

# Green infrastructure solutions: A decision-support system for green roof incentive policies

## Summary

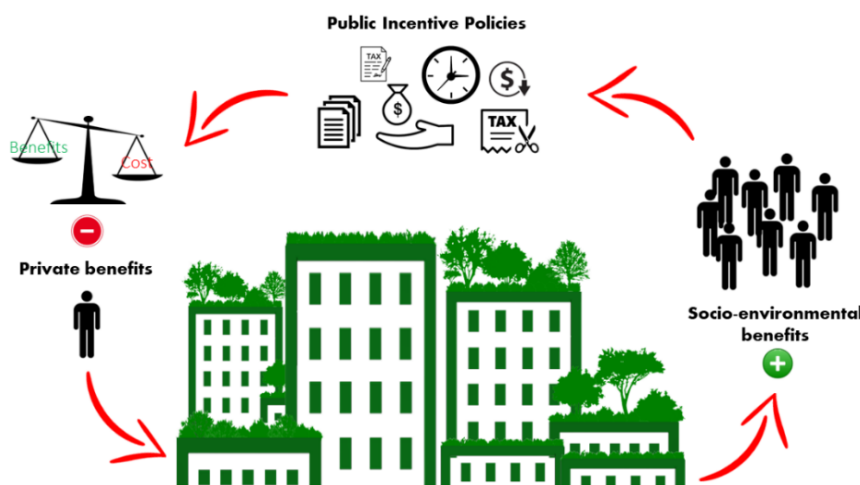
Green roofs (GR) are a typology of green infrastructure solutions that incorporate vegetation over flat or slightly sloped surfaces, providing an alternative to traditional concrete constructions. GR provide several ecological, economic, and socio-environmental benefits. GR play a key role in urban resilience, reducing risks and damages from potential disasters caused by extreme events, and helping cities to achieve the United Nations Sustainable Development Goals. However, despite these benefits, GR installation and maintenance costs can be burdensome to private investors and, generally, from a purely financial point of view, the quantified benefits are not compensated by the costs.

On the other hand, the public benefits generated by the widespread installation of GR can be significantly positive from a socio-environmental perspective. Therefore, public investments in such solutions would be strongly recommended. In several countries, some municipalities have developed incentive policies to promote GR installation; these incentive policies take different designs and depend on local factors. However, regardless of location, economic factors or climate conditions, the incentive policies have proven effective in promoting and facilitating the installation of GR by private investors worldwide. These incentive programmes comprise a set of pre-determined requirements that must be fulfilled to access the benefits provided for in the legislation. However, the methodologies for establishing these legal requirements are generally not specified. To bridge this knowledge gap, this thesis proposes a decision-support system to design incentive policies, based on the economic value of the ecosystem services generated by green roofs. The methodology is based on an inclusive three-level cost-benefit analysis (CBA) - financial/ economic/socio-environmental - and the quantification procedure incorporates local characteristics to establish a realistic approach regarding the socio-environmental needs.

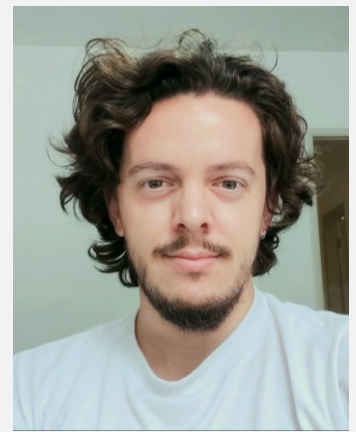
The city of Lisbon has been used as a case study and the proposed methodology applied. The city's civil parishes were defined as working zones, and the amounts of direct financial subsidies required to balance costs and benefits were estimated based on the CBA outcomes. Results showed that direct financial subsidies can be a significant burden to the public purse, in the Lisbon case. Therefore, alternative incentive policies, such as legal obligation, tax reduction, or even a combination of different types of incentives, could be recommended to avoid a significant negative effect on the sustainability of public finances.

## Keywords

Green roofs, incentive policies, nature-based solutions, cost-benefit analysis, sustainable development.



*Incentive policies are feasible when public benefits are greater than private ones.*



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