

## COUNTERMEASURES TO URBAN HEAT ISLAND EFFECT 2014

OUTDOOR THERMAL COMFORT AND HEALTH IN THE URBAN ENVIRONMENT;  
URBAN VEGETATION AND GREENERY

### INTEGRATION OF MICROCLIMATE-RESPONSIVE DESIGN IN THE PLANNING OF URBAN OUTDOOR SPACES - A CASE STUDY IN ATHENS, GREECE

Dipl. Ing. Leman Altinisik<sup>1</sup>, Dipl. Ing. Wiebke Klemm<sup>2</sup>, Arch. Giulia Peretti<sup>1</sup>, Prof. Dr. Michael Bruse<sup>3</sup>

<sup>1</sup>WSGreenTechnologies GmbH, Albstraße 14, 70597 Stuttgart, Germany

<sup>2</sup>Wageningen University and Research Centre, Landscape Architecture Group, The Netherlands

<sup>3</sup>Department of Geography, Section Geoinformatics, University of Mainz, Germany

leman.altinisik@wsgreentechnologies.com

wiebke.klemm@wur.nl

giulia.peretti@wsgreentechnologies.com

bruse@uni-mainz.de

#### **Abstract:**

##### Introduction

In the design of outdoor urban spaces microclimate consideration are often relegated in the background compared to the functional, aesthetic and economic design purposes. Even though the necessity of mitigating urban heat and improving thermal comfort is evident, in planning and design processes urban microclimate is hardly addressed as design criteria yet. However, as a consequence of climate change and increasing urbanisation/ densification, urban heat and thermal discomfort in urban environments are likely to increase. Therefore, climate-responsive designs should be integrated in on-going urban developments to ensure comfortable living conditions for cities' inhabitants now and in the future. The landscape and urban planning project "One-step beyond. Re-Think Athens, towards a new city centre" represents such an integrative approach. The study exemplarily describes the process of re-designing urban outdoor spaces in Athens by means of climate-responsive greenery.

##### Contents

Within the architectural assignment for the redesign of city centre of Athens the topic of improved microclimate and thermal comfort was stated from the beginning with strict criteria. The aim of the bioclimatic contribution had to meet strict criteria, like the reduction by 1,5 °C in the maximum summer air temperature or the improvement by 20% of the thermal comfort index during a typical summer day. To achieve those goals, bioclimatic aspects were included in the design process from the very beginning until the last stage of the detailed design.

To achieve those demands an interdisciplinary team was formed by landscape architects and urban designers, urban climate experts and engineers in model simulations.

Based on a literature review bioclimatic studies in Mediterranean climates a heat mitigation toolbox was developed in the first design stage. The heat mitigation toolbox provided appropriate urban design principles with (1) greenery, (2) cool materials and (3) water measures which reduce the urban heat

island effect and energy consumption in Athens. Those design principles were integrated in the preliminary designs. The preliminary design has been simulated using the microclimate simulation model ENVI-met in order to investigate the differences in thermal comfort conditions between the actual and the expected situation and suggest re-design measures to improve the microclimate conditions. For more precise input data and results a pre-validation measurement campaign was conducted. The local measurements of the development area were used for the setting of the material database of ENVI-met.

In the second design phase, results of the ENVI-met simulations were used to adjust and improve the preliminary design in terms of thermal comfort. The newly developed final design was investigated again with high resolution models (ENVI-met). The results of this second simulation provided the basis for the calculation of the microclimate goals. It was proven by the simulations that all criteria defined for the microclimate analysis were met.

### Conclusion

The case study "One step beyond" describes the redesign-planning process in which besides spatial, functional, social, economic and security demands focus was put on microclimate considerations. It shows that encouraging the integration of urban climate aspects from the very beginning of the design process can lead to significant improvement of the microclimate conditions.

The project reflects also about the integration of microclimate aspects into urban planning assignments as well as about the cutting point between architects and designers and microclimate researchers.

### Keywords:

Climate-responsive design, interdisciplinary team, climatic improvements, ENVI-met simulation, microclimate goals, urban planning assignments, redesign-planning process, urban outdoor spaces