

# Green Infrastructure as a Means of Combating Climate Change in the City of Podgorica

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**Abstract.** As a dynamically developing urban system, Podgorica, the capital of Montenegro, is particularly vulnerable to climate change impacts. Although recognised in relevant local documents, new solutions, globally proven to be successful in combating climate change, have not yet been fully implemented in Podgorica.

**Keywords:** green infrastructure; climate changes; Podgorica

## 1 Problem definition

Due to worldwide urbanisation, the demand for new buildings, land, water, and energy has drastically increased over the last four decades. Thus, the space in cities has been increasingly occupied, and it would be very difficult, almost impossible, to restore it to its original state, consequently making urban environments particularly vulnerable to the impact of climate change.

The construction and maintenance of buildings account for about 40% of the global primary energy demand, and buildings account for 33% of the global greenhouse gas emissions. For that reason, and considering that Podgorica is a developing urban system, it is of the highest importance to define and implement innovative solutions with green infrastructure as one of globally the most successful tools to mitigate climate change.

## 2 Background

Green infrastructure is based on the principle of intentional integration of nature protection and enhancement into spatial planning and territorial development.

Some examples of green infrastructure are parks, urban forests, green roofs, green walls, green parking, bioremediation, beehives. Green areas in Podgorica have been significantly expanded and improved in the last few years, in terms of newly developed city parks and reconstruction of existing ones, but the number of buildings is also increasing, as well as the need for parking spaces, so it is necessary to develop and implement new solutions in the preservation of the space, that is, to use the space more sustainably, also to combat climate change. Namely, certain solutions proved to be successful globally in this regard, such as green roofs and green walls, but have not been extensively implemented yet. New solutions are of particular importance for concrete surfaces, recognised as *urban heat islands*, where tree planting, as one of the green infrastructure mechanisms widely implemented in

Podgorica, is not possible. Furthermore, Podgorica, as the capital of Montenegro, with the highest administrative and other capacities, inhabited by a third of the state population, should also act as a role model for other Montenegrin municipalities.

### 3 Research methodology and our progress

This correspondence and the framework for further research are mostly based on the author's work experience in environmental protection at the local level and analysis of relevant local documents.

An analysis of extreme weather events recorded in the period 2003 - 2013, conducted for the purpose of developing the Climate Change Adaptation Strategy, proved that in the context of climate change, Podgorica is a rather vulnerable urban system. Green infrastructure, including green roofs, has been recognised by the Strategy as a mechanism the City should implement to combat climate change successfully. Also, the Spatial Urban Plan of the Capital City Podgorica recognises the City's potential for green roof implementation. Furthermore, with the support of international partners, the City has recently started concrete analyses in this regard, which would provide a solid base for further elaboration.

### 4 Further work

Further work will be focused on a comprehensive analysis of existing spatial planning documentation to obtain a projection of the City's further spatial expansion and further greening with an emphasis on the possibility of implementation of green roofs and green walls in densely built-up city areas, analysis of ecosystem services in the urban area, connecting fragmented ecosystems by expanding adjoining green spaces, and transdisciplinary collaboration of urban planners, engineers, and ecologists.

Experiences of European countries with a long tradition of green roof installation will be particularly analysed and taken into account within further steps.

### 5 Conclusions

The necessity and possibilities for implementing green infrastructure tools as an effective mechanism to combat climate change have been recognised worldwide for decades.

Still, some of these tools, such as green roofs and green walls, have not been implemented in the City of Podgorica, although the results of the research conducted proved that Podgorica is a rather vulnerable urban system and that its vulnerability can increase if no concrete activities are taken in the near future.



**Branka Knežević** has been working in the local self-government department for environmental protection for almost 15 years. She graduated from the Faculty of Natural Science and Mathematics, University of Montenegro, Department of Biology, and at the same Faculty defended her master's thesis in the field of lichenology. In the academic year 2021/22, she enrolled in Doctoral studies in the Sustainable Development Program at the University of Montenegro. Her research is focused on the sustainable development of the City of Podgorica.