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Book of Abstracts

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Becoming Acquainted with Green Roofs Contribution Towards Circular and Resilient Cities

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Abstract

Cities, due to their high population density, are characterized by a high built-up area, extensive soil sealing, and low vegetation cover. In urban areas water is generally exploited in a linear process: "extract from adjacent freshwater ecosystems - use - dispose". Stormwater management aims to discharge rainwater quickly to avoid flooding. However, when rainfall exceeds the capacity of drainage systems, widespread flooding eventually occurs in urban spaces. On the other hand, when dry weather persists, there is a need to watering green spaces in order to maintain them. In this case, water is again used in a linear fashion: drinking water is often used since there are no other water sources that can be considered (1). The impossibility of circular water management in urban areas makes these spaces particularly vulnerable to extreme droughts and floods, which in a climate change scenario are increasingly frequent. It is therefore urgent to increase the resilience of cities by promoting measures to make cities "Water Wise Cities" (2). The implementation of green infrastructures as a complement to grey infrastructures is crucial to achieve this goal. These green infrastructures include Nature-Based Solutions (NBS) that provide various environmental services (e.g. water, soil, and biodiversity conservation, making cities more resilient to climate change) and socio-economic services (e.g. creating places to live, jobs, property valuation).

Green roofs are an example of NBS that can be used in conjunction with other tools aimed at promoting the circular economy of water in urban spaces. These structures are built based on technical and scientific guidelines and result from planting vegetation on a substrate followed by several layers of other materials that sit on a built structure (3). Green roofs can be constructed at ground level or on top of buildings and are efficient solutions to mitigate flooding as they delay the peak flow of stormwater, releasing the water gradually (sponge effect) and avoiding overloading the stormwater drainage system. Part of this water infiltrates and is retained in the substrates, being released during dry periods by evapotranspiration (4). In addition to being important tools for circular urban water management, these structures also offer potential benefits in terms of aesthetic value, biodiversity conservation, noise, air pollution, and "heat island" effect reduction, ultimately promoting energy efficiency and the reduction of CO₂, and other greenhouse gas emissions.

However, although the widespread implementation of green infrastructure in urban spaces is foreseen in European (e.g. European Green Deal) and global (e.g. Sustainable Development Goals - United Nations Agenda 2030) policies and strategies, there are still difficulties for large-scale implementation. These difficulties are in part due to the fact that the concept of green infrastructure is relatively new and complex, nor sufficient quantitative analysis and indicators. As a result, it is very difficult for policy makers to integrate it into various policies. On the other hand, there is still a widespread lack of knowledge by the public and private sectors, as well as the general public, of the high potential contribution of this natural engineering tool for water and energy management in urban areas, which, together with the need for the intervention of professionals from different disciplines, hinders a greater implementation of these infrastructures in urban areas.

Therefore, the aims of the present communication are:

- 1) Presenting the project "Exploring the functioning and functions of green roofs in water management:

A prototype for experimental and interactive activities", winner of the 1st prize in the environment category of the ideas contest "Ideias Hidrodinâmicas" promoted by Ciência Viva, Fundação Calouste Gulbenkian, and Águas do Tejo Atlântico, that will be implemented in IPB;

- 2) Discussing the state of the art of green roofs in Portugal;
- 3) Introducing some approaches on green roofs that are being developed by the team, namely in Master's degree theses.

Keywords: Green Roofs, Urban Water Management, Circular Economy, Nature-Based Solutions

References

- [1] D. Pearlmutter et al., «Closing Water Cycles in the Built Environment through Nature-Based Solutions: The Contribution of Vertical Greening Systems and Green Roofs», *Water*, vol. 13, n. 16, Art. n. 16, jan. 2021, doi: 10.3390/w13162165.
- [2] «The IWA Principles for Water Wise Cities», International Water Association. <https://iwa-network.org/publications/the-iwa-principles-for-water-wise-cities/> (acedido 7 June 2022).
- [3] C. S. C. Calheiros, B. Castiglione, e P. Palha, «Chapter 14 - Nature-based solutions for socially and environmentally responsible new cities: The contribution of green roofs», em *Circular Economy and Sustainability*, A. Stefanakis e I. Nikolaou, Eds. Elsevier, 2022, pp. 235–255. doi: 10.1016/B978-0-12-821664-4.00015-7.
- [4] C. S. C. Calheiros e A. I. Stefanakis, «Green Roofs Towards Circular and Resilient Cities», *Circ.Econ.Sust.*, vol. 1, n. 1, pp. 395–411, jun. 2021, doi: 10.1007/s43615-021-00033-0.