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Partners involved	LP1 MČelje (Petek T., Tamše T.), PP2 IPOP (Simoneti M., Didovič U.), PP3 MoI, PP4 Parkovi d.o.o., PP5 COM, PP6 Gjorce Petrov, PP7 Budva, PP8 AMBIT (Sejdullahu I.), PP10 UNIZG FFWT (Paulić V.), Bistra Ptuj (Čeh D.)

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Abbreviations

NBS/NbS Nature-based Solutions

SMSCTS Small and medium-sized cities and towns

ES Ecosystem services

NEB New European Bauhaus



Introduction and objectives

The report collected the baseline information on related research, EU projects and definitions of key terms. Transversally, training and co-design sessions were held with the cities represented in the partnership. We aimed to establish a common understanding and shared knowledge, integrating the cities context and their specific needs, to enable the cities officials to develop and implement the Urban Nature Plans (UNPs). This process lied on the understanding of (i) the main categories of urban and peri-urban green infrastructure, (ii) terminology and the key elements of NBS, (iii) strategic steps to improve green planning, (iv) best practices, helping partner cities to better address their planning context.

As such, this report identified and integrated the terms and experiences of relevant research studies, EU projects, strategies, to mainstream the inclusive planning and management of different types and categories of NBS/GI that are applicable in the urban context, as well as an introduction to the criteria that need to be considered when planning such interventions in urban areas (small and medium cities specifically). Transversally, knowledge providers have been organizing co-design workshops and training, to support territorial partners to deliver the city's case studies and boost a first capacity building approach.



1. Concepts and key terminology

The structure of this chapter is based on the integration of main keywords and demands in UrbanGreenLeap. The following table presents a summary of the keywords and represents the base for developing literacy and explaining the key terminology, adapted to the Demonstration projects (Table 1).

Table 1. Main keywords addressed by UrbanGreenLeap and Demonstration Projects

Theme	Primary Keywords	Supporting Keywords addressed by the Demonstration Projects
Urban Biodiversity	urban biodiversity enhancement	habitat creation, native species, pollinator support, ecological corridors, forgotten spaces *
Green Infrastructure	Operationalizing ecosystem services	green corridors, nature-based solutions indicators, ecosystem services, urban oases
Climate Mitigation	urban climate resilience	heat island mitigation, rainwater management, microclimate, de-paving initiatives
Flood Prevention	urban flood mitigation	stormwater retention, green water infrastructure, regrading, runoff control
Soil Health	urban soil regeneration	healthy soils, soil biodiversity, organic matter, soil compaction
Public Health & Well-being	green space and health	air quality improvement, nature-based solutions, urban mental health, active lifestyles
Social Impact	inclusive green spaces	participatory design, urban agriculture, social cohesion, eco-tourism
Scalability	replicable urban model	green pilot project, scalable solutions, regional replication, urban planning toolkit
Community Engagement	citizen-led greening	participatory planning, co-design, local stewardship, community nature initiatives, human-nature reconnection
Sustainability & Innovation	sustainable urban transformation	eco-innovation, low-carbon cities, smart greening, circular urban ecology

Knowledge providers to increase NBS and UNP literacy, contextual training based on case studies challenges and TNA, indicators, best practice catalogue



Biodiversity means the variety within and between organisms of an ecological system. There are 3 fundamental levels of biodiversity: genetic, species and ecosystem biodiversity. Some projects mention a 4th level, the cultural biodiversity. Biodiversity is a key element, the basis of ecosystem processes, functions and services.

Urban biodiversity refers to the variety and variability of living organisms found in urban environments, including their habitats, and the ecological interactions among them within cities. Urban biodiversity is a subcomponent of broader biodiversity, focused specifically on the human-dominated landscapes of cities and metropolitan regions.

Studies on urban biodiversity can include, for example, data on presence/absence, richness or abundance of plants (cultivated, planted and spontaneous), animals, fungi, and microorganisms in parks, gardens, rooftops, streets ... and even abandoned lots; and should consider both native and non-native species. Along with the specific field sampling designed for urban flora and fauna, citizen science projects have been an important tool, providing data on urban biodiversity and biodiversity monitoring in various cities (<https://ubms.creaf.cat/en/>, <https://www.3bee.com/it/biodiversa-app/>, <https://www.inaturalist.org/>). Public geo data based on species inventories in cities can also help mainstreaming urban green planning and management.

Local vs broad scale, urban vs peri-urban - landscape factors (such as landscape context, landscape configuration, dynamics and history) are also important determinants of the urban biodiversity. Some typologies of novel urban ecosystems can support substantial numbers of native and endangered species although a considerable number of species remain confined to natural remnants (habitats). Therefore, a major recommendation provided by research findings emphasizes the need to preserve natural remnants from urbanization impacts (Kowarik and von der Lippe 2018). Studies showed that urbanization is able to globally decrease plant diversity by fostering common species with “urban-adapted” trait states, by limiting rare species with traits less suitable for urban environments, and by decreasing phylogenetic diversity. Research also provided evidence that seminatural areas within cities, e.g. protected areas, parks, and even gardens, can protect species with traits less suitable for the typical urban built-up environment. Therefore, a mix of semi-natural habitats and typical urban-industrial habitats within a city (if the latter are allowed for spontaneous vegetation) should permit both semi-natural and typical urban floristic elements and thus enable functional and phylogenetic diversification.



Biodiversity Enhancement turns underused or forgotten spaces into mini-ecosystems that support plants, animals, and soil organisms. Healthy soil can be a key focus to support plant growth and ecosystem services (See, for example, a recent Biodiversa NBS + project in urban gardens, GREENHANCEnbt).

<https://www.slu.se/en/research/research-catalogue/projekt/g/greenhancenbt/>).

Urban Ecology studies can relate to *urban biodiversity*, including the diversity of species, traits, and phylogeny; analysis of the effects of land use and human actions on urban species traits; or linking plant diversity and ecosystem services in urban areas.

EU Biodiversity Strategy for 2030, a key policy for biodiversity Promotes increasing *urban biodiversity* by:

- Creating **Urban Greening Plans**
- Restoring **urban green areas**
- Reducing use of pesticides and invasive species
- Promoting **native species** and pollinators in cities

https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en

Ecosystem services (ES) represent the direct and indirect contribution of ecosystems to human well-being. In the Millennium Ecosystem Assessment (MEA, 2005), four major categories of ecosystem services were identified: Support, Supply, Regulation and Cultural.

- **Supporting ES**: MEA (2005) includes here the biodiversity, habitats and natural processes of the ecosystem. According to various recent studies, we suggest to consider separately the biodiversity and functions of the ecosystem and do not include them as “support services”.
- **Provision services**: refer to the products we obtain from the ecosystem. They are services that the markets benefit from in the form of raw materials and in rural areas they can be the main livelihood of their inhabitants. They include water, food (food supply), wood (forest biomass), medicines (medical plants) etc.



- **Regulatory services:** services that contribute to the regulation of ecosystem processes, such as climate, air quality, erosion control or pollination.
- Climate regulation: Carbon is a key element of the cycle of matter in ecosystems and, at the same time, intervenes in the climate regulation of the planet due to its involvement in the greenhouse effect. Carbon sequestration is a key factor to consider in climate change mitigation strategies. The global climate regulation service is produced mostly in forest ecosystems, although agricultural ecosystems, mainly woody crops can also accumulate significant amounts of carbon and therefore also contribute to global climate regulation (and climate change mitigation). Even urban ecosystems (parks, gardens, road trees, etc.) provide this service even in a moderate way.
- Improvement of air quality: Trees play an important role in the filtration of suspended particles, chemical compounds and gases present in the atmosphere that are harmful to human health (such as suspended particles or nitrogen dioxide). It is a service that can be relevant in urban or metropolitan areas, since these usually have high levels of air pollution, and in many cases exceed the limits established by the European Union. Foliar biomass plays an important role in the filtration of pollutants.
- Regulation of erosion: the ability of ecosystems (mainly woody vegetation) to retain soil and prevent its gradual or sudden erosion (land detachments).
- Pollination: Pollen transfer from stamens to pistils. Birds, insects and wind favour pollination and seed dispersal. It is very important for the dynamics of plant populations (angiosperms) and the incorporation of matter and energy into ecosystems (production of fruits and seeds).
- **Cultural services.** These services are intangible. Some services are related to leisure, aesthetic appreciation of the landscape or other more general cultural aspects, such as the sense of belonging or spiritual experiences.
- Outdoor education: positively affects cognitive development and health, facilitating the learning of nature and the environment.
- Recreational opportunities: any physical activity that provides exercise and relaxation (walks, hiking, sport, etc.) The green spaces of the city encourage physical activity, improving physical and mental health. They are essential for the mental and cognitive health of children's development.
- Aesthetic appreciation, spiritual experiences: landscapes that help to recover cultural memory.



Ecosystem functions should not be confounded with ecosystem services. These are the result of natural processes or characteristic exchanges of matter and energy that take place at various levels within ecosystems (such as *evapotranspiration* or *ecological connectivity*).

Green Infrastructure Planning

Green infrastructure represents a planned network of natural and semi-natural green spaces, designed and managed to promote a wide provision of ecosystem services. The physical components of Green Infrastructure can range from very small local elements such as urban gardens and green roofs to cross-border elements such as mountain ranges or river basins. The definition most frequently quoted is given by Benedict and McMahon (2012), whereby green infrastructure is understood as “an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations”.

The development of the networks of green spaces is sustained by **UGI planning principles**, which have the potential to combine ecological and social perspectives. The key conceptual framework was detailed by Hansen and Pauleit (2014) and Pauleit et al. (2019) and include:

- Integration – combining green with grey infrastructures such as built-up structures, transport infrastructures and water management systems that are more efficient, multifunctional and resilient. Connectivity – creating green space networks in order to enhance social connectivity (for better accessibility, recreation), ecological connectivity (dispersal of plants and animal) or abiotic connectivity (regulating water flow or climate functions).
- Multifunctionality – delivering multiple ecosystem services and functions by their explicit consideration in UGI planning to create synergies while reducing conflicts and tradeoffs between different green space functions. Multifunctional mapping of green spaces or multifunctional landscape assessment tools have been largely used to advance on green infrastructure planning at broader scales (Basnou et al. 2020).
- Social inclusion – collaborative and participatory planning to discover and balance the interests of different stakeholders in order to reach a higher level of accessibility to green space services and benefits, with a special emphasis on vulnerable social groups. In this regard, knowing the **Social Landscape** is fundamental. It reflects how people organize themselves on the land. Understanding the social landscape is essential in creating a larger social movement and bringing about the large-scale change needed to achieve a restoration movement. By emphasizing early understanding of the social landscape and measuring progress, restoration practitioners can be more efficient with resources, improve collaboration and outreach, and anticipate



conflicts and bottlenecks. Mapping connectivity or mapping communities' priorities and values are two important methodologies in Social Landscapes research. Related terminologies in social inclusion approach comprise *Inclusive Urban Planning*, *Child-friendly planning* or *Environmental justice* and are closely linked with the concept of *Accessible green spaces*.

Of fundamental importance, this terminology sets the basis for more recent concepts, such as **Nature-based solutions**. This concept, described in more detail later, allows a better adaptation and implementation of planning principles of green infrastructure at more local scales (urban and peri-urban planning) in the context of global change and novel urban realities.

Strategic planning process. Planning processes based on long-term spatial visions supplemented by actions and means for implementation but that remain flexible over time. The strategic planning processes are usually led by the public sector, but that does not mean that non-state actors are excluded.

Governance. The process by which plans are implemented is linked to governance, since plan implementation involves many actors across all sectors including for example, NGOs, community groups and many departments of municipalities. Governance can be broadly defined as any effort to coordinate human action towards goals. *Actors* are a key part of the policy arrangement and can be affected by decisions and have the means and power to influence decisions. For more recent information on governance frameworks in relation to NBS in Europe, see Roitsch et al. 2021 and Hansen et al. 2023.

Participatory approach. *Participatory* approaches strive to acknowledge diverse perspectives, ensuring a sense of belonging, social cohesion, and well-being for all. Spaces designed for all and by all, that are accessible and affordable, from valuing diversity to securing accessibility and affordability. A well-designed participatory strategy, has a huge potential to deliver long-term social impact.

Participatory approaches are part of cities transformation and should be carefully adapted to context and scale. Dumitru and Wendling (2021) developed a broad framework for successful participatory approaches, embedded in the “theory of change”, showing the following 6 key steps to mainstream the process:

- STEP 1: Constructing a theory of change. The development of a theory of change enables planners and decision-makers to establish a clear



relationship between key local context challenges, strategic objectives and the actions through which these will be reached, and fosters clear identification and reflection on the linkages, or pathways, between them. The following stages can be identified when developing a theory of change: a) Engage in structured reflection on key local context challenges and NBS objectives; b) Involve the appropriate stakeholders and foster a sense of belonging to the process.

- STEP 2: Developing a results chain to outline the theory of change.
- STEP 3: Specifying the evaluation question(s).
- STEP 4: Selecting appropriate and meaningful indicators and data gathering methods - assessment of performance and process.
 - a) Select appropriate indicators
 - b) Choose an appropriate impact evaluation method
 - c) Identify and collect the data needed to assess selected indicators
 - d) Developing a local monitoring and data collection plan
- STEP 5: Implementing the impact monitoring and evaluation plan.
- STEP 6: Disseminating results for all and achieving policy, scientific and society impact.

Storytelling. Storytelling drives system change and encourages novel perspectives. Storytelling has different forms, using arts, games, podcasts etc in oral, written, visual or digital formats. It is a powerful tool of community engagement, and it is based on clear goals and a previous strong documentation (i.e. stakeholders mapping, understanding the challenges, the background and the needs). It is not only about telling your story, it is also about listening to people's stories. A wonderful example of storytelling represents the [3+30+300 rule](#), already being used by hundreds of municipalities across the world. A handbook and practical information on how to apply the rule are available [here](#).

Storytelling is a key resource to projects acceptance by the stakeholders (including citizens), impacts on shifting behaviour to more sustainable mode in demonstration actions, fosters knowledge, exchange and capacity building. A



convincing storytelling needs also clear steps to enhance the impact of your research, plan or policy. [Impact Narrative Tools](https://impactnarrative.nl/en/impact-narrative-tool/) help to potentiate the contribution of research to social change (<https://impactnarrative.nl/en/impact-narrative-tool/>).

Clear goals, knowing your target audiences, the forms (i.e. clear and attractive visuals) and channels needed, help boosting your message. Arts (for example, photographic exhibitions, art contests, urban sketchers meetings) can provide attractive and innovative tools to boost storytelling, community engagement and transformation.

Transformative urban green strategies. The notion of ‘urban transformation’ has been gaining ground in science and policy debates. Urban transformations to sustainability and resilience are defined in the 2030 United Nations Sustainable Development Goals (SDGs). A rich research field around questions of urban transformations has started to emerge, combining multiple scientific disciplines, ontologies and methods (Elmqvist et al. 2019). Key to these debates is the aim to put cities on a central stage for accelerating change towards local and global sustainability and resilience. In addition, there is a strong connection between “*transformation*” and “*impact*”. Apart of the environmental and social impact, there are other forms of impacts: cultural, economic, health and well-being, legal or policy impact.



2. Nature-based Solutions

2.1. Terminology and key planning aspects

Nature-based solutions (NBS) are defined as solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions” (European Commission, 2021; Faivre et al., 2017).

In the past years, the EC has made recommendations to help increase the use of NBS and bring nature back into cities, including a call to action to ‘rewild’ cities (Rewilding Europe, 2020). It also developed a Research & Innovation (R&I) agenda that promotes NBS and their benefits to cities and territories, aiming at improving the implementation capacity and evidence base for deploying NBS and developing corresponding future markets. These recommendations are also expected to foster an interdisciplinary R&I and stakeholder community and the exchange of good practices in this field (Faivre et al., 2017).

Inherent in this definition is the idea that NBS must benefit biodiversity and support the delivery of a range of ecosystem services. Actions that support biodiversity underpin societal benefits in two ways: they boost the delivery of many ecosystem services in the short term, and they support the health and resilience of ecosystems in the long term, that is, their ability to resist or quickly recover from perturbations.

Recently, various scientific findings acknowledged that NbS should be explicitly designed to provide measurable benefits for biodiversity (Seddon et al. 2021). Similarly, the International Union for Conservation of Nature (IUCN) enforces the inclusion of biodiversity and defines NBS as “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”.

Therefore, for interventions to be considered Nature-Based Solutions, they must deliver benefits for nature through enhancing ecosystem integrity and strengthening biodiversity. Assessing the biodiversity outcome of NBS interventions requires data collection for baseline assessment and monitoring. This aspect is the focus of Criterion 3 of the [IUCN Global Standard](#) for NBS.

Recently, important frameworks have been set up to design cross-scale inclusion of harmonised biodiversity monitoring protocols (del Pozo et al. 2025). To translate these principles into action, Biodiversa+ proposes the creation of *Thematic Hubs*: expert-driven, cross-scale platforms that coordinate the work of monitoring communities within specific biodiversity domains.



NBS can also build the adaptive capacity of local communities to future stressors through *participatory* design, implementation and management of NBS. Giving local people leadership roles and supporting them to govern their own resources can strengthen their ability to address future climate hazards. Therefore, the strength of the concept of Nature-Based Solutions is its integrated perspective for addressing societal challenges. Actually, nature-Based Solutions operationalize the concept of ecosystem services in real-world situations to promote sustainability more explicitly.

Recently, there is a *broad terminology derived or integrating the Nature-Based Solutions* concept:

- **Nature-Based Solutions literacy** - knowledge related to context NBS, including misconceptions, confusions or lack of mainstreaming of biodiversity, environmental, social and economic benefits. Based on building meaningful data to set up informational landscapes and community's access to various layers of knowledge (including the lack of knowledge) across a territory. A landscape with information is more than just naming the data: it's about understanding other key ecological details, connections and concepts that can help framing and implementing a realistic vision for territorial planning and decision-making (Basnou et al. 2025).
- **Nature-Based Thinking** - a holistic concept, approaching urban inclusive planning. It builds on the three dimensions of ecology, community aspects, and governance context (Randrup et al. 2000).
- **Nature-based therapy** - therapeutic intervention directed by a trained facilitator in an indoor or an outdoor setting that includes exposure to and interaction with nature to enhance individuals' physical and mental health and well-being. More information and related terminology in GreenME EU project (<https://greenme-project.eu/glossary/>)
- **Planetary health** - includes a holistic concept on health (<https://www.uu.nl/en/background/planetary-health-a-holistic-perspective-on-health>)



2.2. Examples of NBS, criteria and opportunities

Urban forests: tree-based urban ecosystems that address societal challenges, simultaneously providing ecosystem services for human well-being and biodiversity benefits. Urban forests include peri-urban and urban forests, forested parks, small woods in urban areas, and trees in public and private spaces. (Escobedo et al., 2011; FAO, 2017)

Urban forests can be defined as “all forest stands and other tree dominated vegetation in and near urban areas” (Konijnendijk and Randrup, 2005), including the sum of all woody and associated vegetation. A simplified classification by the Food and Agriculture Organization of the United Nations (FAO) lists the following five types of urban forests: peri-urban forests, city parks and urban forests (> 0.5 ha), pocket parks and gardens with trees (< 0.5 ha), trees on streets and public squares, and other GS –such as botanical gardens, urban agricultural plots or river banks (Salbitano et al., 2016).

Urban forests as nature-based solutions (UF-NBS): a subset of nature-based solutions, that build on tree-based urban ecosystems to address societal challenges, simultaneously providing ecosystem services for human well-being and biodiversity benefits. UF-NBS include peri-urban and urban forests, forested parks, small woods in urban areas, and trees in public and private spaces. UF-NBS comprise every measure a city can take to address urban development challenges by deploying tree-based ecosystems. They are socio-ecological interventions that combine human management with nature’s functionality within (peri) urban settings, offering great potential for more sustainable urban development (De Vreese, 2018).

Other examples of NBS related to specific green infrastructure typologies or multidisciplinary approaches can be found below:

- Urban gardens – Urban Agriculture Observatory in Barcelona ([Urban Agriculture Observatory | Espais Verds | Ajuntament de Barcelona](#))
- Urban meadows - <https://urbanmeadows.co.uk/>
- Tiny forests - <https://earthwatch.org.uk/program/tiny-forest/>
- Therapeutic gardens and nature-based therapies – <https://www.bcnuej.org/projects/greenme/>

In the following paragraphs, we address some innovative examples and guidance to mainstream NBS typologies in cities (adapted from Pino et al. 2022):

- **Novel forest ecosystems.** There are excellent opportunities for creating new urban forests in unexpected for protecting emerging urban forests, or for planting forests in degraded areas to restore them. Moreover, the COVID-19 pandemic has shown how ‘wild’ UF, as a supplement to more managed UF, can have socioecological and health benefits. Urban planning experts with a



deeper understanding of urban forests as socioecological systems and of urban ecological novelties are needed for addressing this paradigm shift.

- **Connecting urban and peri-urban green.** Urban forests exhibit a set of ecological particularities that make them different from other forests and vegetation in a given region. Urban woodlands are commonly made up by simplified biotic communities, with a more homogeneous composition and with a larger proportion of generalists and even alien species. On the other hand, urban forests can be very diverse, including a large number of non-native species. Promoting connectivity and species exchange between more natural urban woodlands –such as on the urban fringe– and the rest of the regional GI is an opportunity for ensuring ecological fluxes at regional scale. However, at the same time, there is the challenge of avoiding or at least managing the disservices associated with the spread of these urbanlike species. Specific training of urban foresters and the involvement of urban ecologists is needed to address these opportunities and challenges.
- **‘Trees first’ thinking:** Currently, trees are not often prioritised in urban planning and (re)development process. However, urban forests provide an important and critical infrastructure in cities, and they are not easily dispensable. Therefore, urban design, planning, and building practices need to include trees and their requirements, ensuring sufficient growing space, protective measures, and management.
- **Species selection:** Proposals to integrate native and climate-change resistant, non-invasive, alien species are needed to adapt the UGI to ever-frequent extreme weather events.
- **Opportunities for the environmental justice:** Evenly distributing GI should be a primary goal of new urban forestry projects. Areas with low urban forest cover and areas where vulnerable populations live should be a priority. Urban vegetation should not be a luxury, but provide ES available to all, especially to vulnerable groups, such as children and socially marginalised people. Moreover, it should especially not lead to social segregation and, thus, exclusion –such as green gentrification and displacement.
- **Opportunities in governance** (*Mosaic governance*). Urban green spaces are an opportunity for increasing contact with nature, and to build ‘nature labs’ aimed at exploring new perspectives of management and use, in accordance with the stakeholders’ opinion. New forms of governance and participation can be essayed in the framework of urban forests to bring more (younger) voices to the halls of power, and policy-makers and decision-takers to the social and environmental realities to tackle urban tensions and contradictions. Experts can lead this shift in governance models promoting higher engagement of public officers from different city council



departments, civil society, businesses, and organisations in urban planning, design, implementation and management of natural resources.

- **Opportunities for education.** Nature-based learning (NBL): Although further frameworks to understand and implement NBL are needed, it is clear that trees and forests should be part of teaching. On the other hand, urban forests and urban greening provide excellent opportunities to reconnect with nature and for outdoor learning, especially important also during the post-COVID-19 era. One of the outcomes of this approach is how NBL can contribute to stewardship values or conservation behaviours, or what are the key elements of nature experiences that affect children. One of the issues in environmental psychology relates affordances with urban children's relationships with trees as elements of the landscape that invite to actions, i.e., playing. Recent EU projects of increasing interest in urban areas have already tackled NBL by developing innovative educational packages, with guidelines for both students and teachers –e.g., “City of trees” (<https://www.clearinghouseproject.eu/>).



2.3. Resources on NBS projects, networks and platforms

Till 2022, more than twenty H2020 projects and programmes directly addressing the area of NBS and closely related themes: BiodivERsA, CLEARING HOUSE, CLEVER Cities, CONNECTING Nature, EdiCitNet, EKLIPSE, GREEN SURGE, GROW GREEN, Inspiration, MAES/EnRoute, NAIAD, Nature4Cities, Naturvation, NetworkNature, OpenNESS, OPERAs, OPERANDUM, PHUSICOS, proGReg, RECONNECT, REGREEN, Think Nature, TURaS, UNaLab, URBAN GreenUP, and URBiNAT.

Various web portals, networks, platforms and initiatives have been developed to address NBS at European, national and sub-national levels. A non-exhaustive list of networks, platforms and initiatives includes OPPLA, NetworkNature, BiodivERsA, Biodiversity Information System for Europe (BISE), ThinkNature, the European Climate Adaptation Platform Climate-ADAPT, Natural Water Retention Measures NWRM platform (for some examples and links, see **Table 2**). A new cluster of NBS projects has been created recently, to promote a strategic approach to mainstreaming NBS, as part of the broader European Mission on Adaptation to Climate Change. (<https://www.natalieproject.eu/node/771>).

Table 2. A brief repository of knowledge providers: networks and EU projects

Network, initiative or EU project	Reference
OPPLA	https://oppla.eu/
Network Nature	https://networknature.eu/networknature/nature-based-solutions
Uforest (Erasmus+)	https://www.uforest.eu/case-studies/
Database of EU projects on NBS	https://knowledge.networknature.eu/ridb
Urban Nature Plans – Capacity Building	https://urbanbynature.eu/urban-nature-plans
Urban Nature Plans +	https://urbannatureplans.eu/



2.4. NBS in the EU policy context

In the EU Policy context, NBS present a credible means to address key societal issues, such as climate change, disaster risk, and biodiversity loss (SEP, 2021). A multitude of scientific studies have demonstrated that NBS can contribute to substantial improvements in air quality, microclimate conditions, and the health and well-being of citizens.

The European Commission is actively engaged in investing in Nature-Based Solutions, and using them as a driver for a wide deployment of ecosystem-based approaches in Europe and worldwide.

As such, NBS are highlighted in the European Green Deal and recent key European policy initiatives, such as the EU Biodiversity Strategy for 2030 (EC, 2020) and the new EU Strategy on Adaptation to Climate Change (EC, 2021). In particular, the EU Biodiversity Strategy for 2030 highlights the value and importance of NBS in fighting biodiversity loss, climate change and other critical challenges, and promises funding for investment in NBS. NBS are also likely to play a key role in the new EU Forest Strategy, and the EU Soil Strategy and European Zero Pollution Action Plan for air, water and soil. The New Urban Agenda also makes specific reference to nature-based innovation for urban and territorial planning (Article 157).



3. European plans, guidelines and policies

The [European Green Deal](#) aims at building an Europe climate-neutral by 2050. This policy will be supported by various actions, who will also contribute to the [UN Agenda 2030](#), the [Urban Agenda for the EU](#), the [New Leipzig Charter](#), the [Fit for 55 strategy](#), the [EU Industrial Strategy](#), the [Green Deal Industrial Plan](#) and the [Net-Zero Industry Act](#), the [EU Zero Pollution Action Plan](#), the [Circular Economy Action Plan](#), the [Smart and Sustainable Mobility Strategy](#) and the related new EU urban mobility framework, the [Biodiversity Strategy for 2030](#), [Europe's Digital Decade](#) and the [EU Strategy on adaptation to climate change](#).

EU Biodiversity Strategy for 2030

This strategy outlines the EU's commitment to halting biodiversity loss and restoring ecosystems. It emphasizes the importance of integrating nature into urban planning, including the development of **Urban Greening Plans** for cities with populations over 20,000. These plans aim to create biodiverse and accessible urban spaces such as forests, parks, gardens, green roofs, and tree-lined streets. The strategy also promotes the elimination of pesticide use and the reduction of biodiversity-harmful practices in urban areas.

Nature Restoration Law

Adopted in 2024, this law sets binding targets for the restoration of ecosystems across the EU. Specifically, it includes provisions for urban ecosystems, aiming for:

No net loss of urban green space and tree canopy cover by 2030, relative to 2021 levels.

An increase in urban green space by **at least 3% by 2040** and **5% by 2050**.

Achieving a **minimum of 10% tree canopy cover by 2050** in all cities, towns, and suburbs.

Ecosystem restoration is defined as a process of reversing the degradation of ecosystems, such as landscapes, lakes and oceans to regain their ecological functionality; in other words, to improve the productivity and capacity of ecosystems to meet the needs of society. This can be done by allowing the natural regeneration of overexploited ecosystems, for example, or by planting trees and other plants.

Ecosystem restoration encompasses a wide continuum of practices, depending on local conditions and societal choices. Depending on objectives, restored ecosystems can be achieved by assisting natural regeneration, restoring urban and



farmland areas, and shifting modified ecosystems to more natural ones. More resources can be found within [NetworkNature](#) and the [Ecosystem Restoration playbook](#), released by FAO.

Urban Nature Plan (UNP) functions as a framework, a plan and a process, encompassing adaptive management, planning, and concrete actions to increase nature in cities. The EU Biodiversity Strategy 2030 mandates that European towns and cities with populations over 20,000 create an Urban Nature Plan (European Commission, 2024). This also works in tandem with, and supports, the recently adopted European Nature Restoration Regulation (NRR), which sets binding targets to restore 20% of the EU's degraded ecosystems by 2030 and 100% by 2050; in the urban realm, the NRR, aims to halt the net loss of urban green space and the urban tree cover until 2030, followed by an increase of both from 2030 on (European Commission, 2024). The NRR requires Member States to develop National Nature Restoration Plans, including an approach to comply with the urban targets in the NRR. A key to UNPs is the collaborative process of developing them, including the need for working with citizens and other stakeholders, and for cross-departmental working and integration of the UNPs with other aspects of urban development, from mobility and health, air and water, to energy and climate adaptation. This requires tailoring communication about urban nature to a variety of audiences, and ultimately transforming urban spaces into biodiverse, healthier, and more resilient areas.

Recent guidelines and briefings on UNP can be accessed at <https://urbanbynature.eu/resources/urban-nature-plans-short-brief-why-are-urban-nature-plans-important>.

New European Bauhaus (NEB) The NEB initiative was introduced in 2020, in conjunction with the European Green Deal and the goal of making Europe the first climate-neutral continent by 2050. In 2021, the Commission published the Communication presenting the concept of the NEB, and began promoting its values through several calls for proposals.



Ancillary material to align concepts, boost urban green planning and NBS literacy

Despite a rapidly growing evidence base (Chausson et al. 2020) demonstrates that well-designed NBS can deliver multiple benefits (Seddon et al. 2020), **NBS implementation** can be challenging and various potential pitfalls of NBS and Urban Green Planning can appear:

- Poor or sparse data on local biodiversity
- Over-emphasis on tree planting rather than a wide range of NBS (i.e. prioritizing quantity over quality)
- Maintenance of green spaces
- Failure to ensure benefits for biodiversity
- Insufficient knowledge on species traits, air pollution consequences at various scales or flood risk mitigation
- Not involving local people in urban nature monitoring, planning or decision-making process
- Lack of skills
- No system in place for financing and maintaining NBS (long-term view)
- Nature policies are not linked to a department

In order to begin understanding the planning context and the existing knowledge, but also to boost future training and capacity building in WP1, several co-design sessions were held with the cities. The Dynamics of the co-design session is presented in **Box 1**.



Box 1. Co-design framework to align concepts and advance towards a common understanding across UrbanGreenLeap cities

Co-designing urban green with the cities

Milano, September 2025

Led by **CREAF**, co-designed with **Knowledge providers**

Goals

- Facilitate collaborative thinking and aligning concepts around how different urban vegetation typologies perform under different scenarios.
- Identify strengths (roses), emerging opportunities (buds) and limitations (thorns)

Materials

- Sticky notes for vegetation typologies
- Scenario boards (heat wave, drought, flood, air pollution etc.) *
- Vegetation types board **
- Blank layout

Session Overview

Duration: 60-90 min

Step-by-step agenda

- **Step 1.** Set the Stage (5 min)

Welcome and explain the purpose of the session

Introduce the scenario themes

- **Step 2.** Breakout Exploration by Scenario (20 min)

Split into small groups, each working with one environment scenario

Provide 2-3 vegetation types

One large RTB canvas per scenario/group

Encourage discussion on biodiversity, ecological function, maintenance, social perception etc.

- **Step 3.** Gallery walk or Share-Out (30 min)

Each group presents the key insights from their scenarios



Other participants add ideas with sticky notes

Which vegetation typologies performed well across different scenarios

Main take away around:

- What's working well
- What has potential/innovative
- Challenges (cities context)

***UrbanGreenLeap – Scenario boards**

Scenario 1: Urban Heat Island and Heatwave

- Your city experiments 10 days of > 35° C temperatures
- There is a high citizens discomfort, especially among the most vulnerable population and energy use speaks
- High mortality among recent tree plantings

Scenario 2: Flooding

- 2 hours of intense rain overwhelm sewers and streets
- The river is flooding the nearby buildings
- Water is contaminated

Scenario 3: Air Pollution Spike

- During a restauration action, soil from a playground and urban garden was found contaminated with heavy metals, as a consequence of past land-use
- As a consequence of quick urban sprawl, the city needs more space for crops and 0 km food

Scenario 4: Drought with water restrictions

- As a consequence of 4 weeks without rain, city restricts irrigation for all types of green infrastructure
- Plants begin wilting and dying



****UrbanGreenLeap – vegetation types board**

Agricultural land	Shrubs
Butterfly gardens	Single trees
Floodplains	Therapeutic gardens
Flower beds	Trees with green pits
Forests	Trees with large canopies
Grasslands	Urban gardens
Green roofs	Urban meadows
Green schoolyards	Urban parks
Green walls	Wetlands
Rain gardens	Other
Scented gardens	



4. Participatory approach to planning and management of Nature-based Solutions

The interest in public participation in the planning and management of urban green spaces has been increasing recently for various reasons. The key drivers behind this trend include: the shift in public governance towards reducing public budgets and engaging the citizens and new stakeholders to enhance efficiency (new public governance); the necessity for local policies to boost public trust and acceptance of policy measures; and the growing interest of citizens in urban nature and public spaces, along with their active involvement in the design and maintenance of these areas.

Climate change boosted the mutual interest of public government and its services and the citizens for collaboration. The knowing fact that the nature, plants and their ecosystems, are endangered by climate change raised awareness of its importance for the future quality and safety of life in urban environment and triggered ambitious EU research already at the beginning of new millennium mainly calling for more comprehensive and integrative planning and management of urban green space (URGE, 2004; Green Keys, 2006; Green SURGE 2017). The main point has become **to empower early and sufficient enough collaboration of local actors to protect and engage the potential of local ecosystems in favour of urban nature protection, meeting social needs of local community and ensuring adaptation to climate change**. In this perspective local authorities are getting more **interested to protect and activate the potential all of their green space as well as urban trees** and to thereby **involve local community into new, long-term planning and management strategies and collaborative practice of maintenance**. Doing so, besides public land and public services also private land, land owners and citizens are becoming part of public policy and practice of planning and management of urban green space and trees.

In this framework public participation as an approach to including the residents and local communities into the processes of designing, constructing and maintenance of urban green space and an important part of the instalment of Nature-Based Solutions (NBS). The increasing need for citizen participation in different phases of planning and maintenance of NBS interventions is closely related to climate change and its effects on urban environment and people's expectations of the decision-makers to act in this regard. Participatory approach is also important for ensuring efficient operation of NBS so involvement of local residents and general public as well as of other relevant actors in the process of planning and constructing NBSs is necessary. This means that it is crucial for the municipality and actors responsible for the instalment of NBS **to involve local community and identify the key stakeholders on time and carefully plan out the participation process and methods**.

Speaking about the planning of participation it is very important to be clear about the **intentions and goals** behind because they will lead the design and organisation of the participation process and activities. The ambitions of participation define **how time, people and money consuming the participatory**



process will be. The reasons for public participation are usually diverse, they depend on local circumstances and needs. As mentioned, they range from legal requirements to more practical ideas of building trust between local authority and civil society or strengthening competencies for maintenance and improving the quality of life and social cohesion. We must not overlook the fact that the level of public participation also depends on the historical, geographical and social factors.

In many cities, top-down governance frameworks dominate, often reducing participation to consultation or symbolic engagement. Top-down governance approaches however fall short on reaching long-term sustainability goals and deepen the lack of trust among its citizens (Kiss et al. 2020). Citizen participation is thereof crucial for meeting the aspect of longevity and socio-ecological sustainability.

In the UrbanGreenLeap project, *citizen- or public participation* refers to individuals or local community representatives involved in the planning, design, implementation and maintenance of NBS projects or policies. NBS being rather new type of urban green space design is a novelty in practice of planning and management as well and thereby needs to be meaningfully introduces to professional and general public. While **the interest in participation is evidentially mutual** to both parties it is only to be decided and case by case tailored **how deep and lasting the participation process and activities are going to be.**

The growing interest for public participation in green space design, planning, management and maintenance is emerging as result of two trends:

- **New public management and governance**, leading to a new approach to public administration, which aims to reduce its scope and finances by involving new actors and resources in the provision of public services. This forces public park services to seek new financial options and including citizens in the maintenance of NBS in order to survive in the market (Lindholdst, 2009). This is especially true for small and medium sized cities.
- **People's interest in nature**, living in contact with it and working in it – eg. gardening.

International policies and changes in public administration have encouraged public participation across multiple phases of green space development. Because participation is not only targeting inclusion of general public, but involves also other cooperation of other relevant stakeholders, we must give it enough time and opportunity to start as soon as possible in a process and goes as deep as possible and have in mind that every next call for or opportunity for public participation will be easier and it will pay back the efforts and attention we are investing at very beginning of opening to it.

The advantages of public participation

There are several advantages to public participation in NBS development phases, which should be critically taken into consideration:



- **solutions better tailored** to the needs of public by **acknowledging diverse needs, perspectives, views and opinions**,
- **improved information base and quality** of solutions,
- **better public understanding and acceptance** of new solutions and
- **raising sense of identification with new solutions and willingness to involve** in care taking and maintenance.

If participation process is properly planned and executed, it can strengthen the **sense of belonging**, enhance **social cohesion, equity and inclusion**, deepen **trust** in the local government and **encourage stewardship**. It is important, however, to critically consider the potential, plan the participation process carefully, work with the public to develop solutions that are acceptable for both sides throughout the processes.

The participation can also provide expected **social outcomes** beyond inclusivity, such as:

- knowledge development,
- awareness raising,
- social learning,
- employment,
- decision-making reflexivity,
- changes in attitudes and/or social norms and
- sense of place (Kiss et al., 2020).

Although it is increasingly known that participation brings numerous benefits to local community, it is also accompanied by many doubts and oppositions and **is not yet very popular with all local community leaders and their professional services**. There are different reason for hesitation in those two groups and it is really important that they both get informed about good practices that prove how much they both together with local community can benefit once participation becomes a regular practice of planning and management of urban green space not only of NBS instalment.

Local politics can ask and look around for good practices of participatory budgeting like in Paris which prove in practice how beneficial is the possibility of participation for the growth of public support for local politics in various areas. On the other hand, while participation is welcome from the perspective of managing the scope of work and other benefits it provides to the local community, it has to be seriously considered that for efficient participation public servants and services get also bigger load of work they are not necessary prepared for. Meaning they don't have time and money for it and probably they are also not familiar with and skilled for it. This must be respected when participation is planned so that additional time and money are reserved, additional task force is engaged and also basic education for existing staff can be organised as well. It is important to have in mind that the benefits of participation evidently depend on how much work and time the initiator devote to it.



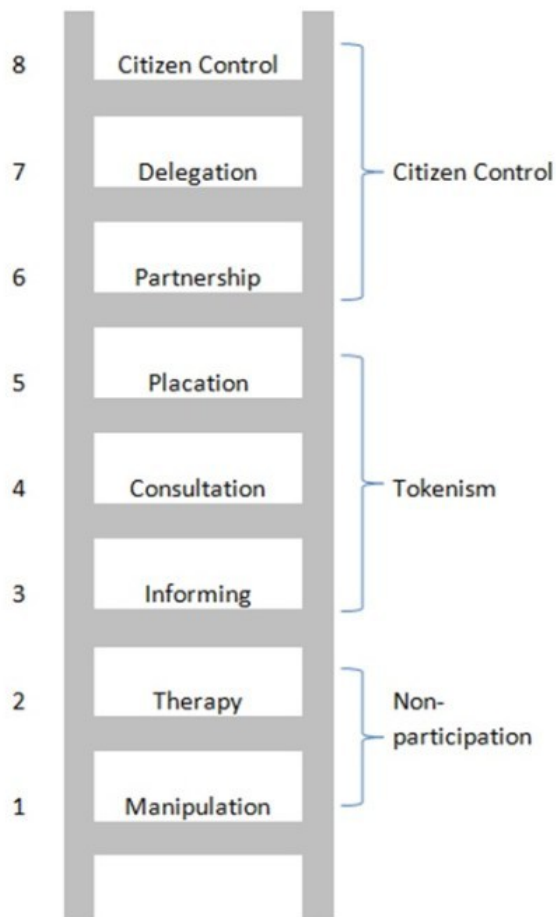
Another fact to keep in mind is that **participation isn't a miracle solution for managing the volume of work and all possible problems** of the professionally and financially underfunded public services in urban green space and trees management and maintenance. Meaning that public participation may not necessarily solve problems and save resources, but it will provide benefits otherwise not being considered efficiently enough like enabling people to have genuine contact and being active in nature, giving residents a sense of usefulness, connecting the local community, developing people's attitude towards the regulation and conservation of urban nature and similar. **The potential of public participation must be critically considered and participation must be carefully planned** and supported, and above all, development of participatory practice must be monitored and, together with the local public, **so that the practical solutions are acceptable to both parties.**

It is thereby very important **to start by creating opportunities for cooperation and encouraging local people to get involved** in designing, constructing and maintenance in a way and where it is most appropriate for them, like close to homes, schools and day care centres. For the development of practice is also helps to create different options for participation like doing it regularly or occasionally, under professional guidance or independently, individually or in a group, etc.

Therefore, there are three important starting points for the development of good practice of public participation in designing, constructing and maintaining the NBS: 1. political will, 2. financial and professional support, and 3. opportunities that enable professional services to open up to new activities and division of work and responsibilities and to enable the public, residents, and civil society organizations to respond to the invitation and find their place in the cooperation processes, develop mutual trust, and ensure other synergistic effects of the work of professional services and the public. Project UrbanGreenLeap is dedicated to support all of the three and help partner cities to experience the benefits of public participation and incorporate it in lasting everyday practice of urban green space planning and management.

Forms of participation

There is a variety of forms of public participation in the phases of NBS interventions. The main question is, what we want from people and how is it going to both benefit the nature and the city or town. Sherry R. Arnstein (1969) introduced the well-known ladder of levels of citizen participation in government decision-making, that paved the way for public participation as we know today. She argues that **the form of participation depends on the initiator and his/their power**. The eight proposed levels are categorized into **3 main types**, which define **the extent to which the public can influence the final decision**. The higher up the ladder, the higher the influence and power of the people.



Sherry R. Arnstein's ladder with eight levels of citizen participation in government decision. Figure by [Katrin Prager](#).

Luyet et al. (2012) later define the **typologies of citizen participation in environmental projects** as follows:

- **Empowerment**
- **Co-Creation**
- **Collaboration**
- **Consultation**
- **Informing**

These can be projected along the Arnstein's ladder, with the level of citizen power being a key focus again. 'Empowerment' gives citizens the knowledge and confidence, as well as the greatest degree of control and power in terms of NBS interventions. According to the research of Kiss et al. (2022), **collaboration is the most used form** of citizen participation. Collaboration, as well as informing and consulting, fall into the category of tokenistic level of public participation, whereas empowerment and co-creation pave paths to deeper levels of public participation. However, many NBS initiatives change levels of participation among project phases (Kiss et al., 2020).



Type of public participation	Forms and methods of public participation*
Empowerment	• Capacity development • Workshops • The public leads the design • Advocacy planning
Co-Creation / Co-Deciding	• Citizen science: monitoring, tree maps, “actionable knowledge” • Co-Design Workshops • Co-management • Citizen panels
Collaboration	• Interactive surveys • Public discussion • Focus groups • Meetings • Social media debates • Q&A’s • Participatory mapping
Consultation	• Interview • Survey • Events (open space) • E- mail feedback
Informing	• Printed materials (flyers, articles in local newspapers, posters in public spaces) • News report • Newsletters • Public presentation • Website and other online information • Field visit with interactions

* Forms and methods can be repeated at several levels and only forms of participation that are representative of a particular type of participation are presented here.

Although tokenistic forms dominate citizen participation in a variety of NBS contexts, collaborative, multi-stakeholder engagement does not necessarily lead to improved ecological functions (Kiss et al., 2022). Therefore, to make participation be meaningful, it’s important to work with a broader goal of improving the quality of NBS interventions and tailor-made solutions to local specific through building trust and social benefits.

The strongest association between social inclusion through a deeper form of participation and ecological outcomes were observed in community gardens Kiss et al. (2020). The same type of green area however also forms the most tension and conflict (Kotsila, Angelovski, et al., 2020), so professional knowledge or mediators are welcome to enable these democratic participatory processes.



Phases of participation

Effective participation is important at every stage of NBS development. Fors et al. (2015) and Kiss et al. (2022) both identify 3 key phases:

- **Planning and design**
- **Implementation**
- **Maintenance and monitoring**

Planning and design involve co-defining project goals, deciding on an appropriate location of the NBS intervention, and shaping visions. Participation can increase relevance and ownership.

During **implementation** phase, citizens may contribute labour, knowledge, or coordination during planting or construction process.

Maintenance and monitoring are critical for NBS sustainability and community-based monitoring and stewardship are key tools for fostering long-term social and ecological resilience (Kiss et al., 2020). Successful maintenance requires the maintenance workers to work closely with the citizens and have a good understanding of a common goal, access to resources, like tools, materials and stable funding, and an ongoing communication channels or methods for feedback, adaptation and new incentives for community contributions. Participatory maintenance can take several forms:

- **Community stewardship programs**, where citizens adopt responsibility for specific areas, from weeding, watering to monitoring wildlife.
- Formal **Co-management agreements** can be achieved between municipality and citizen groups defining shared responsibilities, timelines and resources.
- **Training and capacity building** can empower citizens with technical, horticultural, ecological or other needed skills for long-term maintenance.

It's important to not over-rely on volunteer labour without adequate institutional support (Kiss et al., 2020). Therefore, **all relevant actors should be included** in the phases of the NBS implementation.

Planning and monitoring can also be done using **citizen science** – a process of public participation in scientific research, where people actively participate in scientific findings and help with providing data. They could participate in biodiversity observations (eg. submitting sightings of butterflies, birds, bees, ...), recording nature cycles, or simply measuring the air temperature of selected locations in the urban environment. This method is an effective way of achieving the following aims: raising awareness, spreading knowledge, enhancing social learning and enhancing a sense of place.



Expectations and realities of citizen participation

Public participation is often welcome from the aspect of combining public service workload, **lowering the cost of maintenance** and is **highly appreciated by the public service providers**, but less by citizens themselves and rarely by decision-makers. They tend to lean towards the opinion that participation processes should be limited as it prolongs processes and complicates them.

However, there are several advantages of public participation, especially in the field of landscape planning, environmental impacts assessment, climate change mitigation, resource management and urban green governance (Kiss et al., 2020). The range of NBS benefits on people depend on the type of NBS intervention.

Kiss et al. (2020) have conducted a paper on analysis of forms and citizen participation in 58 NBS case studies, where results show that the association between public participation in (NBS) interventions and environmental and social sustainability outcomes is not always clear-cut.

Municipality-led governance arrangements dominate (Kiss et al., 2020). However, public participation in municipality-led NBS projects can have a negative impact on sustainability of these projects (Wamsler et al., 2020), especially if forms of participation are tokenistic. It can contribute to mistrust and has a significant impact on participatory processes in the future and democracy in general.

The biggest pitfall in public participation are unrealistic expectations. If never done before, citizens' interest in public participation takes time and it is not successful overnight. It is important to maintain a consistent approach to participation beyond the timeline of a single project. To achieve this, it's crucial to have political support. The rigid structure of decision-makers, who dictate how space is used and what it looks like, prevents or hinders deeper engagement, especially in relation to public edible gardens and allotment gardens.

Another downside of public participation is that municipalities and public utility companies with ample funding often lack interest in deeper engagement. Therefore, the lack of trust can be deepened.



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