

Public engagement for nature-based regeneration of the built environment

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Abstract: Cities are increasingly called upon to address the interconnected challenges of climate change, biodiversity loss and growing exposure to natural and anthropogenic hazards. In this context, Nature-based Solutions (NbS) are increasingly recognised as integrated approaches capable of combining ecological restoration, disaster resilience and human wellbeing through the active involvement of communities and living systems. However, their effective implementation requires stronger collaboration between institutions, researchers and citizens, as well as greater public awareness of environmental risks and opportunities for urban regeneration. Moving from an overview of the main international, European and Italian policy frameworks, the chapter investigates public engagement (PE) as a process that can encourage the integration of NbS within the transformation of the built environment. Particular attention is devoted to methodologies relevant to academic research, such as Citizen Science and knowledge co-production, and especially Urban, Environmental and Technological Design, such as co-governance and co-creation. The latter is analysed through a sequence of phases – stakeholder selection, co-design, co-implementation and co-monitoring – that engage communities throughout the entire life cycle of interventions, enabling them to become active agents of change. The contribution also discusses selected tools developed within European research projects aimed at supporting PE in NbS initiatives and highlights the importance of people-centred evaluation methods capable of capturing long-term impacts, particularly in terms of social inclusion and ecosystem services. Collaborative approaches are also central to the Third Mission of universities, which are increasingly called upon to engage with society. Within this framework, the “Code4Risk” project is discussed as an experimental design-based initiative in which knowledge sharing, co-design and self-construction activate the community as a collective architect capable of defining emergency preparedness strategies aligned with the biophilic and circular design principles. Finally, Urban Living Labs emerge as enabling environments where collective intelligence can support the co-creation of resilient and nature-positive urban futures.

Keywords: Nature-Based Solutions, Public Engagement, Co-creation, Multi-stakeholder Partnerships, Urban Living Labs.

1. Cross-cutting cooperation fostering synergies between climate, nature and society

With a 70% probability that the temperature increase will exceed the Paris Agreement threshold of 1.5 °C (WMO 2025)¹, the interconnections between the climate crisis and biodiversity loss are clearly acknowledged, and directly impact the liveability, health and safety conditions of urban environments. Cities, both major contributors to and victims of climate change (CC), are at the same time laboratories of innovation (UN-HABITAT 2024) for the mainstreaming of NbS.

The co-benefits of NbS are recognised as key resources to jointly respond to environmental degradation and social poverty, however, demonstrating these benefits is far from self-evident (EC 2023): while some results are short-term, direct and local, oth-

¹ Available at: <https://wmo.int/publication-series/wmo-global-annual-decadal-climate-update-2025-2029?access-token=pNLbdBu8q2rFHbkLrdh9YE5cold58Ic7lc47kQiUg4U>

ers may emerge in the long-term, with indirect impacts at a large scale (Kabisch et al. 2022). Furthermore, although the benefits of NbS are well recognised within the scientific community, the same cannot be said for technicians, practitioners and citizens.

With regard to public perception, the data provided by Eurobarometer surveys are relevant: 85% of Europeans believe that CC² is a serious problem and a priority for improving the quality of life (2025); while with regard to biodiversity³ (2018), if about seven out of ten have heard the term “biodiversity”, only four out of ten know its meaning. At the national level, ISTAT data on environmental concerns (2024) show that 58.1% of the population expresses worry about the climate crisis.

Dealing with the complexity of the interacting socio-environmental crises that shape our societies requires not only overcoming the boundaries between disciplines and sectors, but also adopting approaches that hybridise top-down and bottom-up logics. Therefore, promoting NbS with a cooperative approach, aligned with the “One Health” vision (WMO⁴) not only raises consciousness and thus reduces social vulnerability, but also ensures that interventions are better tailored to the specific characteristics of the context and helps avoid undesirable effects such as maladaptation or green gentrification.

Philippe Tulkens, Deputy Mission Manager of the EU Mission on Adaptation to CC, emphasises, on the occasion of the *European Climate Change Adaptation Conference* (ECCA 2025), the urgent need to redesign the chain of knowledge transfer from researchers, national and local authorities to citizens. Communities are not passive recipients but active partners in accelerating the ecological transition, which must be founded on trust between people and institutions, listening skills and opportunities for co-creation. Co-creation in the architectural field can be understood as «any act of collective creativity» (Sanders and Stappers 2008, 6): understanding creativity as a collaborative practice can help consolidate NbS within the collective imagination.

Among others, the siloed organisation of urban policies, the competition between different priorities and the limited participation of residents (UN-HABITAT 2024) prevent NbS projects from expressing their full potential. In response, it is necessary to adopt flexible and adaptable tools that raise the understanding of the interconnections between the ecological crisis and daily issues such as poverty, health issues and inequalities, counteracting apathy and scepticism through knowledge-sharing practices.

To this end, universities are called upon to play a fundamental social role as facilitators, opening up to society and finding in public engagement (PE) a driver for cultural and social innovation. Today, the Third Mission assumes strategic value in academia (Claudi de Saint Mihiel 2019) and sees the university engaged in strengthening cooperation between institutions and local communities.

In particular, design disciplines can provide both technical expertise and visionary capacities to support the co-development of sustainable and shared future scenarios.

2. Promoting nature-based solutions through participatory approaches: from global agendas to local practices

Enhancing NbS through PE is strongly promoted by a wide range of policies, programmes and regulations at multiple governance levels, from the international to the city level.

² Available at: <https://eccoclimate.org/it/italiani-ed-europei-sono-a-favore-dellazione-per-il-clima-lo-dice-l-eurobarometro/>

³ Available at: <https://europa.eu/eurobarometer/surveys/detail/2194>

⁴ Available at: One health

At the international level, several global agendas emphasise the importance of PE in responding to climate-related and ecological pressures. In particular, the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity encourage the implementation of NbS through community-based processes. Similarly, the 2030 Agenda for Sustainable Development, in particular SDG 11 in its target 11.3 “Enhance inclusive and sustainable urbanization and capacity for participatory planning”, calls for strengthening PE in urban regeneration processes.

At the European level, the active involvement of communities in environmental decision-making is rooted in the Aarhus Convention (1998, in force since 2001), subsequently incorporated into the European legislation through Directive 2003/35/EC. More recently, the European Green Deal encourages the active involvement of citizens and stakeholders in shaping climate adaptation and environmental transformation processes. More specifically, both the EU Strategy on Adaptation to Climate Change (2021) and the EU Biodiversity Strategy for 2030 (2020), which paved the way for the EU Nature Restoration Law, establish clear commitments to multi-level collaboration in the implementation of NbS.

In the Italian context, the National Strategy for Adaptation to Climate Change (2015), states that PE in adaptation processes ensures greater public understanding and social acceptance of adaptation measures and highlights the need for collaboration with the scientific community.

Concerning the specific issue of PE in urban planning, the transparency and public availability of planning and territorial governance documents, including plans and their variations, are mandatory under Law 1150/1942, Legislative Decree 33/2013 on administrative transparency and, more broadly, the principles of participation established by Law 241/1990, followed by the regulations of the individual regions. At the local level, some regional planning frameworks – particularly in the Tuscany Region (Regional Law 65/2014) – have introduced the role of the “Information and Participation Supervisor” (*Garante dell’Informazione e della Partecipazione*), whose functions are regulated by municipalities through specific regulations. Engagement is therefore mainly conceived as an information and transparency mechanism, while the development of structured PE practices remains only partially regulated within planning procedures.

Despite the growing recognition of PE as a key enabler for the effective implementation of NbS in urban contexts, the policy framework outlined above suggests the need for a more structured integration of participatory processes, which could be addressed through the definition of specific provisions.

3. Public engagement as a process: methodologies, phases and tools for co-creation

Like other urban transformation processes, NbS intervention are not inherently inclusive or participatory. However, the active involvement from the outset of a multiplicity of stakeholders, and thus a wide range of perceptions, needs and expectations, helps to ensure greater alignment with local needs, facilitating greater acceptance and also nurturing a sense of belonging and ownership. Especially co-ownership, by fostering emotional connections between people and places, generates commitment to the long-term care of the intervention (Brown and Katz 2011).

As Esteban (2020) states, in order to balance the interests of different social groups and local concerns with broader societal objectives, participation cannot be treated as an additional measure but must become a structural and routine component of urban regeneration processes, based on mutual sharing and learning.

3.1. Methodologies

PE can encompass a wide range of initiatives, among which Citizen Science and the co-production of knowledge are of particular interest for academic activities.

Citizen Science (CS) (Capineri et al. 2025) is reshaping scientific research as a societal common good, in the spirit of Open Science. By involving citizens not only in data collection but also in the identification and analysis of local community priorities, CS innovates the ways in which knowledge is produced and used (Hecker et al. 2018) and contributes to the democratization of science (Irwin 1995).

The co-production of knowledge recognises civil society as an active driver of knowledge generation and experimentation. The exchange of different forms of knowledge among citizens, stakeholders and institutions, facilitated by universities, enables decision-makers to gather input from the daily users of spaces, neighbourhoods and services, while allowing people to gain new expertise.

Furthermore, within the fields of Urban Planning and Environmental and Technological Design, co-governance and co-creation, which represent closely interrelated processes, are of particular interest.

Co-governance or collaborative governance refers to «mechanisms in which citizens take part in the decision-making processes alongside local authorities and public or private stakeholders» (EC 2023, 46). Although the bureaucratic structure of public administrations still limits participation today, the ecological crises require the adoption of the “whole of society” approach (World Bank⁵) within «open, multi-phased, iterative, inclusive, flexible and adaptable» processes (Mahmoud et al. 2021).

Co-creation, understood as «the process of participation, interaction, collaboration, or co-production with citizens (organised or unorganised), political representatives, public officers, private stakeholders, and researchers» (EC 2023, 18), represents an emerging domain within the design field, whose phases and tools are discussed below.

3.2. Phases

Based on the literature on PE, the co-creation process can be structured into the following four main phases.

3.2.1. Stakeholder selection

Involving a plurality of actors from the outset helps limit potential conflicts, counteract scepticism and build motivation (Zingraff-Hamed et al. 2020). The “ecologically sensitive” Fifth Helix model (Carayannis et al. 2012), identifies the following key actors to be involved: academia, industry, government, culture, environment. Yet, in this first step of the PE process, the key question is: «How to engage all stakeholders and not only the “usual suspects”?» (UN-HABITAT 2024, 25). To prevent urban projects from reproducing, exacerbating or creating inequalities, and thus to ensure a “just transition” (UNDP⁶), it is necessary to give a voice to the most vulnerable groups: the elderly, women, children, and ethnic and religious minorities. In this regard, the Re-

⁵ Available at: <https://blogs.worldbank.org/en/arabvoices/how-can-governments-develop-a-whole-of-society-approach-to-address-the-climate-crisis>

⁶ Available at: <https://climatepromise.undp.org/news-and-stories/what-just-transition-and-why-it-important>

silience for Communities programme⁷ identifies three factors to fairly select the target community: exposure to risks, access to resources and services, and socio-economic and institutional conditions. Useful tools for conducting fair stakeholder mapping include the RESIN guide, suggested by the Climate-ADAPT web portal, which adopts an influence-interest matrix (high/low influence, high/low interest), while the RACI matrix classifies actors as responsible, accountable, consulted and informed.

3.2.2. Co-design

Co-design (CD) is a collaborative design method in which experts, technicians, architects and facilitators work together with stakeholders and citizens (Holmlid 2009), thereby strengthening the communities themselves. The Engage2020 project identifies art, modelling, photography, graphics, mood boards, map making and scale modelling as tools. Through visioning and forecasting activities, starting from the requirements framework, the project is developed through the creation of one or more shared and collectively accepted scenarios. The design process unfolds through cycles of «divergency, selection, convergence, synthesis and analysis» (EC 2023, 36). CD may lead to longer timeframes and higher costs compared to “expert-led” processes. However, the benefits in terms of environmental and cultural compatibility and social acceptance of the adopted solutions may far outweigh the initial investment in the long run. One of the key outcomes of CD is “mutual learning” (Simonsen and Robertson 2013), which becomes “social learning” when referring to the co-creation of strategies (Sanders and Stappers 2008). Finally, “design as learning” occurs, i.e. that «learning happens within the design process itself» (EC 2023, 40).

3.2.3. Co-implementation

Co-implementation is the phase where «local residents can leave their mark on the land» (EC 2023, 43). Although involving people in site work is a complex challenge, since it requires specific preparation and the use of work and safety equipment, physically realising the intervention helps build a sense of belonging and shared ownership of the space (Lydon and Garcia 2015). People can actively contribute to shaping the outcome, for instance by defining the location of equipment or taking responsibility for small areas, planting vegetation, colouring or adding details, or participating in the choice of materials and urban furniture. Concerning the physical transformation of the urban space, co-implementation is perhaps the phase that plays the strongest role as a catalyst for positive change. Furthermore, training activities can stimulate new micro-economies supporting the most disadvantaged groups.

3.2.4. Co-monitoring

The European Commission’s handbook for NbS practitioners (EC 2021) states that monitoring must be central to every NbS project, emphasising that developing it in a participatory way enhances its value as an awareness-raising and accountability activity. Collaborative data collection and dissemination activities on NbS performance can be classified into four types with different levels of participation (Lawrence 2006, 290): consultative, functional, collaborative, transformative. EU-funded projects on NbS have developed and

⁷ Available at: https://resilientcitiesnetwork.org/downloadable_resources/Programs/R4C_CommunitySelectionGuide.pdf

tested numerous monitoring methodologies: participatory assessment (CONEXUS⁸); social monitoring (CLEVER Cities⁹); comprehensive framework for NbS assessment (PHUSICOS¹⁰); reflexive monitoring (Connecting Nature¹¹). Of particular interest are the four phases identified by the CONEXUS project: 1) defining shared monitoring goals and objectives; 2) indicator selection; 3) data collection; 4) data analysis and evaluation. Among the categories of data used by the CLEVER Cities project in social monitoring, the synergies between nature and wellbeing are investigated in relation to the use of spaces, sense of belonging, social interactions, psychological issues and perceptions of safety and security.

3.3. Tools

The following is a selection of decision-making tools developed within European projects that promote NbS through PE processes and are considered particularly relevant for the research.

ClimateAdapt's "Do-it-yourself" handbook¹² is a step-by-step guide for regional and local authorities to identify the most suitable participatory activities for their purposes, encouraging the establishment of a "community of practice".

The GrowGreen project's "Co-design Guide"¹³ is aimed at policymakers responsible for NbS projects and includes 3 steps: 1) data collection, target setting and impact assessment of the identified alternatives; 2) definition of the financial framework; 3) collaborative monitoring of results.

The NATURE4CITIES open-source platform¹⁴ provides digital tools for creating, evaluating and implementing NbS projects, such as the NbS explorer, Geocluster4NbS, the Environmental Assessment Tool and the "Step-by-step guide on Engagement strategies and tools".

The NATURVATION project's "Book on Citizen Engagement"¹⁵ matches different PE methodologies with the type of promoter or stakeholders involved: for municipalities, round tables, co-design workshops and citizen panels; for associations, neighbourhood forums, district-based community work, environmental education; for the inclusion of marginalised groups, advocacy planning and community organisation.

The URBiNAT project developed an interactive co-selection and co-creation catalogue of NbS¹⁶, by categorising the solutions into 4 groups: territorial, technological, social and solidarity economy and participatory.

The AGORA project¹⁷ created the interactive platform "Agora Community Hub" which shares needs, knowledge and experiences on adaptive communities and aims to define a roadmap to scale up stakeholder and citizen involvement in Europe.

Although these tools differ in scope and methodology, they collectively reflect the growing integration of participatory practice within NbS implementation frameworks.

⁸ Available at: <https://www.conexusnbs.com/>

⁹ Available at: <https://clever-guidance.urbanbynature.eu/>

¹⁰ Available at: www.phusicos.eu

¹¹ Available at: <https://connectingnature.eu/>

¹² Available at: https://climate-pact.europa.eu/eu-climate-action-academy/resources/do-it-yourself-diy-manual-mobilising-and-engaging-stakeholders-and-citizens-climate-change_en

¹³ Available at: <https://growgreenproject.eu/wp-content/uploads/2022/11/NbS-Codesign-guide-Bipolaire-22.pdf>

¹⁴ Available at: <https://www.nature4cities.eu/results>

¹⁵ Available at: https://naturvation.eu/sites/default/files/result/files/citizen_engagement_handbook.pdf

¹⁶ Available at: <https://urbinat.ces.uc.pt/nbs-catalogue/>

¹⁷ Available at: <https://adaptationagora.eu/outputs/>

4. Code4Risk: a design-based community engagement project

Within the PE framework for NbS outlined above, the “Code4Risk” project is proposed as an experimental application of design-based PE to foster community awareness and co-creation processes for urban resilience. Winner of the call for Third Mission projects “UNIFI EXTRA 2024”, the project was promoted by the Department of Architecture (DIDA) and the Civil Protection Centre (CPC) of the University of Florence, and implemented with the support of the Civil Protection Office of the Municipality of Florence and with the collaboration of Sociolab in the conception and facilitation of the activities and of “TEMP- ETS” for the cultural background.

Consistent with the fragility of Italian territories, and specifically the context of Florence, “Code4Risk” adopts a multi-risk approach combining hydrogeological and seismic hazards (earthquake and flooding) and climate-related hazards (heat islands, heat waves and extreme rainfall).

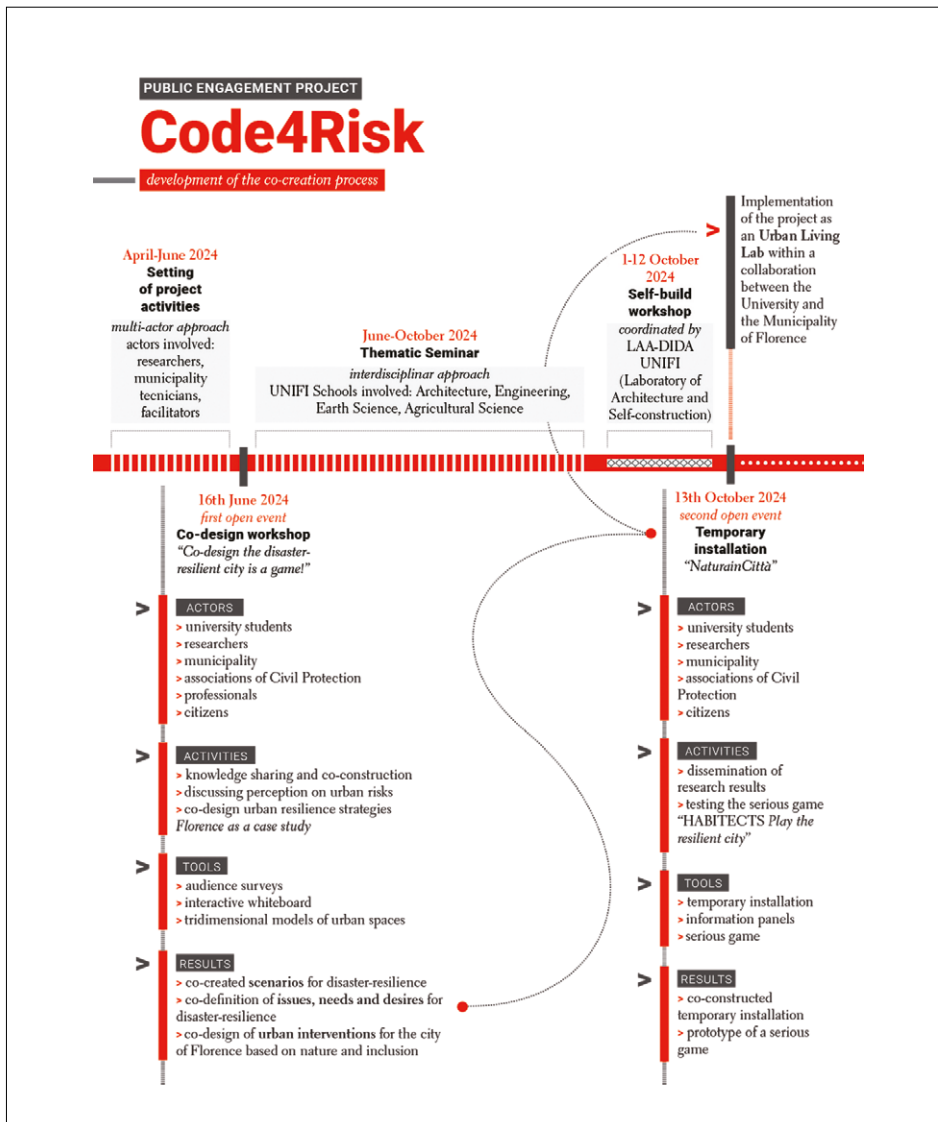


Fig. 1 – “Code4Risk” co-creation process. (Diagram by the Author).

Fig. 2 – Multi-stakeholder discussion during the co-design workshops of the “Code4Risk” public engagement project (16/06/2024, “Le Murate” Florence). (Photo by the Author).



Fig. 3 – Interactive white-boards where facilitators documented key insights from the discussions using post-it notes, drawings, and diagrams during the co-design workshops of the “Code4Risk” public engagement project (16/06/2024, “Le Murate” Florence). (Photo by the Author).



Aiming to boost synergies between the sustainability goals of the 2030 Agenda and Disaster Risk Reduction, the project brings together emergency preparedness with climate adaptation, biodiversity protection, and the liveability of urban spaces, placing the design perspective at the centre according to a collaborative, circular, and biophilic approach.

The initiative took place in Florence between June and October 2024 and was structured into 3 phases (see Figg. 1-4): a co-design workshop (16/06/2024) (Arnetoli et al. 2025), the first open event, which involved technicians, volunteers, citizens and university



Fig. 4 – Opening of the “NaturainCittà” installation and the presentation and first testing of the serious game “HABITECTS. Play the Resilient City®” (13/10/2024, “Le Murate” Florence). (Photo by the Author).

students in thematic discussions on risk perception, co-production of knowledge and co-design of urban resilience strategies through the use of 3D models representing architectural elements (house, street, square); a self-build workshop (October 2024), in which the DIDA-UNIFI Architecture and Self-Construction Laboratory coordinated the design and construction of a temporary installation together with an interdisciplinary group of university students, turning the intervention into an open construction site with strong educational value; the “NaturaInCittà” installation (13/10/2024), the second open event, organised as part of the National Civil Protection campaign “*Io non rischio*”, which hosted information material on natural hazards and nature-based resilience strategies.

The opening of the installation was also an opportunity to test the serious game “HABITECTS. Play the Resilient City®” developed from the results of the co-design workshop, which subsequently led to the establishment of a collaboration with the Municipality of Florence to test the application of NbS as a tool to reconnect fragmented and degraded urban spaces through participative approaches, within the framework of an Urban Living Lab.

5. Urban Living Labs as spaces for collective thinking and design

Implementing the transition from disaster-prone to disaster-resilient cities in a fair and inclusive way requires citizens who are aware of the severity of the ecological crisis and practitioners trained to implement NbS.

Living in a city can disconnect us from nature, but we remain dependent on many ecosystem services [...]. It is critical that policymakers and citizens work together, to better understand, value and protect the crucial relationship between cities and nature, as well as how urban nature-based solutions can facilitate more resilient urban environments (Jennifer Lenhart, global lead of WWF’s One Planet Cities).

PE constitutes a deliberative activity that contributes to building trust between citizens and institutions and thus forms a key component of democratic systems (Willis et al. 2022; Jacobs et al. 2009). Co-creation and co-governance make society – understood as the ‘software’ component that enables the urban ‘hardware’ to function – an active designer, builder and manager of ecosystem-based regeneration processes.

Accordingly, Living Labs (LLs) represent socio-cultural networks where the diverse components of the community can become active and collaborate in the transformation of society and, consequently, of its physical environment. The European Network of Living Labs¹⁸ (ENoLL) gathers experiences and resources with the aim of globally promoting LLs as «user-driven open innovation ecosystems». The Joint Programming Initiative (JPI) Urban Europe¹⁹, introduced the term Urban Living Labs (ULLs), defining them as a forum for innovation. ULLs therefore represent a privileged public arena in which collective thinking can be translated into collective design.

Through his work and reflections, Carlo Ratti (2025) highlights how the myth of the architect as a Promethean figure still survives today, personified by a solitary creator – or archistar – who is convinced of his genius and his power to save society, while architecture has remained one of the few sectors «still largely immune to the gravitational pull of participation» (Ratti 2025, 80). On the contrary, the history of architecture, to quote Ratti again

Is an epic, never told, of anonymous architecture: spontaneous or vernacular architecture, without a name, is the cultural expression of the human need to have not only shelter, but also a position, an identity, pleasures (Ratti 2025, 20).

In this sense, ULLs constitute a hybrid environment that hosts and encourages that *continuum* of small acts of design that, throughout human history, have produced cities as collective works of art. Placed in the tradition of Bernard Rudofsky’s exhibition “Architecture without Architects” (MoMA, New York, 1964-65), ULLs become contemporary spaces in which the “orchestrating architect” is replaced by an orchestra of collective

¹⁸ Available at: <https://enoll.org/>

¹⁹ Available at: <https://jpi-urbaneurope.eu/urbanlivinglabs/>

intelligences, allowing the reactivation «of the ancient settlement process in which the act of living and the built form are a single entity» (Habraken 2013). In Marco Romano's thought, this corresponds to reconnecting "moral citizenship" with "material citizenship".

To encourage the institutionalisation of PE in urban regeneration processes, it is necessary to develop robust economic and people-centred evaluative frameworks capable of capturing both the tangible and intangible benefits generated by participatory approaches, particularly in the implementation of NbS. This includes the integration of cost-benefit analysis, impact assessment and co-benefit evaluation, supported by tools such as Life Cycle Assessment (LCA) and Life Cycle Costing (LCC), in order to capture the long-term environmental, social and economic value of NbS. Such approaches can help highlight benefits that extend beyond immediate economic returns, including community empowerment, ecosystem services, human wellbeing and urban resilience.

In conclusion, the PE gives shape to a renewed form of Tomas Maldonado's (2022) "design hope", grounded in a shared cultural matrix that allows the "human environment", the anthropic subsystem through which human activities continuously transform the planet to coexist again with nature. In this perspective, ULLs emerge as fertile environments in which PE can co-create NBS projects to shape more resilient and inclusive urban transitions.

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