

## JRC PESETA III Science for Policy Summary Series

# OUTDOOR LABOUR PRODUCTIVITY AND CLIMATE CHANGE

**Most forms of human performance generally deteriorate with increasing air temperature. Global warming will result in declines of up to 17% in daily outdoor labour productivity by the end of the century, under a high warming scenario and in the absence of adaptation. The largest impacts are projected for Southern Europe. The potential impacts are not eliminated by mitigation only though – adaptation strategies will be required to lessen the impact of climate change on labour productivity.**

### CLIMATE AND LABOUR PRODUCTIVITY

As the temperature and humidity of the surrounding environment increases, the human body reacts by increasing blood flow to the surface of the skin and by sweating, in order to control the internal body temperature. The level of thermal comfort decreases and it can become more difficult to perform physical and cognitive tasks. In turn, labour productivity starts to decline.

Heat stress occurs when the body's attempts to control its internal temperature start to fail. In extreme cases this can lead to death. Many studies have shown that labour productivity starts to decline above a temperature threshold of around 25°C. Therefore the higher temperatures projected with climate change pose a risk to labour productivity.

### IMPACTS UNDER A HIGH WARMING SCENARIO

Under a high warming scenario and assuming no adaptation, daily average outdoor labour productivity could decline in Southern Europe by up to 17% by the end of the century (Figure 1). Countries in Northern Europe could also see declines in daily average outdoor labour productivity but they are smaller – up to 4%.

The majority of outdoor workers affected would be in the agriculture and construction sectors.

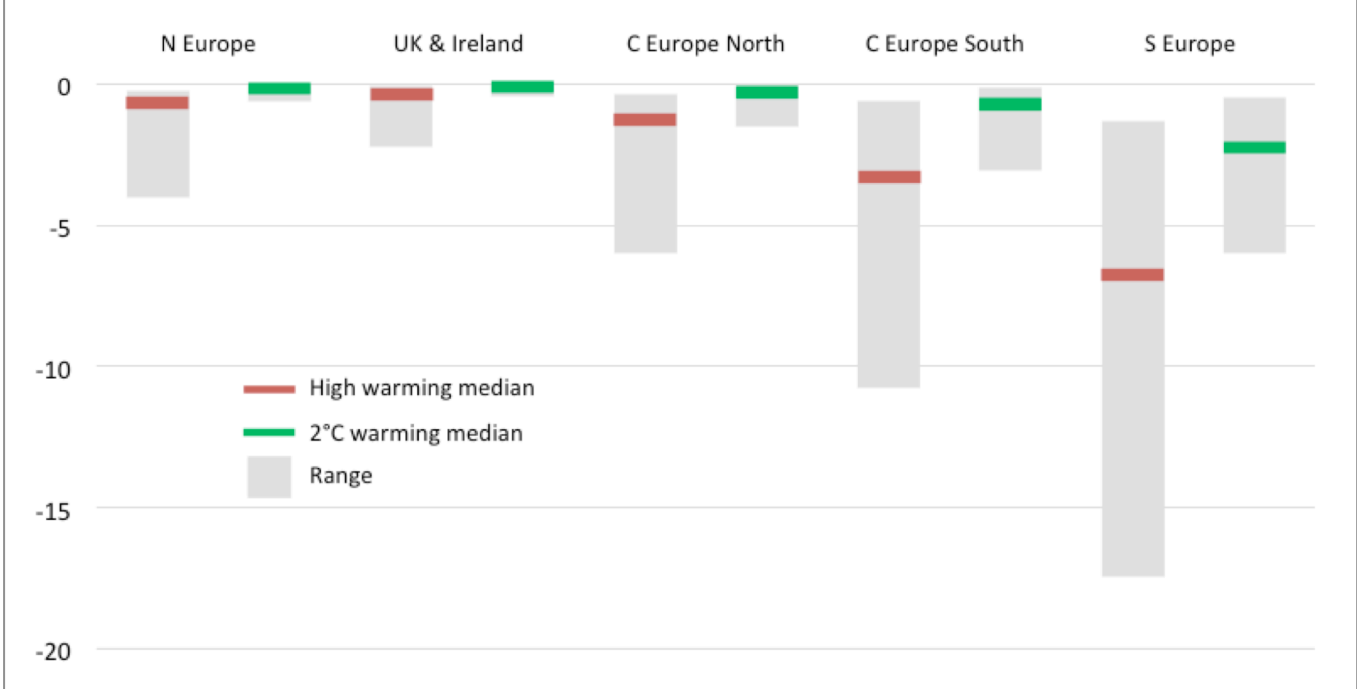
Indoor workers will also be affected by climate change but the impacts are generally 2-4 percentage points lower than for impacts on outdoor labour productivity.

### IMPACTS UNDER A 2°C WARMING SCENARIO

A substantial proportion of impacts on labour productivity could be avoided simply by remaining within a 2°C warming scenario, even with no adaptation. The greatest benefits would be for Southern Europe. (Figure 1). The impacts could be up to 10 percentage points lower under the 2°C warming scenario than under high warming.

Although there is considerable uncertainty in the estimated impacts, the median impacts across all simulations are consistently lower under 2°C warming than under high warming (Figure 1). Furthermore, the range in impacts is smaller for the 2°C warming scenario than the high warming scenario.

Figure 1. Regional differences from present (%) in daily average outdoor labour productivity due to climate change under a high warming scenario and a 2°C warming scenario respectively.



## ADAPTATION

Whilst mitigation has the potential to lessen impacts, adaptation, either planned or autonomous (or a combination of both), will be required to tackle decreasing outdoor labour productivity.

There are various ways in which adaptation may take place, including:

- workers taking more frequent and longer breaks during the hottest parts of the day;
- implementing irregular working hours to enable earlier starts and/or later ends to the working day; and
- including night working for some workers in certain sectors and organisations.

21% of workers in Europe are already employed in jobs with irregular hours that include night and early morning shifts<sup>1</sup> but an important question is by how much could this proportion be realistically and safely increased, particularly in Southern Europe, where the largest declines in labour productivity are projected.

Furthermore, increasing the proportion of the labour force engaged in working irregular hours, particularly at night, should not be considered as a straightforward adaptation response to climate change. This is because more people working at night would require additional energy for lighting of work environments, which would create an increase in energy demand in the energy sector. The additional cost of night-working could offset the possible gains in productivity achieved from it.

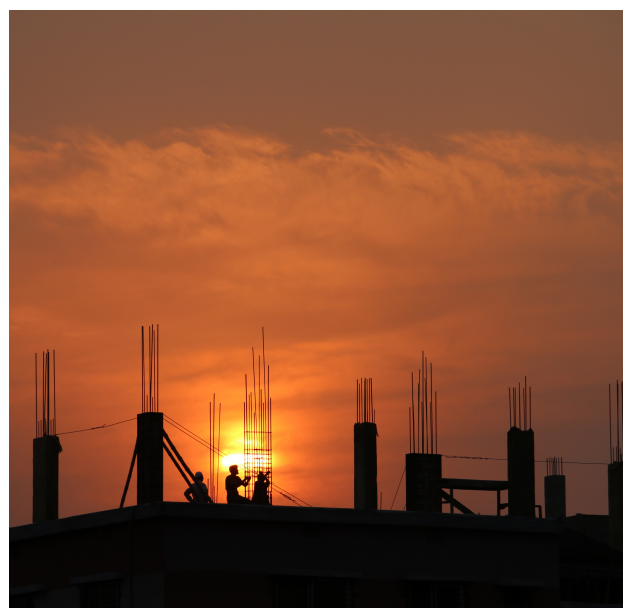


There are also potential implications for human health. Increasing the proportion of the labour force working at night could be associated with adverse health effects, which might also offset any labour productivity gains. There is evidence that night work can have several detrimental side effects, including<sup>2</sup>:

- disturbances of the normal circadian rhythms of psychophysiological functions;
- interference with work performance as well as efficiency that can result in accidents;
- difficulties in maintaining relationships;
- disturbances of sleeping and eating habits;
- chronic fatigue, anxiety and depression; and
- longer-term effects such as coronary heart disease and a higher risk of developing cancer.

A comprehensive review of evidence that reports negative health effects of working irregular hours and at night would be useful for assessing the overall feasibility of changing working hours.

To date, adaptation has not been included in large-scale assessments of the impact of climate change on labour productivity.



<sup>1</sup> Eurofound (2017) Living and working in Europe 2016. Publications Office of the European Union, Luxembourg.

<sup>2</sup> Please refer to PESETA III Task 13 on labour productivity for supporting references.

### APPROACH

PESETA III estimated the impact of climate change on outdoor labour productivity across Europe by using daily Wet Bulb Globe Temperature (WBGT) to estimate changes in daily outdoor labour productivity. WBGT accounts for temperature, but also for humidity – variables that are known to affect labour productivity. Other variables like wind, solar radiation and rainfall can also affect labour productivity but these were not accounted for here. Projections of WBGT from 5 different climate models were used with 5 different labour productivity impact models to provide a range of potential impacts. The study considered a high warming scenario and a 2°C warming scenario. The geographical scope of the study was all countries in Europe.

### Read more

PESETA III Task 13: Climate change impacts on labour productivity. Available on our website

<https://ec.europa.eu/jrc/en/peseta>