Climate change and workers' health

Protecting workers against heat and other climate-related hazards

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Abstract

In a world of work increasingly shaped and disrupted by climate change, particular attention must be paid to workers who are directly exposed to its impacts. Workplace heat exposure has become one of the most significant — if not the most significant — climate change-related threats to workers' health in Europe. Yet important questions remain: how does heat affect workers? Which workers are the most affected ones? These are some of the central questions that the present report seeks to address.

The primary objective of this report is to identify and analyse the impacts that climate change-related hazards are having on workers' health and safety. Although the report places particular emphasis on workplace heat exposure, this focus does not imply an isolated approach. On the contrary, heat exposure is understood as part of a broader and interconnected climate reality that also includes other increasingly frequent and intense extreme weather events and environmental hazards. Accordingly, the report adopts a comprehensive perspective that seeks not only to identify the impacts of climate change on occupational health, but also to highlight the workers and sectors that are most vulnerable and disproportionately exposed to these physical hazards, as well as the broader consequences that such exposures may have for productivity, working conditions and job security.

At the same time, the report does not merely seek to identify the wide range of impacts that climate change is generating in relation to occupational health. In this context, the report develops a legal narrative demonstrating both the urgency and the necessity of strengthening protection against workplace heat exposure. Finally, the study concludes with a *lege ferenda* proposal incorporating an EU Directive on workplace heat exposure, aimed at establishing a more coherent, effective and harmonised framework of protection for workers across the European Union.

Introduction

Climate change is an occupational safety and health (OSH) and labour issue in Europe and beyond (ILO 2024, Azzi et al. 2024, WHO and WMO 2025). Rising average temperatures, the increasing frequency and intensity of extreme weather events, and the progressive transformation of climatic patterns are reshaping the conditions under which millions of workers carry out their activities. In recent years, the number of workers exposed to excessive heat and heat-related occupational injuries and illnesses has increased rapidly across Europe, turning workplace heat exposure into an urgent issue that requires immediate action both from a scientific and a legal perspective.

In this context, the present report places workplace heat at the core of its analysis. This choice is justified by both the strength of the available evidence and its policy relevance. From an evidence perspective, workplace heat stress currently represents the climate-related hazard for which the evidence regarding OSH impacts is most developed (ILO 2024, Azzi et al. 2024, WHO and WMO 2025). From a legal and policy perspective, heat exposure also constitutes the area in which the limitations of existing regulatory frameworks are most evident and where the need for more specific and effective legal protection has become increasingly apparent. At the same time, effective preventive measures are well known and can be translated relatively straightforwardly into clear and enforceable legal requirements.

However, climate change affects work and workers' health through multiple interconnected pathways that require a broader approach. Accordingly, the report situates workplace heat within the broader picture of all kind of climate-related occupational risks including floods, wildfire smoke, drought, UV radiation, vector-borne disease and air pollution. While these risks differ in the extent to which they can be translated into concrete and unified regulatory responses, they all reflect the growing complexity of the relationship between climate change and occupational health.

The report also pays particular attention to the vulnerability of groups of workers facing the impacts of climate change, as climate vulnerability is not distributed evenly across the workforce. Certain categories of workers — including migrant and seasonal workers, agricultural and construction workers, transport and logistics workers, emergency service workers, street cleaners, waste workers, hospitality and tourism workers, manufacturing workers, and workers in poorly cooled indoor environments — face particularly high levels of exposure and additional barriers to exercising their labour rights and accessing effective protection.

On this basis, the key objective of the present report is to examine, in light of the identified health impacts arising from workplace heat exposure, the legal protection currently afforded to workers under European Union (EU) law. In particular, it analyses the existing OSH EU legal framework, its limitations in addressing increasing heat-related risks and the legal challenges posed by it. Building on this analysis, the report develops the legal and policy argument behind the adoption of a dedicated binding instrument aimed at protecting workers' health from workplace heat exposure. Finally, the study also includes — in its annex — a *lege ferenda* proposal for

an EU Directive on workplace heat, conceived as a regulatory instrument capable of strengthening prevention, establishing common minimum standards and ensuring a more effective and harmonised level of worker protection across the EU.

To this end, the report proceeds as follows. Section 1 sets out the main climate trends in Europe and the broader climate-related OSH and socio-economic impacts. Section 2 examines how workplace heat stress affects workers' health and safety. Section 3 analyses productivity, income and job-security impacts. Section 4 studies the challenges of the current legal framework and the political debate that surrounds it. Section 5 considers the measures that should be taken into account for an effective protection. The conclusion draws the core argument together: climate change is already reshaping work in Europe; workplace heat stress is currently the most direct, widespread and preventable climate-related occupational hazard; and effective action requires prevention, enforceable standards, worker participation, social protection and a just distribution of climate-related costs.

1. Climate change is a workplace reality in Europe

Climate change is reshaping the conditions in which work is performed. Rising temperatures, more frequent and intense extreme weather events, and changing weather patterns are creating new OSH risks and intensifying existing ones (ILO 2024, Azzi et al. 2024, WHO and WMO 2025). While weather variability has always affected work, human-induced climate change is increasing the frequency, duration, intensity and geographical spread of hazardous events. This has direct implications for workers' lives, health, livelihoods and capacity to continue working safely. **Climate change** is commonly defined as a persistent change in the state of the climate, identifiable through changes in the mean and/or variability of climate properties over decades or longer (IPCC 2022). The Intergovernmental Panel on Climate Change (IPCC) distinguishes between natural variability and the current human-driven change associated with persistent changes in atmospheric composition and land use, focusing specifically on changes attributed directly or indirectly to human activity that alters the composition of the global atmosphere (IPCC 2022).

The impacts of climate change on OSH can be understood through four interrelated dimensions: extreme weather events, changing weather patterns, compound events and cascading effects (ILO 2026). **Extreme weather events**, such as heatwaves, cold waves, floods, droughts, storms and wildfires, can cause immediate injuries, fatalities and infrastructure damage, while also generating long-term health consequences (ILO 2026). **Changing weather patterns**, including rising average temperatures, altered precipitation and shifting seasonal cycles, create cumulative and chronic risks that affect workers even outside periods of extreme weather (Schoen 2005, ILO 2026). For example, while heatwaves may trigger acute heat-related illnesses, increasing average temperatures can expose workers to chronic heat stress during routine working days (ILO 2024).

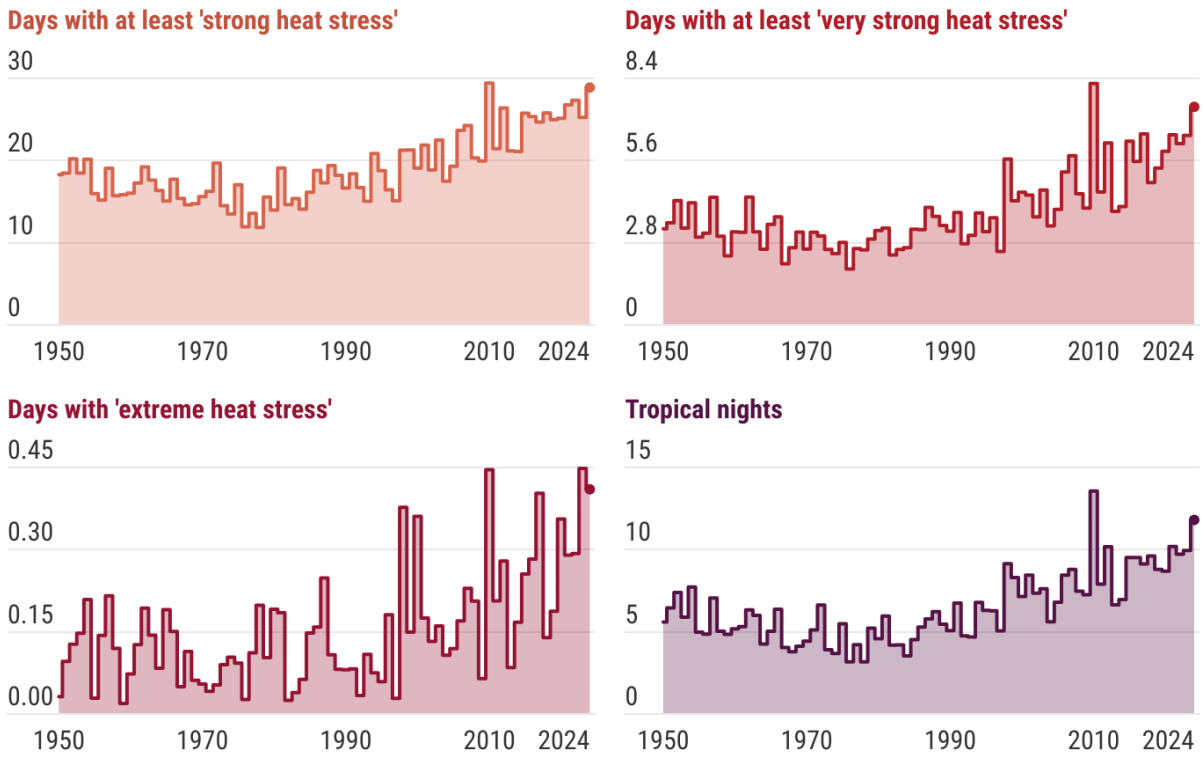
Climate-related risks are often amplified through **compound events**, where two or more extreme events occur simultaneously or in succession, or where different climatic conditions interact to produce particularly severe impacts (Seneviratne et al. 2021; ILO 2026). Hot, dry and windy conditions, for instance, can increase the likelihood of wildfires or sand and dust storms, exposing workers to overlapping hazards such as heat, smoke, air pollution and physical strain. Climate change can also generate **cascading effects**, whereby one event triggers a chain of further impacts (Seneviratne et al. 2021; ILO 2026). Droughts and changing seasonal patterns may increase reliance on agrochemicals, while floods and storms can damage infrastructure and trigger major industrial accidents. Together, these processes illustrate the diverse and interconnected ways in which climate change is transforming occupational safety and health.

Europe is a particularly important region for understanding the impacts of climate change on OSH. The Copernicus Climate Change Service and the World Meteorological Organization report that 2024 was globally the warmest year on record, and that the last ten years have been the warmest on record. Europe has been warming twice as fast as the global average since the 1980s, making it the fastest-warming continent (WMO 2025). This trend is coming with more frequent and severe

heatwaves, widespread droughts in southern Europe, continued glacier melt across European regions and significant changes in precipitation patterns, including more intense extreme precipitation events (WMO 2025).

European climate indicators reinforce this point. In 2024, the number of days with "strong", "very strong" and "extreme" heat stress across Europe was the second highest on record, and the number of tropical nights (nights with temperature above 20 °C) was also the second highest on record (Figure 1) (C3S and WMO 2025). Copernicus, the European Union's Earth observation programme, also notes that high night-time temperatures reduce recovery from daytime heat stress. This is particularly important for workers who return to poorly cooled homes and start the next shift without adequate physiological recovery (C3S and WMO 2025).

Figure 1. Heat stress days and tropical nights are increasing in Europe. Credit: ESOTC 2024 Europe (C3S and WMO 2025).



It has become clear that climate change intensifies OSH hazards. The exposure of European workers to these intensified hazards is shaped not only by environmental conditions, but also by the organisation of work, including staffing levels, work pace, autonomy, rest arrangements, shift scheduling, and production pressures, as well as by workplace design, sector, region, tasks performed, employment status, and workers' capacity to exercise preventive rights collectively and individually. Exposure then affects worker outcomes: acute heat-related illness, accidents, chronic disease, mental strain, work-time loss, lower earnings, job insecurity and, in some cases, displacement from work or from a sector. The present report focuses on the above-mentioned occupational chain: from climate hazard to workplace exposure, from

exposure to health and safety outcomes, and from those outcomes to productivity, income, social protection and regulation.

The central policy question addressed in this report is not whether European workplaces can avoid all climate-related disruption. They cannot. The question is whether climate-related hazards are anticipated, assessed, and controlled through OSH systems, social dialogue, and social protection. If not, the burden will be shifted to individual workers through lost wages, intensified work, unsafe exposure, and preventable illness.

1.1. Workplace heat stress: the clearest climate-related OSH hazard

In its recent global review, the International Labour Organization (ILO) estimated that 2.41 billion workers are exposed to workplace heat stress, with 22.85 million injuries and 18,970 deaths annually related to this exposure (Azzi et al. 2024). **The estimates for Europe include 130 million labourers exposed to workplace heat stress, with 277,000 injuries and 230 deaths annually associated with this exposure** (Azzi et al. 2024). Complementing these estimates, EU-OSHA's OSH Pulse 2025 survey found that around one in five workers in the EU reported exposure to extreme heat at work during the previous 12 months, rising to around one in three workers in countries such as Greece, Cyprus and Croatia (EU-OSHA 2025a).

The distinction between a heatwave and a hot working day is especially important for the present report because workplace heat stress is not limited to exceptional or officially declared extreme weather events. While heatwaves attract media attention, public health warnings, and emergency measures, workplace heat exposure also constitutes a recurrent occupational risk that may accumulate through daily and seasonal exposure. The ILO highlights that nine out of ten worker exposures to excessive heat, and eight out of ten occupational injuries linked to heat, occur outside officially declared heatwaves (Azzi et al. 2024). In Europe, this means that OSH policy cannot focus only on exceptional heatwave alerts. Prevention must also address ordinary hot days in agriculture, construction, transport, waste collection, logistics, hospitality, manufacturing, education, care and other sectors where heat exposure is foreseeable and recurrent.

As recognised by the EU Advisory Committee on Safety and Health at Work (2024a),[1] workplace heat stress is currently the largest and most urgent climate change-related risk to human health. Among climate-related OSH risks, heat stress requires particular urgency because its impacts on workers are already widespread, direct and scientifically well established. Workplace heat stress can cause physiological strain leading to acute and chronic illnesses, injuries and deaths, while also increasing accident risks through fatigue, impaired judgement, reduced vigilance and slower

[1] The Advisory Committee is a tripartite body set up in 2003 by a Council Decision 2003/C 218/01, of 22 July 2003, setting up an Advisory Committee on Safety and Health at Work. Its aim is to assists the Commission in the preparation, implementation and evaluation of activities in the field of occupational safety and health (OSH) and facilitates cooperation between national administrations. For more information see: https://employment-social-affairs.ec.europa.eu/policies-and-activities/rights-work/health-and-safety-work/advisory-committee-health-and-safety-work-0_en

reaction times (Flouris et al. 2018; Azzi et al. 2024; WHO and WMO 2025). It affects both outdoor and indoor workers, including workers in poorly ventilated, poorly insulated or heat-generating workplaces (Azzi et al. 2024; WHO and WMO 2025). At the same time, unlike many other climate-related OSH risks, effective prevention measures are already well known (see below and Section 4).

Workplace heat stress is an OSH hazard determined by a combination of environmental and work-related factors including air temperature and humidity, radiant heat from the sun or machinery, air movement, as well as the metabolic heat generated by physical work, clothing, and the use of Personal Protective Equipment (PPE) (Azzi et al. 2024; WHO and WMO 2025). During exposure to workplace heat stress, excess heat is stored in a worker's body, which, if not released to the environment, will raise their core body temperature, leading to potential health risks and reduced productivity (Azzi et al. 2024).

Hence, workplace heat stress cannot be reduced to the question "*how hot is the air?*". The risk depends on the total heat load experienced by the worker, which varies significantly across tasks and settings. A worker laying asphalt, harvesting vegetables, collecting waste, delivering parcels, operating in a metal workshop, working in a commercial kitchen, caring for children in an overheated school, or wearing protective equipment at a fire or industrial incident may experience dangerous workplace heat stress under very different external temperatures, a situation increasingly aggravated by climate change through rising baseline temperatures and more frequent and intense heatwaves.

Workplace heat stress can lead to both physiological strain and heat-related illness. The term **physiological strain** (sometimes called heat strain) describes the human body's physiological response to heat stress, including increases in core and skin temperature, heart rate, and sweating (Flouris et al. 2018; Kenny et al. 2018; Ioannou et al. 2022a; Azzi et al. 2024; WHO and WMO 2025). **Heat-related illnesses** are health outcomes that emerge as a result of excessive physiological strain caused by heat stress (WHO and WMO 2025). Among others, they include dehydration, heat exhaustion, heat syncope, heat cramps, heatstroke, rhabdomyolysis, cardiovascular strain and kidney injury (Azzi et al. 2024; WHO and WMO 2025). The 11th revision of WHO's International Classification of Diseases (ICD-11) includes 19 codes for injuries, health effects, conditions and illnesses related to heat stress (WHO 2019; WHO and WMO 2025).

Table 1 summarizes the information that will be provided in sections 2 and 3, which pictures why workplace heat stress is the focus of this report.

Table 1. Why workplace heat stress is the focus for this report.

Reason	European relevance	Labour and OSH implication
Climate trend	Europe is the fastest-warming continent, and 2024 saw near-record levels of thermal stress indicators (C3S and WMO 2025, WMO 2025).	Heat exposure must be treated as a present OSH risk, not only a future adaptation issue.

Exposure	EU-OSHA reports that around one in five EU workers faced extreme heat on the job in the previous 12 months, rising to around one in three in Greece, Cyprus and Croatia (EU-OSHA 2025).	Heat affects indoor and outdoor work and requires systematic risk assessment.
Health and safety	Heat is linked to illness, fatigue, impaired judgement and increased injury risk; European studies show associations between heat exposure and occupational injuries (Martinez-Solanas et al. 2018, ILO 2026).	Prevention must include work-rest cycles, training, emergency planning and health surveillance.
Productivity and income	IPCC (Bednar-Friedl et al. 2022) and EU JRC (Garcia-Leon et al. 2021, Szewczyk et al. 2025) evidence links heatwaves to productivity losses particularly in southern Europe and economic losses in agriculture and construction.	Paid breaks, rescheduling and compensation mechanisms are central to fair prevention.
Inequality	Climate-exposed sectors often include seasonal, migrant and self-employed workers with weaker protection and representation (Eurofound 2024).	Worker participation, collective bargaining and labour inspection are needed to prevent unequal risk shifting.
Wider climate risks	Heat interacts with drought, wildfire smoke, ultraviolet radiation, air pollution, vector-borne disease and extreme weather (Azzi et al. 2024, ILO 2024, ILO 2026).	Heat policy should be integrated into broader climate-OSH and just transition strategies.

1.2. Broader climate change effects including socio-economic impacts

Workplace heat stress is not the only climate-related OSH hazard (Advisory Committee on Safety and Health at Work 2025a).[2] Climate change affects OSH through multiple exposure pathways, including ultraviolet radiation, wildfire smoke and poor air quality, floods, storms, biological hazards, vector-borne diseases, drought, water contamination, mould, dust, allergens, agrochemical exposure, and major industrial accident risks triggered by natural hazards (Advisory Committee on Safety and Health at Work 2025a; ILO 2024; ILO 2026). The European Environment Agency's Climate-ADAPT similarly notes that climate change threatens workers' health through heat, ultraviolet exposure, pollution, pathogens and extreme weather, increasing the risks of heat-related illness, infections, allergies, accidents and cancer across sectors (Climate-ADAPT 2023).

The central policy issue is that these hazards are not experienced equally. Work organisation, employment status, bargaining power, housing, access to PPE, sector and region determine whether climate hazards become preventable occupational exposures or costs shifted onto individual workers. In this light, while workplace heat stress is the focus of this report, the present section broadens the analysis to the wider climate–OSH–labour pathway outlined previously, recognising the multiple ways in which climate change is reshaping OSH.

These hazards may occur singly, in combination or as cascading events. A heatwave can coincide with high ultraviolet radiation and ozone pollution. Hot, dry and windy

[2] It is worth mentioning that the Advisory Committee on Safety and Health at Work adopted an Opinion concretely dealing with OSH risks arising from other climate change-related risks different than heat. For more information see Advisory Committee on Safety and Health at Work (2025a) Opinion on climate change – extreme weather and other topics, Doc. 014-25, European Commission.

conditions can increase wildfire risk, exposing firefighters, emergency workers, agricultural workers, construction workers, transport workers and outdoor service workers to smoke and particulates. Flooding can expose emergency responders and clean-up workers to contaminated water, unstable structures, mould, electrical hazards and hazardous substances. Drought can affect agricultural employment and increase dust exposure or reliance on agrochemicals. Warmer conditions may expand the geographical range and active season of vectors: Climate-ADAPT and the European Center for Disease Control note that climate change is expected to shift tick species to higher latitudes and altitudes and to support the expansion of Aedes albopictus and sandfly species in Europe (Semenza and Suk 2018; Climate-ADAPT 2019). Outdoor workers are also exposed to solar ultraviolet radiation. The WHO and ILO joint estimates conclude that nearly one in three deaths from non-melanoma skin cancer globally is caused by working under the sun, a reminder that climate-related prevention must include sun protection as well as heat protection (WHO 2021).

The ILO provides a useful conceptual framework for these linked hazards (ILO 2024; ILO 2026). It identifies associated exposures including changes in vector distribution, increased agrochemical use, changes in air quality, ultraviolet radiation and major industrial accidents, and stresses that workers are rarely exposed to a single hazard in isolation. The relevance for Europe is that workplace heat stress should be treated as the most immediate and measurable hazard, not as a reason to ignore the broader climate-OSH landscape. Later sections of this report examine heat in depth. Before doing so, however, it is important to consider the broader climate-related OSH and socio-economic impacts.

1.2.1. From climate hazard to occupational exposure

The causal pathway is straightforward but often under-recognised. Climate change alters the frequency, intensity, duration and geography of weather-related hazards; workplaces then mediate exposure through task design, work intensity, working time, staffing, PPE, access to water and rest, emergency planning, and workers' ability to stop unsafe work. The ILO distinguishes acute extreme events, such as floods, storms, wildfires and heatwaves, from longer-term changing weather patterns, such as hotter "normal" working days, altered precipitation, extended vector seasons and changing air quality. This distinction matters for Europe because prevention cannot be limited to emergency alerts: many risks arise from cumulative exposure during ordinary shifts, not only during officially declared extreme events.

European evidence supports this broader framing. As previously mentioned, the European Environment Agency's European Climate Risk Assessment identifies 36 major climate risks for Europe, including risks to health, ecosystems, infrastructure, water resources, food security and economic stability, many of which are already at serious levels (EEA 2024a). The European Climate and Health Observatory, developed with EU-OSHA input for its OSH material, summarises the occupational pathways as heat, ultraviolet radiation, pollution, pathogens and extreme weather, increasing the risk of heat-related illness, infections, allergies, accidents and cancer across sectors (Climate-ADAPT 2023).

Among these pathways, extreme weather events represent one of the most visible and immediate ways in which climate change affects. Floods, storms and landslides can cause drowning, traumatic injuries, falls, electrocution, vehicle accidents, structural collapse and exposure to damaged machinery or utilities (ILO 2026). For emergency services, utilities, transport, construction, waste collection and clean-up workers, the post-event phase may be as hazardous as the event itself (ILO 2026). Floodwater and debris can contain sewage, pathogens, dead animals, asbestos, chemicals and carbon monoxide risks from generators or combustion equipment (ILO 2026). Mould may persist in damaged buildings, affecting clean-up workers, maintenance staff and workers returning to schools, care settings, offices and hospitality premises (ILO 2026). The European Environment Agency reports that, in Europe, health risks from floods, droughts and reduced water quality are already being felt through deaths, injuries, infectious disease outbreaks and mental health consequences, and that farmers and emergency service teams are among the groups facing the greatest climate-related health impacts (EEA 2024b).

Air pollution and wildfire smoke are also becoming workplace issues. Air pollution remains Europe's largest environmental health risk, with the European Environment Agency estimating that long-term exposure above WHO guideline levels contributed in 2023 to 206,000 premature deaths from $PM_{2.5}$, 71,000 from ozone and 56,000 from nitrogen dioxide in Europe (EEA 2025a). For outdoor and mobile workers, this background burden becomes occupational exposure when tasks must continue during poor air-quality episodes. Firefighters face the most obvious risk, but smoke exposure also affects agricultural workers, construction workers, transport workers, delivery riders, road maintenance workers, waste workers and outdoor hospitality workers. The evidence on wildfire-specific $PM_{2.5}$ exposure-response in Europe is still developing, but the European Climate and Health Observatory notes associations between wildfire smoke and eye, nose, throat and skin irritation, as well as longer-term respiratory and cardiovascular outcomes (Climate-ADAPT 2024).

Ultraviolet radiation is a long-standing occupational hazard that climate change can intensify through more sunny days, changed cloud cover and more outdoor work during hot seasons.[3] The WHO/ILO joint estimates found that 1.6 billion working-age people globally were exposed to solar ultraviolet radiation at work in 2019 and that almost 19,000 deaths from non-melanoma skin cancer were attributable to occupational sun exposure (WHO 2021). In Europe, construction, agriculture, forestry, fisheries, lifeguarding, utilities, postal work, ports, street work, and outdoor tourism are particularly relevant. Prevention should therefore combine heat measures with sun protection: shaded work areas, rescheduling, protective clothing, sunglasses, sunscreen, training, and health surveillance (ILO 2026).

Biological hazards are also shifting. Warmer temperatures, milder winters and altered precipitation can extend the active season and geographic range of ticks, mosquitoes and sandflies. Climate-ADAPT reports that climate change is expected to shift tick species to higher latitudes and altitudes and to support the expansion of Aedes

[3] This risk factor is particularly dangerous because workers may be unaware that they are being exposed to dangerously high levels of radiation (ILO 2024). The problem is compounded by the absence, in any country, of specific occupational exposure limit values for solar ultraviolet radiation (Cherrie and Cherrie 2022).

albopictus and sandfly species in Europe (Climate-ADAPT 2019); it also notes that Lyme borreliosis remains the most common vector-borne disease in the EU, with around 65,000 cases annually (Climate-ADAPT 2019). ECDC surveillance shows that Aedes albopictus has become established in a growing number of EU/EEA countries, increasing the relevance of dengue and chikungunya preparedness for occupational settings (ECDC 2024). Farmers, foresters, landscapers, park workers, construction workers, delivery workers, firefighters, and emergency responders are among the occupational groups requiring vector-risk assessment, training, repellents, protective clothing, tick checks, surveillance and, where relevant, vaccination or health monitoring (ILO 2026).

The most serious climate-related OSH risks are often compound rather than single. A heatwave can coincide with ozone pollution and high ultraviolet radiation. Drought can increase dust, water scarcity and agrochemical use. Wildfire response combines heat, smoke, physical exertion, long shifts, traumatic exposure and heavy PPE. Flooding can combine injury risks with contaminated water, mould, electrical hazards and chemical exposure. The ILO, WHO, and WMO highlight that workers are rarely exposed to a single climate hazard in isolation and that risk assessments must consider cumulative and synergistic exposures (Azzi et al. 2024; ILO 2024; WHO and WMO 2025; ILO 2026).

Cascading risks are particularly important for industrial sites. Natural hazards such as floods, storms and extreme temperatures can trigger technological accidents, including toxic releases, fires and explosions at installations that process, store or transport hazardous substances. The European Commission's Joint Research Centre notes that Natech risk has become a concern because climate change affects the intensity and frequency of some natural events, and that the Seveso III Directive explicitly introduced Natech risk as an issue to be addressed in major-accident prevention (Necci and Krausmann 2022). For workers, this means that climate adaptation is not separate from major-accident prevention: plant operators, maintenance workers, firefighters, ambulance crews, police, contractors and clean-up workers need climate-informed emergency planning, training, communication and labour inspection (ILO 2026). The relevant hazard pathways, sectors and workers most exposed, as well as prevention and labour policy responses are outlined in Table 2.

Table 2. Climate-related occupational hazard, exposed workers and sectors, and policy responses.

Hazard pathway	Sectors and workers most exposed	Prevention and labour-policy response
Floods, storms, landslides and water contamination	Emergency services, utilities, construction, transport, clean-up, waste, schools and care settings after damage	Emergency plans, evacuation, right to stop unsafe work, safe return-to-work checks, PPE, hygiene, mould remediation, paid work stoppages
Wildfire smoke, ozone, dust and poor air quality	Firefighters, agriculture, construction, road work, delivery, logistics, waste, ports, outdoor services	Air-quality monitoring, task rescheduling, respiratory protection where needed, medical surveillance, smoke exposure records
UV radiation and skin cancer	Agriculture, construction, forestry, fisheries, ports, lifeguards, outdoor tourism, postal and utilities workers	Shade, work-time adjustment, sun-protective PPE, sunscreen, training, skin checks and recognition of occupational disease

Vector-borne and water-borne disease	Agriculture, forestry, landscaping, construction, delivery, emergency and healthcare workers	Biological risk assessment, vector control, repellents, protective clothing, tick checks, surveillance and vaccination where relevant
Drought, dust and agrochemical pressure	Agriculture, forestry, landscaping, food production and seasonal work	Water access, dust controls, safe pesticide systems, substitution, training, PPE compatible with heat, social protection for crop/work disruption
Natech and major industrial accidents	Chemical plants, refineries, storage sites, mines, waste sites, pipelines, emergency responders and clean-up workers	Climate-informed Seveso/Natech risk assessment, emergency drills, worker participation, communication and inspection

1.2.2. Socio-economic impacts and unequal cost-shifting

Broader climate risks also have labour-market consequences. The European Environment Agency estimates that weather- and climate-related extremes caused EUR 822 billion in economic losses in the EU between 1980 and 2024, with floods accounting for 47% of losses, storms for around 27%, and heatwaves for almost 18% (EEA 2025b). Importantly, less than 20% of total losses were privately insured (EEA 2025b). These figures are not occupational statistics, but they indicate the scale of disruption that can translate into damaged workplaces, cancelled shifts, supply-chain delays, crop losses, tourism shocks, construction stoppages, higher insurance costs, and pressure on public services.

The distributional issue is central for workers' organisations. Eurofound identifies agriculture, fisheries, forestry, construction, tourism, and emergency services as sectors particularly exposed to climate-related job-quality risks, and notes that several of these sectors include high shares of seasonal, migrant and self-employed workers with weaker protection, lower trade union organisation and less workplace representation (Eurofound 2024). Mental health risks also arise from traumatic exposure, repeated emergency response, loss of livelihoods, displacement, debt, and uncertainty. Climate-ADAPT reports that extreme weather can contribute to post-traumatic stress disorder, anxiety, and depression, and that mental health impacts remain less developed in climate policy than physical health impacts (Climate-ADAPT 2022).

Therefore, prevention must be combined with income protection. EU OSH law already provides a foundation: the Framework Directive requires action in situations of serious and imminent danger, while ILO Convention No. 155 supports the right to remove oneself from such danger and the role of worker participation in OSH systems (ILO 2026). However, the practical question is whether workers can actually stop work, evacuate, take protective breaks, or refuse unsafe exposure without losing pay, bonuses, hours, accommodation or future work. This is particularly acute for migrant workers, undocumented workers, platform workers, bogus self-employed workers, agency workers, piece-rate workers, young workers, pregnant workers, older workers and workers with chronic conditions, as well as for workers operating within complex subcontracting chains, where fragmented responsibilities may create additional obstacles to exercising their rights. Consequently, measures must also adopt a comprehensive approach capable of safeguarding not only workers' health, but also

their security at work and the continuity of the employment relation, without forcing employers to terminate it on grounds of economic viability. Such protection has to take two different forms.

First, it is essential to adopt **social protection measures** capable of safeguarding the employment relationship between employers and workers during adverse climatic events. Requiring work to continue under conditions that endanger workers' lives is unacceptable. At the same time, workers should not suffer a loss of income as a result of events that are entirely beyond their control. In this regard, instruments such as the Spanish 'climate leave' are particularly significant. This mechanism allows workers to benefit from up to four days of paid leave where commuting/entering the workplace becomes impossible due to a climate emergency (among other extreme situations), provided that teleworking is not feasible (Laabbas-el-Guennouni 2025b). In such circumstances, employers are required to prioritise the protection of workers' health and safety by ensuring the benefit of such leave.

However, these events are equally beyond the control of employers. In cases where work cannot resume within a reasonably short period, businesses may face severe economic consequences resulting from the suspension of activities, while being unable to continue paying wages *sine die*. For this reason, social protection mechanisms must also be established to support employers during such periods.

This is not an entirely new issue. On several occasions, Member states have introduced measures aimed at protecting employment continuity during major emergencies. A relatively recent example can be found in the social protection schemes adopted during the COVID-19 pandemic. These schemes provided access to funds intended to cover the wages of workers who, for obvious reasons, could no longer continue working and whose employers lacked the financial capacity to maintain wage payments due to the temporary closure of the business (Natali 2022). In these situations, the employment relation was temporarily suspended, while replacement income was provided through public funds. This relieved employers of their wage obligations until work could resume, while preserving the continuity of employment relationships. Indeed, such schemes should also be created in order to better prepare businesses and workers for climate situations that are forming the new normality.

Second, **compensation mechanisms** should also be adopted. As noted above, adverse climatic events may cause substantial economic losses in several sectors. Clear examples include crop losses in the agricultural sector and the destruction of materials on construction sites. Such situations place considerable financial pressure on businesses. Compensation mechanisms should therefore be introduced in order to support economic recovery following climate-related losses. Again, examples of such measures have already been put into practice during major emergencies, such as the case of the DANA floods in Valencia (Spain) but they should take a more institutionalised form rather than being developed only once emergencies occur. The objective is twofold. It is not only to compensate for the losses incurred, but also to ensure the continuity and economic viability of businesses and, consequently, the preservation of the employment relations affected by adverse climatic events.

2. Workplace heat stress is affecting workers' health and safety

Climate change increases the frequency, duration and intensity of hot conditions, but the occupational risk arises when environmental heat[4] combines with work intensity, radiant heat, humidity, clothing, PPE, workplace design, and limited control over pace or breaks (Azzi et al. 2024; WHO and WMO 2025). Therefore, the evidence points to a linked sequence: climate change and changing weather patterns increase environmental heat; work organisation converts this into workplace heat stress which, in turn, generates physiological strain, heat-related illness, and a higher risk of accidents; and these effects fall unevenly across sectors, regions, and groups of workers. This section expands the argument presented in Section 1 that workplace heat stress is the most direct and preventable climate-related OSH hazard for European workers.

2.1. Defining and measuring workplace heat stress

The available scientific evidence (Glaser et al. 2016; Kenny et al. 2016; Flouris et al. 2018; Flouris 2019; Notley et al. 2019a; Glaser et al. 2020; Ioannou et al. 2021a; Ioannou et al. 2021b; Ioannou et al. 2022d; Ioannou et al. 2022c; Ioannou et al. 2025) as well as relevant ILO, WHO, and WMO reports (Azzi et al. 2024; Flouris et al. 2019, WHO and WMO 2025) highlight an important distinction in OSH risk prevention: heat becomes a workplace hazard when the body cannot dissipate accumulated heat quickly enough to maintain a safe core temperature.

Several metrics have been developed to assess workplace heat stress and support the identification of hazardous levels of heat exposure. The most used are the Wet Bulb Globe Temperature (WBGT), the Universal Thermal Climate Index (UTCI), and the Heat Index, although they differ in their assumptions, variables and suitability for occupational settings.

The WBGT is calculated based on air temperature, humidity, radiant heat, and air movement and its final value takes into account work intensity, clothing and PPE, as well as acclimatisation (ISO 2017; Ioannou et al. 2019; ISO 2023; Gkikas et al. 2026). Recent large-scale international studies have shown that the WBGT is the most effective workplace heat stress metric (Ioannou et al. 2022a, Ioannou et al. 2022b, Ioannou et al. 2022c). The ILO (Azzi et al. 2024) as well as the WHO and WMO (WHO and WMO 2025) note that WBGT is the best-established indicator for workplace heat-risk assessment, while the Universal Thermal Climate Index (UTCI) and the Heat Index can be useful for screening or climate monitoring but are less directly adapted to specific tasks, PPE, and metabolic workload.

The UTCI is a metric designed around a thermophysiological model of human temperature regulation and a clothing model (Bröde et al. 2012; Fiala et al. 2012; Havenith et al. 2012; Jendritzky et al. 2012). It is widely used in public health because

[4] The terms environmental heat and ambient hear are used to describe environmental conditions, including air temperature, humidity, thermal radiation, and wind.

it presents the advantage of combining environmental heat stress with physiological strain in a dynamic manner. This elegant dynamic integration provides very accurate results in most situations (Bröde et al. 2013). However, an important limitation is that the UTCI assumes fixed levels of exposure duration (2 h), a moderate metabolic rate (135 W/m^2), and free behavioural adaptations of clothing. That is, the adaptive clothing model incorporated in the UTCI adapts the outcome assuming the clothing habits of the general urban population and their choice of clothing insulation related to the environmental temperature (Havenith et al. 2012; Bröde et al. 2013). However, workers in many industries wear uniforms and/or PPE, and/or are not allowed to adjust their clothing if the environmental temperature fluctuates. Though work clothing is typically adapted based on the season of the year, there is very little day-to-day variability. Furthermore, it is often not possible for workers to change their clothing during a work shift. In addition to the clothing issues, workers often work at higher work intensity (metabolic rate) than that assumed in the UTCI estimations.

The Heat Index is used in some countries to evaluate the level of workplace heat stress. In general, there is a good correlation between the Heat Index and the WBGT (Bernard and Iheanacho 2015). In occupational environments, the Heat Index can be easily measured using cost-effective instruments, making it a convenient tool for analysing the level of workplace heat stress. Nonetheless, its limitations include the lack of consideration for radiant heat and airflow. Additionally, there is a lack of evidence supporting the adjustment of Heat Index thresholds according to work intensity or clothing. A further drawback of the Heat Index is that the guidance it offers for initiating a workplace heat stress prevention programme is not robustly backed by evidence.

A further distinction is essential. Heatwaves are acute extreme events, but workplace heat stress is also a "hot normal working day" issue (Azzi et al. 2024). A recent ILO report highlights that nine out of ten worker exposures to excessive heat, and eight out of ten occupational injuries linked to heat, occur outside officially declared heatwaves (Azzi et al. 2024). Therefore, European OSH policy cannot rely only on meteorological heatwave alerts. It must address ordinary seasonal exposure, cumulative fatigue, and insufficient recovery, including after tropical nights, when high night-time temperatures reduce the body's opportunity to recover before the next shift. In this context, the WBGT remains the most widely used and scientifically established metric for assessing heat stress at work because it integrates a broad range of factors relevant to workers' heat exposure. This makes it a particularly valuable tool for the identification, assessment and prevention of heat-related risks in the workplace.[5]

2.2. Health effects and accident mechanisms

The clinical effects of workplace heat stress range from dehydration, heat cramps, heat rash, heat syncope and heat exhaustion to heatstroke, rhabdomyolysis, kidney injury and aggravation of cardiovascular, respiratory and metabolic conditions (Azzi et al. 2024; WHO and WMO 2025). Reports from ILO (Azzi et al. 2024) as well as original (Glaser et al. 2016; Glaser et al. 2020) and meta-analytic data (Flouris et al. 2018)

[5] This is also the chosen metric in the proposal for a Directive on Workplace Heat Stress included in the Annex of this report. This metric is also presented in Section 5.

indicate that frequent exposure to workplace heat stress is linked with kidney disorders, cardiovascular disease, and mental health impacts such as psychological distress, anxiety, depression and irritability. Technical guidance from the WHO and WMO similarly frames workplace heat stress as a combined physiological, organisational, and social risk requiring workplace heat action programmes and specific protection for vulnerable workers (WHO and WMO 2025).

Workplace heat stress also affects OSH through non-clinical pathways. Prolonged exposure can impair concentration, vigilance, and judgement, increase fatigue, slow reaction times and reduce coordination (Azzi et al. 2024, WHO and WMO 2025). Sweat, glare, dehydration, and thermal discomfort may make manual handling, machinery operation, driving, work at height, and emergency work more dangerous (Azzi et al. 2024; WHO and WMO 2025). Climate-ADAPT and EU-OSHA note that intense physical work adds internal heat load and that inadequate cooling at home may prevent workers from recovering between shifts (Climate-ADAPT 2023). This is especially important for workers living in poorly insulated housing, migrant accommodation, temporary housing, or urban heat islands.

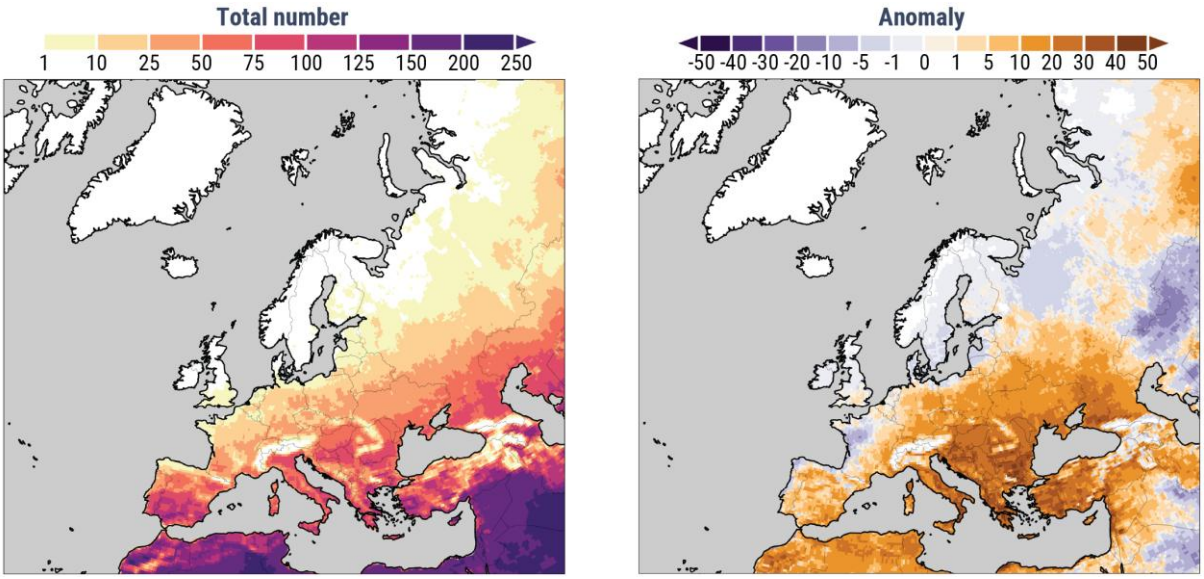
2.3. Unequal exposure across regions, sectors, and groups of workers

Workplace heat stress is not distributed evenly across Europe. Southern Europe and the Mediterranean are already central areas of concern because heat and drought intersect with agriculture, construction, tourism, outdoor services, wildfire risk and water scarcity. The European Environment Agency's European Climate Risk Assessment (EEA 2024a) identifies southern Europe as particularly at risk from the impacts of heat and drought on agricultural production, outdoor work, water availability for economic sectors and fire risk; within southern Europe, rural areas and local economies dependent on agriculture, ecosystem services and summer tourism are especially exposed.

The rest of Europe should, however, not be treated as a low-risk zone. Heatwaves are increasingly relevant in western, central, eastern and northern Europe, especially in urban areas where the urban heat island effect, sealed surfaces, inadequate building design and insufficient ventilation amplify exposure (Figure 2) (C3S and WMO 2025). Moreover, the ILO recently reported that, while occupational illnesses and accidents associated with workplace heat stress are currently more common in Southern Europe, the increase between 2000 and 2020 was actually much faster in Central and Northern Europe (Azzi et al. 2024). In addition, the IPCC reports that indoor overheating and reduced outdoor thermal comfort, often combined with urban heat islands, have already affected European cities, and that heatwaves are likely to become a major threat not only for southern Europe but also for western, central and eastern European cities (Bednar-Friedl et al. 2022).[6]

[6] At the same time, mountain regions face different but connected labour risks. The IPCC concludes that these regions are experiencing accelerated warming, reduced snow cover extent and duration at lower elevations, glacier mass loss and changes in seasonality; it also notes that diminishing snow at lower elevations has already challenged winter tourism operations (Adler et al. 2022). This creates OSH issues, income insecurity and job-security concerns for workers in tourism, transport, maintenance,

Figure 2. Number of days with at least "strong heat stress" during 2024. Credit: ESOTC 2024 Europe (C3S and WMO 2025).



Also, sectoral exposure to climate-related occupational risks is highly uneven. Eurofound identifies agriculture, fisheries, forestry, construction, tourism and emergency services as particularly at risk from climate change impacts on job quality, while also noting that the direct impact of climate change goes beyond heat and affects both these sectors and the wider population through psychosocial risks, air pollution, ultraviolet radiation and extreme weather events (Eurofound 2024). Heat is also a serious issue in sectors sometimes left out of public debate: transport and delivery, logistics and warehousing, waste collection, street cleaning, food production, commercial kitchens, manufacturing, maintenance, utilities, mining and quarrying, education and care work in overheated buildings, and emergency response. The EU-funded HEAT-SHIELD project focused on manufacturing, construction, transport, tourism and agriculture because of their strategic importance and exposure to workplace heat stress (Morabito et al. 2019; Morris et al. 2021; Flouris et al. 2022). Table 3 provides examples of sectors and settings where exposure to workplace heat stress is typically higher.

Table 3. Examples of sectors and settings where exposure to workplace heat stress is typically higher.

Sector or setting	Main OSH concern
Agriculture and forestry	Direct sun, heavy physical work, water scarcity, pesticide, PPE, and seasonal labour create high heat-strain risks; Italian evidence links heat with agricultural injuries (Di Blasi et al. 2023).
Construction, road work, mining and quarrying	Radiant heat from surfaces, work at height, machinery, dust and urban heat islands increase accident risk; Italian industrial and service-sector data identify construction as a high-risk hot-day sector (Marinaccio et al. 2019).

hospitality and seasonal work, as well as for agriculture and pastoralism in mountain areas (Adler et al. 2022).

Transport, delivery, logistics, waste collection and maintenance	Vehicle cabins, street-level heat, time pressure, manual handling and limited access to cool rest areas increase risk; Climate-ADAPT notes heatstroke and fatalities among outdoor workers including street sweepers and waste workers in southern Europe (Climate-ADAPT 2023).
Manufacturing, food processing, commercial kitchens and foundries	Indoor heat from processes, poor ventilation, uniforms, and PPE can create dangerous conditions even without outdoor exposure; IPCC identifies manufacturing and services as vulnerable where cooling is absent (Bednar-Friedl et al. 2022); Slovenian and Greek data in manufacturing workers confirm high exposure during the summer (Pogacar et al. 2019).
Hospitality, tourism, education, care and healthcare	Kitchens, hotels, outdoor tourism, overheated schools and care settings, and PPE in healthcare create heat risks that are often under-measured; evidence is stronger for indoor overheating than for formal occupational injury attribution (Climate-ADAPT 2023).
Emergency services and firefighters	Heat combines with smoke, PPE, long shifts, dehydration, traumatic events, and high physical load; wildfire response is a compound heat, respiratory, and safety hazard (ILO 2026).

Within sectors, exposure is mediated by employment status and workplace power relations. **Seasonal, migrant and self-employed workers** are overrepresented in climate-exposed sectors and may have weaker legal protection, lower trade union organisation and less workplace representation (Flouris et al. 2021; Eurofound 2024, Van der Horst et al. 2025). **Undocumented workers, self-employed workers, subcontracted workers, platform workers, agency workers, workers in microbusinesses and workers paid by task or piece rate** may be less able to refuse unsafe work, take paid breaks, report symptoms, demand water or shade, or insist on rescheduling (Flouris et al. 2021; Ioannou et al. 2023; Azzi et al. 2024; Van der Horst et al. 2025). Additionally, gender, age and health status may affect vulnerability (Laabbas-el-Guennouni 2025c). **Women** workers may face heat risks that are under-recognised in sectors such as care, cleaning, hospitality, education, food processing and agriculture, and pregnant workers need specific protection (Azzi et al. 2024; Bonell et al. 2026). Young workers may lack experience or training; older workers and workers with chronic cardiovascular, respiratory, kidney or metabolic conditions may be more vulnerable; and workers required to wear impermeable or heavy PPE may be exposed to heat strain precisely while being protected from other hazards (Azzi et al. 2024). The IPCC identifies elderly people, pregnant women, people with pre-existing medical conditions and low-income — particularly due to their more limited adaptive capacity — as groups particularly vulnerable to heat-related risks.

3. Workplace heat stress is also affecting productivity, job security, and income

Workplace heat stress is not only a health and safety hazard; it has also significant labour-market consequences. In European workplaces, heat can reduce workers' capacity to work safely and effectively, disrupt working time, slow production, increases absence, and interrupt economic activity. These effects may translate into fewer paid hours, unpaid breaks, cancelled shifts, lower output-related pay, and greater employment insecurity, particularly where protective regulation or compensation mechanisms are weak. Therefore, the central issue for workers' organisations is not productivity in the abstract, but who bears the economic cost of prevention, work stoppages, and climate-related disruption.

3.1. From heat exposure to lost work capacity

Climate change increases the frequency, intensity, and duration of heat exposure; workplace design and work organisation then determine how environmental heat is experienced as workplace heat stress through physical effort, radiant heat, humidity, poor ventilation, clothing and PPE, limited autonomy over the work pace, and insufficient access to water and cool rest areas. Workplace heat stress can cause physiological strain and heat-related illness, but even before clinical illness occurs it can reduce concentration, increase fatigue, impair judgement and vigilance, and make work at height, driving, machinery operation, manual handling, and emergency response less safe. Climate-ADAPT, developed with EU-OSHA, explicitly links workplace heat stress to reduced concentration, mental fatigue, impaired judgement, and increased accident risk, especially where workers perform intense physical work or cannot recover adequately between shifts (Climate-ADAPT 2023).

The above mechanism explains why workplace heat stress affects productivity in two distinct ways. First, workers may be physically unable to maintain the same pace without increasing risk to health and safety. Secondly, prevention itself requires time: hydration, shaded or cooled rest, work-rest cycles, rescheduling, acclimatisation and task rotation. These measures are necessary OSH controls, not optional welfare benefits. However, where they are not treated as paid working time, the economic cost of prevention is transferred to workers through lower pay, reduced bonuses, or pressure to continue working unsafely.

Importantly, emerging evidence suggests that these effects are much more widespread than previously thought. As an example, it was previously thought that workers' productivity is reduced when workplace heat stress rises beyond 28°C WBGT (Kjellstrom et al. 2014; Bröde et al. 2018). However, more recent studies in both field (Ioannou et al. 2022d) and laboratory (Foster et al. 2021) settings showed that humans are most productive at about 15°C WBGT, and that productivity reductions rise exponentially with each 1°C WBGT increase beyond 15°C (Foster et al. 2021, Ioannou et al. 2022d). Interestingly, this is similar to the threshold for workplace heat stress injuries, which rises by 1.7% for each degree increase beyond 13.3°C (Fatima et al. 2021). This demonstrates the physiological connection between health and

productivity. Recent meta-analytic data from 2,409 acclimatized outdoor workers who performed a shift (7.0±2.8 hours) of moderate intensity physical work (metabolic rate: 180.2 W/m^2) in various occupations showed an average 2.4 W/m^2 reduction in work output for each 1°C increase in workplace heat stress beyond 15°C WBGT (Ioannou et al. 2022d).

A detailed methodology based on real-time job task analysis has been developed in recent years to provide a more detailed account of the impacts of workplace heat stress on productivity. This task analysis methodology provides a second-by-second breakdown of the time workers devote to work as well as the intensity of performing that work. These are, then, paired with workplace (indoor vs. outdoor, shaded vs. under the sun) and environmental (temperature, humidity, wind speed, solar radiation) information to delineate the impact of workplace heat stress on productivity (Ioannou et al. 2017; Flouris et al. 2019; Ioannou et al. 2022d; Ioannou et al. 2025). Using this methodology, the above-mentioned meta-analytic results, as well as a previous approach using comparison against a reference value (Fatima et al. 2021), Figure 3 illustrates the loss in productivity induced by workplace heat stress during 2030 across Europe compared to a reference WBGT where productivity loss is minimal [i.e., 15°C WBGT (Ioannou et al. 2022d; Ioannou et al. 2025)].

Figure 3. Absolute and relative loss in productivity caused by workplace heat stress estimated for 2030 across the world in the four quarters of the year. The estimates are done for acclimatized outdoor workers during a shift involving moderate intensity physical work. The productivity loss is expressed in comparison to a reference WGBT where productivity loss is minimal [i.e., 15°C WBGT (Ioannou et al. 2022d; Ioannou et al. 2025)] when performing manual labour.

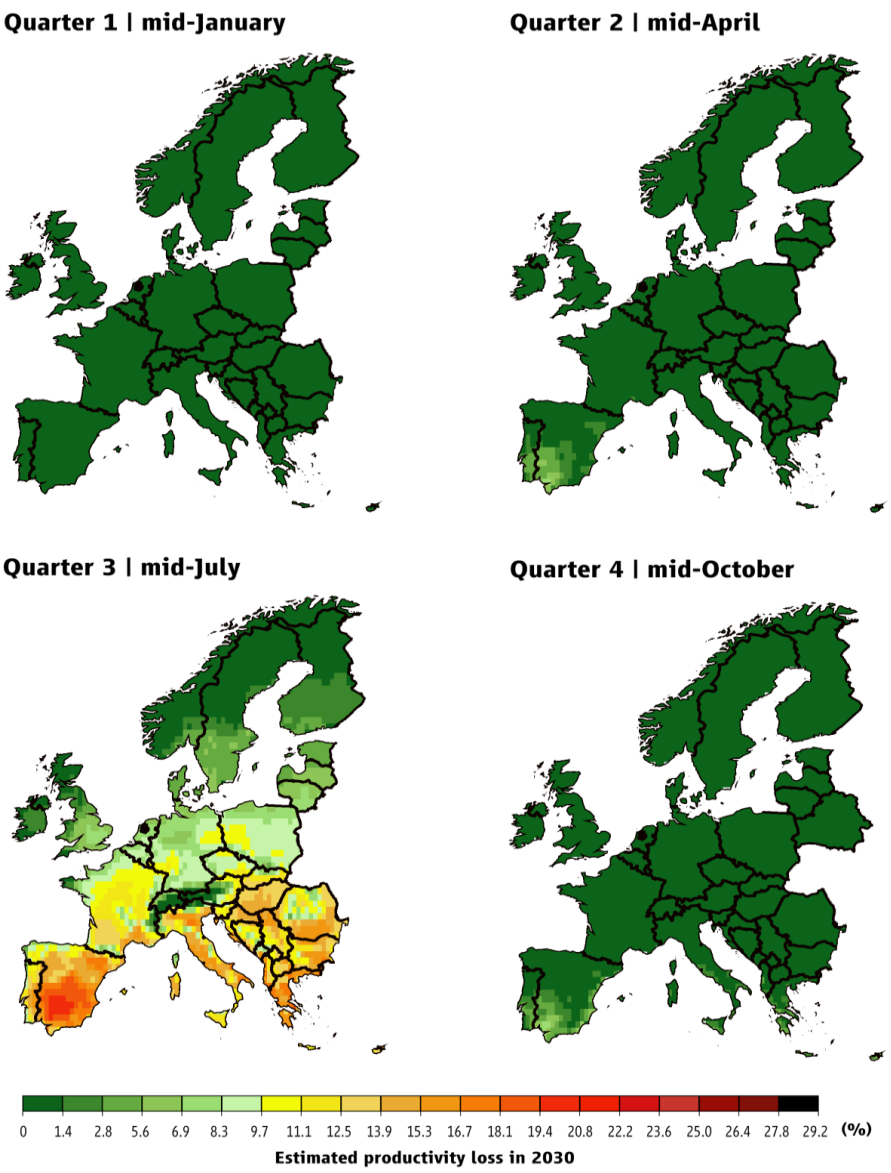


Figure 3 shows that, in 2030, people working in most European regions will be experiencing significant productivity reductions due to workplace heat stress during the 3rd quarter of the year. During this quarter, widespread productivity losses are anticipated in most of the populated parts of Europe. In Southern Europe, these productivity losses are expected to reach up to 20%, with losses ranging 10-15% in Central Europe, and 3-9% in most of Northern Europe. Some parts of the Iberian Peninsula, Italy, Greece, and Cyprus will experience productivity losses up to 8% also during the 2nd and 4th quarters of the year.

Overall, these updated results suggest a re-thinking of how workplace heat stress affects productivity across Europe. Rather than increasing dramatically in a few countries, mainly in Southern Europe, and causing large-scale productivity losses in these regions, recent evidence suggests that the productivity impacts of workplace heat stress may be less severe there than previously assumed, while becoming more widespread across almost all parts of Europe. This means that there are significant productivity losses in countries that were previously thought to be spared from

workplace heat stress, such as those in Central and Northern Europe. It also means that there are many people around Europe who are labouring in workplace heat stress conditions that affect their productivity. Shown in a recent ILO report, currently 130 million full-time workers across Europe are labouring in workplace heat stress conditions (Azzi et al. 2024).

The European evidence strongly associates workplace heat stress with reduced labour productivity, particularly in outdoor and physically demanding sectors, while also highlighting wider impacts on indoor activities and regional economies. The latest European chapter of the Intergovernmental Panel on Climate Change identifies agriculture and construction as the sectors most exposed because of high-intensity outdoor work, although manufacturing and services are likewise vulnerable where air conditioning is absent (Bednar-Friedl et al. 2022). The report further notes that major European heatwaves in 2003, 2010 and 2015 let to monthly worker productivity losses of 3–3.5% on average in Southern Europe, reaching 8–9% in Cyprus and Italy during some events. Modelling studies suggest that these impacts will intensify without stronger adaptation. Research covering 274 European regions estimated annual losses equivalent to 0.3–0.5% of European GDP, with southern regions frequently exceeding 1% and sometimes 2%, while also showing that losses affecting outdoor workers spill over into sectors such as food manufacturing, tourism and travel services (García-León et al. 2021). Similarly, a 2025 assessment by the Joint Research Centre projected that labour productivity losses above 1% could affect 22 European regions by mid-century and 107 regions by the 2080s, with particularly severe impacts in areas such as Murcia, where losses could reach 6% under the most extreme scenario (Szewczyk et al. 2025). These conclusions are consistent with the ILO (ILO 2026), which reports that productivity declines by 2.3% for every degree Celsius above 19°C and identifies agriculture, construction, manufacturing, refuse collection, emergency repair work, transport and tourism as sectors especially exposed to heat-related productivity and OSH risks. Table 4 relates the most vulnerable sectors and workers with the heat-related productivity impacts.

Table 4. Sectors where heat-related productivity and OSH risks are particularly significant.

Sector or setting	Main productivity and income pathway	Workers most exposed	European evidence or policy cue
Agriculture and forestry	Slower pace, longer recovery time, crop disruption, drought-related work loss and reduced seasonal employment	Seasonal, migrant, self-employed and piece-rate workers	IPCC identifies agriculture as a high-risk sector for heat-related productivity loss in Europe (Bednar-Friedl et al. 2022)
Construction, road work and maintenance	Work stoppages, rescheduling, slower manual tasks, delays and reduced paid hours where compensation is absent	Subcontracted, bogus self-employed, migrant and outdoor manual workers	Eurofound notes France's building and civil engineering adverse-weather scheme, under which employees continue being paid during shutdowns due to extreme heat (Eurofound 2024)
Transport, delivery, logistics and waste collection	Route delays, slower loading and unloading, vehicle-cabin heat, fewer completed tasks and pressure to maintain output	Platform workers, delivery workers, waste workers and workers paid by task or route	Climate-ADAPT identifies transport, maintenance and utilities among exposed outdoor sectors (Climate-ADAPT 2023)

Manufacturing, food processing, kitchens and other hot indoor work	Reduced pace, fatigue, quality errors, absence and higher cooling costs	Workers in poorly ventilated or heat-generating workplaces, including women in low-paid service and food work	IPCC notes manufacturing and services are vulnerable where cooling is absent (Bednar-Friedl et al. 2022).
Tourism, hospitality and emergency services	Heat disrupts peak-season work, increases recovery needs and compounds risks with wildfire smoke, PPE or long shifts	Seasonal workers, firefighters, first responders and hospitality workers	Eurofound identifies tourism and emergency services among sectors at particular climate-related job-quality risk (Eurofound 2024).

3.2. Productivity, income and job security

Workplace heat stress affects workers through both clinical and operational pathways. Clinically, workplace heat stress can cause acute heat-related illness and exacerbate cardiovascular, respiratory and kidney conditions (Flouris et al. 2018; Ioannou et al. 2022d; Azzi et al. 2024; WHO and WMO 2025). Operationally, it can make work less safe by increasing fatigue, reducing concentration and weakening coordination (Flouris et al. 2018; Ioannou et al. 2025). These mechanisms are supported by European occupational injury evidence. A Spanish national study analysing nearly 16 million occupational injuries over 20 years found that cold and heat increased the risk of occupational injury by 4% and 9% respectively, and estimated that temperature-related injuries accounted for 2.7% of all work-related injuries in Spain during the study period (Martinez-Solanas et al. 2018). In Italian agriculture, a study covering 2014-2018 found a positive association between increasing daily mean temperature and work-related injuries, estimating 2,050 heat-attributable agricultural injuries over five years, with the highest number among self-employed workers (Di Blasi et al. 2023).

Heat also affects how work is organised and how income is generated. Heat can mean fewer paid hours, cancelled shifts, unpaid breaks, slower work pace, reduced output bonuses, crop losses, disrupted supply chains, higher insurance costs, business closures and reduced local demand. For workers in agriculture, drought and heat can undermine yields and seasonal employment. For workers in mountain tourism, snow loss can reduce winter work. For construction workers, extreme heat, storms or flooding can halt work, creating income insecurity unless compensation mechanisms exist.[7] These issues connect occupational safety and health to social protection. A recent ILO report highlights social protection and compensation measures as part of climate-related OSH governance, including examples from Spain, Austria, and France where workers or employers may receive forms of leave, wage continuation, or compensation when severe weather prevents work (ILO 2026). Eurofound's mapping of EU Member State policy responses to extreme weather events similarly shows that most recorded measures involve financial support, compensation, income support, or access to financing (Eurofound 2024); it also notes that France's adverse-weather unemployment scheme for building and civil engineering allows employees to

[7] These compensation mechanisms already exist. For example, after the DANA floods in Valencia (Spain), compensation mechanisms were activated for sectors that suffered losses as a result of the emergency situation. These measures were adopted be the Royal Decree-Law 7/2024 of 11 November.

continue being paid during a work shutdown due to extreme heat, with partial reimbursement for employers (Eurofound 2024).

Therefore, workplace heat stress interacts with labour-market insecurity, distributing unevenly the economic effects across the labour market. Workers with secure contracts, collective agreements and paid breaks are more likely to benefit from prevention without losing income. Workers paid by output, employed seasonally, working through platforms, or classified as self-employed may face the opposite – very dangerous – incentive: continue working in unsafe heat or lose earnings. Migrant and undocumented workers face additional barriers, including language, legal status, dependence on employers for housing or documentation, and fear of dismissal. In this way, the economic costs of climate-related disruption and prevention can be shifted disproportionately onto workers with the least bargaining power. Workplace heat stress can therefore deepen existing inequalities unless prevention is tied to paid time, enforceable employer duties, and social protection.

Heat-related disruption can also affect job security at enterprise and sector level. Outdoor work may be stopped during extreme heat; agricultural yields and seasonal labour demand may fall during heat and drought; small firms may face delays and cost pressures; and supply-chain disruptions can reduce demand for labour beyond the directly exposed workplace. OECD firm-level evidence from 23 advanced economies found that high-temperature days and heatwaves reduce labour productivity, with stronger effects in smaller and less productive firms and no clear evidence of adaptation to severe extremes (Costa et al. 2024).

The policy implication is that work stoppages and rescheduling must be treated as part of prevention, not as individual absence. A recent ILO report identifies social protection and compensation as important tools for addressing weather-related work disruption, including Spanish leave where severe weather prevents workers from reaching the workplace, Austrian compensation for construction workers when bad weather prevents completion of work, and the French recognition of heatwaves under the weather-related unemployment scheme (ILO 2026). Eurofound's mapping of EU measures after extreme weather events similarly found that most recorded measures involved financial support, compensation, income support or access to financing (Eurofound 2024); it also describes the French CIBTP adverse-weather scheme for building and civil engineering, under which employees continue to be paid during a work shutdown due to extreme heat while employers may claim partial reimbursement (Eurofound 2024).

The key conclusion is that workplace heat stress should be addressed through both OSH prevention and labour protection. Paid work-rest cycles, rescheduling, cooled rest areas, hydration, workload adjustment and the right to stop dangerous work protect health; wage continuation, compensation schemes and collective bargaining protect income. Without these safeguards, the same heat-prevention measures that keep workers safe can also reduce their earnings, particularly for those with the least bargaining power. This connects directly to sections 4 and 5: prevention must be upheld by a clear legal framework, designed with workers' organisations, embedded in risk assessment, supported by labour inspection and negotiated through collective bargaining so that the costs of climate adaptation are not shifted onto workers.

4. Legal protection of workers' health against heat at work

Taken together, the evidence shows that workplace heat stress is already affecting workers' health, safety, productivity, income and job security across Europe. This raises an important question: are existing legal frameworks adequately equipped to prevent and manage these risks?

The existing OSH framework provides an important foundation for addressing climate-related workplace risks. At international level, ILO Convention No. 155 and Convention No. 187 require coherent national OSH policy and support employer duties, worker participation, and the right to remove oneself from serious and imminent danger. At EU level, the Council Directive of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (89/391/EEC) (also referred as Framework Directive) requires employers to perform risk assessment and act upon its findings, enabling workers to stop work and/or leave the workplace in the event of serious, imminent and unavoidable danger. EU rules on work equipment and workplaces also recognise that weather conditions can jeopardise safety, including in temporary work at height and outdoor workstations.

However, these general duties do not in themselves guarantee adequate protection against workplace heat stress or other climate-related hazards as are not always translated into concrete heat-prevention obligations. They lack concrete exposure thresholds, mandatory rest arrangements, enforceable rescheduling rights, emergency planning obligations, and compensation mechanisms for climate-related work stoppages. As a result, protection remains uneven across sectors, occupations, and member states and may depend heavily on enforcement capacity and workers' bargaining power.

Dedicated regulation, therefore, remains a promising avenue for protecting workers from heat exposure. Recent guidance from both the EU Advisory Committee on Safety and Health at Work and the ILO identifies a broadly shared set of core workplace heat stress protections, providing a strong and policy-relevant basis for immediate preventive action (Advisory Committee on Safety and Health at Work 2025b; Azzi et al. 2024). This set includes the 10 basic workplace heat stress protections as listed in Table 5. These protections should be the ones included in dedicated regulation. In addition, worker participation, joint OSH committees, safety representatives, workers' organisations, and collective bargaining are essential for translating minimum legal standards into effective workplace practice. Workers often know where heat accumulates, which tasks are most dangerous, where water is inaccessible, and when productivity targets discourage breaks. Collective agreements are increasingly used to strengthen climate-related OSH protections, including the Spanish construction agreement on adjusting working hours during heatwaves (ILO 2026). However, social dialogue complements rather than substitutes for binding employer duties and enforceable minimum protections. In addition, its use is far from being institutionalised from a heat prevention perspective (Salas-Nicás and Laabbas-el-Guennouni 2026).

Table 5. The 10 basic Protections for mitigating WHS converged from documents introduced by the EU Advisory Committee on Safety and Health at Work (Advisory Committee on Safety and Health at Work 2025b) and the ILO (Azzi et al. 2024).

#	Basic workplace heat stress protections
1	Use of a WHS indicator (e.g., WBGT) to assess the level of hazard exposure. The indicator should include varying safety thresholds based on work intensity.
2	Hydration strategies, including adequate sanitation facilities, especially for female workers.
3	Rest, breaks or modified work schedules to limit or avoid exposure to excessive heat, including the ability to self-pace.
4	Heat acclimatisation measures for workers without recent heat exposure.
5	PPE designed to protect workers from WHS.
6	Provision of cool, shaded, and ventilated rest areas.
7	Education and awareness on heat stress and heat-related illnesses.
8	Identification of and targeted strategies for worker groups at high risk.
9	Participatory risk assessment in the workplace integrating excessive heat.
10	Regular medical check-ups and health monitoring.

Key: PPE = personal protective equipment; WBGT = Wet-Bulb Globe Temperature.

Workplace heat stress is a preventable OSH risk. The policy challenge in Europe is to move from *ad hoc* heatwave response to enforceable prevention systems that cover both acute heatwaves and "hot normal working days", integrate heat into workplace risk assessment, and ensure that the costs of adaptation are not shifted onto workers through unpaid breaks, lost hours, or intensified work. Heatwaves often trigger public warnings and emergency responses, but workplace exposure often occurs before a heatwave is officially declared, especially in agriculture, construction, waste collection, transport, delivery, logistics, tourism, hospitality, manufacturing, commercial kitchens, mining, education, care and emergency services. The ILO's global framework is directly relevant here, but in Europe it requires operationalisation through EU and national OSH duties, labour inspection, social dialogue, collective bargaining, and social protection. The ILO stresses that 90% of excessive-heat exposures and 80% of heat-related occupational injuries occur outside official heatwaves (Azzi et al. 2024), which is central for European policy design. The EU OSH acquis provides an important scaffold for prevention, but it still lacks specific and binding rules on workplace heat exposure applicable to all Member States. Southern Europe already faces higher baseline risk, especially in outdoor and physically demanding work, but a recent ILO analysis showed that the rise in fatal injuries attributable to workplace heat stress has been more drastic in Central and Northern Europe, exceeding 50% over the past two decades (Azzi et al. 2024). This supports a European approach that is differentiated by climate, sector, and work organisation, but not confined to Mediterranean countries. This supports a European approach that is differentiated by climate, sector, and work organisation, but not geographically limited to Southern Europe.

In this context, it is essential to examine the preventive measures capable of ensuring adequate protection for those exposed to workplace heat. To this end, this section analyses the legal protection currently afforded to such workers and its challenges. The analysis pursues a threefold objective. First, it seeks to identify how the existing EU regulatory framework addresses heat exposure through the legal instruments currently in place. Secondly, it examines the limitations and key aspects that should

be addressed to ensure an adequate protection within the current EU legal framework. On this basis, a range of possible regulatory pathways will be proposed through which concrete legal measures may be introduced to effectively address the protection needs of workers exposed to workplace heat.

4.1. EU OSH Legal Framework and exposure to heat at work

The principal legal instrument governing the protection of workers' health at European Union level is the Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (already referred as Framework Directive). This legal instrument establishes the fundamental foundations for protection against all risks that may affect workers in the workplace within its scope of application, including, in principle, workplace heat exposure. This is due to its primary objective, namely 'to introduce measures to encourage improvements in the safety and health of workers at work' (Article 1(1)).

However, its development is characterised by a generalist approach, designed to encompass any type of risk that may affect workers (Article 1(2)). This very feature explains why no explicit reference is made to workplace heat within its provisions. Nevertheless, this general formulation does not disregard the connection between workers' health and the working environment. Indeed, its preamble expressly acknowledges 'that workers may be exposed to the effects of dangerous environmental factors at the workplace during the course of their working life'. This indicates that all provisions included in the Framework Directive are intended to be sufficiently broad to encompass occupational risks within its scope, including heat exposure. In other words, workers exposed to heat should already be covered by the general obligations imposed on employers under the Framework Directive, which provides a general duty-based framework that implicitly covers heat exposure. Yet, workers exposed to heat experience important health issues along their working life and lack effective prevention against the exposure.

In this context, it is key to relate the prevention principle established in the Framework Directive to the risk that poses heat at work. When the Framework Directive was first adopted it intended to consider 'the principle of prevention a cornerstone of the system' (Ponce Del Castillo 2017), in which both employers and workers are required to respect a set of obligations (Articles 6 and 13). These obligations are integrated in a 'preventive hierarchy of control [...] which has two clearly distinguishable hierarchical levels: (1) to avoid the risks or eliminate the hazard; (2) to reduce the hazard and the risks' (Narocki 2021). At the same time, it is essential to refer to Article 5(1), which provides that 'the employer shall have a duty to ensure the safety and health of workers in every aspect related to the work'. Within this framework, a set of measures must be implemented to ensure adequate protection of workers against all occupational risks. This necessarily should cover workplace heat exposure, which clearly constitutes an 'aspect related to the work' where workers are exposed to it in the performance of their tasks. These measures, which will be analysed in a subsequent subsection, stem from the employer's obligations under the principle of prevention (Popma and Jaspers 2024) and include (among other):

- a risk assessment including 'those facing groups of workers exposed to particular risks' (Article 6(3)(a) and Article 9(1)(a));
- the adoption of preventive and protective measures (Article 6(1) and 6(2) and Article 9(1)(b));
- the provision of appropriate information and training to workers (Article 10 and Article 12);
- the organisation of work in a manner that safeguards workers' health and safety (Article 6(1));
- the monitoring and review of occupational risks (Articles 6(1) and 9(1)(c) and 9(1)(d)).

All these measures must be implemented taking into account the nature of the activity carried as stated in Article 6(3), which means that when heat constitutes a factor that may affect workers, it must be integrated into each of them. This leads us back to the issues examined in previous sections, which allow us to affirm that workplace heat is no longer an isolated concern but a widespread reality across all workplaces, both indoor and outdoor. Accordingly, it should be systematically addressed within all these measures. However, this systematic integration of heat into employers' OSH policies is far from becoming a reality (Salas-Nicás and Laabbas-el-Guennouni 2026). Such an integrated approach should address several aspects aimed at ensuring workers' protection. This includes, in particular, the specification of acceptable exposure limit values that shall not be exceeded, going beyond mere references to maximum air temperatures and clearly determining when work should be suspended. Where work can still be carried out despite the exceedance of such limits, a set of protective measures should be activated, which 'may include the adaptation of working hours (scheduling and/ or shortening), the introduction of more frequent and longer breaks, giving employees greater agency in deciding when they need to take breaks, and the provision of shade, water, and body-cooling equipment or clothing' (Schaapman 2023). All this cannot be driven by an implicit coverage of heat through the Framework Directive as it lacks heat-specific operational standards that ensure an adequate legal response.

In this regard, the regulations of the Member States continue to provide differing levels of protection in this area (Schooneveldt 2026). It is in this context that proposals to adopt a regulatory framework specifically dedicated to this issue are particularly noteworthy, as the current lack of harmonisation results in uneven implementation and prevents consistent levels of protection of Member States (Cefaliello 2023). At the same time, such a dedicated and binding instrument would also be an adequate manner of ensuring that Member States currently lack protection in this area incorporate it into their legal frameworks. This would be in line with the ETUC (2025) Resolution on the content of a Directive on the prevention of workplace heat risks, which advocates for concrete preventive measures targeting directly the risk before, during, and after the exposure. In fact, 'a general EU legislative framework specifically dedicated to the regulation of heat, applicable to all workers in Europe, is the most appropriate way to regulate workplace heat exposure. The OSH Framework Directive is not enough to guarantee workers' protection against heat, for it lacks the technical details needed to implement the necessary measures, as well as the limit values to base those measures on' (Schaapman 2023).

4.2. Legal protection of workers and sectors particularly exposed to heat

According to Article 2(1) the Framework Directive is applicable to all sectors of activity, including both public and private.[8] However, Article 16(1) states that 'the Council, acting on a proposal from the Commission based on Article 118a of the Treaty, shall adopt individual Directives' (also known as Daughter Directives). These Daughter Directives follow a legislative technique characteristic of the field of OSH, aimed at safeguarding workers who are particularly vulnerable or at managing OSH in specific sectors. Thus, the adoption of individual Directives has traditionally been justified where a risk presents one or more of the following features: a high degree of severity for workers' health and safety, widespread exposure across sectors, the inadequacy of general preventive obligations alone, the need for specific technical or organisational measures, or the existence of significant divergences between Member States that may undermine equal levels of protection within the Union (Jacobsen et al. 2006). This rationale explains the adoption of specific Directives on risks such as exposure to carcinogens, biological agents, asbestos, noise, or vibration. In light of the evidence presented in the previous sections, heat exposure displays the same characteristics that have justified dedicated regulatory intervention in other areas, supporting the case for a specific Directive on heat exposure at work.

To better understand the approach adopted by daughter Directives, the following subsections reflect on the attention – or lack thereof – paid to workplace heat exposure. More specifically, they examine Directives that regulate groups of workers who are especially vulnerable to heat, address sectors in which heat exposure is particularly significant, or explicitly refer to heat exposure. This analysis will ultimately help to support the argument for a better harmonisation of the EU OSH legislation with regard to heat-related risks.

4.2.1. The insufficiency of the Workplace Directive

The Council Directive 89/654/EEC of 30 November 1989 concerning the minimum safety and health requirements for the workplace (also referred as Workplace Directive) sets out specific provisions concerning room temperature in both of its annexes. Concretely, it states that: 'during working hours, the temperature in rooms containing workplaces must be adequate for human beings, having regard to the working methods being used and the physical demands placed on the workers; the temperature in rest areas, rooms for duty staff, sanitary facilities, canteens and first aid rooms must be appropriate to the particular purpose of such areas; [and] windows, skylights and glass partitions should allow excessive effects of sunlight in workplaces to be avoided, having regard to the nature of the work and of the workplace.' (Annex I, Section 7).

The inclusion of such a provision is paramount, as it explicitly recognises within the EU OSH Legislation the importance of heat for workers' health. Additionally, it establishes the requirement to ensure adequate temperatures for indoor workers, who

[8] The Directive itself also considers concrete exceptions to its scope due to the nature of the activity (e.g. armed forces, the police, or certain activities in the civil protection services). See Article 2(2). Although this issue will not be developed further in this report, the heat-related risks to which sectors such as firefighters are exposed are of particular interest. Wildfires affecting Mediterranean regions are becoming increasingly complex, partly due to changing climate patterns, including rising temperatures. This results in more challenging scenarios in which firefighting activities place those involved at greater risk, requiring enhanced protection.

may also be affected by heat exposure. However, its content remains far from ensuring comprehensive protection against workplace heat as it does not include specific thresholds, preventive measures, or tailored obligations aimed at protecting workers' health. Nevertheless, the main issue of this concrete piece of legislation is the scope in which operates. Article 2 (together with Article 1(1)) clearly stipulate that the content applies to 'the place intended to house workstations on the premises of the undertaking and/or establishment and any other place within the area of the undertaking and/or establishment to which the worker has access in the course of his employment.' In other words, the Workplace Directive mainly covers indoor workers excluding, explicitly from its scope important sectors such as 'means of transport used outside the undertaking and/or the establishment, or workplaces inside means of transport; temporary or mobile work sites; extractive industries; fishing boats; fields, woods and other land forming part of an agricultural or forestry undertaking but situated away from the undertaking's buildings' (Article 1(2)).

As it stands, the Workplace Directive fails at protecting workers against heat from a general perspective 'unless its coverage were to be extended to all workers, which is currently not the case. This directive in fact excludes certain categories of workers who are heavily exposed to heat, such as agricultural and construction workers' (Schaapman 2023), who fall instead within the scope of specific individual directives. In this regard, any further enlargement of the scope of the Workplace Directive should be followed by a substantial effort to update the existing legal texts that already regulate sectors significantly exposed to heat.

Such extended coverage has already been agreed between the social partners within the works of the Advisory Committee on Health and Safety at Work. This approach goes in the direction of enlarging Section 21 of Annex I on outdoor workplaces, which refers to 'workstations, traffic routes and other areas or installations outdoors which are used or occupied by the workers in the course of their activity'. The proposal seeks to broaden the scope of outdoor workplaces by defining them as 'workstations in workplaces that are not enclosed on all sides'. Alongside this modification, the social partners also proposed expanding the notion of room temperature under Annex I, Section 7, by incorporating additional factors such as humidity in order to better assess the impact of workplace heat exposure (Advisory Committee on Health and Safety at Work 2024b). Nevertheless, these remain merely proposals, and the Workplace Directive in its current form does not include such amendments. Furthermore, as mentioned before, the lack of protection afforded to key sectors, including agriculture and construction, would remain unresolved in such possible enlargement of the scope as it would not resolve other persistent gaps as outlined by the Advisory Committee on Health and Safety at Work (2025b).

4.2.2. Outdoor workers' protection

As previously noted, the scope of the Workplace Directive does not extend to outdoor workers, despite the fact that they are among the groups of workers most vulnerable to workplace heat exposure (Azzi et al. 2024). This means that outdoor workers, in the absence of a dedicated legal instrument, are protected only by the scope of the Framework Directive, which has significant limitations in addressing heat exposure. Consequently, workers who are directly exposed to workplace heat—such as those in

sectors including **agriculture, waste management, transport, and tourism**— lack dedicated protection[9].

Nevertheless, there are groups of workers that perform their work outdoors and are protected by an explicit legal tool. This is the case of the fishing and the construction sector through several Daughter Directives.

The Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites is the one regulating OSH in the **construction sector** together with the Framework Directive. This legal text imposes obligations on companies to 'take measures that are in line with the minimum requirements set out in Annex IV' (Article 9(a)), including that 'during working hours, the temperature must be appropriate for human beings, having regard to the working methods used and the physical demands placed on the workers' (Annex IV, Part A, section 1). It also sets organizational measures to ensure that 'the temperature in rest areas, rooms for duty staff, sanitary facilities, canteens and first-aid rooms must be appropriate to the particular purpose of such areas' as well as technical measures to guarantee that 'windows, skylights and glass partitions should allow excessive effects of sunlight to be avoided, having regard to the nature of the work and the use of the room.' (Annex IV, Part B, Section 4). In addition, Article 13 allows the Commission to adopt delegated acts to amend Annex IV in order to harmonise the legal protection and take into account 'technical progress, changes in international regulations or specifications and knowledge in the field of temporary or mobile construction sites.' This is particularly important, as it may provide a means of incorporating more appropriate indices to better assess the health impacts of heat exposure on workers, such as the WBGT.

In turn, the legal framework governing the protection of workers in the **fishing sector** is more diverse, as it is shaped by a range of legal instruments addressing occupational safety and health for seafarers.

First, Council Directive 93/103/EC of 23 November 1993 concerning the minimum safety and health requirements for work on board fishing vessels seeks to address workplace heat in a manner similar to that in the construction sector, with the difference that it goes further, as it refers not only to specific spaces but also to all areas in which work is performed. In this regard, it provides that 'the temperature in working areas must be adequate for the human body during the hours of working, having regard to the work methods used, the physical demands placed on the workers and the actual or potential weather conditions in the area in which the vessel operates. The temperature in living quarters, sanitary facilities, canteens and first-aid rooms must, where those areas exist, be appropriate to the particular purpose of such areas' (both in Annex I, section 7 and Annex II, section 7). In addition to that protection, in application of the Council Directive 92/29/EEC of 31 March 1992 on the minimum safety and health requirements for improved medical treatment on board vessels,

[9] This might change in the case the enlargement of the scope of the Workplace Directive as proposed by the Advisory Committee on Safety and Health at Work prospers. However, the current text does not include these concrete sectors. Other legislative initiatives currently under discussion may provide an opportunity to address heat exposure at work, as illustrated by the proposed Quality Jobs Act. Nevertheless, their potential impact is likely to remain limited given their scopes or objectives.

certain fishing vessels, depending on their capacity, crew and the length of the voyage, are required to be equipped with the necessary medicines and the medical equipment to treat specific health issues that workers may experience. With regard to exposure to heat, the list of examination and monitoring equipment includes the requirement to have temperature charts (Annex II, section 2 and Annex IV, section 4).

Last, it is key to refer to the Council Directive (EU) 2017/159 of 19 December 2016 implementing the Agreement concerning the implementation of the Work in Fishing Convention, 2007 of the International Labour Organisation. While the text does not establish any explicit reference to workplace heat, it does require that spaces on board vessels be equipped with adequate ventilation, heating and air-conditioning systems (Annex II, recitals 21 to 26) in order to ensure appropriate protection of workers' safety and health. Moreover, the measures set out in the text refer to instruments already regulated by the Framework Directive, such as the obligation to carry out risk assessments, provide training and supply the necessary personal protective equipment, among others (Article 35). However, these provisions are framed in general terms and do not explicitly address workplace heat, meaning that its integration is not guaranteed.

To sum up, the protection established in these instruments applicable to outdoor sectors does not reflect the importance of workplace heat exposure. The reason is simple, on one hand, the coverage of outdoor sectors impacted by heat exposure through sector-based Directives is limited as important ones like **agriculture, tourism, waste management, and transport**, lack dedicated protection. On the other hand, those that are covered by a dedicated instrument in which reference to heat is made, the used approach is too narrow focusing on concrete spaces (e.g. construction sector) or lacks a comprehensive perspective due to the limitation of preventive measures (e.g. fishing sector). Indeed, harmonisation and comprehensive protection remain key challenges when addressing protection against workplace heat in the most affected sectors. This reinforces the proposal for a dedicated legal instrument that focuses on heat exposure, encompassing all groups of workers and adopting a clear and comprehensive protection in relation to a form of exposure that is increasingly frequent and severe in its impact at work.

4.2.3. Legal protection of vulnerable workers from heat exposure at work

In Section 2.3, various groups are identified as being particularly vulnerable to heat exposure. Vulnerability, as such, depends on a range of factors, in the sense that it is determined not only by the personal and social characteristics of workers, but also by the sector in which they carry out their professional activity (Laabbas-el-Guennouni 2025c). Nevertheless, this subsection focuses on the protection afforded by the current legal framework to certain groups of workers.

In this regard, it is essential to begin by referring to Article 15 of the Framework Directive, which provides that 'particularly sensitive risk groups must be protected against the dangers which specifically affect them'. The aim of this provision was to claim special attention when protecting vulnerable groups of workers. However, the legal text opted for a generic wording with no specific development nor concrete identification of the workers included in such groups. This open wording has been an

important limitation that Member States have tried to overcome by identifying such workers on the basis of their personal characteristics and their biological and physiological conditions (Sierra Hernáiz 2015). Indeed, an explicit identification of workers in relation to the risks posed by workplace heat would be the most appropriate manner of ensuring their protection; yet this is not the case.

On the other hand, one of the approaches envisaged by this provision is the adoption of individual directives aimed at particularly sensitive groups. This is reflected in EU OSH legislation establishing dedicated legal instruments to protect the health and safety of young workers and pregnant workers.

Although the legal instruments examined thus far do not explicitly refer to the concept of vulnerability, in practice Article 15 of the Framework Directive seeks to provide enhanced protection for workers who may be in a more vulnerable situation. This contrasts with Council Directive 94/33/EC of 22 June 1994 on the protection of young people at work, which expressly refers to the notion of vulnerability in Article 7. More specifically, the Directive recognises the vulnerability of **young workers** resulting from their lack of experience in the labour market (Article 7(1)), even providing for the possibility of prohibiting work involving 'a risk to health from extreme cold or heat (Article 7(2)(e)).

This recognition raises an important question. Why only young workers? It is clear that those who are experiencing working life for the very first time might need more support due to the lack of experience. However, this does not mean that other workers are not affected by heat at work or are fully aware of the impacts that the exposure to heat entails. Vulnerability itself depends on so many factors such as the work that is performed, the biological conditions of the workers or existing medical conditions, among others. This implies that young workers are not the only category at risk, but rather that many other workers may also be affected, as workplace heat exposure has increasingly become a widespread and generalised workplace hazard.

A similar concern arises in relation to another specific group of workers, namely female workers in concrete biological situations, through the Council Directive 92/85/EEC of 19 October 1992 on the introduction of measures to encourage improvements in the safety and health at work of **pregnant workers and workers who have recently given birth or are breastfeeding**. This text includes a clear identification of a risk linked to the heat exposure that might experience a pregnant worker, whose specific occupational health challenges in relation to high temperatures are particularly significant (Bonell et al. 2026). In this sense, Annex 1, Section A(1)(a), states that extreme heat can imply 'foetal lesions and/or likely to disrupt placental attachment', and obliges the employer to 'assess the nature, degree and duration of exposure [...] in order to assess any risks to the safety or health and any possible effect on the pregnancy or breastfeeding of workers [and] decide what measures should be taken' (Article 4(1)).

Once again, this constitutes an important development, as it establishes a link between a specific heat-related risk and the obligations that must be fulfilled by the employer. Nevertheless, this approach is limited to a very specific category of workers, which contrasts with the identification of the broad range of health impacts affecting workers

more generally. In light of these considerations, it would be more appropriate to adopt a regulatory approach that is better aligned with current realities, with the aim of protecting workers against a risk that is neither isolated nor confined to specific groups, but rather one that affects the workforce as a whole. This approach would be applicable not only to young workers, pregnant or breastfeeding workers but a larger range of workers that are extremely impacted by heat at work.[10]

In conclusion, EU OSH law protects certain vulnerable groups (young and pregnant workers) through fragmented and vague provisions, but this group-based approach is insufficient because heat vulnerability is widespread and context-dependent, requiring broader and more generalised legal protection.

4.3. Heat-related provisions in other EU OSH Legislation

The technical complexity associated with workplace heat exposure reinforces the proposal for a dedicated regulatory framework establishing common standards, as the current absence of harmonised rules contributes to fragmented implementation and uneven levels of protection across Member States. The organisational, technical, and personal protective measures that must be implemented need to be aligned with the latest technological and scientific developments, while information concerning the risks posed by heat at work must be made available to both employers and workers. Given this technical and organisational complexity, it is important to examine how other EU OSH legal instruments currently address workplace heat exposure in order to assess the extent to which the intended protection might be more effectively achieved through alternative legal approaches, particularly through the adoption of a dedicated regulatory instrument.

In this context, several legal instruments can be mentioned, without any claim to exhaustiveness. Among the most relevant are the following:

- Council Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.
- Council Directive 89/656/ECC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace.
- Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work.

All of them, in one way or another, contain indirect or contextual references to heat-related conditions. For example, the first text obliges to take into account, within the 'characteristics of the working environments' the highest risk if 'the temperature, humidity or ventilation is unsuitable' (Annex I(3))[11]. The second, refers to the need of

[10] Such proposal would include personal characteristics of workers like age, existing medical conditions, gender, among others. However, it is worth mentioning that the initiative would still face a major challenge such as including workers who tend to lack legislative protection and often have lower levels of trade union organisation and workplace representation such as migrant workers, seasonal workers, and self-employed workers.

[11] At the same time, preventive measures should take into account this factor (Articles 3 and 4).

Personal Protective Equipment (PPE) that is heat resistant and protects workers against heat exposure (Annex II). Such equipment should also avoid increasing heat strain when worn, pursuant to Article 4(1)(a). The last one, establishes a warning sign that employers have to put in case a workplace implies 'high temperatures' with the aim of preventing workers from the risk (Annex II(3)(2)).[12]

In other words, **references to workplace heat exposure across EU OSH legislation are sometimes overlooked** and, when included, remain highly fragmented across legal instruments addressing specific categories of workers, sectors, or activities.[13] With the aim of ensuring greater consistency in the protection of workers against heat exposure, the adoption of a Directive specifically devoted to heat at work appears increasingly justified. The basis for adopting individual directives is Article 16 of the Framework Directive. Moreover, the European OSH legal acquis already contains legislative instruments addressing specific physical hazards, as is the case with protection against ionising radiation, electromagnetic fields, noise or vibration, among others. Against this background, it is reasonable to ask why workplace heat and despite its growing impact on occupational health, has not yet been regulated through a dedicated and coherent legal instrument.

4.4. Policy debate: the position of social partners at EU level

The legal analysis carried out thus far is not detached from social reality. Heat at work has significant consequences for workers' health and has already prompted political debate in this regard. The following pages examine the initiatives proposed by different stakeholders with a view to identifying appropriate responses to this reality.

In this context, the starting point of the political discussion on this issue may be traced back to 2019, when the ETUC issued its Resolution on the **Need for EU Action to Protect Workers from High Temperatures** (ETUC 2019), calling for EU legislation to protect workers from heat exposure.[14] Such worry was also included in the current EU Strategic Framework on Health and Safety at Work 2021-2027 titled 'Occupational safety and health in a changing world of work'.[15] This Strategic Framework was the one that recognised that 'climate change can also affect workers' safety and health, including through increased ambient temperature, air pollution and extreme weather.' However, even if it positions aspects linked to climate change within one of the objectives of the Strategic Framework, it does not establish any kind of

[12] This Annex prescribes the same sign for both 'flammable material' and 'high temperatures', while clarifying that, in the latter case, the sign is to be used 'in the absence of a specific sign for high temperatures'. This formulation therefore leaves room for the introduction of a dedicated sign for high temperatures , since the existing sign established in the legal text is primarily associated with flammable materials rather than thermal hazards.

[13] These legal gaps have already been identified by the Advisory Committee on Health and Safety at Work, and their implications will be explored further in the following sections.

[14] This call was also made at national level through different channels. National trade unions in Italy, Spain, Portugal, France, Belgium, among others have developed action plans/programs in order to raise awareness and better guide their members on how to duly protect workers from heat exposure.

[15] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2021) 323 final, EU strategic framework on health and safety at work 2021-2027, Occupational safety and health in a changing world of work.

concrete measures nor legislative initiative to fight against the consequences of climate change at work. By contrast, it emphasises the capacity of the existing EU legal framework and the measures that Member States could implement in the field (Igartua Miró 2024).

Nevertheless, as a result of the Strategic Framework, is of particular interest the Multi Annual Program of Advisory Committee on Safety and Health at Work (ACHS), which included within the actions for the period 2021-2027, the 'creation of new working parties and preparation of opinions [...] on initiatives relating to [...] green transition and climate change'. Such working party on climate change is finally created in 2023 in order to issue an Opinion by 2024 'in the context of extreme weather conditions such as heat waves, including the exposure to ozone and solar UV-radiation'. In this first Opinion the parties agreed that heat, together with other climate drivers are affecting workers health and safety. In addition, the working party (WP) proposed a definition for heat and heat stress, identified the sectors and group of workers that require special attention regarding heat exposure, and the measures that are important to be implemented. However, the work of the WP regarding the need for an EU Directive on Workplace Heat could not be finalised and committed to continue the work on the topic with the aim to issue a new Opinion.

In parallel, the ETUC adopted a second resolution calling on the European legislator to adopt an **EU Directive on the Prevention of Workplace Heat Risks**, addressing vulnerable groups and incorporating the measures identified in the opinion of the Advisory Committee on Safety and Health at Work (ETUC 2025). This resolution went even further by not only identifying the specific issues that should be addressed through legal initiative, but also by expressly defining the type of legal instrument required: an EU Directive capable of ensuring adequate harmonisation across all Member States.

Following the same approach, other European Trade Union Federations have also made this call. In this sense, the European Federation of Food, Agriculture and Tourism has included climate change impacts on workers' health as one of its key strategic priorities for the upcoming years in its last Congress Document 'Political Vision 2024-2029' (EFFAT 2024). The European Public Service Union has urged 'the European Commission to implement binding legislation that sets limits on working temperatures' (Weghmann 2025). Similarly, the European Federation of Building and Woodworkers has called for 'an EU Directive on working in extreme weather conditions' together with the 'revision of the Construction Sites Directive to address climate-related risks in outdoor work' (EFBWW 2026).

In light of all these demands, the second Opinion of the WP Climate of the Advisory Committee on Safety and Health at Work (2025b) is of particular interest. Again the Committee recognised that heat is the most important climate change-related issue affecting workers' health and clearly stated that workers protection regarding heat and heat stress has to be improved. This is linked to the fact that 'EU OSH Directives rarely use explicit heat terminology. No Directive uses the term "heat stress". Existing Directives do not include any heat exposure indicator or thresholds.' In light of these conclusions, the Advisory Committee on Safety and Health at Work also proposed a set of recommendations 'to strengthen the protection of workers from heat at work:

Identification of indicators or methodologies for the assessment of exposure to heat (e.g., WBGT or an equivalent scientifically validated indicator) with work-intensity levels of metabolic rate. Acclimatisation of workers to heat at work to ensure progressive adaptation, for new or returning workers, sector/task- specific and supported by EU-OSHA guidance. Hydration strategy for workers, during periods of high heat exposure: easy access to potable water and hydration arrangements appropriate to heat exposure and work intensity. Work organisation linked to the heat exposure as referred to in (a) that includes proportionate measures (e.g. rest breaks, self-pacing, task rotation, time-of-day shifting), with sectoral flexibility and attention to productivity.'[16]

However, in order to implement the recommendations, the parties did not fully agree in the most suitable approach. In this sense, the three interest groups (workers, employers, and governments) proposed different pathways. While workers group considered that the issue should be addressed through 'binding legal instruments in the form of a dedicated OSH Directive of minimum requirements to protect EU workers from heat exposure'; employers only considered non-binding instruments and technical EU-guidance.[17]

Nevertheless, the question remains as to which position is the most appropriate in light of the significant legal gaps identified by the Advisory Committee on Safety and Health at Work itself. In this respect, reference should be made to the results of the European Survey of Enterprises on New and Emerging Risks 2025 (also known as ESENER), a survey conducted by EU-OSHA. According to ESENER, the 87% of the employers identified the existence of a legal obligation as the main factor motivating them to implement preventive measures (EU-OSHA 2025b). This being said, it becomes clear that, in the face of a growing risk such as workplace heat exposure, the development of guidance alone would be insufficient, as it would not in itself ensure adequate protection for workers against heat exposure. Moreover, such guidance already exists (EU-OSHA 2023), yet workplace heat-related accidents and illnesses are still happening. In other words, the adoption of a dedicated binding instrument still appears to be an effective means of addressing heat exposure at work.

4.5. National experiences aimed at protecting workers from heat exposure

The political debate taking place at EU level is supported by initiatives developed by several EU Member States. This reflects the perceived need to adopt dedicated instruments aimed at legally protecting workers against the impacts of heat at work.

[16] It is worth mentioning that this is not the only WP that included the issue of workplace heat within its priorities. The WP EU Strategic Framework, National Strategies and ACSH Work Programme" (WP Strategy) also issued an Opinion in which heat at work was treated. The Opinion itself highlights the need, first, to incorporate workplace heat exposure into the next EU OSH Strategic Framework and, second, to adopt specific European legislation on heat at work accompanied by technical guidance. It further notes that several Member States are already moving in this direction and stresses the importance of improving statistical data on accidents and diseases linked to heat exposure. For more information, see (Advisory Committee on Safety and Health at Work 2025c). At the same time, other modifications on the topic are also considered within the WP on the Workplace Directive. For more information see section titled 'The insufficiency of the Workplace Directive' *in fine*.

[17] Governments Interest Group also considered that a binding legal instrument could be one possible solution together with technical EU-guidance.

In turn, this demonstrates the necessity for those States to address a reality that is not adequately covered by existing EU legislation. Consequently, these national initiatives may serve as useful reference points for the future adoption of a harmonising legal instrument at European level.

Without seeking to provide an exhaustive overview, some examples will be examined in order to illustrate how different countries have addressed the issue.

The first country case that deserves particular attention is **Spain**. In 2023, Royal Decree 486/1997 of 14 April 1997 was amended through Royal Decree 4/2023 of 11 May 2023. This reform introduced explicit protective measures aimed at preventing the impacts of heat at work (among others) in outdoor work. The amendment represented a significant development in the field of occupational safety and health, since, for the first time, heat was expressly recognised as a factor to be taken into account in occupational risk assessments, in correlation with the biological characteristics of the worker. On the basis of such risk assessments, employers are required to adopt preventive measures in situations that may compromise workers' health and safety as a result of adverse weather events, including extreme heat, such as the prohibition of certain tasks during particular hours of the day when the worker cannot be protected otherwise. Nevertheless, the legislation does not establish any specific list of measures to be adopted.

Moreover, where the measures adopted by the employer prove insufficient and an orange or red weather warning is issued by the national or regional meteorological authorities, the employer will be required to adapt working conditions, including the reduction or modification of working hours.

Nevertheless, following meteorological events that highlighted the still limited protection afforded to workers in climate-related situations, the Spanish Government adopted a second package of measures through Royal Decree 8/2024 of 28 November 2024, incorporating new rights into the Spanish Workers' Statute (WS). This package introduced measures aimed at reinforcing the use of existing legal instruments in the context of adverse weather conditions, including heatwaves (Laabbas-el-Guennouni 2025a), among which the following are particularly noteworthy:

- Paid leave of up to 4 days in the event of adverse weather conditions, enabling workers to not commute to work when a decision has been issued by the competent authority or in situations involving a serious and imminent risk without loss of pay. (Article 37.3.g WS).
- The extension of workers' information rights, requiring employers to inform workers about the preventive measures in the case of an adverse weather events (Article 64.4.e WS).
- The promotion of collective bargaining through the introduction of mandatory action plans in response to adverse weather events (Article 85.1 WS).

Finally, the intention of the Spanish Government is to expand the attention paid by OSH legislation to climate-related risks through a reform of the Spanish OSH Act or, alternatively, the adoption of a comprehensive regulation on the protection of workers against climate change-related risks.

The second case that deserves our attention is the **Belgian**. This is one of the cases that establishes thresholds based not only in the temperature but including other factors such as humidity, air speed and temperature, and radiation, notably the WBGT. In this sense, the Wellbeing at Work Code (WWC) states a threshold for each type of work, depending on the physical workload, allowing higher values for works that require lower physical workload and lower thresholds for those works that require high physical demands (Article V.1-3 WWC)[18]. In addition to this, the employer is obliged to carry out a heat risk assessment taking into account all the factors mentioned above (Article V.1-1 WWC) and provide adequate preventive measures that also consider these factors and the interaction between them (Article V.1-2 WWC).

In case these values are exceeded, the employer is obliged to put in practice several measures that responds to a comprehensive approach (article V.1-4 WWC):

- Technical measures such as ventilation of the area, work methods and equipment that lower the workload, and ventilation of heated areas.
- Organizational measures including less working time exposed to heat, work schedules that take into account periods in which heat exposure is lower, and more breaks in adequate break rooms.
- The use of Personal Protective Equipment as last resource of prevention and prepared not only for hight temperatures but also to avoid UV radiation and humidity.

Finally, the case of **Cyprus** is also worth mentioning. One particularly noteworthy aspect of its approach is that the applicable regulations also cover self-employed workers and the identification of a clear Maximum Safety Exposure Limit. The rules establish requirements for the management of workplace heat stress, taking into account work organisation, rest periods and the physical effort involved. As in the Belgian case, employers are required to adopt both organisational and technical measures, ensuring that workers' core body temperature remains below 38°C and taking into consideration the WBGT index[19]. Where the established thresholds are exceeded, the suspension of work may become necessary and possible by law. Last but not least, employers are also required to justify and document the measures implemented in order to mitigate the impacts of heat stress (Azzi et al. 2024).

As can be observed, the approaches adopted in the three cases examined rely on different regulatory logics in response to a factor that significantly affects workers in Europe. In this respect, it is important to emphasise, on one hand, that the regulation of the issue is increasingly being undertaken by Member States, a development that clearly demonstrates the pressing need to adopt binding rules aimed at protecting workers exposed to heat. However, on the other hand, it also shows that such regulations are being implemented in very different ways and, in some cases, are not implemented at all. This results in significant differences in the level of protection

[18] This legal text also establishes concrete measures to be adopted in case of high temperatures for indoor workers. See Book III, Chapter IV of WWC.

[19] As stated in the ILO report, the 'measures are based on WBGT levels, with complete work interruption for acclimatized workers foreseen when the WBGT rises beyond 32.2°C for low-intensity work, 31.1°C for moderate-intensity work or 30.0°C for high intensity work. For non-acclimatized workers, these values are reduced by 2.5°C' (Azzi et al. 2024).

afforded to workers across the European Union depending on where they perform their work. Accordingly, a European Directive aimed, first, at harmonising protection and, secondly, at extending protection to those territories where it is currently absent, becomes paramount.

5. Elements of an effective legal protection framework

A review of the existing EU OSH acquis suggests that there are structural limitations in the way workplace heat is regulated, as the law now relies on general preventive duties without harmonised heat-specific operational standards, resulting in uneven protection across sectors and insufficiently systematic consideration of heat vulnerability.

A European legal instrument aimed at harmonising protection against workplace heat exposure would therefore significantly strengthen workers' protection. Current rules do not fully operationalise or standardise responses to the technical complexity and wide range of impacts generated by heat in the workplace. Nor do they adequately cover the sectors most affected by such exposure. The protection currently afforded also fails to reflect the particular situation of workers who are especially vulnerable to heat, as no specific measures are established for them.

Furthermore, although several Member States are regulating the issue, there is still no harmonised strategy capable of ensuring comprehensive protection across the European Union.[20] In order to overcome these shortcomings, a European Directive specifically dedicated to the protection of workers exposed to workplace heat could therefore significantly improve the protection of workers. The purpose of such an instrument would not simply be to harmonise protection at EU level. Rather, it should incorporate a number of concrete preventive measures capable of ensuring the effective protection of workers, which will be examined in the following subsections.

5.1. From heatwave alerts to workplace heat stress prevention

European heat policy should start from a clear causal pathway: climate change increases the frequency, intensity, and duration of hot conditions; work organisation, physical effort, clothing, PPE, radiant heat, humidity, air movement, and workplace design then convert environmental heat into workplace heat stress which, in turn, results in physiological strain, accidents, illness, lost work capacity, and income insecurity. Climate-ADAPT, developed with EU-OSHA, summarises the workplace pathways as heat, ultraviolet exposure, pollution, pathogens, and extreme weather, increasing risks of heat-related illness, infection, allergies, accidents, and cancer across almost all sectors (Climate-ADAPT 2023). It also identifies outdoor workers, heat-intensive industries, first responders and indoor workers in poorly cooled or heat-generating workplaces as especially vulnerable (Climate-ADAPT 2023).

This means that urgent public heat warnings are necessary but insufficient. A general heat-health alert may warn the population, but it does not identify whether a worker is laying asphalt in direct sun, harvesting under piece-rate pressure, driving a poorly cooled delivery vehicle, cleaning streets, wearing impermeable PPE, cooking in a commercial kitchen, working in a school without adequate ventilation, or responding

[20] See also the discussion in the previous section of regulatory responses adopted in different EU member states, confirming that the need to address climate-related workplace heat risks is emerging across different European regions and is not confined to Mediterranean countries.

to wildfire. Therefore, workplace heat stress prevention needs workplace heat action plans that use workplace-specific assessment, not air temperature alone. WHO and WMO's 2025 technical guidance calls for workplace heat action plans tailored to industries and regions, developed with employers, workers, unions and public health experts (WHO and WMO 2025). These plans should include, among other things, the ten basic workplace heat stress protections described by the EU Advisory Committee on Safety and Health at Work (Advisory Committee on Safety and Health at Work 2025b) and the ILO (Azzi et al. 2024).

5.2. A minimum European prevention floor

To address workplace heat stress – at the workplace, municipal, regional, national, and/or international level – ten basic protections need to be in place (already listed in Table 5). These are described by the EU Advisory Committee on Safety and Health at Work (Advisory Committee on Safety and Health at Work 2025b) and the ILO (Azzi et al. 2024).

1. **Workplace heat stress indicator**: A validated workplace heat stress metric should be used to assess the level of heat exposure and to trigger graded preventive measures. The metric should include thresholds adjusted to work intensity, and should take account of relevant factors such as radiant heat, humidity, air movement, clothing, PPE and acclimatisation. Recent international evidence (Ioannou et al. 2022a; Ioannou et al. 2022b; Ioannou et al. 2022c) supported by the latest ILO, WHO, and WMO guidance (Azzi et al. 2024; WHO and WMO 2025), indicates that the most effective workplace heat stress indicator is the WBGT. Such a validated metric provides an objective and comparable basis for planning, supervision, work-rest decisions and stop-work procedures. Its use reduces ambiguity for employers, workers' representatives and labour inspectorates, and can support more consistent protection across Member States.

2. **Hydration strategies and sanitation facilities**: Effective prevention requires more than a general instruction to drink water. Employers should guarantee free, cool and safe drinking water close to the task, provide sufficient opportunities for regular drinking, and ensure adequate sanitation facilities, including gender-responsive facilities for women workers (Venugopal et al. 2016; NIOSH 2017; Flouris et al. 2019; Morris et al. 2020; Azzi et al. 2024; WHO and WMO 2025). Hydration strategies help maintain cardiovascular stability and sweating capacity, reducing dehydration and heat-related illness (Azzi et al. 2024; WHO and WMO 2025). Sanitation is also an occupational health and dignity issue: where toilets are inadequate, distant or unsafe, workers may restrict fluid intake, increasing the risk of dehydration and, particularly for women, urinary tract problems (Venugopal et al. 2016; NIOSH 2017; Flouris et al. 2019; Morris et al. 2020; Azzi et al. 2024; WHO and WMO 2025). Hydration, sanitation, rest and shade should therefore be planned together.

3. **Modified work schedules**: Rest breaks, self-pacing, task rotation, and modified schedules reduce metabolic heat production and cumulative heat strain without limiting productivity (Flouris et al. 2019; Morris et al. 2020; Schlader et al. 2025). They are especially important during peak heat, for heavy physical work and where

engineering controls cannot fully remove exposure (Berry et al. 2011; Flouris et al. 2019; Azzi et al. 2024; WHO and WMO 2025). These measures should be linked to workplace heat stress indicator thresholds so that breaks, work-rest ratios, shift timing, and work stoppages are triggered by measurable risk rather than by symptoms alone. They should also be treated as paid preventive measures; otherwise, workers may be pressured to continue working unsafely to avoid losing income.

4. **Acclimatisation**: Acclimatisation programmes should provide gradual exposure to heat for workers without recent heat exposure (Azzi et al. 2024; WHO and WMO 2025). This includes new starters, seasonal and migrant workers, workers returning after sickness, leave or cooler periods, and workers transferred to hotter or more physically demanding tasks (Azzi et al. 2024; WHO and WMO 2025). Proper acclimatisation improves sweating efficiency, plasma volume and cardiovascular tolerance, thereby reducing heat-related illness risk and supporting safer work capacity (Sawka et al. 2011; Flouris et al. 2014; Périard et al. 2021). Programmes should be supervised, begin before or at the start of the hot season, and include reduced workload, additional breaks, and medical oversight where workers have known risk factors (United States Army 2019; Brown et al. 2022; Azzi et al. 2024; WHO and WMO 2025).

5. **Personal protective equipment**: PPE should be selected and designed so that it controls residual risks without adding unnecessary thermal burden (Chan et al. 2015; Morris et al. 2020; Ioannou et al. 2021a). Employers should assess insulation, evaporative resistance, weight, fit, compatibility with other equipment and the ability to dissipate heat (Chan et al. 2015; Morris et al. 2020). Where PPE is needed for chemical, biological, fire, UV, dust or impact risks, the resulting heat load must be integrated into the risk assessment and matched with stronger controls, including shorter exposure periods, cooling options, additional hydration and more frequent recovery breaks. PPE should not substitute for collective and organisational controls (Flouris and Cheung 2006; Chan et al. 2015; Morris et al. 2020; Ioannou et al. 2021a; Azzi et al. 2024; WHO and WMO 2025) and should also take into account the gender perspective (Laabbas-el-Guennouni 2025b).

6. **Cool, shaded and ventilated rest areas**: Workers need accessible recovery spaces that are cool, shaded, and ventilated. These rest areas allow workers to lower core and skin temperature, rehydrate, identify symptoms early and recover between work bouts (Flouris et al. 2019; Ioannou et al. 2021a; Ioannou et al. 2022d). They are essential for outdoor work, mobile work and indoor hot work, including agriculture, construction, waste collection, delivery, transport, logistics, kitchens, manufacturing and emergency response. Rest areas are a practical collective control and should be located close enough to the work activity to be usable during short breaks (Azzi et al. 2024; WHO and WMO 2025).

7. **Education and awareness**: Workers and supervisors should receive regular training on heat stress, heat-related illnesses and the workplace measures used to prevent them (Pogačar et al. 2019; Han et al. 2021; Bonafede et al. 2022). Training should cover early symptoms, emergency response, first aid, hydration, acclimatisation, work-rest arrangements, reporting procedures and the right to stop unsafe work. It should be delivered before the hot season, refreshed during periods of risk, and made accessible to migrant, seasonal and temporary workers

through appropriate languages and formats. Awareness measures such as signage and heat alerts can support implementation, but they cannot replace enforceable preventive controls (Azzi et al. 2024; WHO and WMO 2025).

8. **Worker groups at high risk**: Risk assessment should systematically identify groups of workers who may face higher heat-related risk, including young workers, older workers, pregnant workers, workers with chronic cardiovascular, respiratory, kidney or metabolic conditions, workers taking medication that affects thermoregulation, migrant and seasonal workers, undocumented workers, workers in precarious employment, workers without recent heat exposure and workers required to wear heavy or impermeable PPE (Notley et al. 2019a; Notley et al. 2019b; Notley et al. 2019c; Ioannou et al. 2023). Targeted measures should provide reasonable accommodation and stronger protection without discrimination, exclusion from work or loss of income (Azzi et al. 2024; WHO and WMO 2025).

9. **Participatory risk assessment**: Workplace risk assessment should explicitly integrate excessive heat and be carried out with meaningful worker participation (Azzi et al. 2024; WHO and WMO 2025). Workers, safety representatives and joint OSH committees are well placed to identify where heat accumulates, which tasks are most dangerous, where water and rest areas are inaccessible, and when production targets discourage safe behaviour (Azzi et al. 2024; WHO and WMO 2025). Participatory assessment improves the accuracy of risk characterisation, the feasibility of controls, and the uptake of preventive measures (Azzi et al. 2024; WHO and WMO 2025). It also strengthens employer accountability by linking heat risks to concrete preventive actions (Azzi et al. 2024; WHO and WMO 2025).

10. **Medical check-ups and health monitoring**: Occupational health surveillance should identify workers who may be at elevated risk because of medical conditions, medication, previous heat illness, pregnancy, or reduced heat tolerance (Kenny et al. 2016; Notley et al. 2019a; Notley et al. 2019c; Bonell et al. 2026). Medical check-ups should support prevention, fitness-for-work decisions, follow-up after heat-related incidents and reasonable accommodation, not punitive exclusion from employment (NIOSH 2016; Azzi et al. 2024; WHO and WMO 2025). Health monitoring should also capture sentinel events, near misses and heat-related symptoms, with anonymised aggregate data used to evaluate the effectiveness of prevention programmes and to improve workplace controls over time (Kenny et al. 2016; Notley et al. 2019a; Notley et al. 2019c).

As noted by the EU Advisory Committee on Safety and Health at Work (Advisory Committee on Safety and Health at Work 2025b) and the ILO (Azzi et al. 2024), these protections should be treated as an integrated prevention package rather than a menu of optional measures.

5.3. Workplace controls: applying the hierarchy of prevention

At workplace level, prevention should follow the hierarchy of controls. Engineering and collective measures should come first (in accordance with Article 6(2)(h) of the Framework Directive): shade, insulation from radiant heat, ventilation, sustainable

cooling, cooled or shaded rest areas, cooled vehicle cabins where necessary, and changes to work processes that reduce heat generation. Administrative measures should then include work-rest cycles, rescheduling heavy work to cooler hours, task rotation, reduced pace, avoidance of lone work in high-risk heat, acclimatisation plans, emergency response and first aid. PPE may be needed for ultraviolet radiation, chemicals, fire, dust or biological hazards, but it should not be the default heat-control strategy because protective clothing can itself increase physiological strain (Azzi et al. 2024). The ILO identifies ventilation, cooling, work-rest regimes, hydration strategies, cool and shaded rest areas, acclimatisation, work-organisation adjustments, training and PPE as core workplace measures (Azzi et al. 2024).

Hydration and rest must be treated as employer duties, not as individual lifestyle advice. Drinking water is ineffective if it is too far from the task, unavailable on mobile worksites, practically difficult to access, or if workers lose income when they stop to drink. Likewise, rest breaks must be paid and protected from productivity penalties. Piece-rate, platform, subcontracted, bogus self-employed and migrant workers may face strong pressure to continue working despite symptoms. Therefore, prevention must be linked to wage protection, safe staffing, and enforceable work organisation.

Acclimatisation deserves more emphasis in the EU than it receives. The ILO, WHO, and WMO guidance states that workers without recent exposure to heat should be considered non-acclimatised and that repeated exposure over one to two weeks typically increases tolerance (Azzi et al. 2024; WHO and WMO 2025). This is key to seasonal agriculture, construction, tourism, delivery, emergency work, and temporary agency work, where workers may start intense tasks suddenly during hot periods.

5.4. Regulation, inspection and collective bargaining

The European regulatory problem is not the absence of all legal protection, but the lack of operational heat-specific duties. As noted by the EU Advisory Committee on Safety and Health at Work (Advisory Committee on Safety and Health at Work 2025b), there is currently no EU OSH Directive that addresses workplace heat stress. A stronger European framework should establish a minimum prevention floor while allowing Member States and sectors to adopt effective protections. National examples show both feasibility and fragmentation. A recent ILO report records that Belgium and Greece use WBGT-based thresholds, while Austria, Hungary, Portugal and Spain use air-temperature or indoor-climate approaches for particular settings (Azzi et al. 2024). These examples demonstrate that binding thresholds are possible, but also that workers' protection currently depends heavily on national law, sector, workplace type, and enforcement capacity.

Labour inspection is essential. Inspectors need heat-specific tools to verify whether exposure has been measured, whether thresholds have triggered action, whether water and shaded or cooled rest areas are available, whether breaks are paid, whether subcontracted and migrant workers are covered, and whether incidents are recorded. They should also be able to assess compound hazards: heat combined with ultraviolet radiation, ozone, wildfire smoke, agrochemicals, dust, PPE, emergency work or damaged infrastructure.

However, the enforcement role of the labour inspectorate and the adequate prevention cannot be fulfilled if the number of accidents and illnesses linked to the heat exposure is underreported. A clear example is provided by the European Statistics on Accidents at Work (ESAW) compiled by Eurostat. First, ESAW does not separately identify heat-related cases, instead grouping them with health effects arising from exposure to vibration and radiation. Second, the figures reported since 2020 raise concerns regarding their reliability, as substantial discrepancies, such as 6,012 cases reported in Italy compared with only 151 in Spain, (Eurostat 2026) are difficult to reconcile with the underlying reality. These data therefore appear to reflect differences in reporting practices rather than actual levels of exposure or harm.

Collective bargaining is equally important because workplace heat stress prevention is about time, pace, staffing and pay. Workers know where heat accumulates, which tasks are unsafe, when vehicles or classrooms overheat, where water is inaccessible, and when productivity targets discourage breaks. This knowledge should be profited and labour law does have the perfect tool to do so: collective bargaining (Laabbas-el-Guennouni 2023, 2024). Collective agreements can define heat triggers, paid breaks, maximum exposure periods, rescheduling rules, staffing levels, multilingual training, accommodation standards, transport, emergency procedures and wage protection. The ILO has highlighted that collective agreements are increasingly used to address climate-related risks, such as the Spanish construction-sector agreement of negotiated adjustment of working hours during heatwaves (Azzi et al. 2024). Collective bargaining is also increasingly used to mitigate income loss for workers in the event of adverse weather conditions, when there is no legal protection in place, including during the summer. A good example is the summer allowance negotiated for the roofing sector in Germany and paid out via the social partner organisation SOKA-DACH.[21] Collective bargaining can also complement social security benefits, as many collective agreements in Germany increased the income replacement provided through short-time work allowances.

Indeed, prevention must be linked to social protection. When work must stop because workplace heat stress cannot be controlled, workers should not bear the cost through lost wages, cancelled shifts, or reduced bonuses. A recent ILO analysis identified social protection and compensation as important tools, including Spanish leave where severe weather prevents workers from reaching work, Austrian bad-weather compensation in construction, and French recognition of heatwaves under a weather-related unemployment scheme (ILO 2026).

Taking the above into account, the policy conclusion is straightforward: Europe needs workplace heat stress prevention that is anticipatory, measurable, enforceable, and collectively governed. Guidance and heat alerts are useful, but they are not enough for working people. The priority is to translate general OSH duties into binding, paid and worker-centred prevention, so that climate adaptation protects workers' health without transferring climate-related costs to those with the least bargaining power.

[21] For more information see https://soka-dach.de/leistungen/ausfallgeld/.

6. Conclusions

Climate change is already an OSH and labour issue in Europe. Its effects are not confined to environmental policy or future adaptation planning: they are already altering exposure to hazards at work, reducing safe work capacity, affecting income and job security, and widening inequalities between sectors, regions and groups of workers. The strongest conclusion from this report is that workplace heat stress is currently the most direct, widespread, well-documented and preventable climate-related occupational hazard for European workers. This makes workplace heat stress the immediate prevention priority, while also requiring integration into a broader climate-related OSH and labour market agenda.

Climate change is reshaping work in Europe

The causal pathway is clear. Rising temperatures, changing weather patterns and more frequent or intense extreme events create climate hazards; workplace design, work organisation, task intensity, clothing, PPE, working time, and bargaining power then determine whether those hazards become occupational exposures; and exposure can lead to illness, injury, lost work capacity, reduced earnings, and insecurity. The European Environment Agency's first European Climate Risk Assessment identifies 36 major risks to Europe, including risks to health, food systems, infrastructure, water, ecosystems and financial stability, many of which have already reached critical levels (EEA 2024a). Copernicus and WMO evidence confirms that Europe is the world's fastest-warming continent, and the 2025 European State of the Climate points to heatwaves from the Arctic to the Mediterranean, record wildfire burned area and widespread drought indicators (C3S and WMO 2026).

Workplace heat stress is the clearest and most preventable risk

Workplace heat stress matters because the biological mechanism is direct and the preventive measures are known. It is also not only a heatwave issue: scientific data as well as ILO, WHO, and WMO guidance reviewed in the present report highlight that workplace heat stress can occur during routine seasonal work and that nine out of ten above-threshold exposures, and eight out of ten related occupational injuries, occur outside declared heatwaves. In Europe, this means that prevention cannot depend only on emergency heat alerts. It must address "hot normal working days" in agriculture, construction, transport, delivery and logistics, waste collection, emergency services, hospitality, manufacturing, education, mining, as well as other indoor or outdoor settings where heat combines with physical work, radiant heat, poor ventilation or PPE. EU-OSHA's Survey OSH Pulse 2025 indicates that 33% of EU workers report exposure to one climate change-related risk factor at work, including 20% reporting exposure to extreme heat and 19% to poor air quality (EU-OSHA 2025a).

The labour and income dimensions are central

Workplace heat stress is also an income and job-security issue. European research reviewed in the present report links heat to occupational injuries and productivity losses, while recent Joint Research Centre analyses project that 22 European regions could face annual labour productivity losses exceeding 1% by 2050, rising to 107 regions by the 2080s (Szewczyk et al. 2025). These losses are not distributed evenly. Southern Europe and the Mediterranean are already highly exposed, but central, eastern and northern Europe are also increasingly affected, especially in urban heat islands, poorly adapted buildings and sectors not historically designed around heat (Szewczyk et al. 2025). The workers least able to absorb the risk include migrant and undocumented workers, seasonal and platform workers, bogus self-employed workers, piece-rate workers, pregnant workers, older and younger workers, workers with chronic health conditions and workers required to wear heavy or impermeable PPE, although their vulnerability arises from different factors, including physiological susceptibility, concentration in high-risk sectors and occupations, precarious working conditions, and more limited capacity to exercise labour rights.

Prevention against heat exposure must be comprehensive and binding

The conclusion for policy is straightforward: workplace heat stress is preventable, but only if prevention is treated as an employer duty and a collective labour issue, not as individual resilience. A minimum European prevention floor should include the ten basic workplace heat stress protections described by the EU Advisory Committee on Safety and Health at Work (Advisory Committee on Safety and Health at Work 2025b) and the ILO (Azzi et al. 2024). These include performing heat-risk assessment using appropriate indicators such as WBGT, hydration, cool or shaded rest areas, paid work-rest cycles, rescheduling, acclimatisation, ventilation, emergency planning, training, health surveillance and specific measures for workers at higher risk.

Existing EU OSH law provides an important foundation, including duties to act in situations of serious, imminent and unavoidable danger, but general duties require operational translation into measurable triggers, enforceable controls, worker participation, and protection from loss of income. Thus, social partners, workers' organisations, safety representatives, and collective bargaining are essential. They can turn broad OSH principles into practical rules on paid breaks, staffing, work stoppages, rescheduling, multilingual training, emergency procedures, and compensation. Without this, climate adaptation risks becoming another mechanism through which workers with the least bargaining power carry the greatest cost.

Nevertheless, as noted by the Advisory Committee on Safety and Health at Work (2025b), there is currently no EU OSH Directive specifically addressing workplace heat stress. Although several Member States have begun to regulate this issue, no harmonised framework yet ensures comprehensive protection at EU level. To address these shortcomings, a dedicated European Directive on workplace heat stress could represent an appropriate regulatory response. Beyond harmonising protection, such an instrument should establish concrete preventive measures capable of ensuring effective worker protection, as examined in this report. Europe needs workplace heat stress prevention that is anticipatory, measurable, enforceable and worker-centred. Guidance and heat alerts are useful, but insufficient. The priority is to translate general OSH duties into binding protections that safeguard workers' health. In light of the

findings presented in this report, a proposal for a Directive on Workplace Heat Stress is set out in the Annex. While focused on the most immediate and preventable climate-related occupational hazard currently affecting workers, the Model Directive also contributes to the broader discussion on how occupational safety and health systems, labour regulation and social protection can respond to the growing challenges posed by climate change and changing weather patterns.

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ANNEX A proposal for a Directive on Workplace Heat Stress

Directive on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents

(Heat stress)

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 153(2), point (b), in conjunction with Article 153(1), point (a), thereof,

(…)

Whereas:

(1) Pursuant to Article 3 of the Treaty on European Union (TEU), the aims of the Union are, amongst others, to promote the well-being of its peoples and to work for the sustainable development of Europe based, inter alia, on balanced economic growth, and a highly competitive social market economy, aiming at full employment and social progress.

(2) Article 31 of the Charter of Fundamental Rights of the European Union (the 'Charter') provides for the right of every worker to fair and just working conditions which respect his or her health, safety and dignity.

(3) A definition of heat-related risks at work, risk factors related to heat exposure at work, and the prevention of heat-related accidents and illnesses due to work should be adopted at a European level to provide certainty to employers and workers.

(4) Heat-related risks at work should be recognised as occupational risks within the meaning of Union occupational safety and health law.

(5) The prevention of heat-related risks at work should be based on collective, technical, and organisational measures, in accordance with the hierarchy of prevention, including the adjustment of working time, adequate working environment and proper prevention measures. Stresses that individual resilience training and workplace guidance cannot replace employers' legal obligations to prevent heat-related risks at work.

(6) Employers should ensure that workers' health, dignity and fundamental rights are respected in a changing world of work directly linked to climate factors.

HAVE ADOPTED THIS DIRECTIVE:

CHAPTER I

GENERAL PROVISIONS

Article 1

Subject matter and purpose

1. This Directive lays down the minimum requirements concerning the protection of workers from risks to their safety and health arising or likely to arise from exposure to heat.

2. It establishes binding organisational, technical, structural and participatory obligations for employers in order to protect workers that are or may be exposed to heat stress hazards as a result of their work. Particular attention shall be paid to heat stress in the summer period, especially during heatwaves.

3. This Directive shall be without prejudice to existing or future national provisions which are more favourable to protection of the safety and health of workers at work.

Article 2

Scope

This Directive applies to workers in all sectors of economic activity, both public and private.

Article 3

Definitions

For the purpose of this Directive, the following definitions shall apply:

1. "Workplace heat stress" means a physical hazard that is caused by the following factors, acting alone or in combination:

   (a) Environmental heat, manifested through the combined interaction of increased air temperature/humidity, limited air flow and radiant heat sources.

   (b) Thermal insulation from clothing and Personal Protective Equipment.

   (c) Metabolic heat generated when performing physically tasks.

2. "Physiological strain" means the series of physiological manifestations that occur as a result of internal heat accumulation and an increase in the temperature of the human body.

3. "Wet-Bulb Globe Temperature" or "WBGT" means the index used to estimate the heat stress experienced by a person, which is a function of environmental parameters. The WBGT index (unit of measurement: °C) is calculated for indoor and outdoor areas using the equations presented in Annex 1. Annex 1 also includes a widely accepted simplified equation for indoor and outdoor use, in cases where only air temperature and relative humidity measurements are available, as well as the calculation of this index for a wide range of temperature and humidity values.

4. “Intensity of work” means the level of physical effort required to perform a work activity, determined according to the worker’s average metabolic rate. The different levels of intensity are classified and defined as follow:

   (a) “Light intensity work” means the work involving mild manual activity (using hands or a combination of hands and feet) in a sitting position, driving, light work in a standing position and occasional walking.

   (b) “Moderate-intensity work” means the work involving normal walking with prolonged moderate-intensity activity with the arms and forearms, moderate activity with the arms and legs, moderate activity with the arms and torso or mild pushing and pulling of light loads.

   (c) “High-intensity work” means the work involving intense manual and trunk activity, carrying, shovelling, sawing, pushing and pulling heavy loads and walking at a fast pace.

   (d) “Very high intensity work” means the work involving very intense activity at a fast or maximum rate.

5. “The core of the body” means the part of the human body in which the temperature is relatively constant and relatively homogeneously distributed. It includes the brain and the organs of the trunk (such as the heart, lungs, viscera). Under normal conditions, the temperature of the body's core is 37°C.

6. “Acclimatisation” means the physiological adaptations developed by the human body through gradual exposure to heat exposure, typically combined with physical activity, which reduce physiological strain and the risk of heat-related harm while improving the body’s capacity to tolerate heat and perform physical work in hot environments. These adaptations involve adjustments in the body’s thermoregulatory systems and functional homeostasis.

7. “Exposure limit value” means internal body core temperature value to protect the health of workers established on the basis of biophysical and biological considerations, in particular on the basis of scientifically well-established short-term and acute direct effects.

8. “Action levels” means operational levels established for the purpose of simplifying the process of demonstrating the compliance with relevant exposure limit values or, where appropriate, to take relevant protection or prevention measures specified in this Directive. The action levels terminology used in this Directive is as follows: (a) low action levels, including, inter alia, provision of training and personal protection measures, (b) high action levels, including, inter alia, complete cessation of work. In between the low and high action levels, different organizational and technical measures are applied.

Article 4

Exposure limit value and action levels

1. For the purposes of this Directive, the exposure limit value and the action levels for workplace heat stress exposure levels are set as follow:

   (a) The exposure limit value shall be a core body temperature of 38°C.

   (b) In order to ensure compliance with the exposure limit value, measurable action levels for acclimatised workers are fixed at:

   i) The high and low action levels in low-intensity work: 32.5°C and 31.0°C WBGT, respectively.

   ii) The high and low action levels in moderate-intensity work: 31.5°C and 28.0°C WBGT, respectively.

   iii) The high and low action levels in high-intensity work: 30.5°C and 27.5°C WBGT, respectively.

   iv) The high and low action levels in very high-intensity work: 30.0°C and 28.0°C WBGT, respectively.

2. When applying the action levels, the worker's actual thermal exposure should take into account the reduction provided by the personal protective equipment that the worker may be using. The impact of such protective equipment on the high and low action levels is presented in Annex 2.

3. When applying the action levels, the determination of the actual exposure of the worker shall take into account the reduction achieved by a possible lack of acclimatisation of the individual to work in the hot environment. This effect of acclimatisation on the high and low action levels shall be taken into account as shown in Annex 3.

4. In accordance with previous points, the high and low action levels are calculated by taking the WBGT for action according to work intensity and correcting it based on the personal protective equipment worn (Annex 2) and the acclimatisation level (Annex 3) of the workers.

5. Based on the final high and low action levels, the working time and the breaks that workers must take to ensure compliance with the exposure limit values are set as follow:

Table 1. Working time according to the high and low WBGT (°C) action levels.*

Time per 60 minutes of working shift		**WBGT (°C) based on the intensity of work**			
Work (minutes)	Break (minutes)	Low intensity	Medium intensity	High intensity	Very high intensity
Up to 60	Up to 0	31.0	28.0	**	**
″ 45	at least 15	31.0	29.0	27.5	**
″ 30	″ 30	32.0	30.0	29.0	28.0
″ 15	″ 45	32.5	31.5	30.5	30.0
Complete cessation of work		>32.5	>31.5	>30.5	>30.0

* This table aims to adapt heat production from the human body and therefore to maintain the exposure limit values by dividing working time into work-rest intervals in descending proportions of 100%-0% (continuous work), 75%-25%, 50%-50%, 25%-75%, 0%-100% (cessation or postponement of work), depending on the WBGT value.
** =no high and low action levels of WBGT are provided for continuous or almost continuous high and very high intensity work. In these cases, an accurate assessment of the thermal stress by means of body core temperature measurements of workers during their work is required.

CHAPTER II

OBLIGATIONS OF EMPLOYERS

Article 5

Identification and mandatory assessment of heat-related risks

1. The employer, in response to the obligations contained in Articles 6(3) and 9(1) of Directive 89/391/EEC, shall carry out a mandatory heat risk assessment, including the measurement of the levels of heat stress exposure to which workers are exposed. This assessment shall take into account Article 4 of this Directive and be updated regularly, in particular if there have been significant changes which may render it obsolete, or when the results of health surveillance so require.

2. The methods and devices used shall be suitable for the prevailing conditions. Such methods and instruments must permit the determination of the parameters contained in Article 3 and the checking of exceedances of the values laid down in Article 4.

3. The methods used may include representative sampling of the individual exposure of the worker.

4. In applying this Article, the assessment of the measurement results shall take into account the measurement errors determined by the metrological practice.

5. The assessment of the risks from exposure to heat is an integral part of the written assessment of occupational safety and health risks referred to Article 9(1)(a) of Directive 89/391/EEC, which must be provided by the employer. This assessment shall be updated regularly, in particular if there have been significant changes which may render it obsolete, or when the results of health surveillance so require.

6. The assessment, measurement and/or calculations referred to in this article shall be planned and carried out by competent services or persons at suitable intervals, taking particular account of the provisions of Articles 7 and 11 of Directive 89/391/EEC concerning the necessary competent services or persons and the consultation and participation of workers. The data obtained from the assessment, measurement and/or calculation of the level of exposure shall be preserved in a suitable form so as to permit consultation at a later stage.

7. The employer shall pay particular attention, when assessing the risks, to the following:

   (a) The categories of workplaces in terms of their heat exposure characteristics.

   (b) The level, type and duration of exposure, including any exposure to heat.

   (c) The exposure limit value and the action levels referred to in Article 4.

   (d) Any effects on the health and safety of workers belonging to particularly sensitive risk groups as described in Annex 4.I.

   (e) Any effects on the health and safety of workers resulting from heat stress caused by the interactions between environmental parameters (including protective equipment) and the heat generated within the body from metabolic activity due to the intensity of work.

   (f) The information on the reduction of body heat dissipation capacity provided by manufacturers of clothing and work equipment on the basis of relevant standards.

   (g) The availability of alternative clothing or personal protective and other equipment that has fewer negative effects on the ability to remove heat from the body.

(h) The extension of heat exposure beyond working hours under the responsibility of the employer.

(i) Appropriate information gathered during health surveillance.

Article 6

Measures to prevent or reduce exposure

1. Taking into account technical progress, available risk control measures at the source, as well as local forecasts of meteorological conditions, particularly during heatwaves, the risks arising from heat exposure should be eliminated at the source or, where this is not possible, reduced to a minimum.

The reduction of risks arising from exposure to heat shall be based on the general principles of prevention set out in Directive 89/391/EEC, taking into account in particular the following technical and organisational measures:

(a) Other working methods and/or equipment that ensure the reduction of either the physical stress of workers or the heat released into the surrounding area and thus reduce the exposure of workers to heat.

(b) Selection of appropriate clothing, taking into account the task(s) performed, which has the least negative impact on the ability to dissipate heat from the body.

(c) The design and layout of premises and workplaces, including appropriate ventilation and/or air conditioning.

(d) Adequate and accessible information and training of workers on the application of preventive measures and early recognition of symptoms for heat-related disease.

(e) Appropriate maintenance of ventilation/air conditioning systems in the workplace.

(f) Adequate hydration strategies, including regular supply of cool water and electrolytes to workers.

(g) Limitation of continuous exposure to direct sunlight by implementing shading systems and providing appropriate personal protective equipment in accordance with applicable legislation, especially in hot weather conditions and where such exposure cannot be avoided.

(h) Mitigation of heat stress by organising work:

i) Limiting the duration and intensity of heat exposure.

ii) Providing an appropriate work schedule which includes adequate rest periods taking into account Article 4(5) of this Directive.

iii) Scheduling the heaviest work at cooler parts of the day during hot periods, if the microclimate of the workplace is directly or significantly affected by the weather conditions.

2. On the basis of the assessment of the risks from heat exposure provided for in Article 5, if exposure exceeds the high action levels, the employer shall draw up and implement a programme consisting of technical and organisational measures to reduce heat exposure, taking into account in particular the measures provided for in paragraph 1. When such measures are insufficient to ensure the safety and health of workers, work shall be suspended.

3. In accordance with Article 8(4) of the Directive 89/391/EEC, in the event of serious, imminent and unavoidable danger caused by extreme heat exposure, workers are entitled to leave their workstation and/or a dangerous area without being placed at any disadvantage because of their action and must be protected against any harmful and unjustified consequences, in accordance with national laws and/or practices.

4. On the basis of the assessment of the risks from heat exposure provided for in Article 5, workplaces where workers are likely to be exposed to heat levels exceeding the high action levels shall be marked with appropriate signs where practicable. Such sign will follow the model included in Annex 5. The boundaries of such places shall be defined and access to them shall be restricted where technically feasible and justified by the risk of exposure.

5. Where, due to the nature of the activity, workers have rest areas under the responsibility of the employer, cool, shaded and well-ventilated rest areas shall be provided, including the access to sanitation facilities. The level of ambient heat in these areas shall be reduced to a level compatible with their purpose and conditions of use.

6. Under Article 15 of Directive 89/391/EEC, the employer shall adapt the measures referred to in this article to the requirements of workers belonging to particularly sensitive risk groups, as described in Annex 4.I of this Directive.

Article 7

Personal protective equipment

1. If the risks arising from exposure to heat cannot be prevented by other technical and organisational measures, appropriate personal protective equipment shall be made available to workers and used by them in accordance with the provisions of the legislation in force, subject to the following conditions:

   (a) Where heat exposure reaches the low action levels, the employer shall make personal protective equipment against heat stress available to workers.

   (b) Where heat exposure exceeds the low action levels, the use of personal protective equipment against heat stress is mandatory.

   (c) Personal protective equipment against heat stress is selected in such a way as to prevent or minimise the risk to workers.

2. The employer shall make every effort to ensure the correct use of the means of protection against heat stress and shall be responsible for verifying the effectiveness of the measures taken in accordance with this Article.

Article 8

Limitation of heat exposure

The worker's exposure to heat, as determined in accordance with Article 4 paragraph 1, shall not exceed the exposure limit values. This requirement shall be ensured by compliance with the high action levels.

If, despite the measures taken to implement this Directive, exposures above the high action levels occur, and unless the assessment carried out in accordance with Article 4 shows that the exposure limit values has not been exceeded and that safety risks can be excluded, the employer shall:

1. Take immediate action to reduce workers' exposure to heat,

2. Identify the reasons why the action levels were exceeded, and

3. Modify and/or adapt the protection and prevention measures in order to prevent any recurrence.

Article 9

Worker information and training

Without prejudice to Articles 10 and 12 of Directive 89/391/EEC, the employer shall ensure that workers who are exposed to heat reaching or exceeding the high action levels, and/or their representatives, are provided with information and training on these risks, in particular on:

1. The nature of these risks.

2. The measures taken in application of this Directive to eliminate or minimise the risks arising from heat stress, including the circumstances in which such measures are to be applied.

3. The exposure limit values and action levels provided for in Article 4.

4. The results of the heat assessments and measurements carried out pursuant to Article 5 of this Directive, together with an explanation of their significance and potential risks.

5. The correct use of thermal protection equipment.

6. How to recognise symptoms of heat stress and responding appropriately.

7. The conditions under which workers are entitled to health surveillance and the purpose of such surveillance, in accordance with Article 11 of the present Directive.

8. Safe working practices to minimise heat exposure.

Article 10

Consultation and participation of workers

1. Without prejudice to Articles 11 of Directive 89/391/EEC, workers and workers' representatives shall be consulted and allowed to take part in the assessment and prevention of heat risks at work.

2. Such consultation and participation shall concern, in particular:

   (a) The assessment of the risks from heat exposure and the definition of the measures to be taken, as referred to in Article 5.

   (b) The design, planning and implementation of measures aimed at preventing or reducing the risks arising from exposure to heat, as referred to in Article 6 including training, work schedules and emergency procedures.

   (c) The choice of personal protective equipment against heat stress as referred to in Article 7 paragraph 1 point c.

   (d) The monitoring and evaluation of the effectiveness of those measures;

   (e) The continuous improvement of policies and practices relating to occupational heat risks.

3. Workers and/or their representatives shall be provided with the necessary information, training and means to participate effectively in the process referred to in paragraph 2.

4. Participation shall take place in good time and in a meaningful manner, allowing workers and/or their representatives to contribute to decision-making and the development of appropriate measures.

5. The provisions of this Article shall apply without prejudice to national laws and practices concerning information, consultation and participation of workers.

CHAPTER III
MISCELLANEOUS PROVISIONS

Article 11

Health Surveillance

1. With a view to the prevention and early detection of adverse health effects related to heat stress, appropriate health surveillance shall be ensured for workers expected to be exposed to heat stress risks based on risk assessment and in accordance with Article 14 of Directive 89/391/EEC. Such surveillance shall be proportionate to the risk and carried out at suitable intervals, as determined by national law and practice.

2. The results of health surveillance shall be recorded and stored in accordance with applicable data protection rules. Workers shall have access to their personal medical records and to the results of any laboratory tests.

3. Where heat exposure exceeds the high action levels, the employer shall ensure that the worker(s) concerned are offered appropriate medical examinations in accordance with national law and practice and Article 14 of Directive 89/391/EEC. Such surveillance shall be proportionate to the level and duration of exposure and aimed at the prevention and early detection of adverse health effects.

4. These examinations or surveillance shall take place at times chosen by the employee and any costs incurred shall not be borne by the employee.

Article 12

Derogations

1. In exceptional circumstances and because of the nature of the work, the competent authorities may grant derogations from the provisions of Article 7.

2. In duly justified circumstances, and only for as long as they remain duly justified, the temporary exceeding of the exposure limit values is permitted in specific sectors or for specific activities. For the purposes of this point, 'duly justified circumstances' means circumstances in which the following conditions are met:

   (a) The risk assessment carried out in accordance with Article 4 indicates that the exposure limit value is exceeded.

   (b) Taking into account technical progress, all possible technical and/or organisational measures have been implemented.

   (c) The specific characteristics of the workplace, work equipment or working practices have been taken into account.

   (d) The employer demonstrates that workers continue to be protected from adverse health effects and safety risks, including through the use of comparable, more specific and internationally recognised standards and guidelines.

3. The derogations referred to in paragraphs 1 and 2 shall be granted by Member States after consultation of the two sides of industry in accordance with national laws and practice. Such derogations must be accompanied by conditions which guarantee, taking into account the special circumstances, that the resulting risks are reduced to a minimum and that the workers concerned are subject to increased health surveillance.

CHAPTER IV
ENFORCEMENT, DATA AND SANCTIONS

Article 13

Labour inspections

Members states shall ensure that labour inspection authorities are prepared and duly provided with expertise, training, tools and resources to adequately identify, assess, and investigate heat-related risks.

Article 14

Monitoring and data collection

The European Commission, together with relevant EU agencies and bodies, shall monitor work-related heat risks to workers' health and safety across Members States to assess the effectiveness of this Directive.

Member States shall ensure that records are maintained of occupational accidents and diseases attributable to heat exposure taking into account the list of diseases in Annex 4.II, for statistical purposes and in accordance with Union and national rules on the protection of personal data.

Article 15

Sanctions

Member States are required to establish appropriate sanctions under national law for infringements of legislation adopted pursuant to this Directive. These sanctions must be effective, proportionate and dissuasive.

CHAPTER V
FINAL PROVISIONS

Article 16

Non-regression

Implementation of this Directive shall not be used to lower the level of protection already afforded to workers.

This Directive does not affect Member States' prerogative to maintain or to introduce laws, regulations or administrative provisions that provider greater protection for workers or to allow collective agreements that offer more favourable conditions to workers.

Article 17

Transposition

Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive within two years of its entry into force. They shall communicate to the Commission the text of the main measures of national law which they adopt in the field covered by this Directive.

ANNEX 1

WBGT INDEX – CALCULATION AND TABLES

The Wet-Bulb Globe Temperature (WBGT) estimates the heat stress experienced by a person, which is a function of environmental parameters and the heat generated within the body by metabolic activity. The WBGT (unit of measurement: °C) is calculated by means of equations (1) and (2) which combine three parameters:

a) The *natural wet-bulb temperature*, which is assessed with a wet-bulb thermometer exposed to thermal radiation and wind.

b) The *black globe temperature* (known as "globe temperature"), which is evaluated inside a black sphere.

c) The *air temperature*, which is assessed with a standard thermometer in the shade.

(1) Equation for calculating the WBGT index outdoors (under conditions of direct exposure to solar radiation):

$_{OUT}WBGT = 0.7 \times (\text{Natural wet bulb temperature}) + 0.2 \times (\text{Black bulb temperature}) + 0.1 \times (\text{Air temperature})$

(2) Equation for calculating the WBGT index indoors or outdoors in the shade (without direct exposure to sunlight):

$_{IN}WBGT = 0.7 \times (\text{Natural liquid bulb temperature}) + 0.3 \times (\text{Black bulb temperature})$

In cases where only air temperature and relative humidity measurements are available, the simplified equation (3) can be used.

(3) Equation for simplified calculation of the WBGT index ($_{SIMPLIFIED}$WBGT). This equation calculates the WBGT for indoor or shaded outdoor (i.e., without direct exposure to solar radiation) settings as well as non-shaded outdoor (i.e., with exposure to direct solar radiation conditions) settings as follows:

$_{SIMPLIFIED}WBGT\ (\text{indoors or outdoors in the shade}) = 0.7 \times (\text{air temperature} \times ATAN(0.151977 \times SQRT(\text{relative humidity} + 8.313659)) + ATAN(\text{air temperature} + \text{relative humidity}) - ATAN(\text{relative humidity} - 1.676331) + 0.00391838 \times \text{relative humidity}^{3/2} \times ATAN(0.023101 \times \text{relative humidity}) - 4.686035) + 0.2 \times (\text{air temperature} + 1.6)) + 0.1 \times \text{air temperature}$

$_{SIMPLIFIED}WBGT\ (\text{outdoors under direct solar radiation exposure}) = 0.7 \times (\text{air temperature} \times ATAN(0.151977 \times SQRT(\text{relative humidity} + 8.313659)) + ATAN(\text{air temperature} + \text{relative humidity}) - ATAN(\text{relative humidity} - 1.676331) + 0.00391838 \times \text{relative humidity}^{3/2} \times ATAN(0.023101 \times \text{relative humidity}) - 4.686035) + 0.2 \times (\text{air temperature} + 7.5)) + 0.1 \times \text{air temperature}$

Note: in the above equations of SIMPLIFIEDWBGT, air temperature is measured in °C, the term ATAN refers to the arctangent and the term SQRT refers to the square root.

The SIMPLIFIEDWBGT is shown in Table 2 for a wide range of temperature and relative humidity.

Table 2. Calculation of the SIMPLIFIEDWBGT index for a wide range of temperature and relative humidity.

Temperature (°C) \ Relative humidity (%)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
45	27.9	30.0	31.8	33.3	34.6	35.8	36.9	37.9	38.8	39.6	40.5	41.2	42.0	42.7	43.4	44.1	44.7	45.4	46.0	46.6
44	27.2	29.3	31.0	32.5	33.8	35.0	36.0	37.0	37.9	38.7	39.5	40.3	41.0	41.7	42.4	43.1	43.7	44.4	45.0	45.6
43	26.6	28.6	30.3	31.7	33.0	34.1	35.2	36.1	37.0	37.8	38.6	39.4	40.1	40.8	41.5	42.1	42.8	43.4	44.0	44.6
42	25.9	27.9	29.5	30.9	32.2	33.3	34.3	35.2	36.1	36.9	37.7	38.4	39.2	39.8	40.5	41.2	41.8	42.4	43.0	43.6
41	25.2	27.2	28.8	30.2	31.4	32.5	33.5	34.4	35.2	36.0	36.8	37.5	38.2	38.9	39.5	40.2	40.8	41.4	42.0	42.6
40	24.6	26.5	28.0	29.4	30.6	31.6	32.6	33.5	34.3	35.1	35.9	36.6	37.3	37.9	38.6	39.2	39.8	40.4	41.0	41.6
39	23.9	25.8	27.3	28.6	29.8	30.8	31.8	32.6	33.5	34.2	35.0	35.7	36.3	37.0	37.6	38.2	38.8	39.4	40.0	40.6
38	23.3	25.0	26.6	27.8	29.0	30.0	30.9	31.8	32.6	33.3	34.0	34.7	35.4	36.0	36.7	37.3	37.9	38.4	39.0	39.6
37	22.6	24.3	25.8	27.1	28.2	29.2	30.1	30.9	31.7	32.4	33.1	33.8	34.5	35.1	35.7	36.3	36.9	37.5	38.0	38.6
36	22.0	23.6	25.1	26.3	27.4	28.3	29.2	30.0	30.8	31.5	32.2	32.9	33.5	34.1	34.7	35.3	35.9	36.5	37.0	37.6
35	21.3	22.9	24.3	25.5	26.6	27.5	28.4	29.2	29.9	30.6	31.3	31.9	32.6	33.2	33.8	34.4	34.9	35.5	36.0	36.6
34	20.7	22.2	23.6	24.7	25.8	26.7	27.5	28.3	29.0	29.7	30.4	31.0	31.6	32.2	32.8	33.4	33.9	34.5	35.0	35.6
33	20.0	21.5	22.8	24.0	25.0	25.8	26.7	27.4	28.1	28.8	29.5	30.1	30.7	31.3	31.8	32.4	33.0	33.5	34.0	34.6
32	19.4	20.8	22.1	23.2	24.1	25.0	25.8	26.6	27.2	27.9	28.5	29.2	29.7	30.3	30.9	31.4	32.0	32.5	33.0	33.6
31	18.7	20.1	21.3	22.4	23.3	24.2	25.0	25.7	26.4	27.0	27.6	28.2	28.8	29.4	29.9	30.5	31.0	31.5	32.0	32.6
30	18.0	19.4	20.6	21.6	22.5	23.4	24.1	24.8	25.5	26.1	26.7	27.3	27.9	28.4	29.0	29.5	30.0	30.5	31.0	31.6
29	17.4	18.7	19.9	20.9	21.7	22.5	23.3	23.9	24.6	25.2	25.8	26.4	26.9	27.5	28.0	28.5	29.0	29.5	30.0	30.6
28	16.7	18.0	19.1	20.1	20.9	21.7	22.4	23.1	23.7	24.3	24.9	25.4	26.0	26.5	27.0	27.5	28.1	28.6	29.1	29.5
27	16.1	17.3	18.4	19.3	20.1	20.9	21.6	22.2	22.8	23.4	24.0	24.5	25.0	25.6	26.1	26.6	27.1	27.6	28.1	28.5
26	15.4	16.6	17.6	18.5	19.3	20.0	20.7	21.3	21.9	22.5	23.0	23.6	24.1	24.6	25.1	25.6	26.1	26.6	27.1	27.5
25	14.8	15.9	16.9	17.7	18.5	19.2	19.9	20.5	21.0	21.6	22.1	22.7	23.2	23.7	24.1	24.6	25.1	25.6	26.1	26.5
24	14.1	15.2	16.1	17.0	17.7	18.4	19.0	19.6	20.2	20.7	21.2	21.7	22.2	22.7	23.2	23.7	24.1	24.6	25.1	25.5
23	13.5	14.5	15.4	16.2	16.9	17.6	18.2	18.7	19.3	19.8	20.3	20.8	21.3	21.8	22.2	22.7	23.1	23.6	24.1	24.5
22	12.8	13.8	14.7	15.4	16.1	16.7	17.3	17.9	18.4	18.9	19.4	19.9	20.3	20.8	21.3	21.7	22.2	22.6	23.1	23.5
21	12.1	13.1	13.9	14.6	15.3	15.9	16.5	17.0	17.5	18.0	18.5	18.9	19.4	19.8	20.3	20.7	21.2	21.6	22.1	22.5
20	11.5	12.4	13.2	13.9	14.5	15.1	15.6	16.1	16.6	17.1	17.6	18.0	18.5	18.9	19.3	19.8	20.2	20.6	21.1	21.5
19	10.8	11.7	12.4	13.1	13.7	14.2	14.8	15.3	15.7	16.2	16.6	17.1	17.5	17.9	18.4	18.8	19.2	19.6	20.1	20.5
18	10.2	11.0	11.7	12.3	12.9	13.4	13.9	14.4	14.8	15.3	15.7	16.1	16.6	17.0	17.4	17.8	18.2	18.7	19.1	19.5
17	9.5	10.3	10.9	11.5	12.1	12.6	13.1	13.5	14.0	14.4	14.8	15.2	15.6	16.0	16.4	16.9	17.3	17.7	18.1	18.5
16	8.9	9.6	10.2	10.8	11.3	11.8	12.2	12.6	13.1	13.5	13.9	14.3	14.7	15.1	15.5	15.9	16.3	16.7	17.1	17.5
15	8.2	8.8	9.4	10.0	10.5	10.9	11.4	11.8	12.2	12.6	13.0	13.4	13.7	14.1	14.5	14.9	15.3	15.7	16.1	16.5

ANNEX 2

INCLUSION OF PERSONAL PROTECTIVE EQUIPMENT IN THE DETERMINATION OF THE WBGT INDEX

For the determination of the actual WBGT index the employer must take into account the effect of the personal protective equipment that the worker may be wearing. The impact of personal protective equipment on the high and low action levels shall be accounted for as presented below:

1. Typical single-level workwear made of woven fabrics or full-face coveralls made of treated cotton woven fabrics or single-level coveralls made of polypropylene non-woven fabrics: reduction of the high and low action levels by 0°C WBGT.

2. Single-ply polyethylene full body coveralls without weave: reduction of the high and low action levels by 2°C WBGT.

3. Two-layer workwear made of woven fabrics: reduce the high and low action levels by 3°C WBGT.

4. Full-face coveralls and additional long vapour and chemical protection apron with long sleeves: reduction of the high and low action levels by 4°C WBGT.

5. Single-level hoodless full-face coveralls with protection against vapours and chemicals: reduction of the high and low action levels by 10°C WBGT.

6. One-level full body hooded overalls with vapour and chemical protection: reduction of the high and low action levels by 11°C WBGT.

7. Two-layer workwear with hoodless coveralls with vapour and chemical protection over workwear: reduction of the high and low action levels by 12°C WBGT.

8. Workwear that includes a headgear of any fabric: reduction of the high and low action levels by 1°C WBGT in addition to the reduction indicated above for each item of workwear.

Note: Given the evolving nature of PPE technologies, these values should be subject to periodic review and updating as further robust evidence becomes available.

ANNEX 3

INCLUSION OF HEAT ACCLIMATISATION FOR THE DETERMINATION OF THE WBGT INDEX

The determination of the worker's actual exposure shall take into account the reduction of the action levels caused by a possible lack of acclimatisation of the worker to the hot environment. This effect of acclimatisation on the high and low action levels shall be taken into account as shown below:

1. Workers who in the previous 15 days have performed 12 or more 8-hour shifts working in the environmental conditions under investigation: no reduction to the high and low action levels.

2. Workers who in the previous 15 days have not performed 12 or more 8-hour shifts of work in the environmental conditions under investigation: reduction of the high and low action levels by 2.5°C WBGT.

ANNEX 4

I. RISK FACTORS FOR OCCUPATIONAL HEAT ILLNESSES / INJURIES

Risk factors for heat-related illnesses/injuries due to workplace exposure include: 1) lack of acclimatisation to heat, 2) low physical fitness, 3) dehydration, 4) advanced age, 5) high body mass index, as well as 6) certain underlying conditions/diseases and 7) certain medications.

Table 3 presents individual, environmental and pharmaceutical factors as well as pathological conditions that predispose to heat-related illnesses/injuries due to workplace exposure. These injuries can occur even in low-risk individuals who implement appropriate heat exposure mitigation procedures. The table shows that there may be factors that make some workers inherently more vulnerable on a particular day.

Table 3. Factors that predispose to heat-related illnesses/injuries due to workplace heat exposure.

Individual factors	Environmental factors	Drugs / Medications	Health conditions
▪ Pregnancy ▪ Disability ▪ Lack of heat acclimatization ▪ Low physical fitness ▪ Hypohydration ▪ Advanced age ▪ High body mass index ▪ Limited work experience	▪ Heavy/impermeable clothing ▪ Physical work/exercise ▪ Heatwave ▪ High temperature ▪ High relative humidity ▪ Little air movement ▪ Sources of radiant heat (sun and/or machinery)	▪ Antiepileptic, antipsychotic and neuroleptic drugs, tricyclic antidepressants, amphetamines, cocaine, "ecstasy" ▪ Anticholinergic substances ▪ Heart and antihypertensive drugs: (diuretics, nitrites, vasodilators and calcium ion channel blockers) ▪ Hormones (including insulin) ▪ Alcohol ▪ Ergogenic stimulants	▪ Acute illness (e.g., inflammation with fever, gastroenteritis) ▪ Diseases of the central nervous system and mental illnesses ▪ Cardiovascular diseases ▪ Malignant hyperthermia ▪ Diabetes mellitus ▪ Kidney diseases ▪ Skin rash, sunburn and/or previous burns on large skin areas ▪ Hemoglobin diseases (sickle cell anemia) ▪ Chronic liver diseases ▪ Chronic respiratory diseases

II. DISEASES AND HEALTH PROBLEMS ASSOCIATED WITH OCCUPATIONAL HEAT STRESS

The list of diseases to be considered within the scope of this Directive is the latest version of the International Classification of Diseases (ICD-11) published by the World Health Organization.

ANNEX 5

INDICATION OF WORKPLACES WHERE WORKERS MAY BE EXPOSED TO HEAT LEVELS EXCEEDING THE HIGH ACTION LEVELS