

Nature-Based Urban Planning: Investing in a New Paradigm for Resilient Cities

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Executive Summary

Cities are facing increasingly demanding climate challenges, such as urban heat islands, flooding, and biodiversity loss. Nature-based Solutions (NBS) have gained prominence as a response to these pressures, but their integration into urban planning remains limited and unsystematic, reducing their potential impact. Findings from PLANN@T highlight the need to transition towards a Nature-Based Urban Planning (NBUP) model, enabling NBS to be incorporated as essential components of urban infrastructure. To implement this model, it is crucial to address critical gaps in data and knowledge and to establish appropriate financing mechanisms and incentives that maximise the potential of existing legal instruments, namely Information, Incentive, Planning and Project, Regulatory, and Agreement instruments. Improving these instruments must be evidence-based and oriented towards flexibility, resilience, and the strengthening of technical capacities within the relevant institutions. It also requires promoting inter-municipal cooperation, adopting innovative solutions supported by Artificial Intelligence and digital technologies, and reforming governance structures and participation processes.

Recommendations

- More applied research on urban ecosystems and their services to take decisions based on scientific knowledge.
- More real-time data collection and investment in sharing platforms, ensuring transparency and access to data.
- More experimentation across ecological and urban typologies to support context-specific decisions.
- More capacity building of all stakeholders as basis for more engaged collaboration.

Policy Brief Recipients

Government areas of Environment and Energy, and Territorial Cohesion, specifically the Secretaries of State for Environment and for Local Administration and Spatial Planning.

Nature-Based Urban Planning: A Strategic Reframing for Nature in Cities

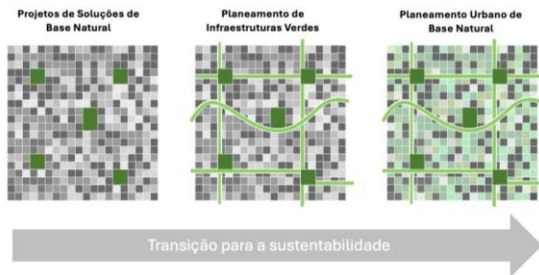
At a time when over 4% of summer mortality is attributable to urban heat islands¹, cities are increasingly turning to Nature-Based Solutions (NBS) to address the impacts of climate change. However, traditional urban planning approaches are proving inadequate in leveraging these solutions. As a result, NBS are often implemented as isolated projects, lacking

coherence and failing to leverage their full potential. Some scholars have even cautioned that NBS, when poorly embedded, risk becoming “dangerous distractions”².

Nature-Based Urban Planning (NBUP) responds to this challenge by proposing a shift from conventional *land-sparing* models, where the “green” is planned separately from built

“grey”, either isolated or integrated in green infrastructures, to a *land-sharing* approach. This integrated approach addresses “green” and “grey” simultaneously across scales, from city-wide systems to individual plots, embedding NBS and the Green Urban Infrastructure.

Figure 1 – NBUP versus conventional models.



NBUP does not require the creation of new planning instruments. Instead, it calls for a re-orientation, strengthening, and deepening of existing tools through a nature-based lens, ensuring that all new interventions, public or

private, comply with climate adaptation measures grounded in NBUP principles.

Implementing this shift demands visionary leadership at the governmental level. It requires: (i) embedding nature-based objectives into national strategies and foundational legal frameworks in a way that cascades down to local urban planning processes; and (ii) to detail existing legislation promoting the systematic application on ground.

Now that Member States are preparing national plans to comply with the European Nature Restoration Law, the NBUP Model offers a purposeful approach to improving urban ecosystems while addressing housing and infrastructure, by moving beyond the practice of merely accounting for green spaces. NBUP sets the foundation for a new vision of the city, where nature is an integral part of urban infrastructure arising from everyday urban planning and management practice.

The Nature-Based Urban Planning Model

Cities are complex socio-ecological systems. NBUP connects societal challenges and values with a set of planning principles to achieve local targets. These targets must be tailored to the specific context of each situation, considering territorial profiles, the performance of NBS, and the existing planning instruments.

Figure 2 – NBUP Model.



Nature-based Urban Planning addresses these challenges through a set of eight planning principles designed to ensure interventions deliver co-benefits, such as health, biodiversity, and community well-being:

1. **Connectivity** along ecological and social structures.
2. **Integration** of social and ecological systems within the city.
3. **Multifunctionality** of land uses and activities to provide ecosystem services.
4. **Inclusiveness** of perspectives and actors in collaborative governance.
5. **Subsidiarity**, reinforcing contextualized and democratically legitimized solutions.
6. **Precaution**, avoiding serious or irreversible ecological damage under uncertainty.
7. **Persistence**, valuing pre-existing elements with long-term functional importance.
8. **Circularity** of materials and resources within cities.

Goals and Praxis

Through a cocreation process involving 136 participations from 40 municipalities from Mainland Portugal and Islands, four main key-ideas emerged:

- **Local knowledge on implementing NBS exists.** There is extensive experience in creating green spaces in cities, both in public and private domains.

- **Planning legislation and instruments are sufficient.** However, it is the governance models that most influence the effective and coherent application of these instruments in implementing NBS.

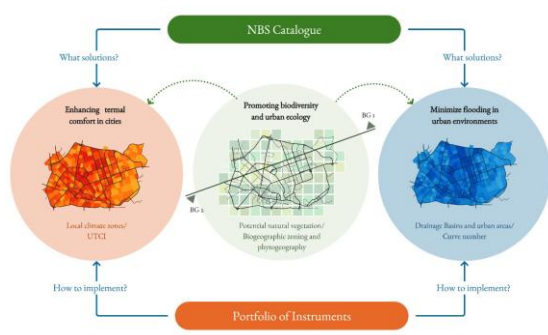
- **There are no one-size-fits-all solutions.** Specific standards and norms must be defined locally, based on ecological context and institutional culture, rather than imposed through national legislation.

- **Central government** should issue guidelines, provide mechanisms for sharing performance data and support capacity-building for all stakeholders involved in city-making processes.

Territorial Profiles, NBS Performance, and Planning Instruments

Based on the insights from the cocreation process, PLANN@T scrutinized existing scientific evidence on the NBS performance for enhancing thermal comfort, minimizing urban flooding and promoting biodiversity. Based on such analysis, it curated an [NBS Catalogue](#) aligned with a [Portfolio of Instruments](#) suitable for supporting the implementation of NBS in urban planning. Territorial Profiles enable each municipality to position itself within these profiles and define realistic targets and desired performance trajectories.

Figure 3 – Articulation of NBUP elements.



Governance and Monitoring

An effective articulation between governance and monitoring is essential for achieving targets. It was observed that monitoring is closely

linked to governance, particularly due to the need to ensure transparency and equity in data access, enabling active scrutiny by the entire community and fostering the co-construction of solutions capable of addressing current crises in the face of uncertainty.

Critical Issues for Implementing NBUP

Improving territorial profiles requires more detailed data on urban land use, particularly at the thematic resolution of open spaces. Currently, there is insufficient information to calculate surface water runoff and limited shared data on biodiversity status. A critical gap lies in hydrological and hydraulic data needed for model calibration. Regarding NBS, systematic research on the performance of specific categories across diverse ecological and urban contexts in Portugal is scarce. Overall, there is a lack of continuous monitoring of implemented NBS using instrumentation capable of collecting real-time and systematic data on temperature, meteorological variables, runoff, and urban biodiversity. Consolidating NBUP requires:

- **Quantifying the Ecosystem Services by NBS:** Measure benefits such as thermal regulation, water retention/runoff, and carbon sequestration for each type of solution.

- **Assessing the Economic Value of NBS:** Evaluate contributions to energy savings, health cost reductions, and property value enhancement across territorial contexts.

- **Mapping Urban Soils:** Understand water behaviour and biomass support capacity in Technosols and Anthrosols.

- **Analyse Decision-Making Criteria for NBS Adoption:** Study stakeholder perceptions and systemic barriers to implementing nature-based planning.

- **Leverage Artificial Intelligence for Real-Time NBS Performance Mapping:** Explore potential of AI-driven tools to monitor and share NBS effectiveness.

- **Explore Digital Twin Technology:** Develop virtual models to simulate complex interactions among ecological, social, and physical systems, enabling scenario testing before implementation.

Policy Recommendations

The following recommendations aim to inform public policy making in the government areas of Environment and Territorial Cohesion. They are structured according to the type of instruments systematized in the portfolio – information, incentives, planning and project, regulation and agreement – and target specific existing legislation and government bodies.

#1. Recommendations on Information-Based Instruments: Information instruments empower stakeholders and generate technical and scientific knowledge to support decision-making throughout all phases of urban planning, ultimately fostering a culture of nature-based planning.

Strengthen Monitoring and Data-Driven Decision-Making – Implement effective monitoring practices based on meaningful data to evaluate outcomes and underlying processes, enabling timely adjustments for greater efficiency. Incentivise local administrations to adopt tailored monitoring methodologies aligned with territorial objectives and planning instruments, leveraging decentralized approaches and voluntary collaborations, and the central government to aggregate regional and local data to produce national performance criteria.

Foster Intermunicipal Cooperation and Knowledge Sharing – Promote structured collaboration among municipalities to exchange best practices for integrating NBS. Encourage financial incentives for developing intermunicipal digital platforms, enabling open data and participation in European knowledge-sharing networks (e.g., *OPPLA*). Encourage municipal associations (CIM) in acquiring data and baseline studies, leveraging economies of scale and supporting resource-limited municipalities.

Enhance Technical and Institutional Capacity – Develop dedicated programs at national and regional levels to strengthen technical, financial, and management skills across municipalities for data collection, including advanced training, experience-sharing mechanisms, and adequate financial support to address disparities in planning and implementation capacity.

Create and Share Systematic Ecosystem Data – Ensure comprehensive baseline information on ecosystems, habitats, and biodiversity within Municipal Land Use Plans, in line

with the existing legal framework. Promote intermunicipal and regional coordination to guarantee data consistency and integration into open-data platforms, supporting effective NBS integration in spatial and urban planning.

Deploy Integrated Environmental Sensor Networks – Establish urban sensor networks for real-time monitoring of temperature, water infiltration, biodiversity, and other ecological indicators. Ensure interoperability with national territorial and environmental information systems, leveraging AI, ICT tools (sensors, GIS, digital platforms, modelling) for data collection and open data access. Expand thematic and spatial resolution in land-use mapping to support predictive models for hydrological, climatic, and ecological impact assessment.

Strengthen Science-Policy Collaboration – Reinforce partnerships with universities and research centres for performance evaluation of NBS targets and indicators. Implement national programs for applied research and knowledge transfer, including technical guidelines, best-practice seminars, and advanced training based on innovation.

Support Operationalization of Municipal Ecological Structures (EEM) – Develop a manual of guidelines for municipalities for integrating EEM into urban planning and management. The manual should define minimum content, diagnostic methodologies, objectives, action plans, financing strategies, monitoring indicators, and implementation mechanisms and instruments.

#2. Recommendations on Incentive Instruments: Incentive instruments mobilize financial resources and create favourable conditions for the systematic integration of NBS into urban planning.

Support Pilot NBS Projects in Cities – Encourage municipalities to implement innovative and emblematic NBS through dedicated funding programs leveraging national and EU funds (e.g., *Environmental Fund*). Prioritize critical urban and environmental contexts to test scalable solutions, following successful models like APA's "Sustainable Urban Mobility" program.

Introduce Incentives in Urban Development Permits – Implement legal frameworks for

municipal licensing incentives, such as fee reductions, building credits, or expedite permitting for projects integrating NBS that improve thermal comfort, reduce urban flooding, and enhance biodiversity.

Align Municipal Financing with the Objectives of NBUP – Create mechanisms linking local financing instruments for NBS lifecycle needs, including tax or fees benefits (e.g., IMI reductions), positive discrimination rules, and ecological compensation systems. Integrate the costs of off-site green infrastructure into urban infrastructure fees (TRIU) and offer reductions for projects with proven environmental performance.

Embed Ecological Criteria in Public Procurement – Incorporate measurable performance indicators into tendering processes, rewarding effective NBS integration for thermal comfort, flood mitigation, and biodiversity. Develop a minimum list of criteria and metrics to standardize practices across municipalities.

Establish Performance-Based Environmental Benefits – Convert verified environmental outcomes into tangible incentives, such as bioclimatic credits, tax benefits, and ecosystem service payments. Link these benefits to certification systems and ensure scalability across buildings, neighbourhoods, and urban areas.

#3. Recommendations on Plan and Project Instruments: Plans and Projects translate strategic guidelines into concrete actions for land-use planning, zoning, urban design, infrastructure, and territorial management. They are essential for systematically integrating NBS from the earliest planning stages, ensuring that territorial models, zoning schemes, and urban design incorporate objectives such as enhanced thermal comfort, flood mitigation, and biodiversity promotion.

Integrate NBS into Public Space Design – Ensure that urbanization projects incorporate NBS to enhance connectivity across scales and complement green infrastructure with other networks (mobility, sanitation). This requires revising the Urbanization and Building Legal Framework (RJUE) to mandate green infrastructure as a core urban system and define connectivity criteria at multiple scales.

Lead by Example in Major Public Works – Apply Nature-Based Planning principles in large-scale public projects, such as airports,

metro expansions, roads, hospitals, and schools, demonstrating innovation in infrastructure design and public space reconfiguration.

Embed Persistence and Precaution Principles in Planning – Safeguard structural landscape elements that resist fragmentation and urban pressure, ensuring their preservation and integration throughout their lifecycle. Apply precaution by assessing ecological impacts and ecosystem service trade-offs before project approval, prioritizing solutions that minimize disruption and enhance resilience.

Develop Advanced Monitoring Methodologies – Implement performance monitoring for plans, programs, and projects, integrated with smart urban environmental systems at multiple scales (building, block, neighbourhood, city), and encourage citizen participation through mobile apps and interactive platforms.

#4. Recommendations on Regulatory Instruments: Regulatory instruments must combine clarity of objectives and principles with technical flexibility, enabling adaptive, evidence-based solutions rather than rigid rule application.

Apply the Principle of Subsidiarity in NBS Regulation – Central government should provide guidelines, model clauses, and share best practices, while ensuring minimum harmonization. Local authorities should regulate NBS use, set targets, and define context-specific requirements based on their territorial profiles. Issues such as thermal comfort, urban flooding, and biodiversity must be addressed at appropriate scales, municipal, intermunicipal, and regional, given their geographic context.

Promote Smart, Goal-Oriented Regulation – Regulatory instruments should be evidence-based, resorting to rules that must be adaptive and conditional (following *if-then-else* logic), interoperable with urban management systems.

Introduce Burden-of-Proof Requirements in Local Regulations – Municipal licensing should require developers to demonstrate, with verifiable evidence, that proposed solutions meet defined objectives for thermal comfort, flood mitigation, and biodiversity enhancement. Municipalities must set clear performance targets and monitor compliance through measurable indicators.

Strengthen Municipal Regulations as Operational Frameworks – Position municipal

regulations as flexible yet stable repositories for detailed NBS rules, enabling iterative updates based on monitoring and evolving territorial contexts. This approach fosters a culture of nature-based planning tailored to local conditions.

Align Nature Restoration Law with Urban Ecological Structures – Integrate the European Nature Restoration Law with municipal ecological frameworks, using the NBUP Model to translate EU targets into locally adapted strategies. Ensure strong institutional coordination and allocate adequate technical, human, and financial resources to reinforce planning and execution capacity at local level.

#5. Recommendations on Agreement Instruments: Agreement instruments rely heavily on how different actors in the territory are organized, both formally and informally, depending strongly on governance arrangements. This instruments emphasize the Principle of Inclusiveness, fostering a culture of nature-based planning, effective collaborative processes, and community-driven approaches.

Conclusion

The NBUP model was developed as an integrative tool linking the environment and spatial planning sectors responding to the IPBES³ call for systemic integration of NBS into urban planning through inclusive governance and data-driven decision-making.

Despite the evidence collected, significant progress is still needed before we can define concrete standards and norms for urban planning aimed at mitigating climate change impacts and enhancing urban biodiversity:

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References

¹Iungman, T., et al. (2023). Cooling cities through urban green infrastructure: a health impact assessment of European cities. *The Lancet*, 401(10376), 577 – 589.

²Melanidis, S., & Hagerman, S. (2022). Competing narratives of nature-based solutions: Leveraging the power of nature or dangerous distraction? *Environmental Science & Policy*, 127, 44–53.

Revise Formal Public Participation in Planning and Environmental Assessment – Mandate systematic and proactive stakeholder and community involvement from the earliest stages of planning and project design through collaborative processes. To ensure quality, planning teams should include specialists in participatory process design and facilitation.

Review Institutional Structures to Strengthen Interdepartmental Coordination – Promote governance within public institutions. Enhanced coordination supports coherent decision-making and reinforces institutional capacity for collaborative planning.

International and national good practices confirm that real progress on integration of NBS occurs when there is a coherent mix of regulatory, incentive-based, and informational instruments, combined with collaborative governance.

For further details please refer to the [full report](#).

- **More applied research** on urban ecosystems and their services to take decisions based on scientific knowledge.

- **More real-time data collection** and investment in sharing platforms, ensuring transparency and access to data.

- **More experimentation** across ecological and urban typologies to support context-specific decisions.

- **More capacity building of all stakeholders** as basis for more engaged collaboration.

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³McElwee, D., et al. (2024). *Summary for Policymakers of the Thematic Assessment Report on the Interlinkages among Biodiversity, Water, Food and Health of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. IPBES.



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