Multifunctional Protective Workwear for Outdoor Workers: Developing a Spacer-Fabric Shirt for UV Protection, Cooling and High Visibility

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The Influence of Climate Change on Working Conditions

The Emissions Gap Report, published in October 2026, indicates a 66 per cent chance of global warming reaching 2.8°C by 2100 if climate policy targets are not significantly tightened. [1] Workers who are exposed to the elements whilst working outdoors are suffering from extreme weather conditions. Besides feeling unwell, increased temperatures can lead to dehydration, circulatory failure, heart failure or even death. [2] According to Copernicus and the WMO, heat-related deaths in Europe have risen by about 30% in the last 20 years. [3] Furthermore, it is considered proven that so-called basal cell carcinomas (white skin cancer) or multiple actinic keratoses can be caused by occupational UV radiation exposure during outdoor work. [4] In addition to direct health risks, heat reduces concentration, performance and can lead to an increased risk of accidents. [5 - 6] The likelihood of a workplace accident can increase with every one-degree Celsius rise in temperature [7] The DGUV recommends long-sleeved clothing that protects against UV radiation, has a cooling effect and, for certain work areas, provides an appropriate warning effect. Currently, the market mainly offers products that are not sufficiently accepted or do not fulfil all the required functions simultaneously.

Sources (For more information use QR-Code below): *[1] UNEP, "Emissions Gap Report 2026: The point of return", Executive summary, 2026. [2] Mücke, Hans-Guido, "Klimawandel und Hitze", 2024. [3] Copernicus Climate Change Service, World Meteorological Organization, „European State of the Climate, Summary 2023", 2023. [4] Deutsche Gesetzliche Unfallversicherung e.V. (DGUV), „Geschäfts- und Rechnungsergebnisse der gewerblichen Berufsgenossenschaften und Unfallversicherungsträger der öffentlichen Hand", 2023. [5] C. Crämer, A. Templiner, „Hitze- und UV-Schutz bei der Arbeit im Freien", 2020. [6] BZgA, „Hitze und Klimawandel, Hitze und Hitzeschutz", n.A. [7] Syeda Hira et al „Extreme heat and occupational injuries in different climate zones: A systematic review and meta-analysis of epidemiological evidence", 2021.*

Technical Approach

The aim of the project is to develop an innovative long-sleeved outerwear that protects outdoor workers from overheating and UV exposure. The project aims to result in a multifunctional Shirt that considers the needs of both men and women. The current research project, which runs until mid-2028, is characterized by its high relevance and innovative potential, as it addresses several needs and gaps simultaneously.

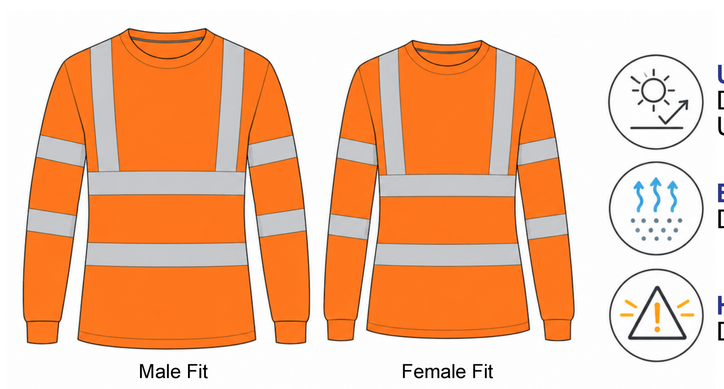


Image [1]: Overview target goals

The textile construction is modified and optimized to simultaneously combine UV-protection, evaporative cooling, and high visibility. Another innovative focus lies in the development of segmented retro-reflective applications, which are intended to offer improved freedom of movement and greater thermophysiological comfort compared to conventional reflective strips. This task presents a major challenge regarding the selecting of suitable materials, processes and structures, as there is a risk of these factors negatively interfering with one another. The development is intended to comply with the requirements of Regulation (EU) 2016/425 on personal protective equipment.

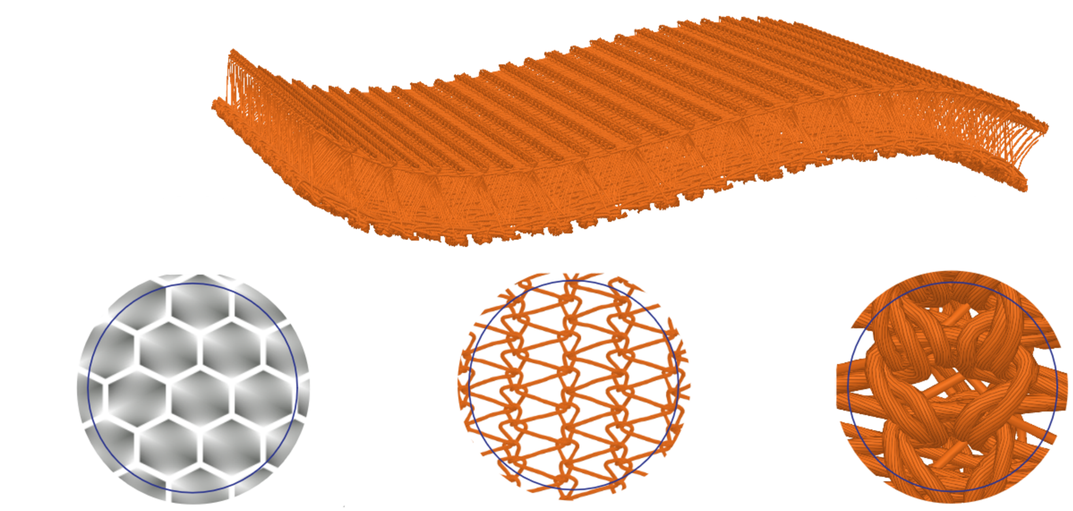
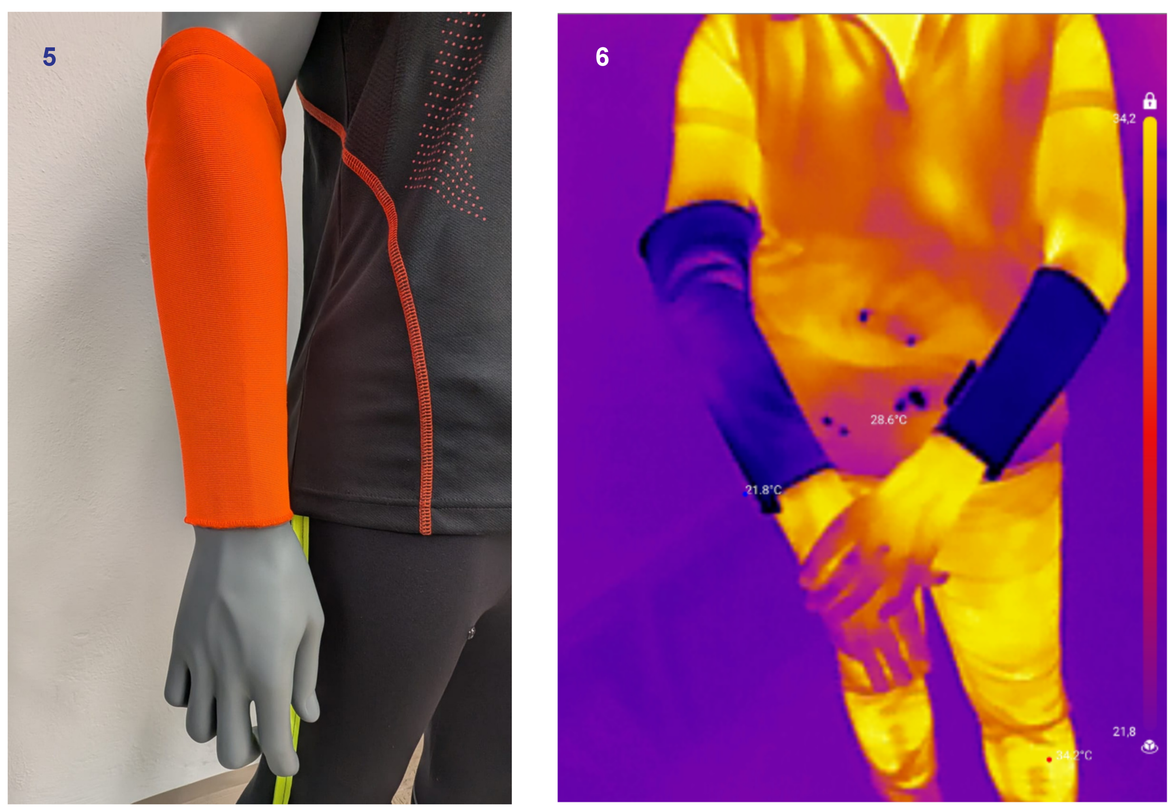


Image [2]: Methodology for implementing target goals

Current Progress

The protective shirt was developed using an iterative methodology including design, material selection, and optimization cycles. The initially developed warpknitted fabrics were tested regarding the fulfilment of predefined requirements for UV protection, cooling performance and high-visibility and were evaluated in initial wear trials. The resulting user feedback will be incorporated into the next iteration to further refinement and validation of the prototypes.





Images:
[3]: Dyeing Samples
[4]: Testing of segmented retroreflective coatings on spacer structures
[5]: Demonstrator sleeve for first wear trials
[6]: Thermal image of demonstrator (left) and commercially available cooling sleeve (right); image by Franke/BG ETEM

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Sources

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