiv.com/section/politics/news/flood-damage-in-slovenia-estimated-at-e5-billion/. [cit. 2024-04-10].

[3] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

temperatures and lack of water. High temperatures in northern Europe may create conditions for thermophilic plants, but these yields will not offset losses in other regions.4

- **Forestry**

Forests are affected by increased risk of drought, storms, fires, pests and diseases due to climate change. This is reflected in the deteriorated health of forests. For example, the total spruce infestation by bark beetle in the Czech Republic in 2020 alone amounted to at least 25 million cubic metres of wood because of the trees are weakened by drought.5 But drought poses a risk for many tree species. For example, there is an increase in dead fir or ash trees as a result of drought and drought stress in the Czech Republic.6

There will be a change in the biodiversity of European forests because climate change threatens in particular those animal and plant species that depend on highly specific weather and environmental conditions.

Decreasing rainfall in southern Europe will probably cause a loss of forest cover. In addition, wildfires are more common in southern regions, which has a major impact on already damaged ecosystems. The situation is expected to deteriorate further as a result of longer and more severe periods of fires.7

- **Insurance**

According to forecasts, the frequency and intensity of most types of extreme weather phenomena will change significantly as a result of climate change. Taking into account the basic trend on an ongoing basis, premiums will gradually increase in the short term

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[4] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

[5]VÝZKUMNÝ ÚSTAV LESNÍHO HOSPODÁŘSTVÍ A MYSLIVOSTI. Kůrovcová kalamita v roce 2020 a výhled na rok 2021. Online. 2021. Dostupné z: https://www.vulhm.cz/kurovcova-kalamita-v-roce-2020-a-vyhled-na-rok-2021/. [cit. 2024-04-10].

[6]VÝZKUMNÝ ÚSTAV LESNÍHO HOSPODÁŘSTVÍ A MYSLIVOSTI. Vrchol kůrovcové kalamity je možná za námi. Online. 2022. Dostupné z: https://www.vulhm.cz/vrchol-kurovcove-kalamity-je-mozna-za-nami-2/. [cit. 2024-04-10].

[7] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

and the insurance market will absorb these changes rather easily. However, the knowledge of the risk is often improved ‘in stages’. This can lead to a jump in prices over a short period of time. Climate change in the long term, especially in the most vulnerable sectors or areas, may indirectly increase social disparities because premiums will become inaccessible to part of the population.

- **Tourism**

There can be significant economic effects of climate change on regions dependent on tourism. Southern Europe’s attractiveness in terms of tourism will decrease significantly during the crucial summer months but will grow in other seasons. In the case of Central Europe, its attractiveness for tourists is expected to increase over the course of the year. The projected loss of snow cover in many regions will negatively affect the winter sports industry.8

For example, a study of 2,234 ski resorts in 28 European countries found that 53% of the ski resorts will suffer from a lack of snow with a global warming of 2°C (98% with a warming of 4°C). The ski resorts at lower altitudes would be most at risk in this scenario. Those in higher altitudes could survive, but they will become more inaccessible and exclusive.9

- **Problematic cross-cutting aspects**

Climate change is a risk for all businesses as it affects the situation across the planet. But some businesses are more vulnerable than others. SMEs are expected to be disproportionately affected by the impacts, especially in areas such as business

[8] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

[9] FRANCOIS, Hugues a , a kol. Climate change exacerbates snow-water-energy challenges for European ski tourism. Online. Nature Climate Change. Dostupné z: https://www.nature.com/articles/s41558-023-01759-5. [cit. 2024-04-10].

disruption, property damage, supply chain and infrastructure disruptions. This will lead to higher maintenance and material costs and higher prices.10

3.2. Impacts of climate change on society

According to the European Bank for Reconstruction and Development (EBRD), there are five main social impacts of environmental transition:[11]

- **Fair transition:** just environmental transition is crucial for maintaining public support to achieve zero net greenhouse gas emissions in the economy, i.e. that the transition provides decent and well-paid jobs to all workers, regardless of their level of qualification or origin.
- There is a **high demand for professional green skills**, which is a benefit for rather highly skilled individuals in sectors with lower carbon emissions.
- Worker **mobility** between sectors and jobs **remains low due to the cost** of change and up-skilling, despite the possibility of higher wages.
- **Workers are replace**d by new green technologies **less** than by other technologies on average.
- The transition to green technologies has the potential to progress **faster** than the transition to information and communication technologies.

The European Commission recognises four main types of negative effects of climate change in the social field, namely **health, vulnerable population groups, employment and education**.[12] These four areas of social impact are analysed in more detail in the following text.

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[10] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

[11]EVROPSKÁ BANKA PRO OBNOVU A ROZVOJ. Transition report 2023-24: Transitions big and small. Online. 1. London: EBRD, 2023. ISBN 978-1-898802-55-6. Dostupné z: https://www.ebrd.com/news/publications/transition-report/transition-report-202324.html. [cit. 2024-04-10].

[12] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

- **Health**

Climate change poses a significant threat to human health. The changing climate will not necessarily create entirely new (unknown) health threats, rather the existing effects will become worse and more pronounced than is apparent now. The most significant impacts of future climate change on health include:

  - higher mortality and sickness rate in the summer due to heat;
  - reduction of mortality and sickness rate in the winter related to frost;
  - increase in the risk of accidents and impact of extreme weather phenomena (floods, fires and storms) on living conditions;
  - changes in the impact of diseases, e.g. vector- (ticks, mosquitoes, black flies), rodent-, water- or food-borne diseases;
  - changes in the seasonal distribution of certain types of allergenic pollen, the prevalence of viruses, pests and diseases;
  - emerging and re-emerging animal diseases that pose a danger to animal and human health;
  - emerging and re-emerging plant pests (insects, pathogens and other pests) and diseases affecting forest and plant systems;
  - risks related to changes in air quality and ozone.[13]

- **Vulnerable population groups**

In the context of climate change, the European Commission considers the following to be vulnerable population groups:

  - *Residents of low-income urban areas with poorly developed infrastructure and, in general*, *population groups with lower incomes and assets*: these people are more exposed to the effects of climate change than others because they do not have free resources to face climate change.

[13] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

- *Women* are disproportionately more affected by climate change than men. They are also disadvantaged when expensive adaptation measures need to be put in place. However, they are also the key actors in adapting to climate change and implementing more generally sustainable practices.
- *Unemployed* and *socially marginalised people.*
- *Older generations* are disproportionately affected by reduced mobility and health barriers; Europe's population is ageing and an increasing share of the continent's population will thus be particularly vulnerable to the effects of climate change.
- *Migrants.* Climate change has already been reflected in displacement and migration. People in countries affected by climate change are often highly dependent on natural environment, while having the least resources to combat changing climate conditions.[14]

- **Employment**

The productivity and resilience of all sectors of the economy, with related consequences for the (sectoral) labour market, will be affected by various manifestations of global warming, such as the effect of increasing temperature or changes in precipitation regimes.

Climate change can affect the availability of the workforce, for example by causing a deterioration in population health or by causing other limitations in health at work (higher temperature at work, more frequent and intense natural hazards preventing people from getting to their workplace, etc.).

Some sectors of the economy are vulnerable due to their dependence on normal weather conditions. This can affect performance in sectors such as agriculture and tourism.

[14] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

Significant investments in adapting to climate change can bring job opportunities and new sources of income, for example in areas such as construction and (green) infrastructure, water management or the relocation of people from vulnerable zones. However, the effects of these investments in terms of job creation are difficult to estimate, especially because it is necessary to increase staff skills to make use of these opportunities.[15]

- **Education**

Increasing resilience to climate change and implementing adaptation measures are not the task and responsibility of only the executive. The severity of climate change requires public and private actors to cooperate to reduce vulnerability and adapt to the effects of climate change. But not all stakeholders are aware of their vulnerability. They often may not have a detailed picture of what measures to take to actively respond to climate change. Therefore, education and awareness are an important part of adaptation to climate change. They lead to society coping with these effects and impacts, increasing its adaptation capacity and reducing society's overall vulnerability to the effects of climate change.[16]

3.3. Employment and the labour market in the context of green transition

Working environment is constantly changing in connection with the introduction of new technologies, substances and work procedures, changes in the structure of the workforce and the labour market and new forms of employment and work organisation. The green transition means, among other things, that traditional sectors of the economy are being transformed towards circular, low-carbon production, with greater respect for resource

[15] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

[16] EVROPSKÁ KOMISE. Důsledky změny klimatu. Online. Dostupné z: https://climate.ec.europa.eu/climate-change/consequences-climate-change_cs. [cit. 2024-04-10].

use and biodiversity protection. New production and service trends are emerging in the green economy. New green technologies are transforming existing jobs or creating new, green jobs.

Regarding the effects of climate change on the global labour market, climate change poses a threat to about 800 million jobs, i.e. about one quarter of the current workforce, according to the '*Work Toward Net Zero*'17 study by Deloitte. On the other hand, the absence of a societal response to climate change can generate global economic losses of US$178 trillion (measured at present value) by 2070. The Deloitte model shows that more than 300 million additional jobs can be created worldwide by 2050, of which 21 million in Europe, by making use of the opportunity of decarbonisation and ensuring a fair green transition for all. Proactive transition combined with adequate political support from governments means more jobs and better results for workers globally compared to a passive, uncoordinated transition to net zero. According to Deloitte, a coordinated response to climate change can increase the world economy by $43 trillion (by 2070; expressed in the current value of the US dollar)[18].

Deloitte mapped current skills and found out that there are already 80% of the skills needed to achieve climate neutrality in the short to medium term. This means that most current workers are likely to need only up-skilling (e.g. training at the workplace) rather than re-skilling to keep their current job or to get a new job as a result of decarbonisation.

[17]DELOITTE. Work toward net zero. Online. 2022. Dostupné z: https://www.deloitte.com/global/en/issues/climate/work-toward-net-zero.html?id=gx:2el:3pr:4work_toward_net_zero:5GC1000045:6abt:20221101:gc1000136. [cit. 2024-04-10].

[18] DELOITTE. Work toward net zero. Online. 2022. Dostupné z: https://www.deloitte.com/global/en/issues/climate/work-toward-net-zero.html?id=gx:2el:3pr:4work_toward_net_zero:5GC1000045:6abt:20221101:gc1000136. [cit. 2024-04-10].

3.3.1. Green jobs

There are many definitions of green jobs, reflecting the needs for which each definition was created. One of the most frequently cited definitions was introduced by the United Nations Environment Programme (UNEP) in 2008:

> '*We define green jobs as work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonise the economy; and minimise or altogether avoid generation of all forms of waste and pollution*.'[19]

The European Commission presented its own broad definition of green jobs in 2012, which it considers complementary to the UN definition:

> '*(European Commission) understands 'green jobs' as covering all jobs that depend on the environment or are created, substituted or redefined (in terms of skills sets, work methods, profiles greened, etc.) in the transition process towards a greener economy.'*[20]

For the purpose of assessing the impact of the green transition on the labour market, the European Commission recognises 3 types of jobs[21]:

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[19]UN ENVIRONMENT PROGRAMME. Green Jobs: Towards Sustainable Work in a Low-Carbon World. Online. 2008. Dostupné z: https://www.unep.org/resources/report/green-jobs-towards-sustainable-work-low-carbon-world. [cit. 2024-04-10].

[20]EVROPSKÁ KOMISE. Exploiting the employment potential of green growth. Online. 2012. Dostupné z: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2012:0092:FIN:EN:PDF. [cit. 2024-04-10].

[21]EVROPSKÁ KOMISE. The Possible Implications of the Green Transition for the EU Labour Market. Online. 2022. Dostupné z: https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf. [cit. 2024-04-10].

- **Green jobs**: include work tasks aimed at reducing the impact of economic activities on the environment, from waste recycling to research and development in green innovation. The number of these jobs is expected to grow and to have, on average, higher qualification requirements than other jobs.
- **Brown jobs**: they include activities with high pollution (e.g. mining, manufacturing, agriculture). These jobs will face a decline in labour demand (and even discontinuation in some cases, such as hard coal and lignite mining) or significant structural changes related to the greening of these sectors.
- **White jobs**: have a relatively neutral impact on the environment. Only slight changes in the content of tasks are expected here, related to the extensive greening of activities. Some white jobs may experience an increase in labour demand due to the green transition, although these are not directly green tasks.

3.3.2. Impacts of the green transition on employment and the labour market

Accelerated obsolescence of certain technologies and products will affect the structure of labour demand. It can lead to the obsolescence of some jobs and human capital. The available estimates indicate only minor and transitory effects of environmental policy (especially decarbonisation policy) on employment. This is because people working in these sectors may find work in other sectors even though some sectors may be negatively affected. If the potential workforce at input is measured as the number of people who are ready and able to work, the impact of the green transition on potential employment is ultimately equal to the number of people who leave or enter the labour market (if at all) as a result of structural economic change. A smooth green transition of the labour market will thus depend fundamentally on how easily workers from obsolete sectors can reintegrate into other sectors (jobs) and on the ability of employment policies to support people during possible unemployment in re-skilling and finding new jobs.[22]

[22]EVROPSKÁ KOMISE. The Possible Implications of the Green Transition for the EU Labour Market. Online. 2022. Dostupné z: https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf. [cit. 2024-04-10].

Estimates of the global effects of climate change on individual segments of the economy may vary according to the methodological approaches of each author. For example, the '*Work Toward Net Zero*'[23] study by Deloitte considers the following to be the most vulnerable sectors in terms of the effects of climate change on the workforce:

- agriculture;
- conventional energy;
- heavy industry and manufacturing;
- transport;
- construction.

Estimates of the impact of the green transition on the European labour market vary slightly.

- The 'Fit for 55' impact assessment study foresees employment growth in the EU by 2030 from -0.3% to 0.5%. With the right accompanying measures in place, such as the recirculation of carbon tax revenue that is favourable to employment, the green transition could create around 1 million jobs in the EU by 2030 (i.e. 0.5% of current employment) and around 2 million jobs by 2050 (i.e. 1% of current employment) – including semi-skilled and medium-paying jobs in the energy and construction sectors. However, the impact will vary from country to country and from sector to sector.[24]

[23] DELOITTE. Work toward net zero. Online. 2022. Dostupné z: https://www.deloitte.com/global/en/issues/climate/work-toward-net-zero.html?id=gx:2el:3pr:4work_toward_net_zero:5GC1000045:6abt:20221101:gc1000136. [cit. 2024-04-10].

[24] ASIKAINEN, T., BITAT, A., BOL, E., CZAKO, V., MARMIER, A., MUENCH, S., MURAUSKAITE-BULL, I., SCAPOLO, F., STOERMER, E. The future of jobs is green, EUR 30867 EN, Publications Office of the European Union, Luxembourg, 2021. ISBN 978-92-76-42571-7. [cit. 2024-04-10].

- The European Centre for the Development of Vocational Training (CEDEFOP) forecasts an increase in employment by 1.2% by 2030 in connection with the implementation of the European Green Deal.[25]
- Niggli and Rutzer made a study on the manufacturing sector in 19 EU countries for the years 1992 to 2010 and found that although the environmental policy stringency (EPS, according to the OECD methodology[26]) almost tripled during that period, its effect on total employment was insignificant. But they recorded shifts between jobs with low and high environmental potential.[27]

The small effect of the green transition on total employment can be explained by the fact that most jobs in the EU are in the white sectors producing little CO_2 emissions. Activities such as electricity generation, transport, manufacturing, agriculture and mining together account for around 90% of all CO_2 emissions in the EU, but less than 25% of employment.[28]

While the impact of the green transition on total employment is relatively small, another picture offers a closer look at individual sectors, jobs and work activities. According to the European Commission, there are chiefly shifts between sectors and enterprises with high and low pollution levels and changes in the professional structure and qualification requirements[29], which is reflected in the following manner in the three categories of jobs (green, brown, white):

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[25] CEDEFOP. The green employment and skills transformation: Insights from a European Green Deal skills forecast scenario. Online. 2021. Dostupné z: https://www.cedefop.europa.eu/en/publications/4206. [cit. 2024-04-10].

[26]OECD. How stringent are environmental policies? Policy perspectives. Online. OECD. 2016. Dostupné z: https://www.oecd.org/economy/greeneco/How-stringent-are-environmental-policies.pdf. [cit. 2024-04-10].

[27] NIGGLI, M., RUTZER, C. Environmental policy and heterogeneous labor market effects: evidence from Europe. WWZ Working paper 2020/09. 2021. University of Basel.

[28] EVROPSKÁ KOMISE. Employment and social developments in Europe 2019 – Chapter 5: Towards a greener future: employment and social impacts of climate change policies. Online. 2019. Dostupné z: https://op.europa.eu/en/publication-detail/-/publication/747fefa1-d085-11e9-b4bf-01aa75ed71a1/language-en.. [cit. 2024-04-10].

[29] HOFMANN, C., STRIETSKA-ILINA, O. Greener Skills and Jobs. OECD Publishing. Online. 2014. https://doi.org/10.1787/9789264208704-en. [cit. 2024-04-10].

- First, the green transition leads to the creation of new green jobs, i.e. jobs that reduce the environmental impact of economic activity, such as the renovation of buildings to increase their energy efficiency or research and development of green innovation.
- Second, brown jobs are likely to be under pressure or at least experience a significant change at the workplace. The most significant example of activities to be completely discontinued in the medium term is the extraction of hard coal and lignite. Moreover, it is unlikely that all brown jobs will be phased out as the green transition may still require certain inputs from sectors such as metal mining, chemical production and metal production.[30]
- Third, the green transition is expected to affect a significant share of white jobs through the adoption of more environment-friendly working procedures. The green transition takes place not only by shifting jobs towards greener activities and moving away from brown activities, but also (and probably to an even greater extent) by 'greening' and reducing emissions in existing activities. Research suggests that most people work in environmentally neutral white jobs. They are expected to undergo only certain changes at the task level as manufacturing processes are becoming green.[31] In addition, some white jobs could grow as a result of the green transition (e.g. bus drivers if demand for public transport grows), even if they cannot be directly classified as green jobs.[32]

The European Commission describes other impacts of the green transition on employment:

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[30] MEZINÁRODNÍ MĚNOVÝ FOND. World Economic Outlook April 2022 – Chapter 3: A Greener Labor Market: Employment, Policies, and Economic Transformation. Online. 2022. Dostupné z: https://www.elibrary.imf.org/view/book/9781616359423/9781616359423.xml. [cit. 2024-04-10].

[31] COPELAND, B.R., SHAPIRO, J.S., TAYLOR, M.S. Globalization and the environment. Handbook of International Economics: International Trade. 2022. Handbook of International Economics, Volume 5, Elsevier: 61-146.

[32] BOWEN, A., HANCKÉ, B. (2019). The Social Dimensions of 'Greening the Economy. European Commission and LSE Consulting. Online. 2019. Dostupné z: https://op.europa.eu/en/publication-detail/-/publication/24c67b4c-3293-11ea-ba6e-01aa75ed71a1/language-en [cit. 2024-04-10].

- Impacts of the green economy on the labour market will be uneven and they can also have significant economic effects on related sectors and support services at local level. Highly polluting sectors will undergo a strong structural transformation and/or production will be (partially) discontinued at the sectoral level. Contrarily, there will be a potential significant increase in jobs in green sectors. The geographical distribution of green jobs is usually more dispersed; on the contrary, regions with a currently high concentration of brown jobs may be disproportionately affected by the decline in employment. Removal of brown jobs is likely to affect semi-skilled men who are already at risk of losing their jobs as a result of digitalisation and gradual deroutinisation of work.
- The green transition may negatively affect total employment if labour market frictions hinder the redistribution of labour. If new jobs are in other regions or if they require significantly different skills, it will be more difficult for the dismissed workers to move to new posts. They may be forced to migrate to other areas or face long-term loss of earnings. The share of workforce directly related to the phasing out of certain activities, such as hard coal and lignite mining, is relatively small on a European or national scale. However, the impact could be significant at the local level.
- Experience shows that political support will be needed to:
    - help workers with a smooth transition to new jobs;
    - diversify the economy towards less polluting activities and prevent any job losses from translating into structural unemployment and deterioration of social cohesion.

Provided effective policy measures are in place, it would thus be possible to limit the negative effects of job decline on certain groups and regions.[33]

[33]EVROPSKÁ KOMISE. The Possible Implications of the Green Transition for the EU Labour Market. Online. 2022. Dostupné z: https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf. [cit. 2024-04-10].

3.3.3. State and development of green jobs in the EU and the Czech Republic

It is complicated to get an accurate overview of the state and development of green jobs. It depends mainly on the availability of relevant data, which are however largely limited. As Bowen and Hancké (2019) state[34], '*Green jobs are an elusive concept in the academic and policy literature'*.

Researchers examine various environmental parameters of jobs to obtain estimates. The estimates differ from each other depending on the chosen approach. The most common method of measuring green jobs is the use of O*NET – a US database of occupations and worker attributes, for which a methodology for marking skills related to the green transition was developed in 2009. However, the transfer of information from O*NET to data for EU countries is not trouble-free. The main complication is that green jobs usually refer to relatively small professional groups that need to be identified at a more detailed level than the current data collection of the European Statistical Office (Eurostat) allows.[35]

Eurostat at least gives a classification of employment in 'environmental goods and services' in various economic activities based on data from national accounts. The Czech Republic is approximately in the middle of the ranking of EU countries and its values are very close to the EU average. The share of people employed in environmental goods and services in total employment in the Czech Republic has been increasing in recent years. While it was 2.28% in 2016, it was 2.81% five years later. The number of employees (full-time equivalent – FTE) in environmental goods and services in the Czech Republic increased by thirty thousand between 2016 and 2021 – from 120,000 to more than 150,000 employees.

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[34] BOWEN, A., HANCKÉ, B. (2019). The Social Dimensions of 'Greening the Economy. European Commission and LSE Consulting. Online. 2019. Dostupné z: https://op.europa.eu/en/publication-detail/-/publication/24c67b4c-3293-11ea-ba6e-01aa75ed71a1/language-en [cit. 2024-04-10].

[35] VONA, F., Labour Markets and the Green Transition: a practitioner's guide to the task-based approach, Biagi, F. and Bitat, A. editor(s), Publications Office of the European Union, Luxembourg. Online. 2021, ISBN 978-92-76-42260-0. dostupné z: https://publications.jrc.ec.europa.eu/repository/handle/JRC126681 [cit. 2024-04-10].

The following table shows the development of the share of employment in environmental goods and services in total employment in the EU.

Table 1: Share of employment in environmental goods and services in total employment (%, EU countries, 2016-2021)

Country/Year	2016	2017	2018	2019	2020	2021
EU 27	2.23	2.21	2.22	2.31	2.45	n.a.
Belgium	1.44	1.46	1.52	1.55	1.52	1.56
Bulgaria	1.24	1.31	1.42	1.79	1.90	1.97
CR	**2.28**	**2.24**	**2.29**	**2.33**	**2.63**	**2.81**
Denmark	2.63	2.72	2.74	2.69	2.75	2.81
Germany	1.27	1.31	1.40	1.45	1.48	1.58
Estonia	5.14	4.78	4.54	4.76	5.73	5.03
Ireland	1.54	1.75	1.88	1.86	1.93	1.69
Greece	1.31	1.52	1.73	1.83	1.75	1.78
Spain	1.96	1.94	2.16	2.12	2.37	2.53
France	3.13	3.23	3.31	3.39	3.41	3.66
Croatia	2.35	2.34	2.32	2.30	2.30	2.46
Italy	2.43	2.45	2.46	2.53	2.42	3.66
Cyprus	n.a.	n.a.	2.67	2.73	2.33	2.64
Latvia	2.96	3.01	2.67	2.72	2.79	2.81
Lithuania	2.88	3.20	3.12	3.49	3.36	3.80
Luxembourg	3.10	3.40	3.70	4.16	4.60	5.37
Hungary	n.a.	1.04	0.96	0.99	1.00	0.91
Malta	1.79	1.89	1.65	1.64	1.52	1.49
Netherlands	1.60	1.66	1.70	1.79	1.93	1.93
Austria	3.96	4.04	4.27	4.35	4.47	4.52
Poland	1.32	1.37	1.51	1.73	1.77	1.83
Portugal	2.12	2.16	2.18	2.20	2.40	2.62
Romania	1.67	1.63	1.74	1.78	1.75	1.61
Slovenia	2.76	2.99	3.03	2.89	2.90	2.87
Slovakia	n.a.	n.a.	1.37	1.41	1.92	2.07
Finland	5.46	5.45	4.47	4.70	4.73	4.69
Sweden	2.72	2.82	2.94	3.01	3.07	3.18

Source: Eurostat (2024), TREXIMA calculations

The data show that the high dynamics of employment growth in environmental goods and services occurred in the Czech Republic in 2020 and 2021 (more recent data were not available at the time of this study). The share rose to almost three percent in 2021, equalling Denmark and significantly surpassing countries such as Germany or the Netherlands. The lowest value in 2021 was detected in Hungary (0.9%), Malta (1.5%) and Belgium with Germany (almost 1.6%). On the other hand, the highest share of employment in environmental goods and services in 2021 was recorded in Luxembourg (5.4%), Estonia (5%) and Finland (4.7%). Regarding the neighbouring countries of the Czech Republic, Austria has the highest share (4.5%).

The development of the number of jobs in environmental goods and services in the Czech Republic from 2014 to 2021 is shown in the following table.

Table 2: FTE in environmental goods and services and the share of the sector in total employment in the Czech Republic (2014-2021)

Year	FTE	Share in total employment (%)
2014	120,952	2.36
2015	120,686	2.33
2016	120,018	2.28
2017	119,897	2.24
2018	124,028	2.29
2019	126,560	2.33
2020	140,287	2.63
2021	150,744	2.81

Source: Eurostat (2024), TREXIMA calculations

3.3.4. State, development and specifics of brown jobs and sectors in the EU and the Czech Republic

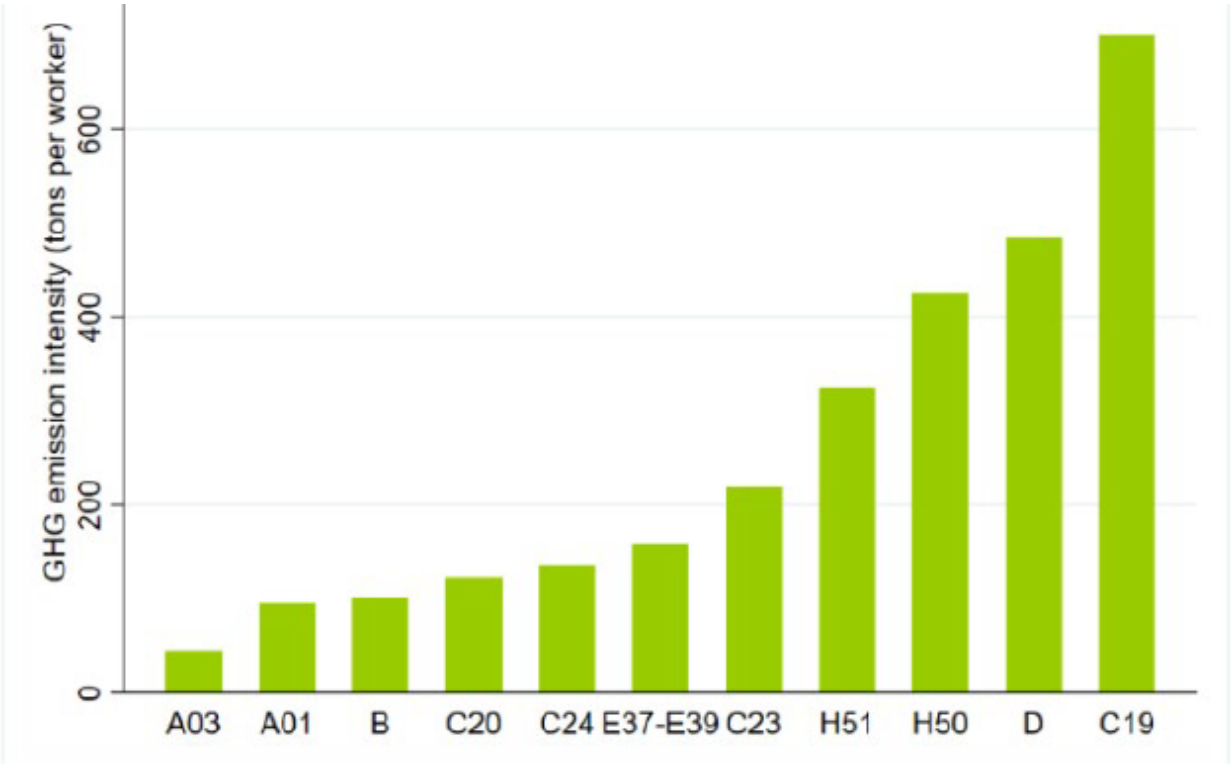
Brown jobs will be affected by changes in business due to the green transition the most. There will be a direct decrease in labour demand or a significant structural transformation towards more environment-friendly manufacturing processes. Keeping a better track of where the main costs of adaptation will fall helps policy makers to anticipate losses and

propose targeted policies to address these costs. In this context, brown jobs are jobs in highly polluting sectors.[36]

A data-based method is used as the standard for identifying brown activities. Data from ESTAT air emissions accounts (AEA) by economic activity are combined with data on employment from the European labour force survey (LFS) to determine the greenhouse gas (GHG) emission intensity per worker (kg per worker). While the level of GHG emissions per worker varies significantly among the Member States, the sector ranking is relatively stable. Sectors that are most often in the foreground based on the GHG emission intensity are considered brown. The green transition in these brown sectors is expected to lead to a substantial structural transformation affecting labour demand. Although production will continue in most activities, there will be a partial reduction, which in turn will lead to a reduction in labour demand. In addition, some manufacturing processes will experience a substantial change, which can lead to a change in skill requirements. The impact of the green transition is likely to differ from sector to sector. Employment will be protected by more room for innovation towards green technologies in some sectors. The importance of certain activities, such as waste management, may increase as a result of increased need for recycling. The following chart presents an overview of the economic activities with the highest rate of greenhouse gas production per worker.

[36]EVROPSKÁ KOMISE. The Possible Implications of the Green Transition for the EU Labour Market. Online. 2022. Dostupné z: https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf. [cit. 2024-04-10].

Figure 1: Economic activities with the highest greenhouse gas emissions per worker (EU 27, 2020)



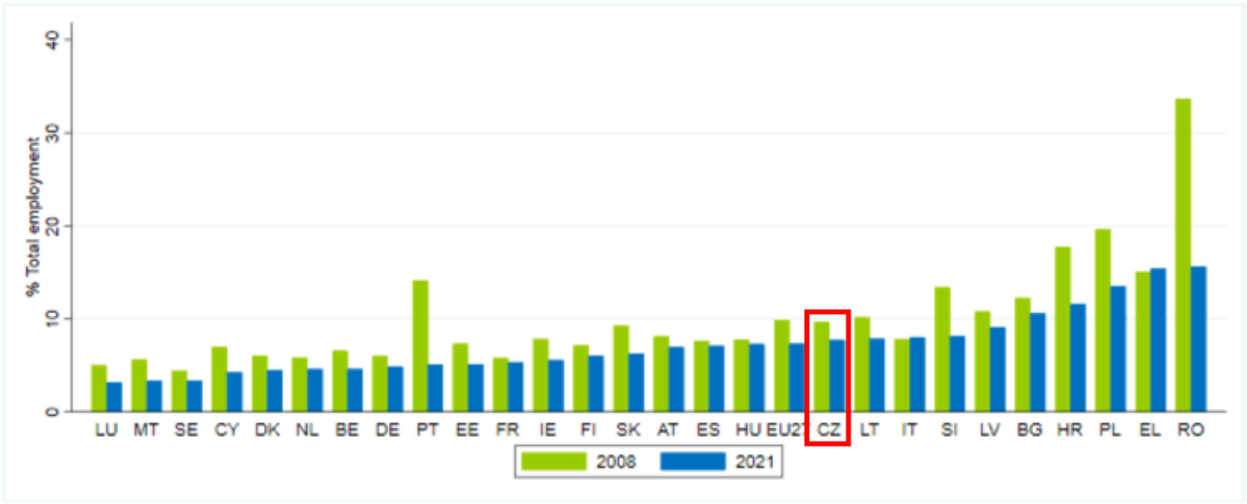
Source: European Commission (2023)

Explanation of sectors: A03 – Fisheries and aquaculture; A01 – Crop and livestock production; B – Mining and quarrying; C20 – Manufacture of chemicals and chemical products; C24 – Manufacture of basic metals; casting of metals; E37-39 – Sewerage; Waste collection, treatment and disposal activities; materials recovery; Remediation activities and other waste management services; C23 – Manufacture of other non-metallic mineral products; H51 – Air transport; H50 – Water transport; D – Electricity, gas, steam and air conditioning supply; C19 – Manufacture of coke and refined petroleum products.

Employment in the brown sectors across Europe is decreasing over time. While it was 8.2% in the EU in 2008, it dropped to 5.7% by 2021.

The Czech Republic is similar to the EU average in both the total employment in the brown sectors (around 6% in 2021) and the trend of their decline, which is illustrated in the following chart.

Figure 2: Employment in the brown sectors (EU 27, 2008 and 2021)



Source: European Commission (2023)

The findings of the European Commission also show the knowledge about employment in the brown sectors:

- Data on employment distribution by gender and age in brown sectors indicate that the main burden of the costs of environmental transition will affect men in the 25-49 age group.
- Women are significantly less represented in the brown sectors than men.
- Young people in the brown sectors work less often than older people.
- While older workers are over-represented in the brown sectors as a whole, this is not the case in the coal mining sector, which is probably due to early retirement in this sector.
- Although older workers usually face a lower risk of job losses, particular interest should be paid to them as they are more at risk of leaving the labour market in the event of job losses. The EU LFS shows that out of approximately 250,000 coal

mine workers in the EU, approximately 54,000 are over 50 years old, of which 7,000 are in the Czech Republic.[37]

Brown jobs require less skills on average than jobs in the economy as a whole. There are fewer high-skilled jobs in the brown sectors, but more semi- and low-skilled jobs than in the economy as a whole. In this context, the OECD points out that it is usually more difficult for low- and semi-skilled workers to re-skill or start a new job than for highly-skilled workers. OECD research shows that low-skilled workers have the following characteristics:

- most at risk of losing their jobs;
- it takes them longer to take up a new job;
- when starting a new job, they experience a loss of wages more often.[38]

Studies also indicate that a large part of the qualification characteristics of jobs in the brown sector is transferable to the green economy. For example, Vona et al. (2018)[39] states that the skills gap between brown and green jobs is generally small and often the general skills requirements of brown jobs are closer to the requirements of green jobs than other (white) jobs. Reintegration into local labour markets should therefore be possible with the right support. The above-mentioned authors also point to an exception in workers in mining (including those employed in coal mines). These workers have very specific skill profiles that differ from those requiring green and white skills, which can make finding a new job more difficult.

[37]EVROPSKÁ KOMISE. The Possible Implications of the Green Transition for the EU Labour Market. Online. 2022. Dostupné z: https://economy-finance.ec.europa.eu/system/files/2022-12/dp176_en_green%20transition%20labour.pdf. [cit. 2024-04-10].

[38]QUINTINI, G., VENN, D. Back to work: re-employment, earnings and skill use after job displacement. Final report. 2013. VS/2011/0352-SI2.609973 (DI110934).

[39]VONA, F., MARIN, G., CONSOLI, D., Popp, D. Environmental regulation and Green skills: an empirical exploration. 2018. Journal of the Association of Environmental and Resource Economists 5(4), 713–753.Walker, W.R. (2011). Environmental Regulation and Labor Reallocation: Evidence from the Clean Air Act. American Economic Review: Paper and Proceedings 101(3): 442-7.

What is interesting in relation to these findings are the results of the 2023 analysis of the Czech Radio data journalists[40], examining the re-skilling of persons dismissed from the Ostrava-Karviná Mines (OKD), which were implemented through the OKD Foundation and the re-skilling programmes of the Labor Office of the Czech Republic.

The findings of the Czech Radio data analysts show the following facts:

- Initial situation:
    - More than 3,500 people were dismissed from OKD from 2020 to 2022.
    - Of these, 2,500 took up a job in the state-owned enterprise DIAMO, of which 30% continue to do abatement work in the mines and the remaining 70% were dismissed with redundancy payment (about 400 people from this group took advantage of the offer of counselling and re-skilling).
- Re-skilling programme 'Nová šichta' (re-skilling for IT, organised by the OKD Foundation and Jobs.cz):
    - 29 people attended the introductory lesson;
    - of them, 15 people formed a group that took part in self-study and preparation for the entrance test for their own course;
    - of them, 4 people managed to meet the conditions for the re-skilling course, i.e. study home-made scripts and pass an entry test focused on tasks in Visual Basic;
    - these 4 people completed the course;
    - of them, 3 people were employed in IT and worked there even at the time of publishing the Czech Radio analysis (i.e. 3 November 2023).
- Outplacement re-skilling program (re-skilling courses of various types, provided by the Labour Office of the Czech Republic from 2020 to 2023):
    - people were interested the most in re-skilling for 'Operation of electric and motor forklift' (59 persons)

[40]ČESKÝ ROZHLAS. Přeučit se na programátory dokázala desetina z přihlášených horníků. Víc je lákalo řízení a řemesla. Online. 2023. Dostupné z: https://www.irozhlas.cz/zpravy-domov/okd-rekvalifikace-horniku-programatori-ridici-data_2311030620_fil?_ga=2.25764669.1629626420.1711099697-197809881.1711099697. [cit. 2024-04-10].

- Re-skilling ‘Extension of driving licence category B by category C’ was second (29 persons).
- Ranking of other re-skilling courses:
  - Initial training according to Decree 156/2008, basic scope (professional competence of drivers; 22 persons)
  - Basic welding course ZK 135 1.1 (16 persons)
  - Computer basics (10 persons)
  - CNC machine tool operators (8 persons)
  - Business fundamentals (7 persons)
  - Extension of driving licence category C by category D (6 persons)
  - Extension of driving licence category C by category E (6 persons)
  - Basic welding course ZK 111 1.1 (6 persons)
  - Preparatory welding course according to ČSN EN ISO 9606-1 135 (4 persons)
  - Category C driver (4 persons)
  - Driving licence category T (3 persons)
  - Construction machinery operator (3 persons)
  - Basic welding course ZK 141. 8.0 (3 persons)
  - Extension of driving licence category B by category C+E (3 persons)
  - Computer literacy according to ECDL Core syllabi (3 persons)
  - Professional competence in electrical engineering according to Decree No 50/1978 Sb. (3 persons)
  - Network management (3 persons)

4. Quality of work in the context of green jobs

The working environment is constantly changing as a result of many influences, including new physical conditions for work (e.g. temperature rise) or new technologies. New situations at work bring about new risks and challenges for workers, employers and other actors in the social dialogue, including trade unions.

The transformation of existing jobs or the emergence of new jobs responding to the green transition creates many opportunities but also new risks that may affect the quality of work and thus the quality of life of people working these jobs. Given the ever-increasing need to respond adequately to the threats resulting from global warming and other negative human impacts on the environment (loss of biodiversity, overexploitation of resources, pollution), the pressure on the fundamental economy transition and thus on strengthening the importance of green jobs is also growing. It will be therefore necessary to pay more attention to the risks associated with working these jobs. New challenges will require appropriate political, administrative, technical and regulatory approaches to ensure a high level of health and safety in green work.

4.1. Risks to the quality of work in green jobs

As discussed in the previous chapter, there are various definitions of green jobs. One of the possible approaches to defining them may be the aspect of risks associated with the performance of these jobs. These risks affect the quality of work in terms of potential health and safety threats to workers in working green jobs. This criterion defined the approach of the European Agency for Safety and Health at Work (EU-OSHA), or its European Risk Observatory (ERO), aimed at identifying new and emerging risks in OSH in order to improve the timing and effectiveness of preventive measures.

From the perspective of EU-OSHA, green jobs are analysed primarily to explore new types of risks associated with new technologies related to the green transition. EU-OSHA is interested in workers who work with or are directly affected by new green technologies and not in those who are only indirectly associated with new technologies. Management, administration and other ‘white collar’ jobs in the green industry thus do not fall within the

definition chosen by EU-OSHA. The agency studies new combinations of risks: for example, when installing solar panels, where the risks associated with electricity are combined with the risks of working at heights. It does not focus on jobs in green sectors in which the risks are the same as in other jobs (such as transporting ‘green’ goods). EU-OSHA examines new risks in the context of green jobs and is less interested in increasing or reducing known risks. Prioritising this has allowed EU-OSHA to focus on the unique risks related to green jobs[41].

The European Agency for Safety and Health at Work recognises two types of risks:

- new risks;
- emerging risks.

‘New risk’ means that:

- the risk did not exist before and is created by new processes, new technologies, new types of workplaces, new social conditions or organisational changes;
- a long-term problem is now considered a risk due to a change in social or public perception;
- new scientific advice makes it possible to identify a long-term problem as a risk.

‘Emerging risk’ occurs when the following conditions are met:

- increased number of dangerous situations leading to a threat;
- increased likelihood of being exposed to a threat leading to a risk (i.e. the level of exposure increases and/or the number of people at risk increases);
- increased impact of the hazard on the health of employees (i.e. health effects become more severe and/or the number of people at risk increases).

EU-OSHA defined a total of nine green technological areas, determining the research framework for new and emerging risks associated with them.

[41]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

The green technological areas include:

- wind energy;
- green building;
- bioenergy and energy aspects of biotechnology;
- waste management and recycling;
- green transport;
- green manufacturing, robotics and automation;
- domestic and small-scale renewable energy;
- batteries and energy storage;
- energy transmission and distribution.

In addition, EU-OSHA established a group of cross-cutting safety and health factors in green work.

4.1.1. Risks of working in wind energy

Working on wind turbines is, by its very nature, potentially dangerous. It is difficult for both operators and regulators to oversee work procedures and enforce their safe, as this is highly decentralised work.

The potential of risks in OSH will continue to grow regardless of the subsidy regime. If the subsidies continue, larger and larger turbines will be installed. If the subsidy is reduced, price competition will exert a downward pressure on costs. Deadlines for obtaining subsidies will increase the pressure on deadlines for turbine installations, thus causing unnecessary risks that can be avoided.

According to EU-OSHA, primarily the following areas need to be monitored:

- New turbine designs may bring new electrical or ergonomic risks;
- New materials and coatings can be problematic. New composites are used for producing wind turbine blades, which will eventually have to be disposed of;
- Physical safety may be a risk if high metal prices increase the risk of theft that may damage the structure and compromise the safety of the equipment;

- Ice falling from turbines may endanger workers on or around the wind farm premises, especially if building regulations permit installations near human dwellings; falling ice is therefore also a problem for the population;
- Safe disposal of designed turbines should be ensured at the end of their service life. They should also allow for extensive maintenance and replacement if governments require the renovation and extension of the life of wind turbines in the future instead of their simple demolition[42].

4.1.2. Risks of working in green building

The construction sector is responsible for a significant part of carbon dioxide emissions; any reduction in emissions within the construction and life cycle of buildings thus has the potential to significantly affect total emissions.

The required impact on the building infrastructure can be ensured either through the construction of energy-efficient new buildings or the renovation of existing buildings. Since the pace of replacing buildings is relatively slow, the importance of building renovations is growing.

In addition to reducing consumption and material waste, the increasing use of building prefabricates (off-site construction) has health and safety benefits as well.

According to EU-OSHA, primarily the following areas need to be monitored:

- Off-site construction and modular construction places many elements of construction to the factory settings in which having more control over the work is possible. This reduces the time that workers spend on the construction site and thus reduces the risk of accidents on the construction site and poor health due to being on the construction site. On the other hand, new problems arise on the

[42] EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

construction site, such as higher transport rates and lifting of large components. Off-site construction transfers some risks to the factory (e.g. handling large components and exposure to new materials such as composites).

- The increasing use of robotics and automation could improve safety in production and construction, but the human-machine interface needs to be monitored with regard to the increasing flexibility and autonomy of robots.
- There is a risk related to exposure to new materials and substances in construction – including composites, phenols and nanomaterials (e.g. aerogels).
- Workers may face intense exposure to dust particles and other hazardous materials, including asbestos, when replacing insulation and installing small-scale renewable energy equipment.
- Intensification of renovations may increase the occurrence of existing hazards (e.g. falls from a height, slipping, diseases of the musculoskeletal system), but in some cases it could also expose workers to risks related to electricity in new situations (e.g. installation and reconstruction of renewable energy systems on the roofs carried out by relatively inexperienced workers). If reconstructing existing buildings becomes an obligation, it may also result in poor work by unskilled craftsmen offering cheap installations.
- EU-OSHA further points out that the significant shift towards off-site construction and modular construction means that traditional construction activities are essentially replaced by production. This requires different skills and there may be a significant need for training (re-skilling). Existing construction workers will have to adapt to this change. And this change will be difficult especially for the older generation of construction workers. Automation in construction could also be an opportunity for an aging workforce that can be more vulnerable to repeated manual handling of heavy loads in traditional construction activities. However, it is necessary to monitor whether the OSH benefits of off-site construction do not pose a corresponding increase in risks in production. This may be caused by the use of new substances or the transfer of activities that were previously carried out on the construction site to the indoor environment.

- It is necessary to take into account the risks associated with many new entrants to the sector and the introduction of new energy systems.[43]

4.1.3. Risks of working in bioenergy and of energy aspects of biotechnology

The volume of production and use of biofuels depends on different scenarios, differing in the emphasis on local production and use. Third-generation biofuels (from algae) are likely to become increasingly important with gradual development and introduction of this technology.

EU-OSHA defined the following risks in this segment:

- Risks related to the production of biogas, biodiesel and bioethanol include:
    - risk of explosion and fire in the production of biofuels, even on a large scale;
    - fire and explosion caused by sparking of electrical equipment in an explosive environment, e.g. in an environment filled with methane;
    - explosion of pressure vessel;
    - effect of biogas or synthetic gas that does not meet the required specification on the gas network pipelines;
    - possible large-scale accidents caused by the ‘domino effect’, when a minor initial incident can lead to a catastrophic situation;
    - risk of suffocation in confined spaces (e.g. anaerobic fermenters);
    - exposure to chemicals and solvents, such as methanol used in fuel production and in cleaning of the production unit;
    - exposure to CO_2 during fermentation and to volatile by-products of microbiological processes;
    - operational risks associated with the scaling-up of third-generation biofuel production from demonstration plant to commercial scale.
- Risks related to biomass (possibly used together with coal) include:

[43]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

- large-capacity reserves of raw material from biomass that can self-heat and spontaneously ignite;
- exposure to dust, mould, endotoxins and volatile organic compounds;
- grinding coal and biomass together, which can lead to explosion and rapid and intense ignition;
- exposure of the worker to acidic gases during removal (sulphane or carbon dioxide as typical gaseous impurities);
- exposure to microorganisms and metal residues;
- possible long-term health risks arising from exposure to chemicals contained in raw materials and substances used in the production of biofuels and chemicals from waste products;
- deteriorated function and finally suffocation due to inhalation of carbon monoxide and aldehydes formed during the storage and transport of raw materials;
- respiratory allergies due to degraded raw material from biomass;
- usual hazards during the import, transport and storage of raw materials from biomass – exposure to volatile organic compounds, lack of oxygen in confined spaces, exposure to dust, mould and endotoxins.

The risk common to biofuel production and biomass combustion lies in the fact that especially new entities may be at risk as they are less familiar with the risks related to fuel management. The hazard can be caused mainly by the fact that bioenergy is used in a decentralised way, with a large number of small projects within communities or even schools. Other new players may include farmers producing small quantities or businesses starting to use their own waste as an energy source, for example in the textile or food industry. There may also be problems with the quality of their products and thus safety issues. The hazards related to biofuel production and biomass combustion include the following:

- increased collection of wood from forests (forestry activities show a high rate of injuries, including fatalities);

- high temperatures and sometimes high pressures used in pyrolysis (350-550 °C) and gasification (over 700 °C); there is also a potential issue with the increased variability in the constitution of gas derived from biomass compared to fossil fuels;
- potential problems for land use planning in connection with the use of biogas (such as the use of biogas generators in landfills);
- increased collection, transport and use of large amounts of animal waste for energy production, posing a potential risk of slipping and tripping, falling into slurry/manure, exposure to fumes, microbiological exposure, methane explosions and fires[44].

4.1.4. Risks related to waste management and recycling

The growing diversity and growth of recycling and waste management will lead to increased hazards and risks in this sector. There are many examples of expanding recycling of plastics, paper, glass, aggregates and other materials for construction. The increasingly important area of waste management and recycling entails specific risks, pointed out by EU-OSHA.

According to EU-OSHA, attention should be paid to the following topics:

- Waste management and recycling of older wastes may expose workers to unknown hazardous substances due to poor traceability of the provenance of materials. Landfill mining (a process which excavates and processes solid wastes which have previously been landfilled) can be particularly hazardous in this regard.[45] There may also be a risk of fire and explosion of methane due to the decomposition of biological material in the underground area of the landfill.

[44]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

[45]ENVIRONMENTAL ALTERNATIVES. Landfill Mining. Online. Dostupné z: http://www.enviroalternatives.com/landfill.html. [cit. 2024-04-10].

- New products are likely to pose a risk from exposure to new materials at the workplace, including nanomaterials. But new products are easier to document and check. However, the increasing sorting of waste can lead to a greater concentration of hazardous materials.
- The increasing use of automation in waste sorting and handling has the potential to reduce risks at work. Since products are more often designed taking into account their dismantling and recycling, risks to workers can be further reduced.
- Known risks associated with waste and recycling will be further extended along with the corresponding expansion and diversity of the industry. These risks include, for example, the risk of being run over by a large vehicle, physical injuries, diseases of the musculoskeletal system due to long-term handling of waste products and risks arising from interaction with large machines and equipment such as presses, boilers, chippers, compactors and crushers.
- Other known risks that will increase with the development of the industry include exposure to biological hazards (when handling rotting waste, sorting textiles or dismantling cars, etc.) and exposure to toxic materials such as mercury and lead (when dismantling equipment such as computers and televisions, etc.).
- Given the growing global shortage of raw materials and rising energy costs, the reuse of metals, polymers and glass will be widely spread and the exposure at the workplace to the chemical processes used in these recycling processes will increase accordingly.
- A significant number of new companies enter the waste management sector. Existing companies diversify their activities by other areas of this sector (e.g. metal waste treatment companies start recycling end-of-life vehicles, the number of lithium-ion battery recycling facilities increases).
- The impact of increasing waste sorting could lead to a greater concentration of potentially harmful microbes, chemicals and dust (e.g. the increasing sorting of food waste leads to increasing collection and handling of rotting waste and thus to increasing exposure of workers to the resulting pollutants).

- Due to the growing complexity of waste recycling and management in Europe, there will be a greater dependence on multiple suppliers and multiple supply interfaces. This is likely to increase the risk of incidents due to poor communication.
- New procedures are being developed, introduced or expanded in Europe. Specific hazards are connected with each of them. An example is the anaerobic decomposition of organic substances with a risk of fire/explosion due to the formation of methane and the separation of flame retardants from waste electrical equipment with possible exposure to toxic or carcinogenic substances.
- The expansion or introduction of processes is caused by European legislation on recycling. Increasing landfill costs in Europe contribute to the increase in the circular economy and recycling. A large number of companies recycle discarded electronics and batteries.
- Electronics and equipment used by households now will sooner or later become waste that is likely to be increasingly recycled. This means that there will be changes in the waste stream, which could lead to increasing risks (e.g. switching to energy saving bulbs increased the risk of mercury exposure in workers). Organisations dealing with OSH will need to be aware of changes in the waste stream and thus the transformation of risks at the workplace.
- The priority should be to integrate OSH into the concept of the entire waste treatment process and into the organisation of the relevant work.
- Certifications and standards (for waste operators and for the entire waste management process) can contribute to increasing safety if they support the principles of the proposed safety[46].

[46]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

4.1.5. Risks related to green transport

There is great potential for green changes in transport, including rail, aviation and shipping, focusing usually on electric and hybrid road vehicles, i.e. areas where the greatest activity is currently being developed.

The set emission targets and the price of oil will probably lead to an increase in the number of electric and hybrid cars. Electric cars pose a significant risk both to workers and their users, which is associated with high voltage. Drivers and car maintenance staff may underestimate the risk of high voltage (approximately 360-500 V) at first, as they are used to 12V batteries in cars with internal combustion engines.

According to EU-OSHA, this implies possible areas of risk related to electricity:

- maintenance as electric vehicle service shifts from specialised providers to smaller independent garages as electric vehicles become more widespread;
- recharging (by cable or by changing batteries);
- rescue work after accidents.

This means that there is a need to raise awareness about the potential hazards associated with high-voltage batteries in vehicles and related infrastructure. Independent mechanics and rescuers are the most vulnerable groups of workers. Appropriate accredited training should also be provided for mechanics who will service and maintain hybrids and electric vehicles and for workers in recharging or replacing batteries.

An increase in the number of electric or hybrid vehicles due to government incentives or a decrease in prices will probably lead to a corresponding increase in the number of decommissioned vehicles (as happened in Europe with a scrappage scheme intended to stimulate the European car market). European legislation on end-of-life vehicles means that more vehicles will be dismantled and recycled, leading to a corresponding increase in the number of potential exposures to hazardous chemicals, materials and microbes at the workplace.

There may be risks due to exposure to new materials used in manufacturing and repairs as lighter and more efficient vehicles are designed and manufactured. For example, the

increasing use of carbon fibres may pose a health risk to workers who manufacture these vehicles.

Rising fuel prices and European legislation on air quality in cities will increase the number of bicycles and two-wheeled vehicles on urban roads. The risk of accidents and injuries to workers who will use two-wheeled vehicles instead of four-wheeled vehicles to commute to or from work will increase. In contrast, there will be fewer cars and large vehicles in city centres, which can reduce the risk of accidents.

The expansion of hydrogen vehicles will also signify the expansion of hydrogen storage and distribution. This entails risks of explosion, fire and burns, especially because the public is not familiar with the differences in refuelling, operation and hazards associated with this technology.

Firefighters, paramedics and police officers are unlikely to know that the crashed vehicle is powered by hydrogen or how to handle it.

Placing hydrogen fuelling stations or hydrogen storage facilities near residential areas, commercial areas or other inappropriate places is also a risk. This should be addressed through local plans.

Increasing imports of LPG and LNG for vehicles will increase the risk of fires and explosions in related facilities, e.g. storage facilities. In addition, the widespread use of LPG and LNG in vehicles is likely to lead to ignorance of the new refuelling systems, infrastructure and operation by the public, which may increase the risk of fires, burns and explosions.

Sophisticated transport networks with a complex combination of multiple systems and modes of transport may be exposed to increased risks. Such increased risk will be caused by a combination of OSH risks resulting from the use of combined transport (trains, cars and road freight transport).

Due to the combination of risks, the construction and rapid modernisation of infrastructure for railway and road electrification will affect OSH. This includes risks related to construction activities, together with risks related to electricity. These works are usually

done by less skilled workers, often migrant workers, used at the beginning of the supply chain. Higher risks are associated with poor communication, language barriers and possibly a different OSH culture. Attention of all persons concerned, including OSH experts, is required to eliminate risks. This involves monitoring, training and ensuring sufficient resources to allow such extensive work to be carried out safely[47].

4.1.6. Risks related to green manufacturing, robotics and automation

Parts of manufacturing change significantly as sophisticated production processes offer more flexibility and allow even small production batches and customisations to be profitable. Advanced materials will allow the modification of properties to suit a variety of applications. Such development offers higher efficiency, lower energy consumption and less waste, but causes a change in environment (safety and health conditions) for workers in this sector.

According to EU-OSHA, attention should be paid to the following topics:

- new processes and materials leading to potential exposure to new (‘green’) substances, including nanomaterials, or to substances used or emitted (incl. dust) from new (‘green’) manufacturing processes;
- the scope of use of chemicals and the possibility of exposure because manufacturing is divided into smaller units as a result of rapid manufacturing techniques (3D printing);
- difficult monitoring of OSH in manufacturing with a high level of distribution (in small enterprises);
- increasing use of lasers in techniques such as rapid manufacturing;
- potential physical risks of human-robot interaction because robots gain increasing autonomy and move freely;
- potential psychosocial risks:

[47]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

- high cognitive load associated with the human-machine interface, lean production and just-in-time principles may result in higher work intensity, higher pressure on workers and psychosocial issues;
- potential impact of renewable energy sources (RES) on the predictability of working time. By their nature, RES can supply energy irregularly, with a possible impact on shifts in enterprises consuming intermittently supplied energy and thus on the (un)predictability of working hours;

- workers may turn to performance-enhancing technologies in order to keep up with their colleagues and probably with robots (this may also apply to other sectors);
- greater focus on safety than on health, which can be caused by a greater impact of accidents on productivity (this may also be typical of other sectors).[48]

4.1.7. Risks related to domestic and small-scale renewable energy

The use of renewable energy technologies will be affected by the amount of government subsidies and their dissemination will depend on the level of support until the actual costs become competitive with other sources. The use of solar energy and other renewable sources compared to building insulation savings will also depend on the location. There may be new players selling energy, such as small and medium-sized enterprises and farmers.

According to EU-OSHA, it is necessary to focus on the following areas:

- the risk of poor quality installations due to new entrants to the market, installation by self-help (e.g. using Internet sources) and hasty system installations to meet deadlines can lead to the risk of fires, problems related to electricity, maintenance problems (e.g. at heights) and risks related to gases. Risks may arise especially in cases where assembly companies overstep their original knowledge. For example, technicians who previously installed gas boilers will start installing solar thermal

[48]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

systems, working at heights on roofs and expanding their competences by new technologies in new situations.

- Rescue services are endangered when working with such equipment. For example, solar panels stay live as long as there is daylight, but firefighters often need to get through roofs to get to them. Various sprays are available on the market which allegedly ‘turn off’ the panels, but it is still a high-risk area.
- Connecting systems to the grid poses a risk for workers as electricians have to deal with bi-directional flows in cables and smart metering.
- Particular attention has to be paid to risks in groups of buildings that combine renewable technologies but do not have a clear responsibility for safe operation.[49]

4.1.8. Risks related to batteries and energy storage

According to EU-OSHA, the development of battery technologies and energy storage using them has different scenarios – from significant progress through emphasis on specialised applications as a result of the need to reduce costs to the context of changed behaviour of the society in order to reduce the need for storage.

According to EU-OSHA, it is necessary to focus particularly on:

- exposure to chemicals, including nanomaterials, in the manufacture, use and recycling of batteries;
- risks associated with electricity for rescue services in electric vehicle accidents;
- risk of fire and explosion of batteries in vehicles and buildings, especially when old batteries from vehicles are used in buildings;
- use of batteries as energy storage in buildings by untrained workers or building users who do not have sufficient knowledge of the risks of large-capacity batteries;

[49]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

- other forms of energy storage include hydrogen (see above), flywheels (risk of the flywheel breaking) and energy storage in compressed air (risk of damaged pipe integrity). Electricity risks are common to all of the above-mentioned forms of energy storage;
- there may also be unknown risks caused by connecting different types of energy storage devices[50].

4.1.9. Risks related to energy transmission and distribution

According to EU-OSHA, the development of energy transmission and distribution grids is associated with the following risks:

- The main risks in the construction of smart grids and infrastructure are electrical shock, burns caused by discharge and falls. These risks are related to activities such as connecting and maintaining new energy sources.
- Smart grids are very complex, which increases the likelihood of the occurrence of these risks. Much more work is performed with live equipment.
- Time pressure from governments or deadlines of energy companies (e.g. deadlines for feed-in tariffs) may lead to hasty installations of smart grids and thus to the risk of accidents or poor quality execution.
- Given the scope of the requirement to build a European network of smart grids, a large amount of construction and excavation work will be carried out. It is linked to risks related to cable laying, construction of substations, etc. Specifically, the grid construction is associated with the risk of explosion, collapse of the structure, being stuck in a tunnel, hit by heavy machinery, work at heights, enclosed spaces and heat. Another risk is musculoskeletal disorders. Tight deadlines, physically demanding work and long working hours can cause psychosocial problems in workers.

[50]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

- Large construction projects usually use subcontractors to a large extent. Several subcontractors are needed due to the complexity of smart grids. This may lead to problems with compliance with OSH requirements throughout the chain. There is a likelihood of language barriers and different cultural approaches to OSH, thus causing an increased risk of accidents.
- A shortage of skilled workers (especially electrical engineers and electricians) is likely given the number of people needed to build smart grids. The use of less experienced or insufficiently skilled people can lead to safety issues.
- Another risk of a complex chain is the unclear determination of which of the many suppliers involved in the construction of smart grids is responsible for the maintenance of a given grid interface in the system.
- The high diversity and number of energy suppliers connected to the grid and the complexity of the system will result in an increased number and a wider range of OSH risks. Working with direct current is more dangerous than with alternating current. There may also be risks of electrical burns and fires at the DC/AC interface. The diverse range of small-scale energy technologies and local or community electricity producers, spread over vast territories with millions of bi-directional grid connections, means that an enormous number of people, including local electrical engineers, maintenance workers and the general public, will be exposed to the risk of electrical shocks.
- The lack of experienced employees means the risk of overloading current skilled employees. Chronically long working hours will increase health and accident risks and may affect equipment safety and connection to the grid. Psychosocial risks may also occur.
- Domestic and business parts of the grid will be monitored with smart electricity meters. It will be necessary to install a lot of them throughout Europe in the near future. A shortage of skilled electricians to install smart electricity meters is highly probable. Moreover, there is a risk that the meter installers will not have the necessary qualifications or accreditation to install them. It is unlikely that all installers will be qualified at the level of electricians for household or light industry;

they will thus not be able to make a high-quality connection of the building system to the new meter. Inexperience and lack of qualification will expose workers and the public to the risk of electrical shock, burns and fire. Residential and multi-site buildings that share a common smart electricity meter also raise concerns about safety, both in terms of access control and meter connection to a number of different electrical installations managed by various suppliers.[51]

4.1.10. Cross-cutting risk factors across technologies

EU-OSHA also focused on risks that occur in several sectors. They are cross-cutting, not unique for each sector.

Cross-cutting risks include:

- **Skills and training**

EU Member States have ambitious targets for improving the environment and using low-carbon energy sources, so there is a rapid development of renewable energy technologies. Workers were found to be more vulnerable in the first days of their employment. The risks may increase when there are many people who are new to the industry or people who are already working in a particular industry but are facing significant changes. The case of former gas workers who move to installing solar thermal systems on roofs is often mentioned as an example. In addition, there are many new entrants to the market: small businesses and self-employed persons. They may not have sufficient experience with new technologies and it may be harder for them to cope with OSH requirements. An example of a risk area is the development of biogas production in methane fermenters.

- **Economic and time pressure**

[51]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

If there are poor economic conditions, there may be pressure for cheap work and a tendency to use subcontractors. Deadlines for feed-in tariffs or compliance with EU environmental objectives may be other reasons for the pressure on the quick installation of renewable energy technologies. Cost reduction and lack of time can negatively affect OSH conditions because occupational safety and health is not considered a priority in these conditions.

- **Psychosocial risks related to work**

Factors such as the speed of innovation, increasing complexity of systems, increasing use of robots (especially those that communicate with people), increasing automation, increasing dependence on information technologies and issues with the human-machine interface, increasing number of work shifts and remote work or high competition can have a psychosocial effect on workers.

- **Health and safety risks arising from exposure to new materials and their use**

Various new materials are put into practice and the health risks associated with them may not yet be fully known. Materials will be adapted to specific applications in more cases. Growing range of materials can mean that there will be no such thing as a standard material. It will thus be difficult to set relevant standards. If the materials are intended for a particular application, a hazard may arise when they are used for a different purpose.

New materials include composites, ceramic materials, new nanomaterials, smart materials (e.g. piezoelectric, shape memory, thermochromic, photochromic and magnetorheological). These materials will appear in multiple sectors such as construction, manufacturing and waste treatment. New biological materials will also appear as a result of the development in biotechnology. We are currently witnessing the development of new materials that bring completely new risks. Exposure at the end of life due to product degradation or waste treatment can have the greatest impact.

In a world where people are more likely to change jobs and where lifelong employment is an exception, a history of exposure will be difficult to track without exposure registries or health surveillance. This in itself increases the risk of long-term effects[52].

According to EU-OSHA, it is necessary to:

- investigate the long-term health effects of new materials, thoroughly assess the risks and carry out initial testing before placing the materials on the market;
- perform exposure monitoring;
- make better use of existing information (e.g. there is already a lot of information on the biological hazards of new materials).

- **Waste and recycling**

On the one hand, this sector will stand as a separate sector, on the other hand, the issue of waste management also penetrates other fields. Technological progress (e.g. waste sorting robots) may increase occupational safety in this industry by reducing workers' contact with hazardous materials. However, the development of technologies in other areas will constantly expand the range of materials and equipment and thus the risks that need to be addressed. These may include a wide range of applied materials or disposable products with unknown properties that pose potential risks to workers in waste management and recycling.[53]

Table 3: Summary of safety and health risks across green technologies

OSH factor: **Name and brief description**	**Area of new and emerging risks**
New materials may have an unexpected impact on health and the environment:	New risks.

[52] EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

[53]EU-OSHA. Green jobs and occupational safety and health: Foresight on new and emerging risks associated with new technologies by 2020. Online. EU-OSHA. 2013. Dostupné z: https://osha.europa.eu/en/publications/green-jobs-and-occupational-safety-and-health-foresight-new-and-emerging-risks. [cit. 2024-04-10].

• **nanomaterials** • **new insulation materials** • **new composite materials** • **smart materials** • **new organisms** • **biofuels and byproducts** **There is a real risk of long-term risks (e.g. carcinogenic substances): it is difficult to trace the origin of work-related diseases without exposure registries because only few workers have the same job until retirement now.**	
New occupational diseases **It is not clear what the health risks of new materials, processes and procedures will be in a few decades.**	Extent of new physiological risks. E.g. new musculoskeletal disorders, chemical and biological exposure.
Variety of risks **There will be a variety of risks that are difficult to monitor and regulate in relation to decentralised renewable energy installations, including photovoltaics, cogeneration units and biogas production.**	These are not new risks, but their importance is growing.
Rapid innovation **Rapid innovation can lead to various OSH risks, as there will be new materials and new processes, but little time to learn how to use them safely.**	New risks.
Automation **Automation will positively affect safety in the long term, but the absolute reliability of the technology is an essential condition.**	New processes bring risks; the impact on OSH is highly likely to be positive for automation.
Human-machine and human-ICT interfaces **These interfaces can create complex risks (e.g. ergonomics and high cognitive load) and excessive reliance on information technology.**	Increasing risks.
Performance-enhancing technologies (e.g. new drugs, implants, bionic limbs) **There is evidence of increasing use of drugs by healthy people as a means to increase concentration and performance at work; dramatic developments in bionics and implants.**	High coverage of many sectors and types of jobs.
Stress and mental health **Given the increasing insecurity, complexity and intensity of employment, it is highly likely that the level of stress and mental health problems will increase.**	Potentially growing problem.
Unpredictability of shift work **The unstable nature of renewable energy sources entails unpredictability of shifts: unpredictable working hours and shift work affect health and safety. This risk depends on the scenario of the development of electricity grids and storage technologies.**	High probability of risk.
End of life	High probability of risk.

Reconstruction, demolition, disposal, waste and recycling entail new challenges: e.g. the demolition of buildings in which new modern materials were used; robotic dismantling of manufactured goods; decomposition of photovoltaic panels and batteries of end-of-life electric vehicles.	
Rescue system **Rescue services will face various unknown risks resulting from different combinations of energy sources, devices and systems.**	Very high probability of risk.
Metal theft **Metal theft brings health and safety risks in a situation where valuable components are stored outside the walls of buildings. Cable theft can lead to power outages. The interruption of industrial (manufacturing) processes and the uncovering of live cables are safety risks. It also poses risks to maintenance workers. Theft of other metal objects is also a security risk.**	This is not a new risk, but the risk is increasing in many technologies, including wind power, batteries and domestic energy production.
Government deadlines **The deadlines set by the government put undue pressure on reducing requirements, thus leading to less emphasis on OSH.**	Relevant to OSH policy making.
Subcontractor agreements **Subcontracting may lead to cost reductions, which may result in less emphasis on OSH issues.**	This is not a new risk, but its importance may increase under certain circumstances.
Availability of skilled workforce **New technologies will need skilled workers and obtaining the necessary skills requires a lot of time. Fast-growing sectors (e.g. renewable energy sources) may suffer from a shortage of skilled workers. Workers without sufficient skills and education may be exposed to risks.**	Growing problem with impacts on OSH.
Ageing workforce **People work longer, so the average age of the workforce is increasing and more people work also in their retirement age. People over the age of 50 used to be considered 'older workers'. Relatively little research has been done on workers over the age of 65, so the OSH risks specific to this group are not well documented.**	The potential for OSH risks increases with the increasing age, but the consequences are not very well known.

Source: EU-OSHA (2013)

4.2. Impact of temperature rise on the quality of work

Climate change has many different manifestations. One of the burning socio-economic issues of global warming is the deterioration of the quality of work due to temperature rise, especially in terms of threats to occupational safety and health.

According to the International Labour Organization (ILO), the increase in heat stress due to global warming will lead to a global loss of productivity equivalent to 80 million full-time equivalent (FTE) jobs in 2030[54]. This amounts to a loss of 2.2% of working hours globally, with an economic value of $2,400 billion. The prediction is based on the assumption that the temperature will increase by no more than 1.5 degrees Celsius compared to the pre-industrial era and that work in agriculture and construction will be carried out in the shade.

A significant temperature rise in the Czech Republic can be documented by measurements of the Czech Hydrometeorological Institute (CHMI). The average annual temperature in the Czech Republic increased by 2.03 °C over the last 61 years.[55]

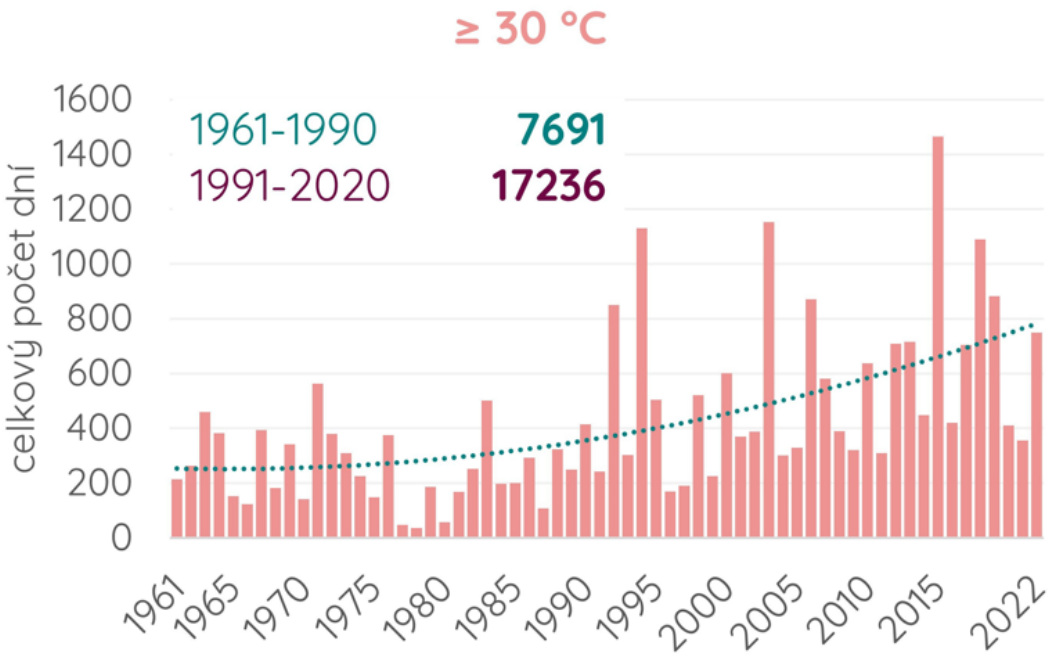
The number of tropical days from 1991 to 2020 increased more than 2.2 times compared to the period between 1961 and 1990. The number of days with temperatures exceeding 35 °C increased almost nine times.[56] These data are clearly shown in the following charts.

[54]MEZINÁRODNÍ ORGANIZACE PRÁCE. Working on a warmer planet: The effect of heat stress on productivity and decent work. Online. MEZINÁRODNÍ ORGANIZACE PRÁCE. 2019. Dostupné z: https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_711917/lang--en/index.htm. [cit. 2024-04-10].

[55]FAKTA O KLIMATU. Trend nárůstu teplot v ČR v jednotlivých měsících [online]. [cit. 2024-04-10]. Dostupné z: https://faktaoklimatu.cz/infografiky/trend-teplot-cr

[56]BRZEZINA, Jáchym. Maximální teplota vzduchu, 1961-2022, Česká republika. Online. 2023. Dostupné z: https://www.infoviz.cz/graphic.php?ID=278. [cit. 2024-04-10].

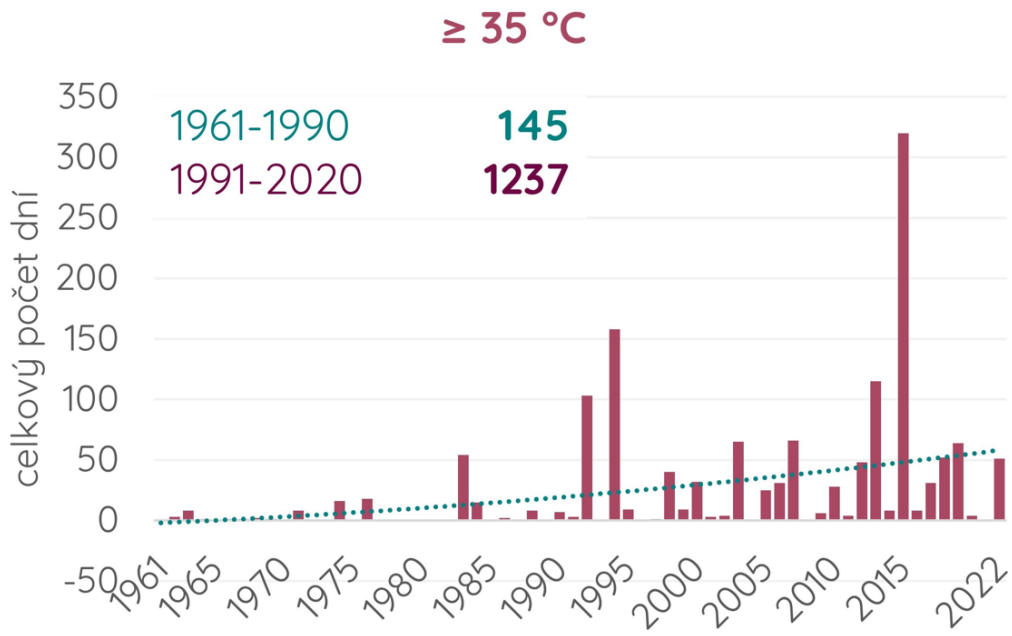
Figure 3: Number of days with temperatures exceeding 30 °C (Czech Republic, 1961-1990, 1991-2020)



Total number of days

Source: CHMI, infoviz (2023)

Figure 4: Number of days with temperatures exceeding 35 °C (Czech Republic, 1961-1990, 1991-2020)



Total number of days

Source: CHMI, infoviz (2023)

The prediction of the Global Change Research Institute of the Czech Academy of Sciences – CzechGlobe assumes that the number of days with extremely high temperatures will continue to grow. Assuming the stabilisation of CO_2 production, the Institute assumes that the number of tropical days in South Moravia will be between 31 and 40 in 2030 and up to fifty in 2050. The average length of heat wave, which was 21 to 30 days until 2010, may be 51 to 70 days in 2050 in the medium scenario (stabilisation of CO_2 production).[57]

It follows from the above that the importance of the issue of protecting employees from heat and heat waves is significantly increasing given the current situation and future development. The topic was extensively addressed in the Czech Republic by the Occupational Safety Research Institute (OSRI) in 2021. The resulting 'Methodology for the Protection of Employees from Heat and Heat Waves in the Framework of Climate

[57]CZECHGLOBE. Klimatická změna v České republice. Online. 2024. Dostupné z: https://www.klimatickazmena.cz/cs/?l=40. [cit. 2024-04-10].

Change'[58] is conceived as a voluntary tool intended for employers, focused on OSH with regard to heat stress, using the simplest measures and adapted to use in the context of climate change. The Methodology contains several recommendations, the application of which should be discussed with a specialist (occupational physician).

According to OSRI, the **issue of protecting employees from heat stress and heat waves is not adequately addressed**. Climate change and the expansion of areas of concentrated heat in urban areas as a result of increasing population and urbanisation amplify the impact of heat waves and exacerbate the risks to employees. This creates new conditions that need to be addressed correspondingly. **However, the current legislation** (in particular Government Regulation No 361/2007 Sb.) **addresses this problem only partially**. The regulation is primarily focused on work in mines and indoor hot operations with more or less stable temperature conditions. **It does not reflect** dynamically changing **conditions affected by climatic factors**. According to OSRI, the regulation is complicated and experimentally demanding. It primarily deals with work classification and the much less current state variable in time. Nevertheless, the Labour Code requires the employer to identify and eliminate all risks. The OSRI methodology tries to span this gap.

According to OSRI, heat stress poses the greatest threat to jobs in the following sectors:

- agriculture
- environmentally oriented services
- construction
- casting of metals
- mining
- heavy industry
- waste management

[58]DANIHELKA, Pavel a kol. Metodika Ochrana zaměstnanců před horkem a vlnami veder v rámci klimatické změny. Online, Metodika. Praha, 2021. Dostupné z: https://vubp.cz/soubory/vyzkum/projekty/V05-S4/NmetS-Metodika-Ochrana-zamestnancu-pred-horkem-a-vlnami-veder-v-ramci-klimaticke-zmeny.pdf. [cit. 2024-04-10].

- emergency services
- transport
- tourism
- sports
- jobs requiring personal protective equipment that makes microclimatic conditions under the clothing worse (e.g. firefighters in chemical protective clothing, the army, doctors)

Employees working in industrial indoor areas are also at risk if the temperature inside factories and workshops is not regulated. Even basic office tasks are difficult to perform and mental fatigue often occurs when working in high-temperature environments. Certain factors can increase susceptibility to diseases associated with heat stress. These factors include age, gender, body fat, fitness level, dehydration, and the use of medications or other substances that may affect thermoregulation of the body. An important aspect may also be the initial deteriorated physical and mental health as well as the physical and mental condition of the individual which affect the individual's tolerance to heat.

Excessive heat during work poses a risk to the safety and health of employees. It limits their physical abilities, work capacity and productivity. Heat stress usually occurs at temperatures above 30 °C and in high-humidity environments. The critical point is 'heat exhaustion', which occurs when the body temperature exceeds 38 °C. This leads to reduced work productivity, an increased risk of errors and accidents at work. Exposure to extreme temperatures may even jeopardise the life of employees: people can survive a 10°C decrease in core body temperature, but only a 5°C increase.[59]

The OSRI methodology includes:

- information on heat stress (onset, symptoms and consequences);

[59]DANIHELKA, Pavel a kol. Metodika Ochrana zaměstnanců před horkem a vlnami veder v rámci klimatické změny. Online, Metodika. Praha, 2021. Dostupné z: https://vubp.cz/soubory/vyzkum/projekty/V05-S4/NmetS-Metodika-Ochrana-zamestnancu-pred-horkem-a-vlnami-veder-v-ramci-klimaticke-zmeny.pdf. [cit. 2024-04-10].

- draft heat stress risk management (including topics such as evaluation of jobs in terms of heat stress, information and training, individual sensitivity and acclimatisation of employees, recognition of risk levels);
- prevention according to different levels of risk;
- emergency preparedness;
- access to monitoring, records and improvements;
- appendices:
    - Symptoms and first aid – heat exposure
    - General preparation – awareness and training
    - Organisational and technical measures to prevent the risks of heat stress
    - Symptoms of heat-related illnesses and first aid
    - Anonymous questionnaire for subjective assessment of microclimatic conditions
    - List of drugs with (undesirable) effects on thermoregulation

In addition, the methodology highlights:

- The importance of collecting subjective information from employees as part of the evaluation of jobs in terms of heat/cold load (questionnaires in the appendix to the methodology or other methods can be used);
- The need for a heat stress training programme. Employees incl. managers should be trained in risks, prevention and first aid for heat-related illnesses before they start working in hot environments;
- Possible procedures for identifying individual susceptibility and vulnerability of employees (e.g. impaired thermoregulation of persons over the age of 60, increased risk of heat-related illness in obese persons – 3.5 times higher than in slim employees, reduced tolerance to heat stress in pregnant employees);
- Heat index issue (combination of temperature and humidity);
- Factoring energy expenditure as one of the effects of heat stress;
- Various options for preventive measures (technical measures, strategies for organisational measures, approaches to dealing with high levels of hazards);

- Proactive and reactive methods of risk monitoring.

According to OSRI, the application of the methodology at employers can help manage risks related to heat stress. It explains how to recognise the level of risk and what measures need to be taken in terms of prevention and preparedness. The methodology allows employers to meet the requirements of the Labour Code and effectively manage the risks related to heat stress to minimise the impact of heat stress on the comfort and health of employees.

5. Development of green competences as a way of ensuring the quality of work in a sustainable economy

In connection with the European Green Deal (the EU strategy for the transition to a sustainable, fair and prosperous society with a modern circular and competitive economy and a neutral balance of greenhouse gas emissions by 2050), the European Commission prepared two documents that address selected aspects of the social pillar of the green transition for the first time. The EC presented a **Proposal for a Council recommendation on ensuring a fair transition towards climate neutrality** at the end of 2021. This document presents a series of recommendations to ensure that the green transition is fair and does not leave out any individual or region. Another key European document aimed at promoting competences for just environmental transition is the **Proposal for a Council recommendation on learning for environmental sustainability**, presented by the European Commission in January 2022.

5.1. Proposal for a Council recommendation on ensuring a fair transition towards climate neutrality

According to the Proposal[60], the transition could create around 1 million jobs in the EU by 2030 and approximately 2 million jobs by 2050. The newly created jobs will be intended mainly for semi-skilled workers and will be valued at an average wage. This could help mitigate labour market polarisation that occurs as a result of other megatrends, in particular digitalisation, and increase incomes, reduce poverty. It is necessary to use all available tools and to put in place appropriate accompanying policies at EU, Member State, regional and local levels to make full use of the potential of the green transition in employment and social area. Otherwise, the lack of well-designed accompanying employment and social policies will be accompanied by socio-economic risks. The

[60]EVROPSKÁ KOMISE. Doporučení Rady ohledně zajištění spravedlivé transformace na klimatickou neutralitu. Online. EUR-LEX. 2021. Dostupné z: https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:52021DC0801. [cit. 2024-04-10].

pessimistic scenario assumes that the consequences of the green transition on climate neutrality, combined with an inappropriate combination of policies, could mean a decrease in GDP in the EU by up to 0.39% and the loss of jobs by up to 0.26%. With regard to these facts, part of the EC recommendation is also aimed at the labour market and the development of green competences.

The European Commission has called on the Member States to take the following measures:

- **active support to quality employment for a fair transition**:
    - support access to quality employment, notably through tailored job search assistance and flexible and modular learning courses (employment programmes) that also target green and digital skills where appropriate;
    - stimulate job creation, especially in territories most affected by the green transition and, where appropriate, in sectors supporting climate and environmental objectives;
    - ensure the effective implementation and enforcement of existing rules on working conditions, especially those concerning OSH, work organisation and worker engagement, in order to safeguard job quality in the transition;
    - ensure the full and meaningful involvement of workers and their representatives as regards the anticipation of change and the management of restructuring processes, including those linked to the green transition.
- **provide equal access to quality and inclusive education, training and life-long learning as well as equal opportunities**:
    - integrate the employment and social aspects of the green transition in the development and implementation of the national skills strategies;
    - develop up-to-date labour market and skills intelligence and foresight, identifying and forecasting occupation-specific and transversal skills needs. Build on and work with existing tools and initiatives, including the expertise of and cooperation with social partners and relevant stakeholders. Adapt education and training curricula accordingly;

- provide high-quality and inclusive initial education and training, including vocational education and training, which equips learners with skills and competences relevant for the green transition;
- introduce or strengthen support schemes for apprenticeships and paid traineeships with a strong training component, in particular in micro, small and medium-sized enterprises, including those contributing to climate and environmental objectives and in sectors facing particular skill shortages, such as construction and ICT;
- increase adult participation in training throughout the working life, in line with the upskilling and reskilling needs for the green transition. To this end, provide training entitlements in line with the proposed Council Recommendation on individual learning accounts and in the form of paid training leave and career guidance. Support the development of short, quality-assured and widely recognised courses building on the European approach to micro-credentials.

- **policy-making**:
  - involve social partners at national, regional and local levels in all stages of policy-making foreseen under this recommendation, including through social dialogue and collective bargaining where adequate.[61]

[61] EVROPSKÁ KOMISE. Doporučení Rady ohledně zajištění spravedlivé transformace na klimatickou neutralitu. Online. EUR-LEX. 2021. Dostupné z: https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:52021DC0801. [cit. 2024-04-10].

5.2. Proposal for a Council recommendation on learning for environmental sustainability

Another key European document aimed at promoting competences for just environmental transition is the **Proposal for a Council recommendation on learning for environmental sustainability**[62], presented by the European Commission in January 2022. This document was created as a response to the fact that learning for environmental sustainability is not yet a systemic feature of policy and practice in the EU.

Therefore, the European Commission hereby recommends that Member States:

- Urgently step up efforts to support education and training systems to take action for the green transition so that learners of all ages and from all backgrounds can access high-quality and inclusive education and training on climate change, biodiversity and sustainability;
- Establish learning for environmental sustainability as a priority area in education and training policies and programmes in order to support and enable the sector to contribute to the green transition;
- Develop a comprehensive and collaborative approach to learning for environmental sustainability involving all bodies, organisations and players in the education and training system;
- Fully align strategies and plans in education and training with environmental sustainability, including those related to curricula;
- Develop comprehensive curricula frameworks, allowing the time and space for in-depth learning for environmental sustainability so learners can develop sustainability competences;
- Support cooperation and networking on sustainability and biodiversity;

[62]EVROPSKÁ KOMISE. Doporučení Rady o učení v zájmu environmentální udržitelnosti. Online. EUR-LEX. 2022. Dostupné z: https://eur-lex.europa.eu/legal-content/CS/TXT/PDF/?uri=CELEX:52022DC0011. [cit. 2024-04-10].

- Strengthen, including through financial support, high-quality lifelong learning for environmental sustainability, including traineeships, apprenticeships and other forms of learning;
- Support higher education and VET institutions in the development of small and tailored learning courses on environmental sustainability, leading to micro-credentials, in order to deepen, broaden and update professional competences.
- Support partnerships of educational institutions and schools (incl. vocational ones) with enterprises and other entities in education. Provide support for internships in, for example, enterprises and other organisations.

6. Attitudes, roles and activities of trade unions

Trade unions can play a key role in the process of environmental transition, in particular support the social pillar of the transition in response to climate change. By engaging in strategic planning, educating members, social dialogue and international cooperation, they strive for a just transition. The International Labour Organization (ILO) and the European Trade Union Institute (ETUI) provide them with tools and opinions in this endeavour. The European Trade Union Confederation (ETUC) formulated recommendations for education, social dialogue and financing. We can find inspiration for bottom-up measures in the examples of successful involvement of trade unions at local and corporate level.

6.1. Areas of trade union agenda in the just transition

According to the European Trade Union Institute (ETUI) of the European Trade Union Confederation (ETUC), trade unions are increasingly aware that they must be more active in addressing the challenges and opportunities of climate change and just transition. On the one hand, there are many positive experiences and innovative practices from around the world in which trade unions proved their ability to address environmental changes and promote a just transition and in which they respond to environmental changes in a sustainable way, through decent work. However, employee organisations are still struggling to be adequately heard in climate forums in many countries.

The ETUI defined several **dimensions of just transition** that need to be developed within the trade union agenda:[63]

- Thinking strategically about climate change and a just transition and its impact on workers, workers' organisations and the world of work per se;
- Creating awareness among its members and the broader public abound climate change impacts on the labour market, jobs and on workers;

[63]MEZINÁRODNÍ ORGANIZACE PRÁCE. Just transition – a priority for trade unions in transformation. Online. 2023. Dostupné z: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/projectdocumentation/wcms_905552.pdf. [cit. 2024-04-10].

- Being proactive in addressing challenges and opportunities related to the just transition in the world of work such as anticipating structural change and developing mitigating and adaptation measures for workers and their families;
- Strengthening effective and inclusive social dialogue and collective bargaining at all policy levels to assure a just transition with decent working conditions. From greening jobs at the workplace level, advocating for an enabling legal and institutional environment and responsible public procurement at the national level, to involvement at the international level in the framework of the Sustainable Development Goals;
- Developing innovative collaborations, coalitions and campaigns among trade unions, broader civil society organisations, employers and other stakeholders;
- Participating in climate change fora at different levels, including the annual Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), to advocate for workers' interests;
- Catering to the needs of workers through innovative services to protect existing members, such as when employers decide to restructure companies;
- Proactively seeking to attract new members in emerging industries, such as the circular economy.
- Using ILO tools to guide and advocate for the development, implementation and monitoring of just transition policies through social dialogue at all levels, including in the framework of the Nationally Determined Contributions of the Paris Agreement[64].

[64] MEZINÁRODNÍ ORGANIZACE PRÁCE. Just transition – a priority for trade unions in transformation. Online. 2023. Dostupné z: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/projectdocumentation/wcms_905552.pdf. [cit. 2024-04-10].

With regard to the **ILO tools** mentioned above, the ETUI includes three sets of tools:

- ILO Guidelines for a just transition towards environmentally sustainable economies and societies for all (2016)[65];
- International Labour Standards;
- Newly adopted Conclusions concerning a just transition towards environmentally sustainable economies and societies for all (2023)[66].

The ILO adopted the **Conclusions concerning a just transition** towards environmentally sustainable economies and societies for all in June 2023. The resolution is one of the main current starting points for defining the role of trade unions in managing the fair green transition process because the third chapter of the resolution is focused on defining the relevant requirements for governments, including the role of trade unions and employers.

According to the ILO, trade union and employers' organisations should:

- Effectively engage in social dialogue in all its forms, including collective bargaining, to share the benefits of technological progress, green transitions and demographic changes and advance just transition and decent work at enterprise, sectoral and national levels;
- Develop the capacity of their members to analyse and respond to the impacts of environmental and climate change;
- Design and implement their own initiatives for a just transition, including sector-specific initiatives, and to contribute to balanced policymaking;
- Contribute as key partners to training and reskilling activities, and cultivate a culture of lifelong learning for workers of all ages;

[65]MEZINÁRODNÍ ORGANIZACE PRÁCE. Guidelines for a just transition towards environmentally sustainable economies and societies for all. Online. MEZINÁRODNÍ ORGANIZACE PRÁCE. 2016. Dostupné z: https://www.ilo.org/global/topics/green-jobs/publications/WCMS_432859/lang--en/index.htm. [cit. 2024-04-10].

[66]MEZINÁRODNÍ ORGANIZACE PRÁCE. Resolution concerning a just transition towards environmentally sustainable economies and societies for all. Online. MEZINÁRODNÍ ORGANIZACE PRÁCE. 2023. Dostupné z: https://www.ilo.org/global/topics/green-jobs/publications/WCMS_432859/lang--en/index.htm. [cit. 2024-04-10].

- Develop and implement sustainable transition plans at enterprise and sectoral level through bipartite social dialogue, including workplace cooperation.

Furthermore, the ILO recommends that governments, through the involvement of trade unions and employers, implement the following measures:

- Formulate, implement, monitor and evaluate green transition frameworks (gender responsive, inclusive, integrated and coherent), coordinated with relevant economic, social and environmental policies;
- Integrate measures into environmental and climate policies (e.g. nationally determined contributions to the Paris Agreement, net-zero targets) and into employment, social protection and industrial policies to advance a just transition;
- Establish mechanisms for intra-governmental collaboration and coordination of policies for a just transition at national, regional and local levels;
- Establish pro-employment macroeconomic frameworks and promote appropriate use of fiscal and monetary instruments, including an appropriate combination of taxes, subsidies, incentives and loans to ensure space for a just transition towards environmentally sustainable activities and to incentivise structural transformation and to reduce inequalities;
- Promote full, productive and freely chosen employment and decent work as a core objective of a just transition;
- Promote the development of sustainable enterprises and create an enabling environment for innovation and entrepreneurship including improved access to finance and business development services, particularly to pursue environmentally sustainable business models;
- Employ active labour market policies to ensure adequate protection of all workers, to ease and accelerate the transition, paying due attention to youth, women and persons in vulnerable situations;
- Formulate and implement sustainable industrial and/or sectoral policies and productive development policies to facilitate and manage a just transition to environmental sustainability and circular economy;

- Support inclusive and sustainable trade and investment frameworks, value chains and supply chains that contribute to a just transition and decent work;
- Promote technological development and access to environmentally-sound technologies, cleaner production and resource efficiency, while ensuring decent work benefits and work–life balance;
- Invest in sustainable infrastructure and quality public services to provide a foundation for a just transition;
- Ensure universal access to comprehensive, adequate and sustainable social protection systems to safeguard populations against adverse impacts, reduce vulnerability and strengthen resilience to facilitate a just transition;
- Promote a conducive environment for social and solidarity economy entities to strengthen their capacity to contribute to the just transition;
- Design coherent and integrated strategies to facilitate the transition to the formal economy and prevent the informalisation of formal economy jobs, paying particular attention to sectors that are highly impacted by environmental and climate change;
- Promote skills and lifelong learning, including quality apprenticeships, which are conducive to personal development and responsive to identified labour market needs as enablers for a just transition and green jobs and as a protection against adverse impacts of change;
- Anticipate skills needs and identify skills mismatches, invest in and strengthen systems to provide equitable access to portable, core, semi-technical and technical skills for all individuals; monitor, evaluate and enhance systems' effectiveness;
- Actively promote freedom of association and inclusive and effective social dialogue, including collective bargaining and tripartite cooperation, at all levels to forge social consensus for ambitious policies and measures for a just transition;
- Consult with affected communities, youth and other relevant stakeholders;
- Respect, promote and implement the fundamental principles and rights at work and accelerate the ratification and effective implementation of international labour standards;

- Formulate, implement, monitor, adapt and periodically review national policies for occupational safety and health which prioritise a preventative approach, identify and manage new and emerging risks from climate change and invest in occupational safety and health capacity development and training;
- Urgently implement occupational safety and health measures for all workers impacted by climate-related risks and extreme weather events addressing the consequences on mental and physical health and promoting safe and healthy working environments;
- Ensure that persons belonging to one or more vulnerable groups or groups in situations of vulnerability can participate in the development of and benefit from gender responsive, inclusive just transition measures;
- In line with the Paris Agreement, mobilise sustainable, affordable, predictable and long-term finance from public and private, domestic and international sources and align public and private financial flows and public procurement to the objectives of a just transition;
- Promote international cooperation and global solidarity supporting developing countries most vulnerable to the effects of environmental and climate change.

6.2. Trade unions' position and recommendations on the social dimension of fair transition

ETUC presented its position[67] on two European Commission documents focusing on the social dimension of fair environmental transition in March 2022. Namely on the Proposal for a Council recommendation on ensuring a fair transition towards climate neutrality (2021) and the Proposal for a Council recommendation on learning for environmental sustainability (both documents are addressed in more detail in Chapter 5: Development of green competences as a way of ensuring the quality of work in a sustainable economy).

[67]ETUC. ETUC Position on Equipping workers with necessary skills for the green transition. Online. ETUC. 2022. Dostupné z: https://www.etuc.org/en/document/etuc-position-equipping-workers-necessary-skills-green-transition. [cit. 2024-04-10].

In its opinion, ETUC states that the reduction of rapidly growing greenhouse gas emissions in the EU is the highest priority for European trade unions. However, this process must be socially fair and, in the opinion of ETUC, the European Green[68] Deal has not been accompanied by an adequate social policy that would make the transition fair. ETUC acknowledges that the two above-mentioned proposals of the European Commission seek to respond to the missing social pillar of the transition in this sense. In addition to appreciating the Commission's proposals that are compatible with the trade unions' priorities, the opinion also presents partial reservations and proposals for its own complementary recommendations.

ETUC gives the following opinions in the document:

- Climate transition policies will have a strong impact on workers. They will require massive training, re-skilling and up-skilling. Transition should be used as an opportunity to create quality jobs with good working conditions in all sectors and regions. **Employers should play a key role**. The emphasis of the two new European initiatives on individual learning accounts and on micro-credentials can leave workers solely responsible for their own skills development, while the changes in their jobs are impacted by climate policies that are disconnected from their social consequences.
- Employee training is a key element of any mitigation policy. Workers in sectors that will be adversely affected need **effective support** to access training, re-skilling and up-skilling programmes. Although the Proposal for a Council recommendation on learning for environmental sustainability also deals with VAT and adult education, ETUC notes that the EU initiatives do not deal with employee training when it comes to the green transition of industries.
- ETUC calls for the necessary **green competences to be more specified in more detail**. Discussing skills for jobs in the regions and sectors affected by the green

[68]EVROPSKÁ KOMISE. Zelená dohoda pro Evropu: chceme se stát prvním klimaticky neutrálním kontinentem. Online. 2024. Dostupné z: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_cs. [cit. 2024-04-10].

transition requires concrete identification of skills needs and going beyond the narrow prism of basic and digital skills. **Anticipating the necessary skills will be crucial** for a successful green transition. Skills changes in the economy will need to match upcoming changes in mitigation and adaptation to climate change and in the shift to a circular economy.

- The skills challenge of the coming decade is enormous, but it is feasible if the right policies are in place. ETUC calls for regional and local differences to be taken into account and for supporting the most impacted regions. This requires effective policies and trade union involvement in the following areas:
    - **Competency requirement forecasting;**
    - **updating job and learning profiles**.

ETUC also formulates its opinions on individual aspects of social policies of fair transition. According to ETUC, a just transition in the context of social policies involves[69]:

- **rigorous socio-economic impact assessments and detailed just transition strategies** to anticipate changes and create alternative job opportunities in those regions and sectors that will be affected by these changes. ETUC requests for a **more detailed analysis of the effects on employment and skills at regional and sectoral levels**. The analyses will enable to prepare tailored regional strategies for the transition of employees from one job to another.
- **Guaranteeing the right to employee training, re-skilling and up-skilling**, as well as active labour market policies to ensure that workers are well equipped with the new skills needs. Learning about environmental sustainability is essential for all adults. The EU countries should **strengthen their adult learning strategies** and the **financing of adult learning.** Better access to employee training for all workers with different contractual situation needs to be guaranteed by the companies through collective agreements.

[69]ETUC. ETUC Position on Equipping workers with necessary skills for the green transition. Online. ETUC. 2022. Dostupné z: https://www.etuc.org/en/document/etuc-position-equipping-workers-necessary-skills-green-transition. [cit. 2024-04-10].

- **Validation of skills of the workers gained within everyday work** is crucial for ensuring that their skills are well recognised in new jobs with good working conditions. In this context, ETUC is concerned that only seven EU countries (Belgium, Spain, France, Italy, Luxembourg, the Netherlands and Romania) have a specific national budget line for validation, while other countries use a decentralised approach and short-term projects to support validation.[70]
- Effective **social dialogue and collective bargaining** to ensure a strong participation of workers at all stages of the process, including in adapting skills strategies, training funds, access to training and qualifications and their organisation. A smooth transition from one job to another is necessary to avoid periods of unemployment. ETUC request **that trade unions are involved in creating and managing skills strategies for the green economy** to set up the 'common principles and a shared language on sustainability' as recommended by the European Commission within the Council recommendation on learning for environmental sustainability. Social dialogue with the trade unions at company, sectoral and national level is essential to make this policy initiative effectively implemented. Social partners play a key role in defining skill needs, updating qualification profiles and providing guidance to workers.
- According to ETUC, a fair transition should be supported by **sufficient financial means**. The EU initiative should ask Member States to guarantee a sustainable public budget to support environmental responsibility education in adult learning, validation of informal and non-formal learning and guidance and counselling.
- ETUC emphasises that it is important to respect **national competences** when implementing the competence strategy for the green economy, in all its aspects. Access to full qualification needs to be a right to all adults and workers. ETUC recalls that trade unions support micro-credentials only when:

[70]ETUC. ETUC Position on enhancing validation of non-formal and informal learning. Online. ETUC. 2021. Dostupné z: https://www.etuc.org/sites/default/files/document/file/2021-03/EN%20ETUC%20Position%20on%20enhancing%20validation%20of%20non-formal%20and%20informal%20learning_1.pdf. [cit. 2024-04-10].

- they are complementary to full qualifications;
- their quality is assured;
- they are accredited;
- they are recognised as a proof of achievement and not only validated;
- they play a role in validation of non-formal and informal learning.

- ETUC believes that the EC document 'Proposal for a Council recommendation on learning for environmental sustainability' does not sufficiently cover the areas of **vocational education and training** and **adult learning**. It also does not present solutions for workers and the unemployed that would help them to acquire the skills needed for green transition. According to ETUC, upskilling and reskilling of the workers should be a social-economic responsibility and not an individual one. Therefore, workers should not be left alone to find and finance trainings on skills for the green transitions of industries. The Council Recommendation should put **more emphasis on the responsibility of the governments and companies** towards ensuring effective, quality and inclusive trainings for quality jobs and just transition.
- According to ETUC, **forecasting skill needs for new green jobs** and **linking them to industry and skills strategies** is essential in relation to this initiative. Social partners and public employment services need to be involved in forecasting skill needs and matching these with jobs and training provision for workers. ETUC appreciates that both Council recommendations focus on the importance of skills forecasting and recommends the European Commission **to set up a yearly indicator** (benchmark) until 2030 on the number of adults and employees participating in trainings on green skills, on green competences and environmental awareness and on responsibility (similar to how the EU set up the digital skills indicators).
- ETUC underlines the importance of adapting **vocational education and training (apprenticeship) programmes** towards the skills needed for the green transition.

The skills of vocational education and training pupils should also include environmental responsibility and climate awareness.[71]

6.3. Attitudes of employees to the need for climate action

One of the key promoters of workplace measures responding to climate change may be the employees themselves. Understanding workers' attitudes in this area is a crucial starting point for trade unions in adopting the green agenda within the just transition framework.

Deloitte analysed employees' attitudes to the issue of green transition of enterprises. The Deloitte survey[72] (March 2023) includes the following findings:

- More than two-thirds of survey respondents (69%) want their employers to invest in sustainability, including lower carbon production, renewable energy use and waste reduction. These requirements usually come from employees in the age group of 18 to 34 years.
- A total of 27% of respondents said that they would also consider potential employer's attitude to sustainability before accepting a job offer.
- A quarter of employees considered changing employer and finding a job with an organisation that has a better attitude to sustainability.
- Only 38% of employees consider their employers' sustainability efforts to be sufficient.
- A total of 45% of employees stated that they had never discussed the issue of sustainability with their superiors.

[71]ETUC. ETUC Position on Equipping workers with necessary skills for the green transition. Online. ETUC. 2022. Dostupné z: https://www.etuc.org/en/document/etuc-position-equipping-workers-necessary-skills-green-transition. [cit. 2024-04-10].

[72]DELOITTE. Engaged employees are asking their leaders to take climate action. Online. Deloitte Insights. 2023. Dostupné z: https://www2.deloitte.com/xe/en/insights/environmental-social-governance/importance-of-sustainability-to-employees.html. [cit. 2024-04-10].

- The Deloitte report also mentions data from its other surveys. For example, a survey among managers found that 42% of managers perceive the positive impact of a company's sustainability efforts on employee morale and well-being. A total of 38% of them believe that these efforts improved recruitment and retention activities.
- Almost 80% of managers say that employee activism in sustainability has already influenced or will soon influence corporate sustainability strategy.
- Almost 60% of managers reported that bottom-up employee activities led to an increase in the organisation's sustainability efforts, with 24% considering such pressure to be significant.
- Half of employers' representatives said they are already educating employees about sustainability and climate change. A further 41% plan to implement the training within two years.

It is clear that young people place the greatest emphasis on sustainability. Deloitte's[73] latest Gen Z and Millennial survey also reveals other significant findings beyond the above survey, for example:[74]

- Around 60% of young people admit that the state of the environment stresses them and causes anxiety.
- About 70% are actively trying to minimise their impact on the environment.
- Climate concerns play an important role in their career decisions. About 55% of respondents say that before accepting a job offer, they find out what the brand's impact on the environment is and what policy it applies.
- One in six Gen Z and millennials said they have already changed jobs or industries due to climate concerns. Less than a quarter said they plan to do so in the future.

[73]DELOITTE. 2023 Gen Z and Millennial Survey. Online. DELOITTE. 2023. Dostupné z: https://www.deloitte.com/global/en/issues/work/content/genzmillennialsurvey.html. [cit. 2024-04-10].

[74] ve studii je generace Z definována jako osoby narozené mezi lednem 1995 a prosincem 2004. Generace Mileniálů je tvořena lidmi narozenými mezi lednem 1983 a prosincem 1994.

- Young people see environmental sustainability as a priority but have economic problems in meeting it. Almost 60% of millennials and Gen Z are willing to pay extra for more sustainable products and services, but almost the same percentage say that their economic situation makes it difficult or even impossible for them.
- Nearly half of the respondents stated that they and their colleagues have put pressure on the employer to implement measures responding to climate change.
- Young employees most often expect their employers to:
    - Offer employees green benefits, such as giving employees contributions to sustainable measures (e.g. subsidies for electric cars, solar panels, ecological thermostats, contributions for using public transport, etc.).
    - Educate/train employees on how to act more sustainably.
    - Stop using/reduce disposable plastic products at the workplace.
    - Reconstruct office space to make it more environment-friendly (e.g. building management systems to ensure efficiency, etc.).
    - Green local communities/municipalities in the area of activity.

The youngest generation of employees expects employers to play a key role in providing vocational education and training in the skills needed to implement the green transition. Approximately half of millennials and Gen Z members report that these skills are provided by their employers; however, as reported by Deloitte[75], if around 800 million jobs are threatened by climate change globally, the development of green skills will still be a key priority.

[75]DELOITTE. Work toward net zero. Online. 2022. Dostupné z: https://www.deloitte.com/global/en/issues/climate/work-toward-net-zero.html?id=gx:2el:3pr:4work_toward_net_zero:5GC1000045:6abt:20221101:gc1000136. [cit. 2024-04-10].

6.4. Examples of implementation of just transition into trade union agendas

The International Labour Organization pointed to various specific examples of implementing the topic of just transition into trade unions' activities:[76]

- Trade unions negotiated impact mitigation through social protection or re-skilling by successfully forecasting skills needs and negotiating trade and investment agreements that include green clauses for their members in sectors particularly affected by the green transition (e.g. coal mining).
- Trade unions gained new members in emerging industries (e.g. wind and solar energy, circular economy).
- Trade unions expand their scope to include structural changes and the importance of policy measures for industry, e.g. in the production of electric cars. Trade unions identified sector-specific consequences of digitalisation and ensured that these consequences are adequately reflected in international framework agreements (IFA).
- Innovative and inclusive social dialogue is an essential tool for ensuring that environmental change, as part of a just transition, goes hand in hand with respect for workers' rights. Many trade unions start to integrate environmental issues into collective agreements, establish cooperation and coalitions with citizens' associations in the form of joint campaigns focused on environmental justice. An example of such a connection is the activity of trade unions in the USA (Washington state), when trade unions joined forces with environmental organisations to negotiate a green transition programme. It includes early retirement, but also securing investment in the local community and the wider region through vocational education and training, including through financial means of employers.

[76]MEZINÁRODNÍ ORGANIZACE PRÁCE. Just transition – a priority for trade unions in transformation. Online. 2023. Dostupné z: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/projectdocumentation/wcms_905552.pdf. [cit. 2024-04-10].

Trade unions in Los Angeles, USA are one of the participants in the Los Angeles' Just Transition Task Force, which is co-chaired by the city and the Los Angeles County. The task force develops a strategy for workers who will be transitioning from the fossil fuel industry, with a particular focus on oil extraction. It was established after the city government voted to end oil and gas production, which was supported by local health and environmental justice groups. Its members are representatives of the city and county, local communities, trade unions, indigenous people, industry and other important stakeholders. The task force examined demographic data on workers at risk of losing their jobs (both trade union members and non-members), financial and social impacts of the closure of urban oil wells on workers. It has served as an important platform for dialogue and involvement of multiple stakeholders.[77]

- The construction sector in the EU expanded the social dialogue to include green topics in the following areas:
    - sectoral changes in technologies
    - digitalisation
    - working conditions
    - skills development
- In Australia's 'Hazelwood case'[78] (a groundbreaking legal case in one of the first climate law disputes over the fate of the Hazelwood coal-fuelled power station in Australia), social dialogue helped to mitigate the impacts of environmental change

[77]C40KNOWLEDGE. Good green jobs: How to ensure an equitable, just transition for workers. Online. C40KNOWLEDGE. 2022. Dostupné z: https://www.c40knowledgehub.org/s/article/Good-green-jobs-How-to-ensure-an-equitable-just-transition-for-workers?language=en_US. [cit. 2024-04-10].

[78]ENVIRONMENTAL LAW AUSTRALIA. The groundbreaking Hazelwood Power Station case [online]. Dostupné z: http://envlaw.com.au/hazelwood-power-station-case/ [cit. 2024-04-10].

and structural transformation on workers and their families through skills development, job creation and early retirement schemes.

- According to the ILO, trade unions, in order to remain relevant in the future, must strive to improve working and living conditions through decent work for all workers, including the most vulnerable, in the green economy and beyond. Trade unions from California are very active in this regard. The trade unions here formed coalition with the environmental justice movement to strengthen the social contract for decarbonisation and ensure that the costs of decarbonisation are not disproportionately passed on to low-income and blue-collar households.[79]

Further examples of the implementation of the green transition agenda in social dialogue on the part of trade unions are presented in the European Parliament study '*Unionisation and the twin transition: Good practices in collective action and employee involvement*'[80] (2022). In addition to examples at the macro level of social dialogue on the topic of green transition, the study also deals with the micro level. The following infobox presents an interesting solution developed at Siemens Energy AG.

Siemens Energy AG

Siemens Energy AG employs 91,000 people in 90 countries worldwide. The company is committed to become carbon neutral by 2030; more than 50% of Siemens Energy's portfolio was already decarbonised by 2022. The largest trade union IG Metall and the works council initiated a dialogue with Siemens Energy management on the topic of preserving as many jobs as possible and the company's responsibility to meet its ambitious environmental and digital goals. Employees are involved in the company's

[79]MEZINÁRODNÍ ORGANIZACE PRÁCE. Just transition – a priority for trade unions in transformation. Online. 2023. Dostupné z: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---actrav/documents/projectdocumentation/wcms_905552.pdf. [cit. 2024-04-10].

[80]BEDNORZ, Jan; SADAUSKAITĖ, Audroné a kol. Unionisation and the twin transition: Good practices in collective action and employee involvement. Online. EVROPSKÝ PARLAMENT. 2022. Dostupné z: https://www.europarl.europa.eu/RegData/etudes/STUD/2022/733972/IPOL_STU(2022)733972_EN.pdf. [cit. 2024-04-10].

green transition through the works council and SEV (Siemens Energy Ventures) programmes.

There is an innovation fund at Siemens Energy AG that provides funds for the development and testing of new technologies, including those proposed by employees themselves.

In addition, funds will be allocated to support structural transformation, part of which is intended for the development of employees' skills in relation to the digital and environmental transformation taking place in the company. The task of employee council representatives is to ensure that the ideas of employees reach the management and that sufficient financial means are available through this fund to respond to the learning needs expressed by employees.

Siemens Energy Ventures (SEV) is an example of direct employee involvement in the development of technologies at Siemens Energy. SEV started in 2020 and is open to all employees and supports transformation teams to develop business opportunities providing sustainable, reliable and affordable energy. One example of an employee-led project promoted by SEV is 'connect2evolve', which used blockchain technology to finance the installation of a solar mini-grid in Ndiob, Senegal. The SEV innovation framework is based on employees' ideas that are further developed through the Let's Innovate SE! movement. The aim of the programme is to unleash the employees' potential to create and take responsibility for the future of energy. More than 5,000 employees have participated in the SEV 'Let's Innovate SE!' events since November 2020 to learn, connect and innovate.

Another inspiring example is the production of guidances for trade unionists, responding to risks to the health and safety of workers related to temperature rise.

TUC guidances for representatives of trade unions in OSH

The British Trades Union Congress (TUC) prepared guidances on the issue of high workplace temperatures[81] and on the issue of skin cancer in outdoor workers[82]. These guidances are designed as a basic information tool used by representatives of trade unions in occupational safety and health. The guidances include the main concepts, describe the essence of the problem for the health and safety of workers, connect topics to legislation. They explain the role and possibilities of trade union representatives for health and safety at work as well as the expectations of trade unions on the part of employers in preventing both risks.

They are described in detail in the appendices to this study.

List of figures

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[82]TUC. Skin Cancer and Outdoor Workers: Guidance for safety representatives. Online. TUC. Dostupné z: https://www.tuc.org.uk/sites/default/files/extras/skincancer.pdf. [cit. 2024-04-10].

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Appendix I: Cool it!: A TUC guide for trade union activists on dealing with high temperatures in the workplace

Contents:

Section one Introduction

High temperatures can be a major problem in the workplace. It can be an issue in some places, like foundries, all year round, and in others during the summer months when outside temperatures soar.

When the temperature rises too much then it can become a health and safety issue. If people get too hot, they risk dizziness, fainting, or even heat cramps. In very hot conditions the body's blood temperature rises. If the blood temperature rises above 39° C, there is a risk of heat stroke or collapse. Delirium or confusion can occur above 41° C . Blood temperatures at this level can prove fatal and even if a worker does recover, they may suffer irreparable organ damage.

However even at lower temperatures heat leads to a loss of concentration and increased tiredness, which means that workers are more likely to put themselves or others at risk. High temperatures mean there is an increase in the likelihood of accidents due to reduced concentration; slippery, sweaty palms as well as an increase of discomfort of some personal protective gear

which can result in reduced protection through inappropriate usage or non-usage.

Heat can also aggravate other medical conditions and illnesses such as high blood pressure or heart disease due to increased load on the heart as well as interacting with, or increasing the effect of other workplace hazards. Workers at greater risk of heat stress include those who are 65 years of age or older, are overweight, have heart disease or high blood pressure, or take medications that may be affected by extreme heat. In addition high temperatures are associated with a reduced sperm count and can be dangerous during pregnancy.

Scientific studies confirm that indoor temperature can significantly impact on productivity and the best performing ‘comfort zone’ lays between 22° C and 25° C. When the temperature went above that productivity fell. By 28° C there was already a 5% decrease, and the higher the temperature the lower the output.

At the same time working in the sun can, for many people, increase their risk of skin cancer, while the glare from the sun can be a problem for drivers and those working on roofs where roof lights can blend into the surrounding roof in bright sunlight.

It is usually accepted that people work best at a temperature between 16° C and 24° C, although this can vary depending on the kind of work being done. Strenuous work is better performed at a slightly lower temperature than office work. The Chartered Institute of Building Services Engineers recommends the following temperatures for different working areas:

- Heavy work in factories: 13° C
- Light work in factories: 16° C

 Hospital wards and shops: 18° C
 Offices and dining rooms: 20° C

Section two The legal position

An employer must provide a working environment which is, as far as is reasonably practical, safe and without risks to health. In addition, employers have to assess risks and introduce any necessary prevention or control measures, and the risk from high (or low) temperatures, and of skin cancer due to exposure to the sun, should always be considered in any risk assessment,

Unfortunately, there is no maximum temperature for workers although the Workplace (Health, Safety and Welfare) Regulations state the temperature inside workplace buildings must be ‘reasonable’. In addition, the approved code of practice to these regulations states that ‘all reasonable steps should be taken to achieve a comfortable temperature’.

The TUC has called for a maximum temperature of 30° C (27° C for those doing strenuous work), so that employers and workers know when action must be taken. However even if the temperature is slightly below that, employers should still attempt to reduce temperatures if they get above 24°C and workers feel uncomfortable.

The Approved Code of Practice to the Workplace Regulations gives examples of what employers must do to ensure a reasonably comfortable temperature for indoor workers. This includes:

 Insulating hot plants or pipes
 Providing air cooling plants
 Shading windows
 Sighting workplaces away from places subject to radiant heat.

Where this is not sufficient, it states that employers must install local cooling systems, increase ventilation, or fans. The code of practice also says that other factors, such as protective clothing, physical activity, radiant heat, humidity, air movement, and length of time of a person doing a job must all be taken into account when assessing what a ‘reasonable temperature’ is.

In addition, the Code of Practice requires employers to provide a suitable number of thermometers to enable workers to check temperatures in indoor workplaces.

The regulations require employers to provide ‘effective and suitable ventilation’, but safety representatives should ensure this is not achieved simply by opening doors, which may be acting as fire doors.

There is also guidance to the regulations that say that protection from the excessive effects of the sun in buildings can be achieved by introducing shading and using reflective materials. Some examples of the measures which can achieve this, either in isolation or in combination, are

 introducing awnings;
 internal or external louvered blinds;
 using dense vegetation, e.g. trees to provide shading;
 use of anti-reflective glazing, e.g. by using films or upgrading glazing;
 introducing overhangs or recesses to windows;
 reducing unnecessary glazing on the sides of the building receiving the most sunshine;

 improving the overall thermal mass of the building by using energy-efficient materials which allow heat to be stored and released at cooler times of the day.

The guidance even says that employers should consider heat when commissioning the design and construction of a new building and consider minimising solar effects by suitable positioning, type of glazing and the materials used.

Although the Workplace (Health, Safety and Welfare) Regulations only apply to indoor workplaces, that does not mean that employers do not also have a duty to employers working outside. All employers have a general duty to protect the health and safety of the workforce under the Health and Safety at Work Act, and also to assess and control risks from working in hot temperatures, or exposure to the sun, under the Management of Health and Safety at Work regulations. This includes drivers where working in a very hot cab can make the person more likely to have an accident.

Many outdoor workers, in particular agricultural workers, may be employed through agencies. Where this happens both the agency and the employer will have a legal duty to protect the worker.

There are also other regulations which employers have to comply with in hot conditions. These include:

 The Personal Protective Equipment at Work Regulations require employers to select protective equipment that is suitable for risks, for the workers using it, and for the working environment. This means that if personal protective equipment is being used in hot weather, whether inside or out, it must be designed to allow workers to keep as cool as possible. This means that when groups such as refuse collectors have

to wear special padding to protect themselves from injury from sharps, the trousers are designed to ensure that they are still as comfortable in hot weather as possible.

 The Manual Handling Regulations require employers to take into account other factors including hot and humid conditions.

 The Display Screen Equipment Regulations require that ‘equipment belonging to any workstations shall not produce excess heat which could cause discomfort to operators or users’.

 The Management of Health and Safety at Work Regulations specifically state that employers have to assess any risks to pregnant women from extremes of heat as pregnant women tolerate heat less well. The same regulations state that young workers must not be employed in situations where they are likely to be exposed to extremes of heat.

The *Health and Safety Executive* (HSE) has two very useful tools on its website (https://www.hse.gov.uk/temperature/) that any employer who has a heat problem should use. One is the ‘thermal comfort checklist’ and the other is the ‘thermal stress checklist’.

Section three The scale of the problem

It is clear from reports from trade unions that high temperatures are a major problem. In the 2016 TUC safety representatives survey, 16% of safety representatives cited high temperatures as one of their top concerns. In some sectors it was particularly high including central and local government, education and manufacturing. Often the biggest problem was in post-war buildings with a high glass content.

A survey of almost 6,000 teachers, school and college leaders and Health and Safety Representatives, found that 94% of respondents reported that they had worked in excessively high temperatures during the summer, with 42% doing so regularly.

The TUC also asked trade unions for examples of where members were exposed to excessive heat. Among the several hundred examples reported were the following:

 A union representative reported on a survey of twenty seven telephone exchanges. The temperatures ranged from the lowest at 21°C increasing to 36°C. The average reported temperature was 28.64°C and 76% of the buildings were over the WHO recommended standard.

 Another representative reported that the tissue culture and virology rooms they were working in reached 32°C last summer, which was made even more unbearable by the fact that the room was full of ethanol fumes.

 A union representative in a chicken factory reported that the high temperatures were leading to reports from the union members of both tiredness and dizziness because of the high temperatures. This was in a factory where there was a lot of hard physical activity.

 A secondary school in Birmingham has its ICT rooms on the top (2nd) floor. At least one of the rooms has two walls that are almost entirely glass. This room receives direct sunlight in summer for the most part of the school day. The safety representative reported that when external temperatures in summer exceed 22°C the room's temperature rises to 31/32°C and on occasions even higher. There is no air conditioning and whilst blinds keep out the sun they trap the heat generated by the 20 computers in the room.

In all these cases the union had tried to get improvements, but without legislative back up and support from the HSE or local authority inspectors, progress is usually impossible. The difficulty with the present regulations is that, without a specific maximum figure, they are impossible to enforce unless a worker is seriously injured or killed by heat stress. Safety representatives who have reported problems with heat to the enforcement authority have said they were unwilling to intervene when asked, and there is no evidence of any enforcement action in this area.

Unfortunately, the actual health effects of extreme heat are difficult to quantify or prove as the main short term symptoms, dizziness, headaches and nausea are often also associated with other conditions and those who suffer from the effects of extreme heat rarely report it or record in accident books.

Given the fact that average temperatures are likely to increase over coming years as a result of global warming this is a problem that is likely to increase. It is also a problem that is usually relatively easy to resolve. Often simple steps, such as having windows that can be opened, fans, moving staff away from windows or sources of heat or installing ventilation or air-cooling will be effective.

If there were a maximum temperature it would also help ensure that the issue of temperature was taken into account during the design stage for new buildings or during refurbishment.

LEGAL PROTECTION NEEDED

Trade unions want to see a legal maximum temperature for indoor work of 30°C (27°C for those doing strenuous work), so that employers and workers know when action must be taken. It should be stressed that this is

intended as an absolute maximum rather than an indication that regular indoor work at just below 30°C would be acceptable.

There should also be a new legal duty on employers to protect outside workers by providing sun protection, water, and to organise work so that employees are not outside during the hottest part of the day.

However these will only help if there is proper inspection and enforcement of the workplace.

Section four Advice for safety representatives Indoor work

Heat is one of the biggest causes of complaint to safety representatives during the summer. However, the air temperature which you can measure from a thermometer is only one part of what safety representatives have to take into account. Humidity, heat sources, clothing, any breeze or wind, can all have an effect on how heat affects someone. In addition, the effects of heat vary depending on the weight and age of a person.

It is possible to get a more accurate assessment of the situation in the workplace using a wet bulb globe thermometer or an electronic equivalent, which measures humidity. The comfort range for humidity is between 40% and 70%.

However, most union health and safety representatives will not have access to sophisticated monitoring equipment and the best rule of thumb in deciding if it is too hot, is whether or not your members feel comfortable. If they don’t, then something should be done to protect them.

The following check-list gives some ideas of what a health and safety representative might want to suggest to an employer if there are problems about heat or humidity. However, before you approach their employer, you

may wish to find out from your members where the worst problems are, what times of the day are worst, and what the causes are.

Measures that might want to be considered could include:

- ✓ Introducing a properly designed air conditioning system into the building: In some buildings this is not possible, either because of the age or type of the building, or because of planning restrictions. A properly maintained air conditioning system is a very effective way of reducing temperatures. However, air conditioning systems do use a very high level of power and other, more environmentally friendly, solutions should also be considered.
- ✓ Relaxing dress codes: Often there is no reason why employers have to insist on workers wearing ties, tights, or jackets for work. The issue is whether or not the clothing is acceptable in the context of the job a person does. For instance, insisting that security guards and porters wear a uniform, with a jacket, in the heat of the summer sun is clearly unnecessary and inappropriate.
- ✓ Redesigning the work area: Often simply moving people away from windows, or reducing heat gain by installing reflective film or blinds to windows can be a very effective way of keeping a workplace cooler.
- ✓ Install fans or natural ventilation: Providing fans or windows that open can also help workers feel cooler, however both these become less effective at higher temperatures. 8 Double click into the footer to put in the title and your subtitle Portable air-cooling cabinets are also available, which are more effective.
- ✓ Allowing staff to be more flexible in their working arrangements: Often staff have to travel to work in overcrowded trains or buses. Allowing

them the flexibility to finish either earlier or later can help, as can allowing them more frequent rest breaks.

- ✓ If none of these measures are sufficient to reduce the level of heat, and staff are still uncomfortable, then the employer should ensure that a competent heating and ventilation engineer is employed to survey the workplace and recommend a permanent solution to the problem.
- ✓ Workers in some indoor situations such as some factories, mines, boiler rooms, kitchens and laundries are at even more risk of heat stress or dehydration. The employer should always seek professional advice on both reducing heat and protecting workers in these situations, and workers should be given information about avoiding heat stress and dehydration, and on how to recognise early symptoms.

- **Section five Advice for safety representatives Outdoor work**

Note: This section of the Handbook is largely identical to the Skin Cancer Handbook (Study Appendix No. 1). Therefore, duplicate information is not listed here. Beyond the description of the topic of outdoor work, only recommendations for employers' measures related to the topic of high temperatures are mentioned below.

- Workers should take regular breaks, especially if they work outside in the heat.
- Employees should always have access to cool, fresh water. It is important to replace water lost through sweating, so the employer should always ensure a regular supply of fresh water for all outdoor workers.
- The appropriate properties of protective clothing (lightweight, long-sleeved, UV-resistant, allowing body heat to be dissipated) motivate

workers to wear it. The employer may also ask employees to remove them when resting to encourage heat dissipation, as long as it is safe to remove the garment.

DRIVING

Heat stress can also be a problem for workers who drive as part of their job. This is particularly dangerous as any driver suffering from fatigue, giddiness, or fainting, is clearly a major risk to both themselves and other people. Employers should provide cars, vans or lorries with air conditioning, or, if a driver is likely to be stuck in traffic for any length of time, make sure they are not driving in very hot weather. material on the risks of skin cancers from the websites of organisations such as Cancer Research UK or the HSE.

More information:

For more information on health and safety, please visit: www.tuc.org.uk/workplace-issues/health-and-safety.

HSE has helpful advice at:

www.hse.gov.uk/temperature.

Workplace regulations are available here:

www.hse.gov.uk/pubns/priced/l24.pdf.

Appendix II: Skin Cancer and Outdoor Workers: TUC Guidance for safety representatives

Background

Skin cancer is the most common type of cancer in the UK. The main cause is excessive exposure to the sun's harmful ultra violet (UV) radiation. There are around 100,000 new cases every year. 8000 of these cases are the most serious form, malignant melanoma, and these figures are rising fast. The number of men getting malignant melanoma had gone up five fold in the last 25 years, and the number of women being diagnosed has gone up threefold in the same period.

Around 2,000 people a year die as a result of skin cancer. It is impossible to say how many of these cases are a result of exposure to the sun at work, but it is becoming much more common in people who work outdoors.

The skin is damaged if a person burns or spends too long in the sun. Although fair-skinned or freckled people are more likely to burn, too much exposure can damage anyone's skin and increase their chance of developing cancer..

The Law

The Health and Safety at Work Act makes it clear that there is a legal duty on every employer to ensure, as far as reasonably practical, the health of their employees.

It also says that employers must provide 'information, instruction, training and supervision' to ensure their safety.

The Management of Health and Work Regulations also require the employer do conduct a suitable risk assessment of the risks to the health of their workforce. That includes the risks from UV radiation.

The law also says that an employer has to remove any risk, or if that is not possible look at other ways of preventing or reducing exposure, including, as a last result protective equipment. Where protective equipment is required this must be supplied free.

Many outdoor workers, in particular agricultural workers may be employed through agencies. Where this happens both the agency and the employer will have a legal duty to protect the worker

Preventing skin cancer

The TUC believes that no person should be exposed to anything that can cause cancer during their work and that employers have a duty to ensure that they remove the risk. That applies just as much to excessive sun exposure as dangerous chemicals.

It is estimated that 90% of all skin cancer deaths could be prevented if people properly controlled their exposure to the sun's UV radiation. Employers have always argued that they cannot control exposure to the sun and that it is up to OSD 2 Skin Cancer and Outdoor Workers individual workers what they wear. They also claim that it is unfair and impractical to ask workers to cover up in very hot weather. This is not true. In practice there is a lot employers can do, but measures must be introduced with the full involvement of safety representatives.

Simply telling workers they must cover up or wear sunscreen is not going to be effective in itself unless there is also a campaign to explain the dangers to the workforce, however many employers have been successful in reducing exposure by looking at the working practices rather than that just putting the responsibility on the worker.

Among things employers can do to reduce the risk are:

• Changing working practices so that less outside work needs to be done either in the hottest months or the hottest time of the day (11:00-15:00). Often it is possible to organise work in summer so that the tasks that require the employees to be outside can be done either in the mornings or late afternoon, or on cloudy days.

• Provide canopies, sheeting, or similar covering over open areas such as building sites where people are working. Also provide shaded areas from breaks

• Provide information and guidance on avoiding exposure to harmful UV radiation both as part of induction and on an on-going basis. The Health and Safety Executive has produced a useful leaflet giving advice on outdoor worker and sun protection (see information and resources). Given the high proportion of outdoor workers who are recent

migrants consideration should be given to ensuring that training information and advice is available in other languages.

• Make sure that any protective clothing is lightweight, long-sleeved and comfortable, but at the same time dense enough to prevent UV rays from getting through. It should also allow body heat to escape. This will encourage workers to wear it.

• Provide lightweight brimmed hats for all outdoor workers.

• Where work is required to be done outdoors in sunny weather, employers should provide dispensers with sunscreen and workers should be encouraged to apply it regularly on any exposed areas. Sunscreen should have a sun protection factor of at least 20 and preferably 30 but also give protection against UVA radiation (some don't). Workers should be given a choice of sunscreens where possible.

These measures will be most effective if the workforce are involved in the decisions, in particular on types of clothing and sun-screen provided. The OSD 3 Skin Cancer and Outdoor Workers arguments for change must be given in a way that shows that these measures are intended to help keep employees healthy and prevent cancer.

Some kinds of skin cancer are easily treated and all types are less likely to be fatal if treated early on, Employers should be encouraged to provide occupational health screening programmes which should include checking for the signs of skin cancer. Outdoor workers should also be given information on how to recognise the early signs of skin cancer..

What safety reps should do.

Often it will be safety representatives who first raise the issue of protection against the sun, but regardless of where the idea comes from, any programme aimed at reducing exposure to UV radiation is going to be more successful if safety representatives are involved.

The involvement of safety representatives will help ensure that the measures introduced, including the kinds of protection, are suitable and more likely to be adopted by the workers. They will also be able to ensure that all the issues are understood by the workforce. Ideally safety representatives will discuss the issue with the union members before any measures are introduced. Once the issues are explained most safety representatives have found that the workforce will embrace change, although, like the use of hard hats in construction, in may not happen overnight.

Safety representatives can also circulate material on the risks of skin cancers from the websites of organisations such as Cancer Research UK or the HSE. Some unions have also produced material aimed at outdoor workers.

Employers may expect safety representatives to help enforce any instructions on covering up or wearing sunscreen. This is not a safety representative's role. While they can lead by example, they are not there to police the safety system. If employees are ignoring safety advice it is usually for a reason. Where workers continue to work without tops, hats and sunscreen on the hottest days then perhaps what has been provided is just not suitable or there has not been enough training on the issue.

Where a safety representative raises concerns over the risk of skin damage by the sun, and the employer refuses to act, then they should notify their union. In some cases it may be helpful to contact the enforcing authority (either the HSE or local authority) and ask them to ensure that the employer complies with their legal obligations.

Other issues

Working outdoors in hot weather can do more than just damage the skin. Outdoor workers exposed to high temperatures for long periods are at risk from sunstroke, sunburn, and heat exhaustion. Sun or heat stroke is more likely when OSD 4 Skin Cancer and Outdoor Workers heavy physical work is being done.

To avoid these effects then many of the same measures to prevent skin cancer also apply. Working at the hottest times of the day should be avoided or kept short, clothing, including protective clothing, should not be tight and restricting, and should allow body heat to escape; plenty of rest periods in a cool place should be taken; and cool, clean water should be provided for frequent drinks. It is important to replace water lost through sweating. Employers should always provide a regular supply of fresh water for all outdoor workers.

Further information and resources

The TUC website contains information on all aspects of health and safety, including cancer and skin protection: www.tuc.org.uk/healthandsafety.

A lot of information is available on the HSE website about working outdoors and in hot weather: www.hse.gov.uk/temperature.

Cancer Research UK has very useful information about skin cancer and is also running the 'SunSmart' campaign, which aims to encourage people to protect themselves from the sun. Information is available at www.cancerresearchuk.org.

- SunSmart www.cancerresearchuk.org/sunsmart.