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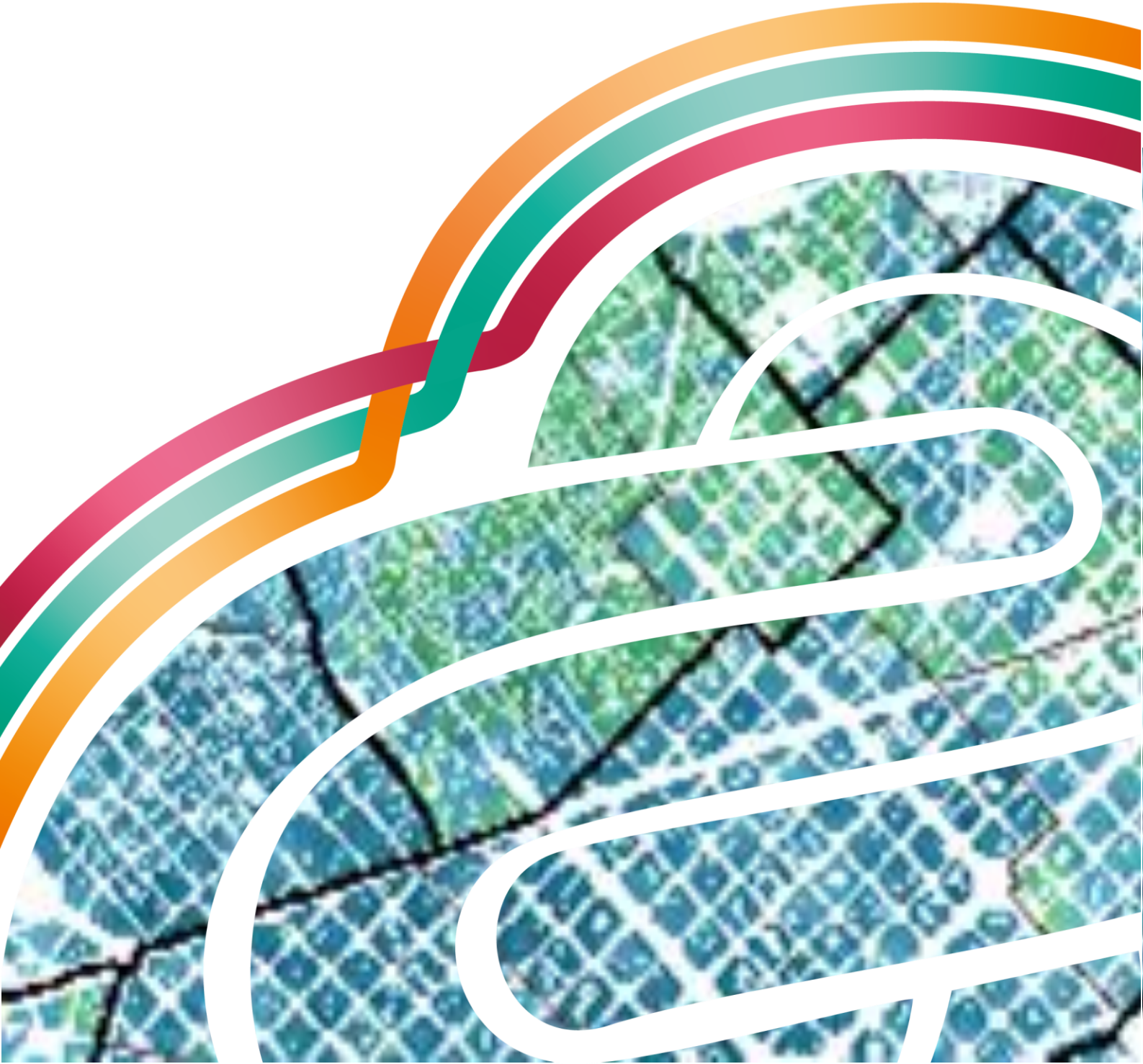
The INTERLACE pilot assessment framework for restorative Nature-based solutions

A step-wise, modular and hierarchical approach



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Executive Summary

This INTERLACE project deliverable presents a scientific-technical report that develops a Pilot Assessment Framework for restorative nature-based solutions (NBS) in urban contexts. This scientific-technical report is meant to guide the project-internal co-development of tailor-made assessment systems in the INTERLACE cities, and It will thus support both city knowledge brokers and city practitioners to develop tailor-made NBS assessment systems in each of the INTERLACE cities. It will further constitute the foundation for a Generalized Assessment Framework for restorative NBS to be developed in INTERLACE. The INTERLACE Pilot Assessment Framework has gone through an agile development process and builds on previous work on NBS conducted in the EC Horizon 2020 programme.

The INTERLACE Pilot Assessment Framework establishes three guiding principles (1) Adaptability and transformative change, (2) Justice and social inclusivity, and (3) Transparency and contested rationality. Methodologically it builds on the rationales and approaches of deliberative co-creation and multi-criteria decision analysis. Based on these foundations, it proposes a **step-wise, modular and hierarchical assessment framework** with flexibility to be tailored to specific needs for evaluating restorative NBS, in a specific context, in line with the city-specific planning cycle, and across different spatial scales (from site to regional scale). The **step-wise** approach defines a clear sequence of methodological steps for the assessment of NBS and guarantees rigidity and repeatability of the methodology. The **modularity**, providing methodological packages, allows creating tailor-made assessment systems in different contexts. Finally, the **hierarchical approach** helps to break-down and represent real-world complexity in a practical way, and supports the repeatable but flexible development of NBS assessment systems.

The INTERLACE Pilot Assessment Framework consists of and is structured around nine core modules (each of them consisting of several sub-modules). Module I of the INTERLACE Pilot Assessment Framework describes the **Policy Context**. Module II addresses the **Decision Framing** in a reflective manner. Module III supports the design of a **Deliberative Co-creation** process. Module IV describes a **Spatial Screening** approach for prioritizing NBS intervention areas. Module V addresses the selection of **Financial Mechanisms** for the implementation of NBS. Module VI consists in the **Design of NBS**. Module VII portrays the **Evaluation of NBS alternatives/scenarios**. Module VIII depicts the **Monitoring of NBS**, ex-post an intervention. Finally, module IX consists in a catalogue of **Assessment Tools** that can be applied across the previous modules. The different modules can be stepwise combined into a tailor-made assessment framework.

Glossary

Ecosystem services	Ecosystem services are defined as benefits people obtain from ecosystems (MEA, 2005). Ecosystem services have classically been divided into supporting services, e.g. natural habitats for animal species, provisioning services including the provision of fruits and vegetables, regulating services, such as runoff mitigation, and cultural ecosystem services defined as non-material benefits arising from social-ecological interactions, such as landscape aesthetics, nature-based recreation, sense of place and natural cultural heritage.
Nature-based solutions	Nature-based solutions (NBS) are defined by the European Union H2020 commission 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." (https://ec.europa.eu/info/research-and-innovation/research-area/environment/nature-based-solutions_en**).**
Multifunctionality	Multifunctionality describes the capacity of NBS to provide a variety of ecosystem services simultaneously, while trade-offs are making reference to the impossibility to maximize multiple ecosystem services at a time. Trade-offs tend to emerge especially if single ecosystem services are maximized (De Groot, 2010). This constitutes a particular risk in the development of NBS that are (per definition) targeted to specific human challenges (Langemeyer & Baró, 2021). As an extreme example, forest monoculture plantations for carbon sequestration and climate change mitigation have been deployed despite known negative impacts on other ecosystem services (Lewis et al., 2019).
Social-ecological systems	Social-ecological systems (SES) are 'complex integrated systems characterised by strong connections and feedbacks within and between social and ecological components that determine their overall dynamics' (Biggs et al., 2022). Therefore, social-ecological systems are characterized by an intertwined nature and interdependence of human and natural systems. These dynamic interrelationships give rise to emergent, system-wide patterns that cannot be predicted from the properties of the individual system components.

Background

This scientific-technical report develops a pilot assessment framework for restorative nature-based solutions (NBS) in the INTERLACE project, in completion of Task 3.2 of Work Package 3 (*WP3: Tools for the assessment of restorative NBS*). This deliverable is an internal project document. It presents the first stage of a three-staged process shown in Figure 1. The primary objective of this report is to provide a framework and to guide the co-production of city-tailored assessment in the INTERLACE cities. Thereby it will provide the foundation for Task 3.3, "co-producing and testing integrated city-tailored assessment systems for restorative NBS". In addition the report will create a foundation for the development of a generalised assessment framework for restorative NBS, which will be developed over the course of the project and to which the experiences from the INTERLACE case studies in implementing this pilot framework will contribute. The report is thus also the base for the development of Task 3.4 "fostering integrated and ecologically coherent urban planning across cities globally".

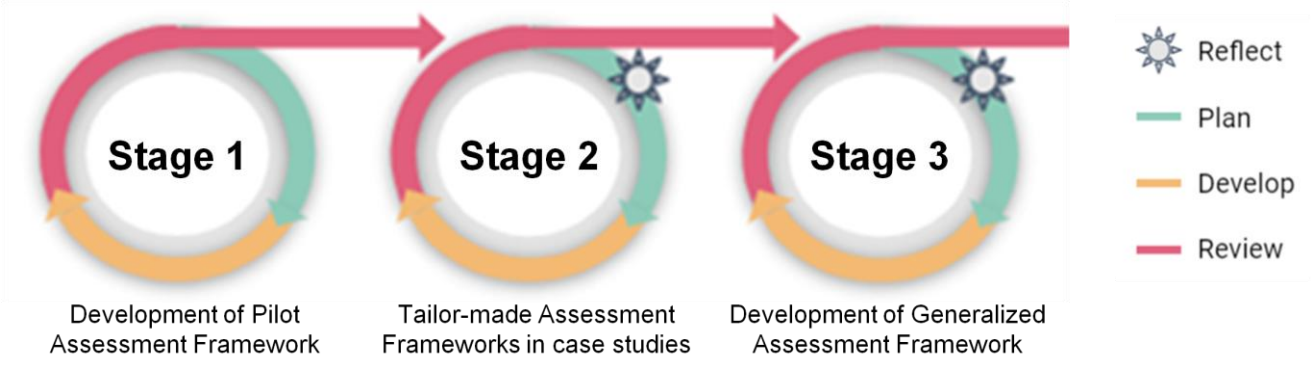


Figure 1. Development stages of the INTERLACE NBS Assessment Framework following an AGILE approach. Each stage embeds several smaller feedback loops not demonstrated here.

B.1. AGILE development of the assessment framework

The development of this deliverable followed an AGILE work process. The goal of this AGILE approach was to ensure that this report meets the stakeholders' needs; in this case, public and private planners and practitioners who plan, implement and manage restorative NBS. The AGILE process lasted from March 2021 until February 2022 and included several feedback mechanisms in order to shape and reshape the pilot assessment framework. The lead authors conducted weekly progress meetings to advance the final product. In the latest stage of the development (beginning December 2021) bilateral meetings with city knowledge brokers provided an early indication of the usefulness of the pilot assessment framework and its applicability in practice - this process will continue after the submission of this report. In addition, a series of meetings with project internals to gather feedback took place. Furthermore, an impact task-force consisting of 15 experts and potential end-users has been established and consulted based on the final draft of the pilot assessment framework. An overview of the main events to develop this report is given in Box 1.

Box 1. Summary of the AGILE process for the development of The INTERLACE Pilot Assessment Framework

- On March 11, 2021, an initial framework proposal was presented and discussed at the monthly INTERLACE core group meeting.
- On March 17, 2021, an internal workshop to discuss ideas regarding the Draft 1# of The INTERLACE pilot assessment framework was carried out, involving representatives of the project partners ICTA-UAB (ES), Humboldt Institute (CO), Yes Innovation (EC), and Tecnalia (ES).
- On April 6, 2021, draft 2# of The INTERLACE pilot assessment framework was presented and 'user stories' were developed during a workshop with the *INTERLACE City Focal Point* members.
- On June 15, 2021, an internal revision of draft 3# of The INTERLACE pilot assessment framework took place, including representatives of the INTERLACE work packages 1, 2, 3, and 5.
- Beginning in June 2021, several bilateral meetings with different INTERLACE WPs were conducted to identify synergies with other INTERLACE products and to deepen internal collaborations.
- On November 2, 2021, draft 4# of The INTERLACE pilot assessment framework was presented to the entire project consortium.
- On November 3, 2021, a second workshop was carried out with the *INTERLACE City Focal Point* members to gain a more detailed understanding of cities' needs in relation to planning, implementation and management of restorative NBS.
- In November 2021, an *Impact Task Force* was established to provide additional feedback regarding The INTERLACE pilot assessment framework.
- Beginning in November 2021, bilateral meetings to discuss the implementation of The INTERLACE pilot assessment framework were held with INTERLACE City Focal Points from CBIMA (CR), Chemnitz (DE), Granollers (ES), and Metropolia Krakowska (PL).
- On January 2,5 2022, a workshop with the *Impact Task Force* was conducted in order to critically reflect on draft 5# of The INTERLACE pilot assessment framework.
- In February 2022, written feedback was provided by INTERLACE project member Gemma Garcia Blanco, and the steering committee member David Jácome-Polit, which led to this final version of The INTERLACE pilot assessment framework.

B.2. Review of NBS Assessment Frameworks

Through the EC Horizon 2020 programme, 24 projects have addressed NBS. In order to develop The INTERLACE pilot assessment framework for restorative NBS, outcomes and deliverables on NBS assessment frameworks developed in these previous projects have been reviewed. Table 1 provides an overview of the seven assessment frameworks we found most relevant for this report.

The six NBS assessment frameworks have been conceptualised distinctively. Most NBS assessment frameworks are designed for the assessment and monitoring of NBS post the implementation. For

instance, *Nature4cities project* has a framework diagnostic of the project's assessment developed as a tool which can be used by cities to assess the impact of the NBS for urban resilience, the environment and on socio-economic features. This is based on a questionnaire that helps in identifying and choosing between all the existing methods and tools that allow analysing climate resilience of cities and NBS. In addition, the need to monitor the benefits of NBS during the process of implementation and using assessment frameworks to make decisions have been addressed by some of the projects mentioned in Table 1. For example, Reflexive Monitoring is a monitoring and evaluation method developed under the *Connecting Nature project* that enables users to gain insight into the progress and direction of their project in real time. Reflexive Monitoring helps to evaluate day-to-day activities and to respond to them while considering the bigger picture while relying on stakeholder workshops. Connecting Nature, as well as *CleverCities* and *NAIAD,* have descriptive analysis assessment frameworks. The CleverCities Impact Assessment Framework supports decisions in relation to the selection of NBS and cost-effective investment. NAIAD addresses the role of stakeholders driven by project incentives. *ThinkNature* and *PHUSICOS* are the only two projects in the list which have been developed out of the need for a quantitative framework. The outcome of the Think Nature framework is a stepwise process which results in a single numerical grade that reflects the benefit of an NBS site and values for each performance indicator. PHUSICOS strongly builds on Multi-Criteria Decision Analysis (MCDA), which allows for the assessment of performance of different Design Scenarios. The outcome of the PHUSICOS assessment framework depends on its application (ex-ante or ex-post), and consists of different scenarios based on a participatory criteria selection and weighting and scoring in terms of NBS effectiveness, feasibility, co-benefits, and resilience. Connecting Nature, NAIAD and Think Nature have applied their framework in the project partner cities / demo cities.

A comprehensive framework, the Green Cities Framework (GCF), has also been established by the *GrowGreen project*. This framework constitutes a comprehensive guidance tool for any city to carry out its NBS City Strategy and implementation. The GCF is conceived in a modular way. The GCF does have 3 core interactive phases for the elaboration of the strategic document (i.e. strategy or action plan): PLANNING, MOBILIZING AND EVALUATING & REPORTING which then split into several steps to guide the process. The phases could read in an organic or systemic way rather than in a linear or sequential way. This means that each city could find their own entry point to the framework, depending on their interests and development phase of each city context and reality. The GCF has a multi-level nature and could be applied at city, district and site level. A specific module focuses on the Co-Design of NBS projects with a supporting digital tool that keeps track of the process.

Table 1. NBS assessment frameworks developed in Horizon 2020 projects

H2020 project	Assessment framework name	Reference
Connecting Nature	Reflexive Monitoring and Impact Assessment	**Reflexive Monitoring -** https://connectingnature.eu/sites/default/files/images/inline/Reflexive%20Monitoring.pdf **Impact Assessment -** https://connectingnature.eu/sites/default/files/images/inline/Impact%20Assessment.pdf
CLEVER Cities	CLEVER Cities D4.1 CLEVER Monitoring and Evaluation Framework	https://clevercities.eu/fileadmin/user_upload/Resources/181130_D.4.1_Monitoring_Framework_TEC.docx.pdf
NAIAD	Guidelines and frameworks applied at NAIAD	http://naiad2020.eu/wp-content/uploads/2020/07/D5.6.pdf
Nature4Cities	Assess an NBS project	https://nature4cities-platform.eu/#/assessProject
PHUSICOS	Deliverable D4.1 Comprehensive Framework for NBS Assessment	https://phusicos.eu/wp-content/uploads/2019/05/D4.1_Task4.1_UNINA_14052019_Final_withAppendicies.pdf
ThinkNature	A Framework for Assessing Benefits of Implemented NBS	https://www.mdpi.com/2071-1050/11/23/6788
GrowGreen	Green Cities Framework a comprehensive guidance tool for any city to carry out its NBS City Strategy and implementation.	https://growgreenproject.eu/greencitiesframework/.

The assessment framework developed in the CONEXUS project has been considered but was not sufficiently developed by the time of preparing this deliverable.

1. Foundations

This document aims to support the development of an overarching INTERLACE Pilot Assessment Framework to guide the co-production of city-tailored, multi-objective and multi-criteria assessment systems. The INTERLACE Pilot Assessment Framework will support the INTERLACE case study cities to develop their own tailor-made assessment systems of restorative NBS, including screening, design, implementation, and monitoring phases. It is neither theory-driven, — and thus overtly complex (e.g. Dumitru et al., 2020) — nor methods-driven, and thus technocratic (e.g. Autuori et al., 2019). Instead, the framework is pragmatic and focuses on stakeholder needs under consideration of core guiding principles, which are laid out in the following.

1.1. Guiding Principles

1.1.1. Adaptability and transformative change

The INTERLACE Pilot Assessment Framework is designed to fulfil user needs regarding the planning, design, and evaluation of NBS. NBS are usually implemented in social-ecological systems deemed to be dynamic, unstable, complex, and of a high degree of uncertainty. Therefore, a deliberative dialogue is needed not only between scientists from different disciplines, but also with different stakeholders and end-users/citizens to guide the choice of appropriate strategies for NBS decision making. Adaptability is a key principle of our framework by promoting a flexible planning approach to enable adaptive responses to contextual changes, shifting user needs and integrating different stakeholders' perspectives while at the same time being rigid in the structuring to enable replicability in the application of the assessment framework. By promoting an agile approach (see methodological foundations), it also allows for regular reflections on how to be more effective in fulfilling user needs by promoting self-improvement, process improvement, advancing skills, and adapting the process accordingly.

Our INTERLACE Pilot Assessment Framework is adaptive; however, due to current socio-ecological challenges, it aims to promote NBS for transformative change rather than adaptive responses. Transformative change in the context of sustainability refers to 'profound and fundamental alterations in social-ecological interactions in a way that sustains the Earth's biophysical systems, while meeting human needs (Palomo et al., 2021). Therefore, transformative NBS are understood as a deliberate, human-driven change in the dominant processes and structures that control social-ecological systems (SES). These processes and structures vary for any SES at a particular scale but can include biophysical cycles (e.g. hydrologic cycles), ecological hierarchies (e.g. food web interactions), human activity (e.g. resource extraction), or social institutions (e.g. laws, rules or policies). In contrast to adaptive responses, which have the goal of building resilience and enabling adaptive management in a desirable regime, the goal of transformative change is to actively shift an SES to an alternative and inherently more desirable regime by altering the structures and processes that define the system. A key aspect of transformative NBS is their multifunctionality (Figueroa-Arango, 2020), which refers to the capacity to solve diverse environmental and social challenges of the urban context by increasing the space for nature, favouring human well-being and biodiversity by providing multiple ecological, social and economic benefits.

1.1.2. Justice and social inclusivity

An uneven distribution of benefits and costs regarding NBS must be assumed between diverse stakeholder groups based on differences regarding, inter alia, gender, age, class, ethnicity, education, disability (Haase et al., 2017; Anderson et al., 2019) and their intersectionalities (Anguelovski et al., 2020). Moreover, these different stakeholders diverge on how nature is perceived and valued and in their levels of influence on decision-making. To avoid NBS reproducing social exclusions and inequalities, different dimensions of justice need to be considered in The INTERLACE Pilot Assessment Framework: distributional, procedural and recognition justice (Øian et al., 2021; Toxopeus et al., 2020; Kabisch & Haase, 2014). Distributional justice concerns how access to green, nature-based amenities is distributed in society, and how the costs and benefits are distributed among the population. Procedural justice involves the levels and forms of civil participation in decision-making to ensure that the planning, design, implementation and evaluation of NBS are open to inputs by diverse stakeholders. It is important to acknowledge which groups should be taken into consideration with respect to issues of social inclusivity. Social inclusivity refers to the involvement of a representative group of stakeholders, paying particular attention to disadvantaged groups according to context, whether by gender, culture, age, class, sexual orientation, education, religion or ethnicity (as well as the intersections between these). If social inclusivity is not promoted, participatory arrangements can, in practice, lead to the exclusion of key social actors from decision-making and ultimately lead to disempowerment of local communities (Maestre-Andrés et al., 2018). Recognition justice acknowledges that the different needs, values and preferences regarding green space and nature must be incorporated in designing, planning, implementing and monitoring NBS. Having justice and inclusivity as guiding principles for the assessment framework implies that processes of information sharing, inclusive decision-framing, active deliberation and engagement, commitment, trust building, empowerment of local actors can all take place when designing and implementing the framework.

1.1.3. Transparency and legitimacy

Another key principle of the assessment framework is transparency, understood as clear and public rules governing the process of designing and implementing the framework. Stakeholders need to understand the process clearly in order to participate effectively and to judge whether participating is likely to be in their best interest. To collaborate under false premises is unfair and unlikely to produce sustainable benefits for any of the participants (Leach, 2006). Stakeholders need to have accurate information and clear expectations about how the data and information they provide and how the products of their deliberations are used. To ensure transparency, there is a clearly defined process to select who can participate in the design and implementation of the assessment framework, it is explained in which form and format the deliberations will take place, how decisions will be made and minutes will be made available shortly after the meetings.

As Richardson (2005) recognises, no longer does scientific rationality prevail in planning and decision-making, as the idea of the separation of political process from (scientific) rational policy has been exposed to critique. Planning usually results from a form of rationality which is ‘often autocratic and technically biased, poorly designed to match contextual characteristics, and weak in fostering creativity, in facilitating dialogue, and in appreciating the political nature of planning’ (Lawrence, 2000, 611). The idea that knowledge in planning is constructed through power relations requires a fundamental

rethinking of the tools that generate ‘knowledge’, such as assessment frameworks. For instance, the construction of methodologies for an NBS assessment framework becomes a moment where certain knowledge gets framed as being significant, as other types of knowledge are sidelined or ignored. This is the construction of rationality. As a response, communicative and deliberative theories of planning and decision-making have been proposed. At the heart of this communicative turn is an attempt to resolve the long recognised problem of ‘power’ by embracing it. In the context of NBS, it means recognising that designing, planning and evaluating NBS is done in an environment shaped by power relations and conflicts of values, and reflecting on how it can be done better. We embrace a critical approach which intends to operate more effectively in challenging environments through reflection. There is the need for practitioners to operate in an ethically reflexive way in a world of contested rationality (Richardson, 2005). Following Campbell (2002), this implies that planning decisions, actions and evaluations ‘cannot be value-free, so rather than hiding, implying or side stepping such concerns, explicit consideration needs to be given to the nature of the ethical values our processes and outcomes are seeking to promote’.

1.2. Methodological Foundations

1.2.1. Co-creation

Co-creation is a form of collaborative governance that promotes cooperation and stimulates learning between different stakeholders to design, implement, evaluate and monitor NBS. A stakeholder is any group or individual that potentially has a direct or indirect interest in, is affected by, or has an influence on the project (Reed, 2008). In the context of NBS, this can include stakeholders who can provide important resources (knowledge, expertise, etc.), stakeholders who are affected by or have an influence on the city's challenges or the planned NBS interventions to address them, or stakeholders who are more distant from NBS but active or interested in restorative NBS (Leone et al., 2021). Through the involvement of stakeholders, issues, concerns, expectations, interests and opportunities regarding NBS can be explored from various viewpoints. By incorporating a greater quantity and diversity of knowledge and perspectives, tailored, locally-adapted and more equitable NBS can be created whilst increasing stakeholders’ appropriation of the NBS and its sustainability. Stakeholders such as public institutions, formal and also informal community organisations (especially in developing countries), and private organisations are involved from the very beginning in the process (consider also the non-usual subjects, e.g. religious communities).

While participatory co-creation has been shown to be a powerful tool for knowledge sharing and creation for multiple stakeholders in the context of NBS planning (e.g. Frantzeskaki & Kabisch, 2016; Pauleit et al., 2019), a deliberative process can increase the legitimacy of co-creation processes (Leitch et al., 2015; Sonnberger & Lindner, 2021). Various scholars have argued for the power of deliberative assessment or prioritisation to inform land use planning under the assumption of trade-offs, not least when different spatial scales are at stake (e.g. Kenter et al., 2016, Ainscough et al., 2018; Langemeyer & Baró 2021). Deliberative prioritisation helps to avoid both oversimplification of the complexity of relationships within social-ecological systems (Kosoy & Corbera, 2010; Norgaard, 2010) and problems of incommensurability between people's different priorities inherent in other methods (e.g. monetary valuation of ES; Saarikoski et al., 2016). Moreover, the legitimacy of deliberative co-creation assessments relies on the representation and engagement of stakeholders at all steps of the

assessment process, from the co-production of information and knowledge at early stages to frame the decisions regarding NBS assessment, the selection of criteria, their joint evaluation and the transmission of knowledge and know-how to relevant stakeholders to promote their replicability and scalability. This makes deliberative co-creation assessments different from other assessment approaches where complex mathematical evaluation models often diminish the transparency and comprehensiveness for non-expert stakeholders.

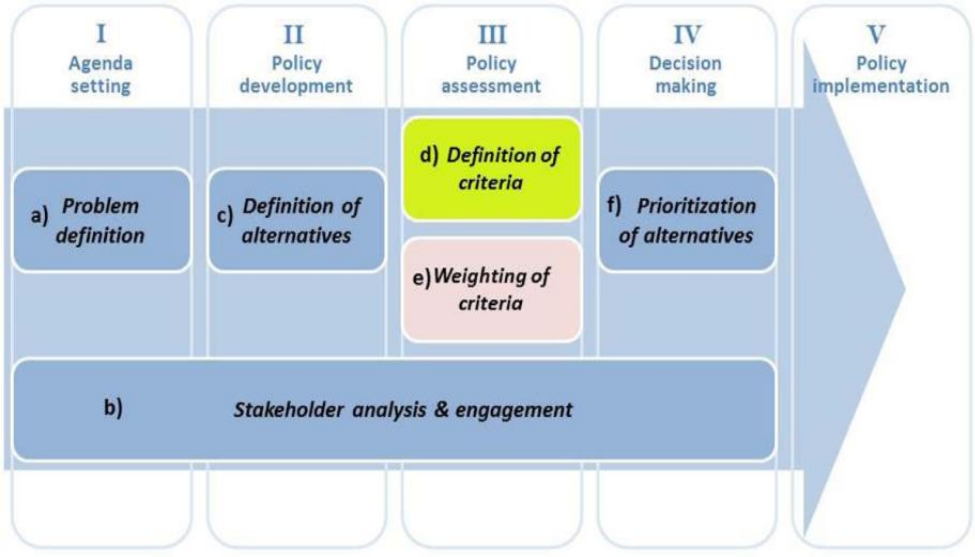
To ensure an inclusive co-creation assessment process, an *AGILE approach* is proposed, which consists of an iterative way of working in short cycles allowing for early feedback and reflection moments during the co-creation process of the assessment framework (see Figure 1). Moreover, this *AGILE approach* seeks to ensure the relevance, legitimacy and impact of the assessment framework, by presenting early versions of the assessment framework to stakeholders for their feedback. The goal is to ensure that the different stages of the assessment framework co-created by governments, decision-makers, urban planners, businesses, civil society groups, education initiatives or city networks meet these stakeholders' needs. Please refer to the *INTERLACE Agile Guidance document* for more information (Mortelmans et al., 2021).

1.2.2. Multi-criteria decision analysis

Multi-Criteria Decision Analysis (MCDA) theory is rooted in operational research (e.g. Mendoza & Martins, 2006) and provides a framework that supports decision-making under consideration of complexity. MCDA has been long advocated as a tool for environmental and land-use decision making (Munda 2008; Saarikoski et al., 2016). Or in the words of Croeser et al. (2021): "Decision support tools such as MCDA can help navigate complex decisions, but their application to urban NBS selection decisions has been limited".

A common approach for MCDA frameworks applied to SES consists in breaking down complexity into several consecutive steps, for instance following: (a) problem definition, (b) definition of alternatives (consisting for example of alternative land-use options), (c) selection of ecosystem services as evaluation criteria (and corresponding indicators to assess them), (d) weighting of criteria (although the weighting is not necessarily made explicit), and (f) prioritisation of alternatives (see Figure 2 based on Langemeyer et al. (2016)).

Figure 2. Idealized Multi-Criteria Decision Analysis process. Based on Langemeyer et al. (2016) and inspired by Marttunen (2010) and Munda (2008)



An additional approach commonly applied in MCDA applications is the development of an analytical hierarchy (Saaty, 1980; Langemeyer et al., 2016). The development of an analytical hierarchy helps to break down complexity, while maintaining transparency. The analytical hierarchy consists in systematically structuring a decision problem in the form of a value tree (Saarikoski et al., 2016) by defining (a) one or several general objectives, (b) a set of evaluation criteria linked to each of the objectives, and (c) a battery of indicators to measure the impact on each criterion. The AHP also defines the quantitative relationships between these hierarchical tiers, i.e. how different indicators are weighted under a criterion, and how criteria are weighted to determine the impact of an NBS intervention on the general objectives. This structuring is fundamental for a rational decision process under complexity assumption, and fundamentally determines evaluation outcomes. The NBS assessment framework developed in the Horizon Phusicos project relies on an analytical hierarchy.

In SES applications of MCDA, different approaches have played a role to support decision-making, including "*unweighted*" and *weighted summation* (e.g. Grêt-Regamey et al., 2013), *pairwise-comparison* (Oikonomouet al., 2011), and *ideal point approaches*, where specific optimal target values for the criteria are defined (e.g. Opricovic & Tzeng, 2007; Sanon et al., 2012). "Unweighted" and weighted summation is most commonly applied in landscape approaches, such as the INTERLACE *Spatial Screening* module (MIII), as it is easiest processed and very intuitive; however, it is less sensitive to issues of incommensurability. *Ideal point approaches* have also shown to be useful in this context as they allow accounting for spatial inequalities (cf. Velázquez et al., 2018; Langemeyer et al., 2020); they do not rely on a maximisation/minimization of criteria performance but allow defining specific target values, which might be variable in space and stakeholder groups. To the contrary, *pair-wise-comparison* and *outranking methods* allow accounting for incommensurability more explicitly and are useful when the assessment focus lies on visualising and accounting for conflicting interests. At the same time, they might be less intuitive for stakeholders, and in general less suitable for spatial applications due to high computational demands.

2. INTERLACE Assessment Framework

Demands for an integrated assessment of restorative NBS differ across cities and regarding different interventions within a city; thus, tailor-made assessment frameworks are required. **The INTERLACE Pilot Assessment Framework combines a step-wise, modular and hierarchical approach**. Step-wise, because a clear sequence of methodological steps is proposed for the evaluation of NBS; the step-wise approach guarantees rigidity and repeatability of the methodology. Modular, because single methodological stages are 'packaged' into separate modules, each of which can be applied as a stand-alone approach; the modular approach makes the framework flexible and adaptable to different planning situations. The different modules can be stepwise combined into a tailor-made assessment framework in line with the city-specific planning cycle and the specific needs for evaluation of restorative NBS. Finally the framework is structured hierarchically into different tiers (Figure 3); this allows breaking down the modules of the highest level (Tier 1, Figure 4) into sub-modules (Tier 2) and sub-sub-modules (Tier 3). The hierarchical approach helps to break-down and represent real-world complexity in a practical way. The step-wise and modular approaches are also applied at the lower hierarchical levels, which guarantees both rigidity/repeatability and flexibility/adaptability at all levels. Practitioners can create tailor-made assessment framework based on the modules (and sub-modules) most suitable to their NBS decision context, without the necessity to select all modules.

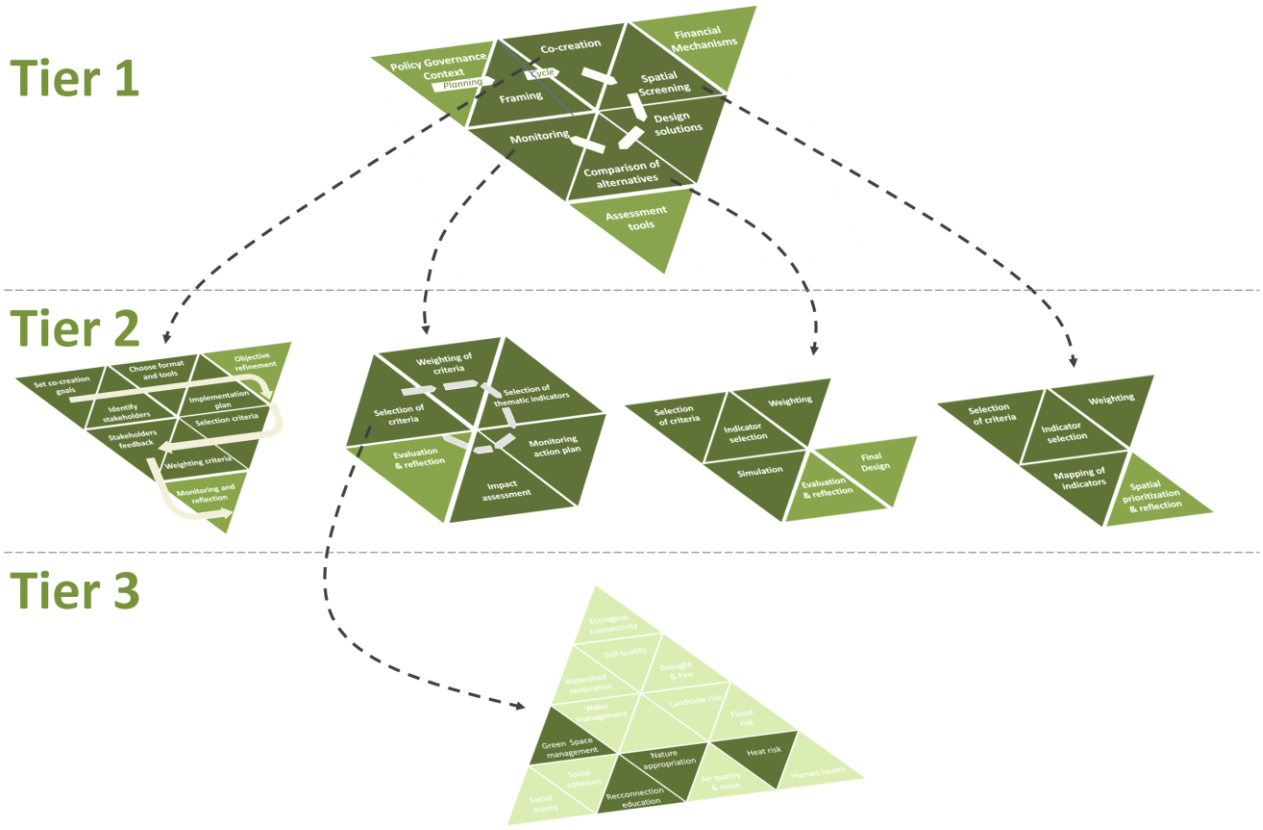


Figure 3. The INTERLACE Pilot Assessment Framework – Exemplary representation of hierarchical tiers (Note: not all sub-modules (Tier 2) and sub-sub-modules (Tier 3) are represented here). Tier 1 corresponds the entry poitn for creating a tailor-made assessment framework; one or more of the modules can be chosen. Each of the modules in tier one can be further devided into sub-steps represented by different sub-modules of Tier 2, and sub-submodules Tier 3.

The modular approach we present here supports cities in creating tailor-made assessment frameworks in different situations, while relying on the same general foundations. In Table 2 we describe the generic approach of the INTERLACE Pilot Assessment Framework. In what follows, we will provide a detailed description of each of the nine core modules (Tier 1, Figure 4), and related sub-modules (Tier 2 and Tier 3).

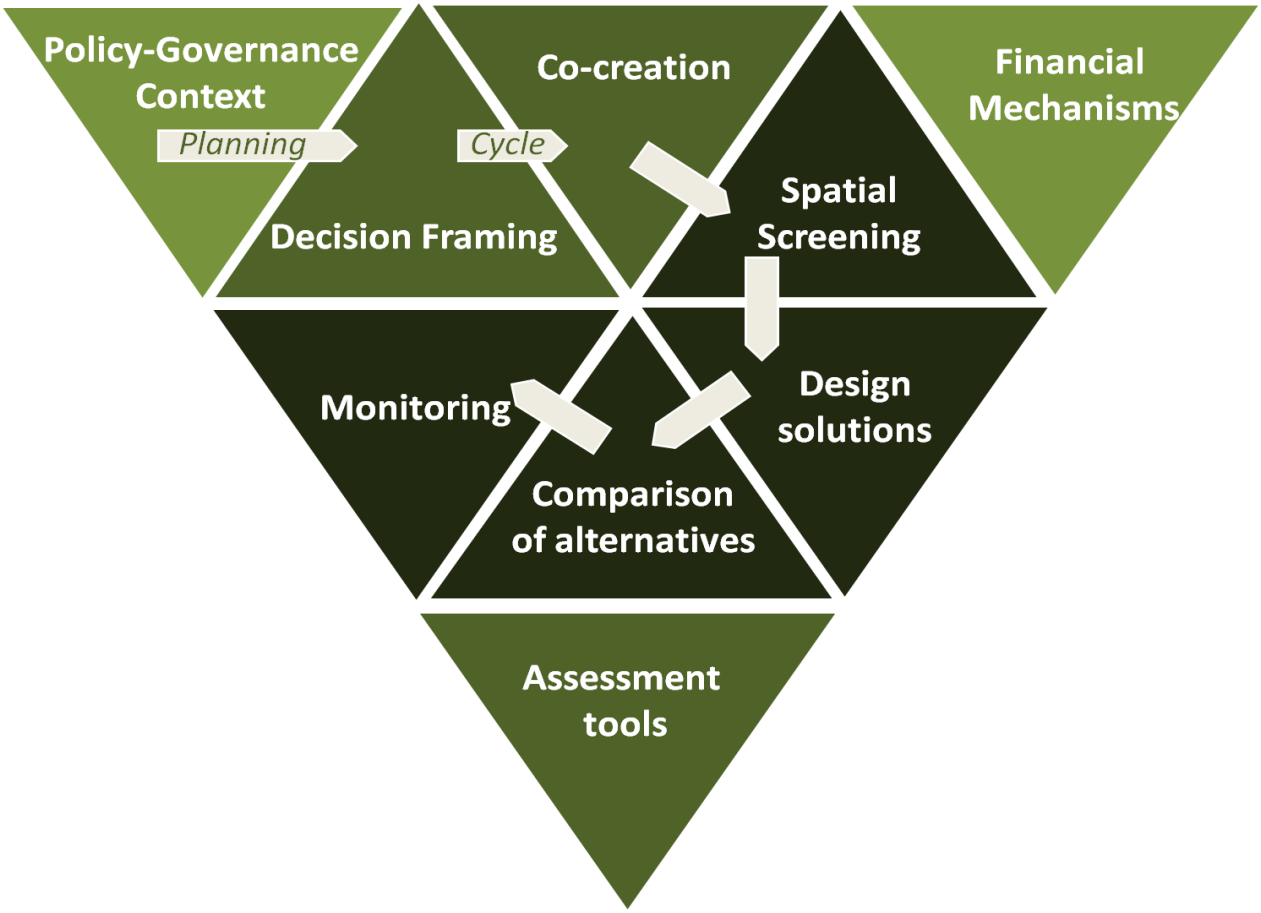
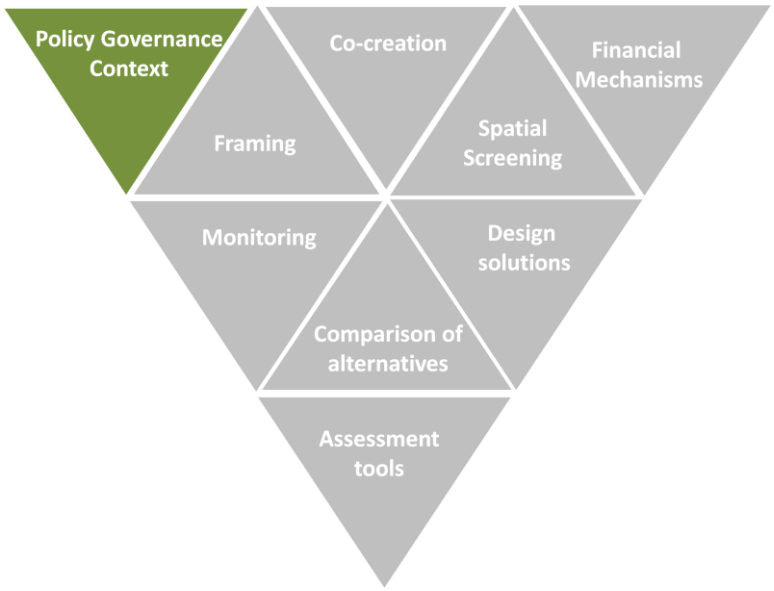


Figure 4. The INTERLACE Pilot Assessment Framework – Modules of Tier 1.

Table 2. Overview of first level modules (tier 1) of the INTERLACE Pilot Assessment Framework.

Module	Description
Module I: Policy-Governance Context	This module supports the coherent integration of restorative NBS within existing and new strategies and policies and appropriate governance approaches across multiple scales. Module I embraces a policy coherence analysis and the governance analysis.
Module II: Decision Framing	This module has to be addressed in order to conduct all following steps. However, the decision framing might already be pre-determined in a given NBS implementation context. Where this is not the case, we suggest dividing the decision framing into the sub-steps of pre-definition of scale, scale including considering cross-scale implications, and the identification of stakeholders.
Module III: Deliberative Co-creation	This module supports an inclusive stakeholder engagement process. Although specific planning contexts might constrain the level of stakeholder engagement, co-created NBS assessment frameworks are more meaningful and add legitimacy to the evaluation. We thus recommend applying this module in all cases, even if the depth of the engagement might differ from case to case. We define nine fundamental steps: the setting of co-creation goals, the identification of stakeholders, selecting the format and tools for engagement, developing an implementation plan, the objective refinement with stakeholders, and — underlying modules IV, VII and VIII — the selection of evaluation criteria, the criteria weighting, receiving stakeholder feedback, and monitoring and reflection.
Module IV: Spatial Screening	This module is generally addressing a wider scale (e.g. city or metropolitan area) and can support the definition of geographical priorities in the implementation of restorative NBS. As such, it may be used to develop NBS and green-blue infrastructure strategies; it may also help to identify socio-spatial inequalities, such as areas of stronger social-environmental risks or areas with lower access to ecosystem services. This module is structured into five steps, including selection of evaluation criteria, selection of indicators, weighting of criteria, indicator mapping, and spatial prioritization and reflection, including considerations of feasibility for NBS implementation.
Module V: Financial Mechanisms	Financial mechanisms encompass economic and fiscal instruments that can enable or disable NBS; at the same time, they are core for the implementation of restorative NBS. This module will be further defined over the course of the project in relation to the development of task 3.5.
Module VI: Design of NBS	This module builds on existing resources in order to provide examples of NBS. Design is characterised by the use of technical modelling, visualisation and simulation tools that facilitate the understanding of problems, feed the co-creation process and enable the potential impacts of the solutions studied to be assessed a priori, as well as their feasibility. The design module can be broken down into four sub-steps: design methodology, diagnosis, inspiration, and modelling.
Module VII: Comparison of NBS Alternatives	The proposed NBS evaluation approach considers multiple challenges, multiple evaluation criteria and peoples context-specific preferences, and provides a rigorous framework for the evaluation of different restorative NBS design alternatives/scenarios. This module is structured into a sequence of seven consecutive steps, including: the definition of alternatives/scenarios, the selection of evaluation criteria, selection of indicators, weighting of criteria, simulation (Impact assessment), evaluation and reflection.
Module VIII: Monitoring of NBS	This module provides a framework for ex-post evaluations of NBS intervention. This module is structured into six steps, including the selection of criteria, selection of thematic indicators, weighting, definition and implementation of the action plan, impact assessment, and evaluation/reflection of the results.
Module IX: Assessment tools	This module provides a catalogue of Assessment tools that can be applied across the previous modules.

2.1. Module I: Policy-Governance Context



- Policy coherence analysis
- Governance analysis

Understanding and analyzing the governance context of an NBS intervention requires to look at several aspects of governance such as the ongoing policy processes, the policy strategies and instruments (the policy mix) in place and their respective coherence, comprehensiveness, consistency, etc. (see Figure 5). It is also important to consider which dimension(s) governance will be looked at, whether it is within a certain policy field or sector (e.g. Tourism or Energy), at a certain governance level (e.g. at city or regional level), in a certain geographical area (e.g. a neighbourhood or along a river) or at a certain time (e.g. looking in the past or the future). Depending on the NBS intervention there may be a need to 'zoom in', in order to better understand specific governance aspects.

Implementing restorative NBS is seen as a promising pathway to address multiple local city challenges in parallel. To be successful, NBS require coherent integration within existing and new strategies and policies and appropriate governance approaches across multiple scales.

Policies provide a mandate to realize the ideas they hold and provide instruments (regulations, incentives, etc.) to support their implementation. Therefore, policies can effectively contribute to NBS by reflecting the concept, principles and/or ambitions. Simultaneously, governance processes should reflect the principles and ambitions of NBS. If NBS are considered to be multifunctional, equitable (fair), efficient (compared to gray interventions), and sustainable, then multi-sector, multi-stakeholder and multi-scale processes (to include multiple types of viewpoints, knowledge and expertise) are key for democratic, legitimate and transparent decision-making.

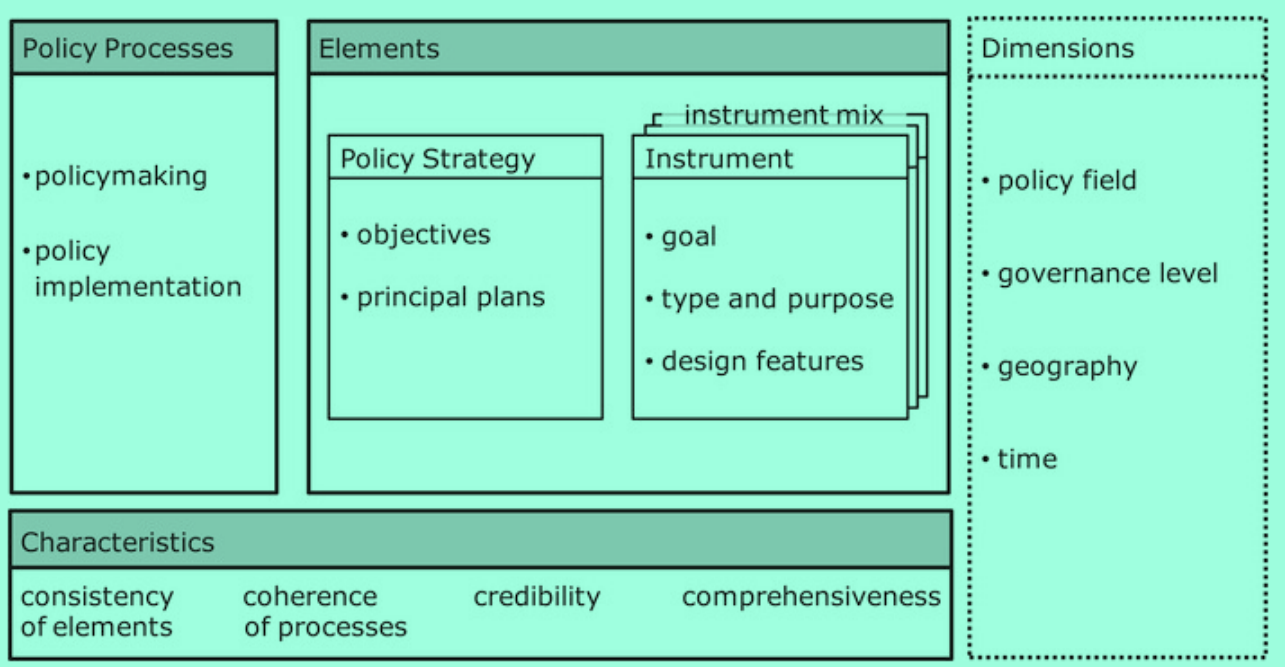


Figure 5: Building block of an (extended) policy mix (Rogge and Reichardt, 2016).

To implement sustainable ('long term') and effective ('does what it is planned to do') NBS, a good understanding of policy and governance contexts is important. Awareness of strengths or opportunities within policies, policy instruments or established governance mechanisms can be exploited to support the creation of NBS. Meanwhile, awareness of weaknesses, challenges or knowledge gaps can be taken into account or addressed while designing NBS (policies). Assessing current policies, policy instruments and governance approaches provide insights into local implementation processes in which new NBS initiatives will be embedded. INTERLACE applies a policy coherence analysis to assess the impact and coherence of policy instruments (2.1.1). Furthermore, INTERLACE analyzes current governance practices of the INTERLACE cities to gain an understanding of their approaches, challenges and needs for knowledge or tools to support NBS implementation (2.1.2).

2.1.1. Policy coherence analysis

Because they address multiple city challenges, NBS interventions tend to interact with a relatively large number of sectorial or cross-sectorial strategies, policies and policy instruments. A first step to get a better understanding of the policy context in which the NBS intervention is planned is therefore to assess how effective current strategies, policies and policy instruments are at achieving these city challenges and how well they function as a policy mix. The latter is important to emphasize as policy effectiveness has traditionally been studied by looking at how well single strategies, policies and policy instruments achieve their objectives. Interaction between policy instruments is then usually not taken into account. This creates a potentially flawed overview as certain policies or policy instruments might be succeeding in achieving the objectives they were designed for, but may also be negatively influencing the objectives of several other policies operating in the same context. This is, for example, often observed when looking at the interaction of species protection policies and recreation policies.

The multi-purpose and trans-sectorial nature of NBS interventions makes the analysis of single policy instruments redundant and inadequate. By analyzing them together in a policy mix, and looking where conflicts and synergies occur, we obtain a better understanding of their efficacy.

We can define *Policy Coherence* as an "attribute of policy that systematically reduces conflicts and promotes synergies between and within different policy areas to achieve the outcomes associated with jointly agreed policy objectives" (Nilsson et al., 2012). Said differently, policy coherence is essentially referring to how effectively different strategies, policies and policy instruments work together regarding a range of challenges or objectives in a given policy field or geographical area for example.

Policy coherence can be evaluated at three levels: 1) vertically (e.g. between EU policies and Member State policies), 2) horizontally (between several policy sectors at the same level or scale) or 3) internally (within the same policy sector) (see Table 2).

Vertical coherence will provide insight into how well top-down (or bottom-up) policy coordination functions. Horizontal coherence on the other hand typically helps to understand how well cross-sectorial objectives or challenges are addressed at a similar governance level. This for example is helpful to understand how sectorial policy institutions coherently work together or instead hamper each others' objectives. Finally, internal coherence helps to understand how different policies and instruments supervised by a given policy institution operate together.

Table 2. Examples of policy coherence levels. Adapted from Nilsson et al. (2012).

Horizontal	Vertical
City level climate change mitigation policy in relation to city level air pollution policy	National climate change policy in relation to city level climate change policy
City level employment policy in relation to city level urban agriculture policy	National agriculture policy in relation to city level urban agricultural policy
City level transport access policy in relation to city level air pollution policy	National transport policy with city level air pollution policy
City level water quality regulation policy in relation to local policies for soft recreation activities	International water quality policies (e.g. Water Framework Directive in EU) with city level water quality regulations

2.1.2 Governance analysis

There are various forms through which governments, civil society and/or the market sector collaborate in different constellations and power relations for land-use planning and decision-making (Figure 6). A trend seen over the last decades in land-use planning is that governance shifted from 'traditional public administration' (in which the government itself determines the issues, the solutions and which instruments are needed) to other forms of governance as the government was not always able to properly respond to certain issues. The complexity of issues increased and the government became more dependent on other stakeholders (for knowledge, expertise and/or resources), while a simultaneous increase in demand for more participation and democratisation in decision-making also

occurred. Nowadays, it is more often expected that a variety of stakeholders are involved in land-use planning (Cowell & Murdoch, 1999).

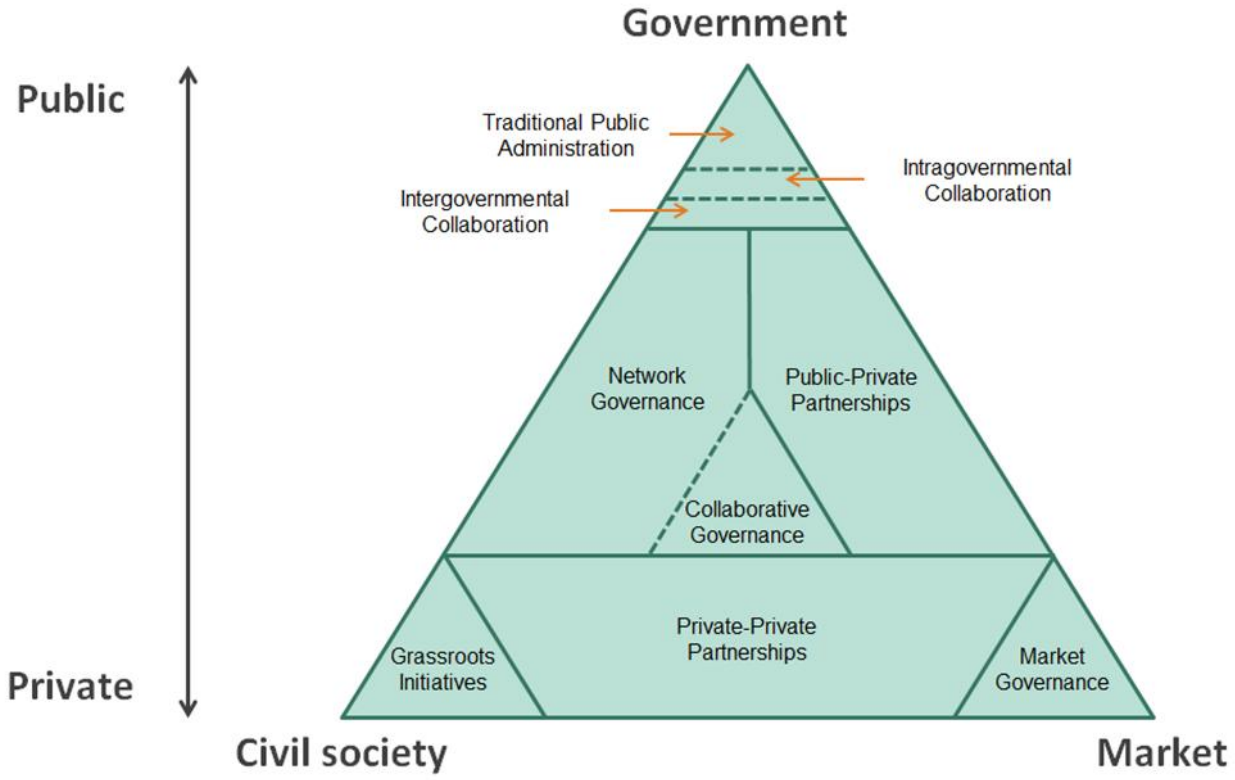


Figure 6. Governance triangle depicting governance forms in which public and private stakeholders collaborate in different constellations. Adapted from Nature 4 Cities (2019).

When the aim is to realize NBS with multiple benefits and to be equitable, it is especially important to have all relevant voices included in its policymaking and implementation processes. Leaving out voices risks leaving out peoples' needs and values, while compounding the risk of overlooking the wellbeing of those who embrace these values (Jax et al., 2013). Governance forms that allow or encourage collaboration between an inclusive range of relevant stakeholders are therefore considered to be more appropriate for the creation of NBS policies or projects.

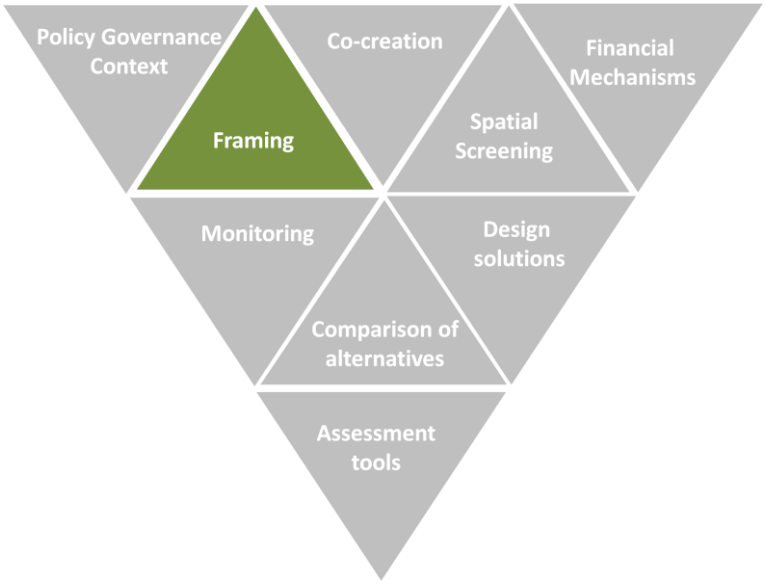
To support the NBS governance of municipalities, we focus on governance forms in which the government (municipality) is involved. Municipalities can lead or facilitate different governance forms depending on the scope and ambition:

- **Intragovernmental Collaboration:** a form of traditional public administration in which multiple departments from one municipality collaborate on cross-cutting themes. For example, local collaboration between a green space department, social department, mobility department and economy department on sustainability issues.

- **Intergovernmental Collaboration:** a form of traditional public administration in which multiple governmental agencies, possibly from multiple scales, collaborate on cross-cutting themes. For example, multiple municipal and regional administrations collaborating on green infrastructure.
- **Network Governance:** collaboration between stakeholders from the government, civil society and/or academia. Governmental roles can vary from leading to being a partner to facilitating.
- **Collaborative Governance:** a form of network governance in which market actors are involved besides stakeholders from the government and civil society. For example, upgrading a park with multiple uses in a city centre, collaborative governance might be the most relevant form through which the municipality, local inhabitants, civil organisations and local commercial parties (e.g., local producers, local cafés) collaborate on the planning and implementation.
- **Public-Private Partnerships:** collaboration between government and market actors. Usually, the government takes the role of partner. An example of when this governance form might be relevant is when the ambition is to increase NBS on industrial sites.

INTERLACE developed interview guidelines to gain an overview of current governance practices applied by cities for NBS policymaking, planning and implementation as well as associated governance challenges, supporting factors and tools and knowledge that can support improved governance (Leone et al., 2021. **D2.2 Governance analysis for planning and implementation of urban NBS**).

2.2. Module II: Decision Framing



- Pre-definition of challenges
- Scale and scope
- Identification of stakeholders

Decision Framing is a critical aspect in the assessment of urban SES. While stakeholder participation has been promoted to add legitimacy to decision making (Hauck et al., 2014), especially since the recognition of plural values (Kenter, 2016); the importance of decision-framing for inclusive urban planning has been often overlooked. In this context it is critical to question "the presence of equitable spaces of engagement (Martin et al., 2016) that determine who is involved with shaping the social, built, and ecological conditions of the city and how that involvement takes place". This embeds the challenge of identifying a diversity of priorities, knowledge and practical needs from a variety of interest groups, enabling the negotiation of contradicting and incommensurable values, and compromising professional experiences and political strategies with local stakeholders wishes and priorities. Participatory planning that integrates stakeholder knowledge strengthens public decisions by reducing blind spots and enhances locally attuned benefits (Shrader-Frechette, 2002) yet, the terms under which this participation takes place and the level of influence stakeholders have on the decision-making process will depend on the formal and informal rules and power structures that define the 'framing' of decision-making relative to existing norms (Scott and Oelofse, 2005). Thus, "enhancing procedural justice [...] requires not only the identification of different interest groups [...], but also an examination of the social-political and cultural context, institutions, governance structures, and power relations within which decision-making is taking place (cf. Dawson et al., 2018; Pascual et al., 2017)." (Langemeyer & Connolly, 2020). The wider framing of decision-making processes, for example in terms of established norms around who has better opportunities to participate in NBS planning as well as laws and regulation (e.g. Aragão et al., 2016) are determining the decision-framing and can set the boundaries for fair processes. *Decision Framing* influences the consideration of policy options and limits alternative choices in NBS decision-making (Opdam et al., 2015), and is, thus, likely to have profound importance for just NBS planning.

2.2.1. Pre-definition of challenges

Restorative NBS — as other projects — start with the initial definition of challenges to address and consequent specific objectives. It is important to make the initial challenges and specific objectives explicit, because they are a critical component in framing the decision-making. If the framing is narrowly focused on a specific challenge the assessment process will mirror this narrow focus and might lack in providing a holistic understanding of restorative NBS and their multifunctionality. If the initial objectives are broadly formulated the assessment is going to be wider, more holistic and also more inclusive, as a larger set of potential stakeholder preferences are taken into account. A broader set of objectives is also in line with multifunctional NBS whereby NBS multifunctionality might enhance adaptive capacities and ultimately the resilience of urban environments.

The INTERLACE project departs from an initial list of 15 objectives, in the project context defined as challenges. The 15 challenges that the INTERLACE project addresses are an outcome of the Joint City Forum held on the 4th and 5th of November 2020, where the 6 cities that are a part of the INTERLACE project participated (Knoblauch et al., 2021). The cities Chemnitz (Germany), Portoviejo (Ecuador), Granollers (Spain), Envigado (Colombia), Metropolia Krakowska (Poland) and Corredor Biológico Interurbano Maria Aguilar (CBIMA) (Costa Rica) discussed and identified their main challenges to be addressed through NBS. These are listed and defined in Table 3 below. Details about how the challenges are persistent in cities have been described in INTERLACE Project **D1.3 Summary report on the contribution of Joint City Forum to all WPs** (Knoblauch et al., 2021). While these challenges support a broad focus on restorative NBS, it is important to acknowledge that less and other challenges might be relevant in the specific NBS context this assessment framework is applied to.

Table 3. INTERLACE identified challenges and their definition according to the INTERLACE City Forum. Summarised from Knoblauch et al. (2021).

Challenge	Definition
Heat stress & heat island effect	Heat islands are urbanised areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas (Petsinaris et al., 2020).
Air quality	Urban air quality can be degraded by multiple factors such as fossil fuel combustion and the presence of particulate pollutants in the air from different sources.
Soil pollution	The presence of toxic chemicals (pollutants or contaminants) in soil is soil pollution. The cities have expanded because of industries and these landmarks in cities are also where brownfields sites exist. Other challenges like lack of environmental education and green space management can further deteriorate the condition of soil.
Water management (i.e. reuse)	The city of Granollers identified this challenge of water reuse, as it suffers frequent droughts and even constant water shortages in some periods. During these periods, rules can be applied to reduce water consumption for public (park watering, street cleaning, etc.) and even private uses (garden irrigation, swimming pools, industrial consumption, etc.). During periods of drought restriction, only alternative water resources can be used (water reuse, desalinated water, rainwater, groundwater, etc.) Granollers is one of the few European cities with a water reuse network for municipal uses, mainly for watering green areas.

Challenge	Definition
Watershed restoration and quality	Water resources, its watercourses and flows may be negatively affected due to uncontrolled and unplanned growth, poor management or due direct modification such as interruption with impervious structures, which in turn may affect immediate surroundings altering the existing flora and fauna.
Ecological connectivity	Ecological connectivity is defined as the ability of species' individuals to move in the landscape, in time and space, to meet foraging, migration or dispersal needs (LaPoint et al., 2012). Drivers such urbanisation, settlement in peri-urban areas, cultural preferences for grey infrastructure above green areas, result in fragmentation, and decrease in natural ecosystems' area and quality. INTERLACE cities identify the need to improve the quality of their green areas and hence their ecological quality and connectivity with the intention of maintaining and promoting biodiversity and nature conservation.
Green space management	Factors such as insufficient urban planning and public funding for urban green areas, lack or insufficient participatory nature conservation and management programmes, difficulties in changing paradigms about traditional green spaces and converting them into renaturalised spaces, coherent with the original ecological conditions of the region, both for urban planners and the general public, investment pressure (especially housing, but also commercial and industrial), and poor management in general threatens the continuity and functioning of the blue-green ecosystems
Drought and fire risk	The risk of drought in INTERLACE cities is associated with rising temperatures and inadequate soil permeability, in some cases combined with inappropriate practises (such as burning to increase soil fertility). In addition, climatic aspects cause periods of drought with a decrease or interruption in the supply of drinking water, which may also be related to the risk of fire.
Flood risk	The influence of climate change on the climatic variables of air temperature and precipitation has an impact on the water cycle and its components. For example, due to the predicted increase in heavy rain events, large discharge amplitudes can occur in the rivers within a very short period leading to flood risk. The indiscriminate deforestation and the filling in of riverbanks to create unsustainable building or recreational areas increase the risk of floods.
Landslide risk	In some of the INTERLACE cities this risk is caused by informal settlements that are vulnerable to landslides during the rainy season. Indiscriminate deforestation and filling of riverbanks to create construction or recreational areas has also been identified causing both flood and landslide risks.
Social cohesion	Social cohesion is a concept whose definition varies widely depending on the context in which it is used, and also by the fact that it can be considered from different interrelated perspectives, such as those linked to the individual and group level (Friedkin, 2004). The two INTERLACE cities that identified the challenges of social cohesion defined it as: the lack of collaboration between environmental groups, each of which manages its own topics; and also as the lack of social cohesion, which is the result of problems of territorial and spatial connectivity, indicating that spatial barriers and segregation limit access to the opportunities that a city can offer to different sectors of the population and hinder cohesion between citizens, which in turn triggers new socio-economic problems, such as an increase in criminal activities.
Social equity	There are numerous definitions of equity, including from the resources or material goods distribution to citizen participation (Meerow et al., 2019). These authors recognize three dimensions in the definition of equity, which contribute to the resilience of communities: distributive equity, which refers to the equitable distribution of goods, services and opportunities; recognition equity, which recognizes and respects the different groups or social structures contributing to equitable distribution and; procedural equity, which refers to the equitable opportunity for participation in decision-making processes (Meerow et al., 2019). It is important to note that disadvantaged population groups tend to live in neighbourhoods with less availability of green spaces (Braubac et al., 2017).

Challenge	Definition
Nature appropriation and stewardship	In some INTERLACE cities, a lack of citizen participation in territorial planning and environmental management was identified, as well as a lack of impact of environmental leadership groups in regional planning, resulting in a lack of appropriation of public spaces by the population.
Reconnection to the biosphere & environmental education	Lack of connection to nature and environmental education may lead for the cities' inhabitants to neglect the care and appreciation for the environment, having negative effects not only in quality of life and heath, but also in the environment itself. For example, by throwing trash into the riverbanks (CBIMA), representing an imminent danger to nature and neighbours.
Human health & wellbeing	The quantity and quality of urban green space affects the health of urban inhabitants. Lack of green space limits opportunities for physical activity and social interaction and thus reduces mental well-being. In addition, progressive urbanisation reinforces the adverse impact of climatic phenomena by reducing the area of green space, worsening the ventilation conditions of the city and increasing the extent and intensity of the urban heat island. Heat waves increase the risk of heat stress and heat-related deaths, especially for vulnerable people, and aggravate various health problems.

2.2.2. Scale and scope

An important sub-step of the framing is the definition of the principal scale to work at; this can be an entire Metropolitan Region or single site of an NBS intervention. Apart from the principal working scale, smaller and larger scales (n-1, n+1, n+2 etc.) shall be considered for being affected or for potential interrelations with the working scale. The consideration of smaller and larger scale relations will increase the potential for NBS to be successful particularly if different planning objectives are aligned across different scales.

In order to foster cross-scale considerations, we suggest conceptualising NBS as nodes within nested GBI networks (Langemeyer & Baro, 2021; Figure 7). These NBS nodes can be tailored to a particular challenge (which we assume is generally scale-dependent); yet, under consideration of its wider effects and functions at lower and larger scales within the GBI network. Considering the function of NBS (or the lack thereof) within multi-scale GBI networks also allows for a strategic prioritisation of NBS interventions in a landscape planning context (see also Module IV: *Spatial Screening*).

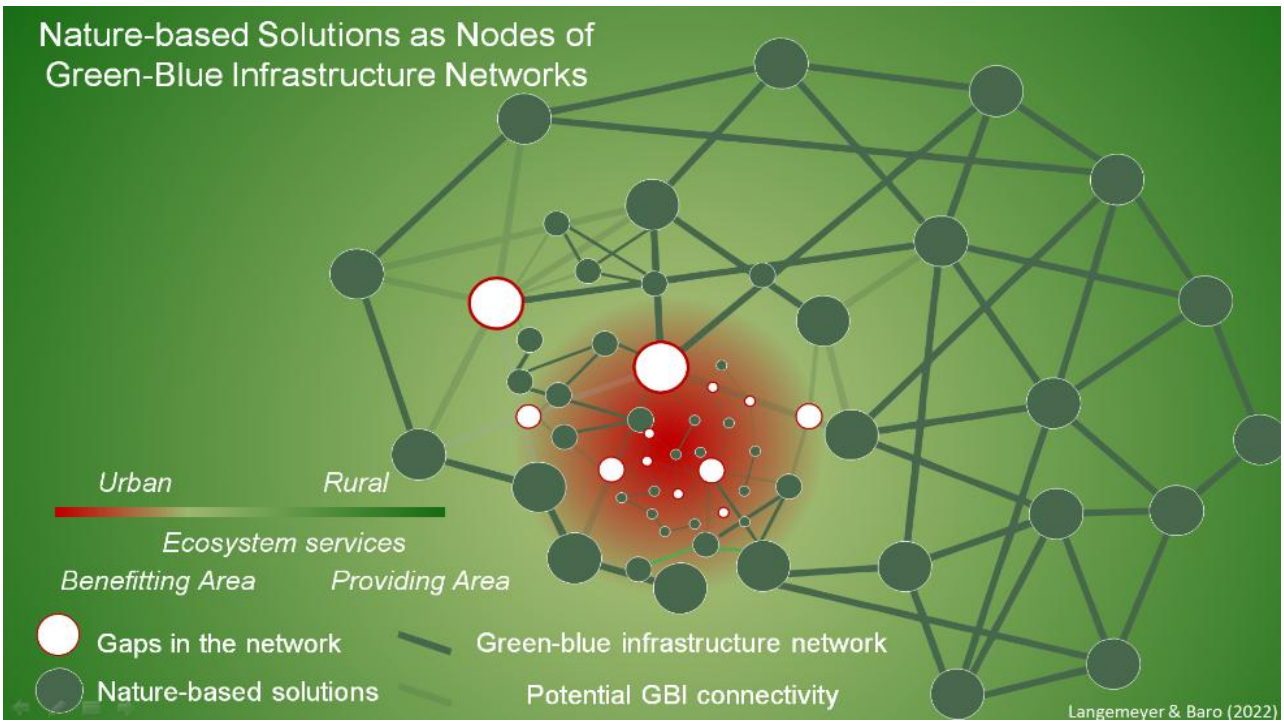
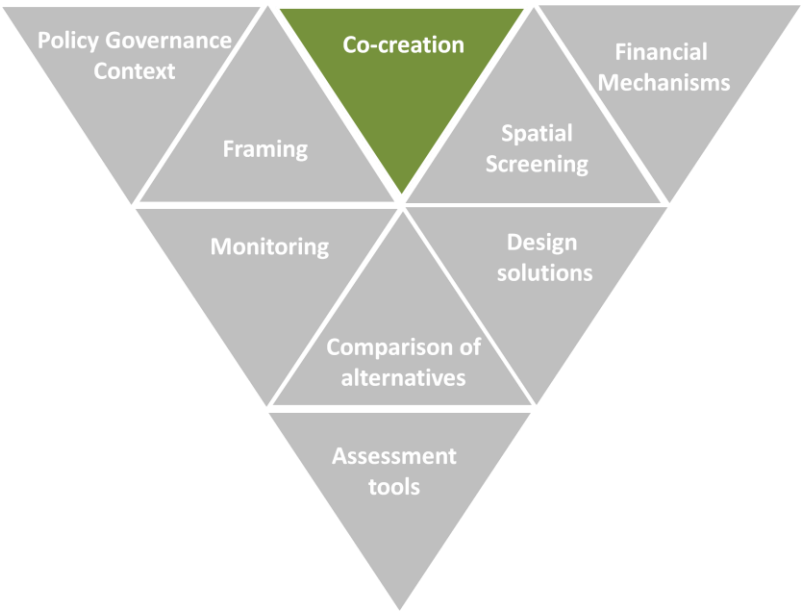


Figure 7. NBS (and the gap thereof) as nodes in Green and Blue Infrastructure networks across different scales (Langemeyer & Baro, 2021)

2.2.3. Identification of stakeholders

The framing of problems determines who is going to be involved in decision-making about them and how, which directly relates to the identification of the stakeholders that will be involved in the deliberative co-creation process. Mapping stakeholders allows identifying and structuring the stakeholder roles and their specific interests, impact, benefits and knowledge in such a way that each stakeholder is engaged differently (see Module III: *Deliberative Co-creation* for more details on stakeholder identification, roles and groups to involve and how to do it).

2.3. Module III: Deliberative Co-creation



- Setting co-creation goals
- Stakeholder identification
- Choose format and tools
- Develop an implementation plan
- Refinement of objectives together with stakeholders
- Selection of criteria
- Weighting of criteria
- Feedback from stakeholders
- Co-creation monitoring and reflection

We present the roadmap below (see Figure 8) as a stepwise approach to guide the creation and implementation of a tailor-made deliberative co-creation process for the assessment framework. The roadmap consists of nine steps, some of which are implemented within particular Tier 1 modules of the assessment framework and others are cross-cutting to all the Tier 1 modules. Depending on the user needs, some steps can be skipped; however, we generally recommend considering all steps when applying the INTERLACE Pilot Assessment Framework.

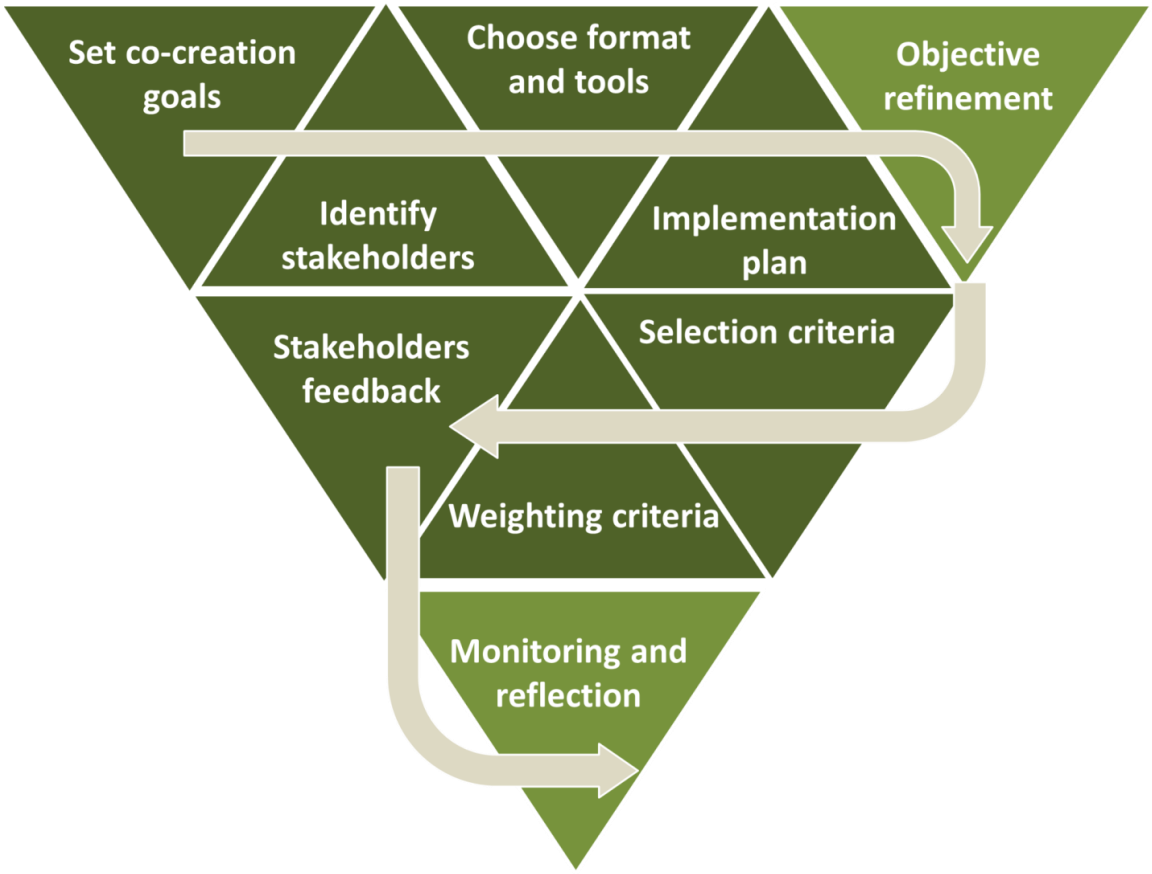


Figure 8. Roadmap to develop a deliberative co-creation of the assessment framework (Tier 2 of Module III)

When working with stakeholders and conducting a co-creation processes, unpredictability is inevitable (e.g. responses or reactions from participants during the engagement activity or changes in the political agenda). An iterative and flexible approach enables the process developer to adapt to unforeseen circumstances.

2.3.1. Setting co-creation goals

The first step is to define the goals of involving the different types of stakeholders in each of the modules of the assessment framework, which may include the provision of data, giving feedback, the development of new visions and strategies and the empowerment of citizens (among others). The goals influence which actors should be involved and the tools to be applied, for instance to empower the actors or to produce shared results. Stakeholders can be engaged for different actions in different modules of the assessment framework depending on the different stakeholders' roles (see Table 4 about stakeholder roles and calls to action) and each action should have its own objective. To help you define the goals of your stakeholder engagement, first decide which **stakeholder roles** and '**calls to action**' are most relevant to you, and secondly define what the **added value** of the call to action is. You can use the following formulation to help setting co-creation goals: "For the assessment framework, the -*stakeholder role*- will - *call to action* - in order to - *added value(s) of engagement".* See Leone et al. (2021) for examples of calls to actions linked to stakeholders' roles and examples of added values of engaging stakeholders roles.

2.3.2. Stakeholder Identification

The exercise to identify and map stakeholders allows to identify and structure the stakeholder roles and their specific interests, impact, benefits and knowledge in such a way that each stakeholder is engaged differently. It is useful to characterise stakeholders based on their role in the assessment framework and based on the group of stakeholders they belong to (Leone et al., 2021):

1. *Stakeholder roles*: stakeholders are grouped based on their role or function within the assessment framework. Five key stakeholder roles are considered (see Table 4). A single stakeholder can take up one or more of these roles (changing over the course of the assessment framework, or simultaneously during the assessment framework).

   Example: To adapt the pilot assessment framework to cities' needs, cities will be involved as shapers to make sure the end-results meet their expectations as an end-user. Also (academic) partners are consulted to identify a comprehensive list of tools that can be included in the assessment framework (shapers). A public institution that provides data to include in the assessment framework is an enabler. The interested public may be people who want to know and learn about the results of the assessment framework.

2. *Stakeholder groups:* stakeholders are grouped based on their profession, knowledge, expertise or background, and are also grouped based on matching needs or interests (see Appendix A: Stakeholder groups to involve in the assessment framework). The categorization of stakeholder groups uses a 'flat' hierarchy and does not list these groups in order of importance.

To identify the stakeholders groups, the following questions can be asked:

- Which groups are likely to be **affected** by the implementation of the NBS?
- Which groups are likely to be **interested** in the implementation of NBS?
- Which groups have **influence** or power over the design and implementation of the NBS?

When it is clear which stakeholder roles and groups are to be engaged with, specific stakeholders can be identified. When possible, try to be as detailed as possible by not only identifying organizations, but also (when applicable) relevant departments of that organisation and which individuals. To meet guiding principles such as inclusivity, we recommend going beyond the "usual suspects" and to further read on these considerations in the **INTERLACE Deliverable 1.6** (Øian et al., 2021). Additionally, identifying engagement benefits for stakeholders, or why it would be interesting for them to engage, and how to communicate with them, increases the likelihood of the stakeholders to engage. Engagement benefits depend on the role they are asked to play and the stakeholder group they are part of. Leone et al. (2021) identifies several examples of engagement benefits depending on the stakeholders' roles and groups.

Table 4. Stakeholder roles within the development of the assessment framework.

Role	Calls to action	Interest	Influence
Developers: stakeholders who are part of the development team of the assessment framework (usually project partners).	*To develop, to organise, to lead, to engage*	Invest knowledge / expertise for research and real-world applications	Determines the vision and application of the assessment framework
Shapers: stakeholders who provide input and feedback on the assessment framework	*To review, to consult, to advice, to co-create, to test*	Share (local) knowledge / expertise for tailor-made assessment framework (increase usability and impact)	Can steer the design of elements within the framework
End-users: stakeholders who use the assessment framework for real-world applications outside the project	*To use, to implement, to apply, to decide, to learn, to exchange knowledge, to participate, to partner up*	Use of the assessment framework to support the realisation and knowledge exchange of NBS	Real world application of the assessment framework
Enablers: stakeholders who are capable of helping the assessment framework to reach and engage a diversity of other audiences, or to achieve other desirable impacts (e.g. promoting and disseminating the assessment framework) Have significant social capital and standing in a community.	*To enable, to provide data, to give mandate, to connect, to mediate, to disseminate, to promote*	Provide the enabling environment for conducting the assessment framework.	Allows hard to reach communities to take up a role (developer, shaper end-user, enabler, public) within the project Can provide data and incite communication and collaboration, with (local) hard to reach groups such as youth, elders, migrants, women, etc.
Interested public: stakeholders who can generate 'bottom-up' support for the assessment framework, and help translate the results to other stakeholders (improved understanding, increased relevance)	*To learn, to be informed, to raise awareness, to have access to.*	Learning about the assessment framework and NBS in general	Awareness raising (e.g. by sharing the results of the assessment framework)

2.3.3. Choose format and tools

Specific co-creation tools and formats facilitate each step of the process towards desired goals. See Module IX 'Assessment tools and thematic indicators' for a broad list of possible tools for co-creation processes. The choice of tools and formats depends on the goals of the co-creation process, on the specific co-creation step and on the type of actors involved (see Table 5, based on Leone et al., 2021).

Table 5. Engagement formats depending on stakeholders roles

Role	Format
Shaper	Workshops, focus groups, interviews, questionnaires, e-mails
End-user	(Network) events, conferences, written media
Enabler	E-mails, (video-)calls, one-on-one meetings
Interested public	Written media (magazine, newspaper, report, etc.), social-media, video, posters, public events

There are multiple considerations to take into account when deciding on the appropriate format of stakeholder engagement processes. See Table 6 for a summary based on Leone et al. (2021). It is important to get familiar with good practises to engage with stakeholders, such as to avoid scientific / technical jargon when engaging, to plan the co-creation process carefully, to be prepared to modify processes as circumstances dictate, to be transparent and honest. See Leone et al. (2021) for an exhaustive list of general good practises for engaging with stakeholders. Due to the unpredictable nature of engagement activities, certain risks may occur, such as that everyone involved is risking their reputation, promised outcomes may not be delivered, and political 'hijacking' may occur (see Leone et al. (2021) for a list of potential risks of engaging with stakeholders useful to bear in mind).

Table 6: Considerations to choose formats and tools

Socio-cultural considerations	Will the stakeholders feel comfortable/safe with the chosen format? Stakeholders can be approached separately or through different formats if there are any potential sensitivities, conflicts, strong power-relations or instances of discrimination. For example, when there are risks of conflict, or in case you want to engage with marginalised stakeholders, bilateral engagement may be better suited to ensure all voices are openly heard in a safe environment.
	Consider how to overcome language barriers (translations and non-technical language).
Organizational and logistical considerations	Location: the choice of venue, outside location or online platform can have positive or negative potential effects on the engagement process and its outcomes, so give this appropriate consideration.
	Timing: are there any other interventions, projects, programmes, campaigns ongoing or planned that could interfere or be linked?
	Adjust the format to the time stakeholders have available.
	Be mindful of different time zones.
Resources - what is necessary so stakeholders can be engaged meaningfully	Availability of time, staff, budget, equipment, capacity (skills/knowledge) - does this match with the goals and ambitions?
	Do all stakeholders have resources to be able to participate? If not, are there ways to provide these resources? E.g. a bus-ticket to the venue, access to phone, computer, stable internet.
Health considerations	Is it possible to organize engagement activities (with restrictions) or should online alternatives be considered?

Moreover, it is important to consider that processes of co-creation require the right leadership to be successful whereby leadership can navigate in conditions of shared power and voluntary engagement, where participants cannot be ordered to collaborate but must be convinced of the merits of collaboration. Ansell and Gash (2012) highlight three leadership roles that are important to facilitate

collaboration: that of the steward, the mediator, and the catalyst. The steward is particularly important in the initial phases of a collaborative process, as the role that establishes and maintains the integrity of the process itself. The steward is perceived as neutral, ensures inclusivity and transparency, and moves the process forward. The mediator acts as a conflict manager and arbitrator, who nurtures relations and builds trust among the participants. The catalyst seeks out and communicates opportunities for value creation and mobilises participants to pursue these opportunities.

2.3.4. Develop an implementation plan

The implementation plan is a logical order of your planned engagement activities, their objectives, who to engage with and through which format. When developing your implementation plan, it is important to consider that co-creation processes involve four components that need to be addressed simultaneously if co-creation is to become a social learning process for the participants (Schauppenlehner & Penker, 2015): each individual with specific interests and needs (I); the interaction and relations between the participants (We); the theme or purpose of concern (It); and the framework, environment, conditions and circumstances in which collaboration occurs (Globe).

In order to plan accordingly, it should be made clear in which order your engagement activities need to be done. One engagement activity might be dependable on another. Set out an overall timeline with an estimation of dates, and be realistic about how long things take. Always allow more rather than less time for planning and for people to get involved (time is needed between events for work to be completed and to be taken to the next stage). The implementation plan is not fixed. Rather, it should be updated after new insights occur during review (self-reflection or input from stakeholders) of each engagement activity. Be sure that the following is communicated clearly to the stakeholders prior to the engagement activities or at the beginning of them (based on AcountAbility, 2015):

- Introduction to the INTERLACE project and the engagement activity;
- The aims/goals of the engagement (call to action + added value);
- What is expected from them (including time investment);
- The benefits to the stakeholder (benefits role + group);
- The planned engagement process (format + timeline);
- Logistical and practical information about the engagement. It should be clear to the stakeholder who has the decision power, what is done with their input and how binding their input is.

2.3.5. Refinement of objectives together with stakeholders

Stakeholders refine the goal and purpose (the “why”) of the NBS intervention. If possible, the refinement of the goal is developed through research on the social context, including socio-ecological needs and expectations of stakeholders. A possible way of refining the goals of the NBS intervention is in the form of “user stories”: through dialogue you map out who the stakeholders are, what they expect from the intervention and why (more on user stories in Mortelmans et al., 2021, **D1.1 Agile guidance**). It is important to acknowledge objectives broadly, and minority objectives should not be outweighed.

2.3.6. Selection of criteria

In order to create a common understanding of the base of the evaluation, the battery of criteria must be agreed upon by all relevant stakeholders (although their relative importance "weights" might differ from different stakeholder perspectives). There are different ways of selecting the criteria in a participatory way. We propose here a possible 'best practice' approach: First, conduct semi-structured interviews to relevant stakeholders to identify relevant criteria. Stakeholders are asked to "free-list" the criteria they perceive as relevant for the evaluation of NBS. Once an initial list of criteria is obtained, they are prioritized by means of a survey conducted with a larger sample of stakeholders. Survey participants are asked to express their level of importance of criteria on a Likert scale, distinguishing importance levels as "high", "substantial", "small" and "negligible". Likert scale rankings are an established tool for the social-cultural valuation (e.g., Maestre-Andrés et al., 2016; Langemeyer et al., 2018), which in our assessment framework are the criteria to assess the NBS. The final list of evaluation criteria encompassed all criteria identified as ''most important" by at least 40% of the survey respondents. As a final step, a workshop can be conducted to discuss and propose additional criteria. An alternative (less sophisticated) option is to organise a workshop where criteria are proposed by stakeholders and later prioritized in a deliberative way to obtain a final list of criteria. A participatory selection of criteria requires defining criteria in a tangible and intuitive way, and to limit technical or scientific jargon. The exercise to select criteria takes place in Module IV (*Spatial screening*), Module VII (*Comparison of NBS alternatives*) and Module VIII (*Monitoring*).

2.3.7. Weighting of criteria

Allowing different stakeholders to attribute weights to each criterion allows considering specific stakeholder preferences. Weighting each criterion determines with which power each criterion relates to the overarching objective(s) of the evaluation. We propose to organise a workshop where each stakeholder individually attributes weights to each criterion. The weighting can, for example, be carried out on a five-point Likert scale, distinguishing between "no importance", "low importance", "medium importance", "high importance" and "very important". The answers are then normalized into numerical weighting factors between 0 and 1. "No importance" renders a weighting factor of 0.00, "low importance" a weighting factor of 0.25, "medium importance" of 0.50, "high importance" of 0.75, and "very high importance" of 1.00. The final weights used in the evaluation can be established as average values across all workshop participants (see Langemeyer et al., 2018 for a practical example), or different weighting schemes can be used to highlight potential trade-offs between NBS alternatives/scenarios. It is important to note that the weights need to be elicited with reference to the range of variations of the criteria that occur in the specific decision problem. The weighting of criteria takes place in Module IV (*Spatial screening*), Module VII (*Comparison of NBS alternatives*) and Module VIII (*Monitoring*).

2.3.8. Feedback from stakeholders

After each engagement activity, it is recommended to collect feedback from stakeholders on whether the engagement fulfilled the aims of the stakeholders, their views on the engagement process and its outcomes. Appendix B provides examples of questions that can be used to collect this feedback. It is also recommended to keep the participants informed on the progress of the project. This communication should include what happened during the engagement activity, what the engagement outcomes are, how stakeholder input is incorporated and what the next steps are. Once the outcomes

of a module (e.g. the evaluation) are available, discuss them with stakeholders in a joint workshop. Use the potential of MCDA to open up discussion among stakeholders rather than to close it down. For the discussion, we recommend dividing stakeholders among heterogeneous break-out groups, each group with a facilitator to keep notes of the discussion results. Several topics can be addressed in this final discussion (see Langemeyer et al., 2018 as an example). Keeping (transparent) contact with your stakeholders increases participation in the following activities. Follow-up communication can happen through different means, e.g. a document with minutes, a report, a separate info-session, an email or phone-call, a website, a newsletter, etc.

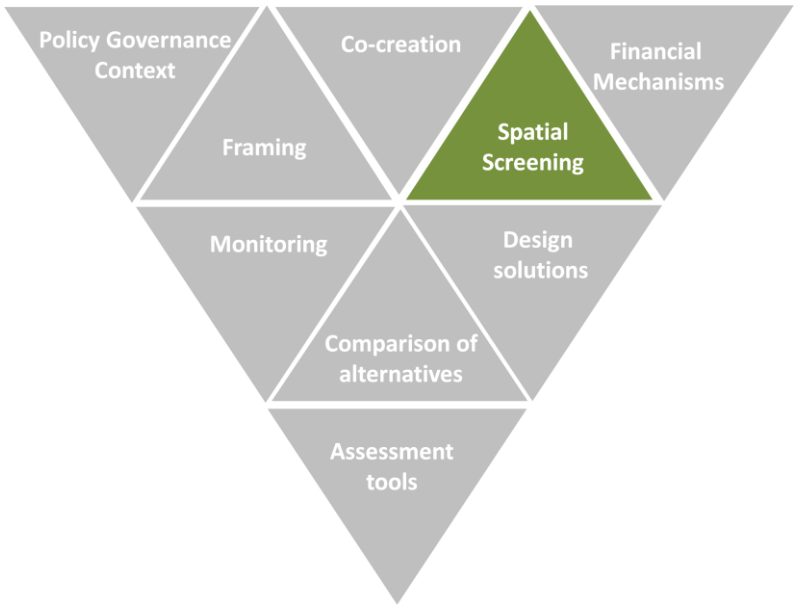
2.3.9. Co-creation monitoring and reflection

The monitoring focuses on assessing the effectiveness, impacts and outcomes of the engagement process. The following aspects can be evaluated using the questions we propose (based on Durham et al., 2014):

- The success of the engagement: Have the co-creation goals been met? Did all relevant stakeholders attend the engagement event? Who was missing?
- The process of engagement: Were the tools and format selected appropriate? Were the costs reasonable? What worked well and less well, and why? What lessons could be learned to improve the co-creation of a particular module or the assessment framework?
- Impacts of the engagement: What impact has the process had on the stakeholders and also on the research? Have there been any unexpected outcomes?
- Social robustness and transformative capacity of outcomes of the assessment framework: Social robustness (Polk, 2015) refers to the usability of results and outcomes. In the context of the assessment framework, it refers to a high degree of relevance, effectiveness and user accessibility of the assessment results as assessed by the involved participants and targeted user groups. Socially robust results can include a variety of non-epistemic results such as increased mutual learning, trust, new relationships and partnerships, shared enhanced knowledge of participants, knowledge and learning across user groups, and increased ability to work together and articulate joint goals.

The feedback collected from stakeholders in 2.3.8 is integrated in the corresponding aspects to monitor. There is an on-going reflection along the implementation of the assessment framework of the choices that are made when identifying and integrating diverse values, priorities, worldviews, expertise and knowledge from diverse stakeholders.

2.4. Module IV: Spatial screening



- Selection of criteria
- Indicator selection
- Weighting
- Mapping of indicators
- Spatial prioritization and reflection

The ***Spatial screening*** module may help to prioritize intervention areas for restorative NBS based on social-ecological riskscapes, and supports the development of strategic NBS planning. The module supports the definition of geographical priorities in the implementation of restorative NBS, based on socio-spatial inequalities, such as areas of stronger social-environmental vulnerability, or areas with lower access to ecosystem services. The module follows an *analytical hierarchy* development (Saaty, 1980) to break down complexity, while maintaining transparency.

NBS can provide multiple ecosystem services and support resilience building in the face of multiple societal challenges. For example, NBS can buffer extreme events such as floods and extreme heat, while providing multiple opportunities for human recreation. However, vulnerabilities, for example to climate change, are not evenly distributed across space and societal groups (Langemeyer & Connolly, 2020), which requires a more nuanced understanding of where and who lacks access to ecosystem services.

Riskscapes, describing social-ecological vulnerabilities are conceptually related to resilience and environmental justice. Accordingly, vulnerability can be defined as exposure to social and environmental risks and the difficulty of individuals, groups or ecological systems to adapt to changes in the environment. Environmental risks show uneven spatial patterns (Queiroz et al., 2021); the assessment of different riskscapes, such as heat exposure and flood risk, thus supports planning to improve environmental resilience. In addition to environmental risks, related social risks need to be taken into account. Social risks are related to demographic attributes such as income, age, gender, ethnicity, race and origin (and their combinations) that also show different spatial patterns. A combined understanding of the spatial distribution of environmental and social risks determines the socio-ecological vulnerability of a specific area. Reducing this vulnerability through NBS is thus improving both resilience and equity. This module is structured into a sequence of five steps that build upon one another (Figure 9).

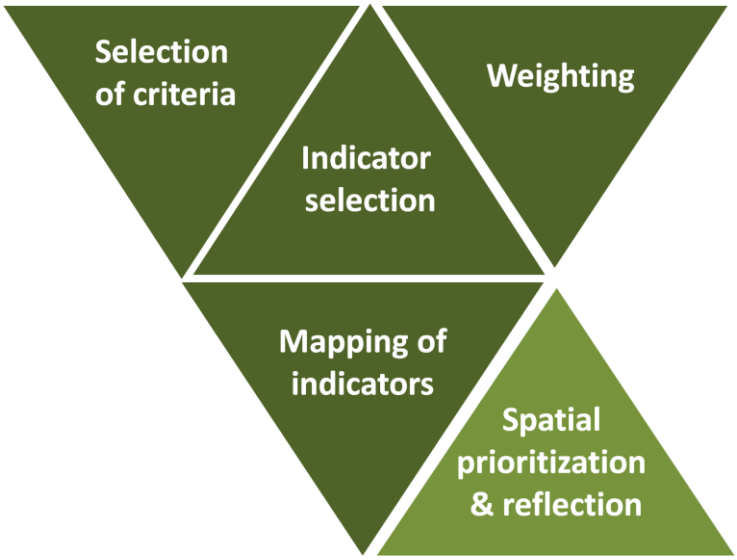


Figure 9. Steps to develop a spatial screening (Tier 2 of Module IV)

2.4.1. Selection of criteria

Following an analytical hierarchy process, the selection of criteria is closely linked to the **overarching challenges**. Evaluation criteria are the operationalization of these challenges. The overarching objective(s) stem from the decision framing **(see Module II)** and are closely linked to the co-creation process (see **Module III**) and the consideration of different stakeholder needs and wants. The establishment of evaluation criteria helps to break down abstract objectives (here 'challenges') into concrete goals. It is strongly recommended to conduct the selection or definition of criteria under consideration of, or in collaboration with key stakeholders (see **Module III**: *Deliberative Co-creation*). Each criterion is further defined through indicators (see 2.4.2) and criteria weights (3.4.4).

2.4.2. Indicator selection

Indicators are linked to the evaluation criteria in order to make them measurable. Each criterion requires at least one **spatially explicit indicator** (there is no upper limit for the number of indicators, neither must the criteria have the same number of indicators). In addition, relative numerical impact factors of the indicators in relation to the criteria must be established; impact factors can — but do not have to be — of equal magnitude but always have to sum 1 (in case of a single indicator attached to a criterion the impact factor is = 1). The indicator selection is in general less sensitive for the final evaluation; an expert approach might therefore be justified, especially when working with lay stakeholders and if the selection and weighting of evaluation criteria has been 'legitimized' through a stakeholder engagement process (see **Module III***: Deliberative co-creation*). Yet, even an expert-driven indicator selection shall be based on the state-of-the-art literature; it might further be backed up by a deliberative approach among experts, for example applying the 'Delphi method'.

2.4.3. Weighting

In MCDA, weights are understood as **relative importance**. The analytical hierarchy approach followed here supports an explicit consideration of weights at each hierarchical level; weights determine, with

which power single indicators influence evaluation criteria and, with which power each criterion relates to the overarching objective(s) of the evaluation. The establishment of weights in an explicit way helps to make the assessment framework more transparent and replicable. Yet, weights may differ with regard to the study context, and different stakeholder groups. Through weights, diverging or even conflicting viewpoints can be articulated and operationalized in the assessment framework.

The elicitation of criteria weights is generally conducted through individual surveys or (preferably) through deliberative group exercises (e.g., Karjalainen et al., 2013; Srdjevic et al., 2013; Zhang & Lu, 2010; Zia et al., 2011). The establishment of weights parallels the selection of evaluation criteria and the selection of indicators. The establishment of criteria weights is strongly recommended to involve stakeholders, while the establishment of 'indicator weights' (= impact factors) is somehow a more technical task that might require a certain level of expert knowledge.

2.4.4. Mapping of indicators

The impact assessment consists in the creation of a series of spatial maps. The mapping exercise follows the analytical hierarchy: Starting with the mapping of indicators; weighted indicators are merged into criteria maps. Finally, the weighted criteria maps are aggregated into an aggregated vulnerability map (see Figure 10 for an example). The indicator mapping can rely on a broad diversity of approaches. There are relatively simple mapping approaches, such as ESTIMAP (Zulian et al., 2013), as well as complex modelling approaches, such as the hydro-environmental modelling through the SWMM model to estimate stormwater run-off. Other potentially helpful tools include SUSTAIN (Lee et al., 2012), SUDSLOC (Viavattene and Ellis, 2013), BeST (Digman et al., 2016), and Spatial Suitability ANalysis Tool (SSANTO); for a broad selection of tools see **Module IX**: *Assessment tools and thematic indicators*.

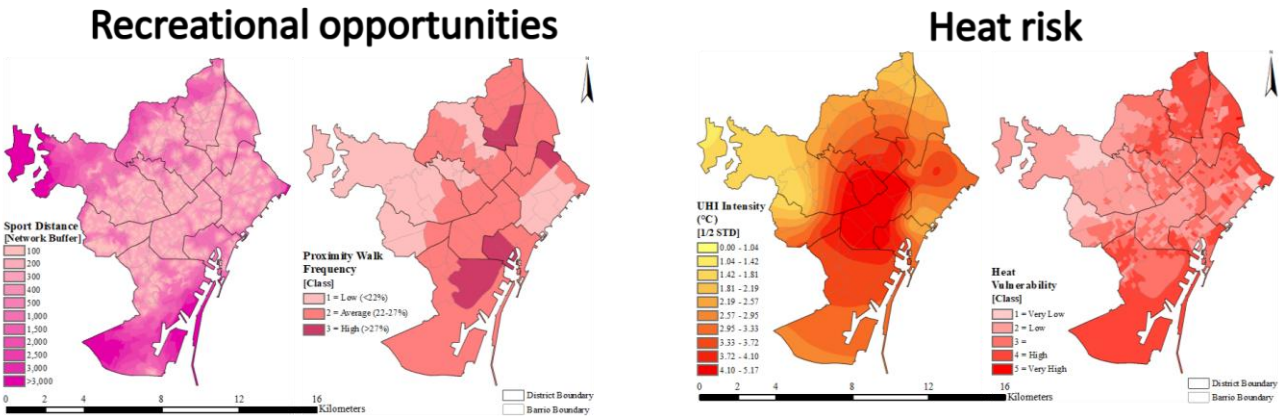


Figure 10. Indicator maps across different criteria for the City of Barcelona (Langemeyer et al., 2020)

2.4.5. Spatial prioritization and reflection

The spatial evaluation is based on the aggregation of the different criteria in a single model (see Figure 11 for an example). MCDA offers different integration models. *Weighted summation* or *value functions* are the simplest model to integrate different criteria. To apply a weighted summation, first, a normalized evaluation matrix is produced, where all criteria are expressed in the same value range (typically, between zero and one). Weighted summation is adding the normalized performance scores of each

criterion multiplied by the weighting factor across all criteria (e.g. Grêt-Regamey et al., 2013). Under certain assumptions (see e.g. Keeney & Raiffa, 1976), one can use an additive model to obtain the overall values for each alternative by multiplying the criteria-wise performance scores with corresponding criteria weights and then summing them up (Saarikoski et al., 2016). (Note: even if weights are not explicit, putting criteria in relative importance to one another does not always mean to weigh them; *simple summation* can be understood as considering implicitly equal weights between the criteria).

An important advantage of weighted summation, especially when working with lay stakeholders, is its intuitiveness and simple understanding. It avoids "black-box" effects often described for MCDA exercises, where assessment results are not transparent and comprehensive for the stakeholders. On the other hand, it bears the risk of oversimplification and it allows single criteria to be fully traded-off (being compensated by others); this is especially problematic when stakeholder interests strongly diverge and conflicts are given about incommensurability of single criteria (Saarikoski et al., 2016).

An alternative and also widely used spatial aggregation approach is given by *ideal point models*. Differently from weighted summation, ideal-point approaches do not simply aim for maximization of the criteria, but allow for determining specific target values for each of the criteria (e.g. Sanon et al., 2012). In these cases more complex integrations are recommended. Specifically designed weighting exercises can support the definition of spatially differentiated target values, a recent example has been provided for Oslo (https://nina.earthengine.app/view/green-roof-mcda, Venter et al., 2021). The additional mapping of NBS implementation potentials can further support the final reflection process on spatial screening and development of spatially explicit transformation strategies, in the face of NBS feasibilities.

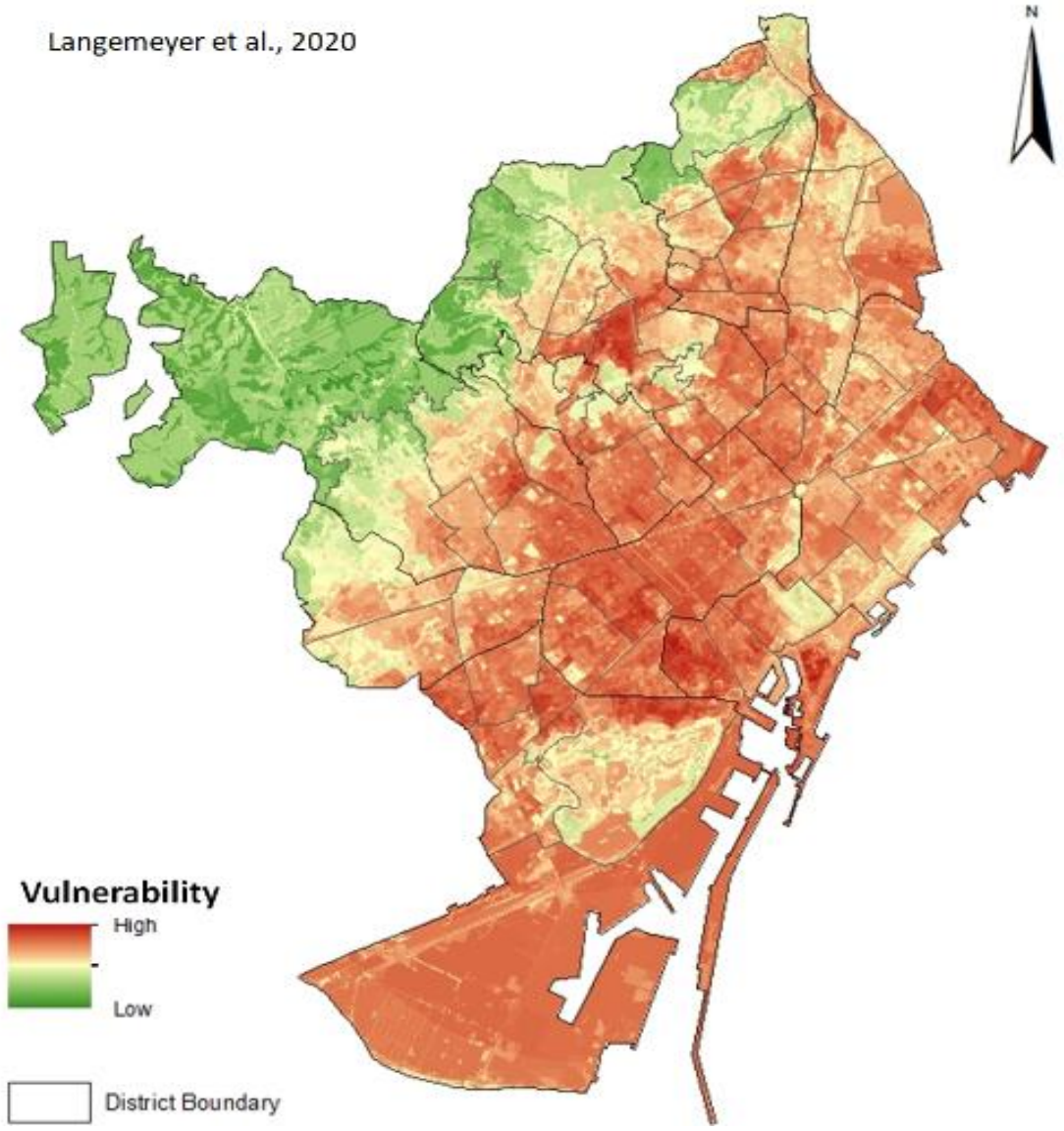
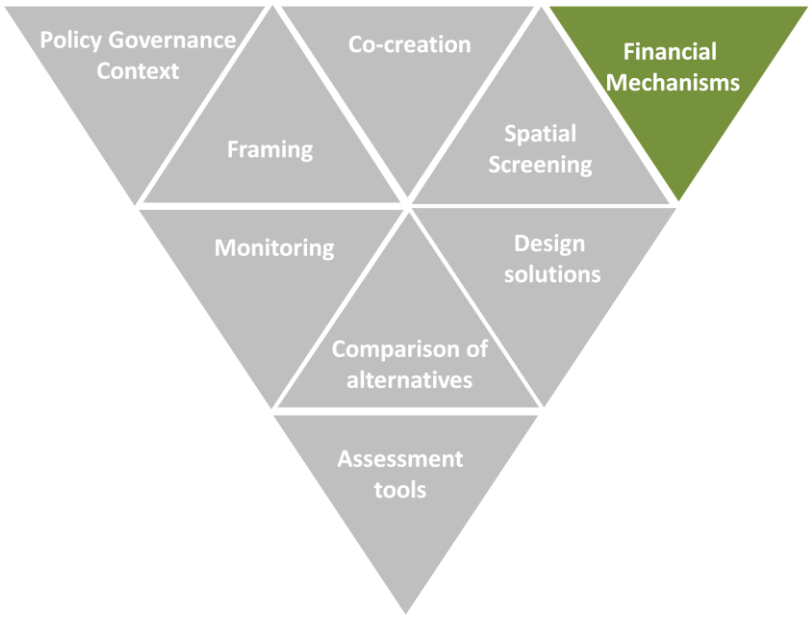


Figure 11. Aggregated vulnerability map based on weighted summation of evaluation criteria for the City of Barcelona (Langemeyer et al., 2020)

2.5. Module V: Financial Mechanisms

Note: The development of Module V is at a very early stage, this module will be developed further over the course of the INTERLACE project and towards the final version of the INTERLACE Assessment Framework.



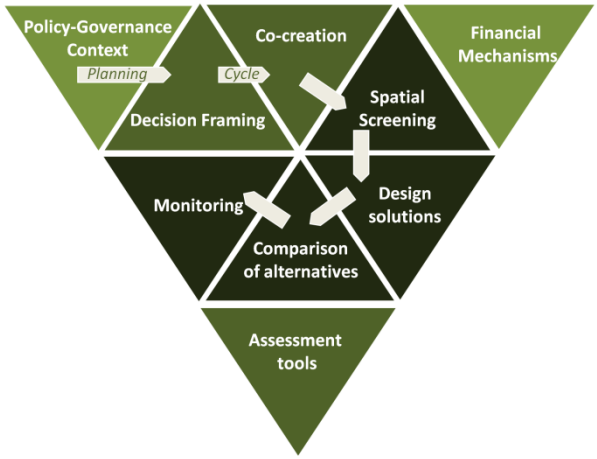
Financial Mechanisms of NBS enable NBS implementation and are analysed through exogenous or endogenous frameworks (Figure 12). An initial framing regards financial mechanisms as a constraint or an exogenous incentive facing the actors implementing NBS. A second framing includes financial mechanisms as an endogenous or internal component to the nature-based solution design and implementation.

Alternative framings may determine (i) the scope of what we consider financial mechanisms and (ii) how we choose to classify and analyse them. In general, we are looking for public policy instruments that enable private financial feasibility of NBS through (see Table 7 for examples):

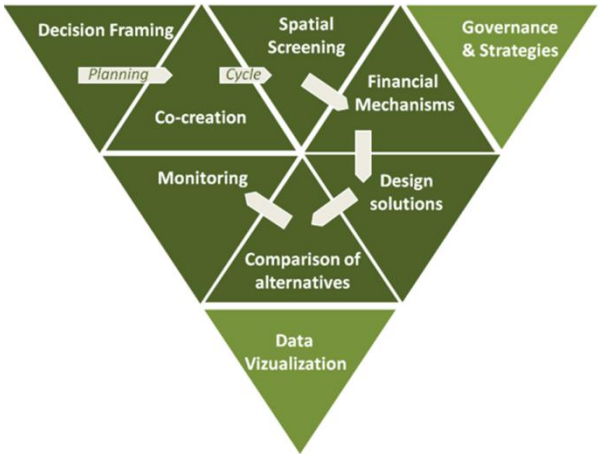
1. Increasing direct or transaction/indirect costs of alternatives to NBS
2. Decreasing transaction costs (e.g. simplification of administrative procedures)
3. Decreasing direct NBS implementation costs
4. Increasing revenue streams

Table 7. Examples of relevant types of public policy instruments for private financial NBS feasibility. Based on examples from Oslo.

Policy instrument	Financial mechanism	Policy instrument Type	Business case example
Municipal stormwater run-off fee	Increasing costs of alternatives to NBS	Economic and financial instrument	Oslo demonstration project Barton et al., 2021
Municipal reverse auction subsidy for NBS	Decreasing direct NBS costs	Economic and financial instrument	Minimum cost subsidy for rain barrels in Oslo Furuseth et al., 2021 Wilkerson et al., 2021
Municipal subsidies for urban agriculture	Decreasing direct NBS costs	Economic and financial instrument	Subsidies also support private start-ups. https://www.facebook.com/bykuben/posts/1934971793337440
Municipal urban ecology innovation hub	Subsidised meeting spaces for knowledge sharing, project generation and innovation	Knowledge, communication, innovation	Bykuben Oslo Centre for Urban Ecology https://www.oslo.kommune.no/miljo-og-klima/bykuben/#gref
Public urban nature atlas; state of the urban environment map portals	Reducing private sector search costs for optimal NBS project locations in the city	Knowledge, communication, innovation	Bykuben Green Portal (in planning)
Green area performance indicators and norms for building permits	Increasing transaction costs of NBS alternatives (delays in permitting if norm is not met)	Legislative, regulatory and strategic	Blue green factor norm (BGF) will be made a building permit requirement in future regulation plans. Stange et al., 2021
National standards for NBS	Reducing transaction costs of NBS	Legislative, regulatory and strategic	Property developers can deal with a single standard for NBS requirements across municipal markets. E.g. Standard Norway BGF . https://www.standard.no/fagomrader/bygg-anlegg-og-eiendom/parker-og-grontanlegg/blagronn-faktor/
Certification of NBS	Increasing revenue stream (marketing; higher value of certified projects)	Agreement-based or cooperative instruments	NBS through BREEAM master planning, infrastructure and buildings https://www.breeam.com/
Guiding plans for Public-Private development of public spaces	Increasing revenue streams (building permits granted in exchange for cost sharing of public space development)	Agreement-based or cooperative instruments	Guiding plans for Public Spaces (VPOR) regulating municipal-private development agreements Business cases: e.g Ensjø, Oslo http://www.ensjo3d.no/About-the-project.html



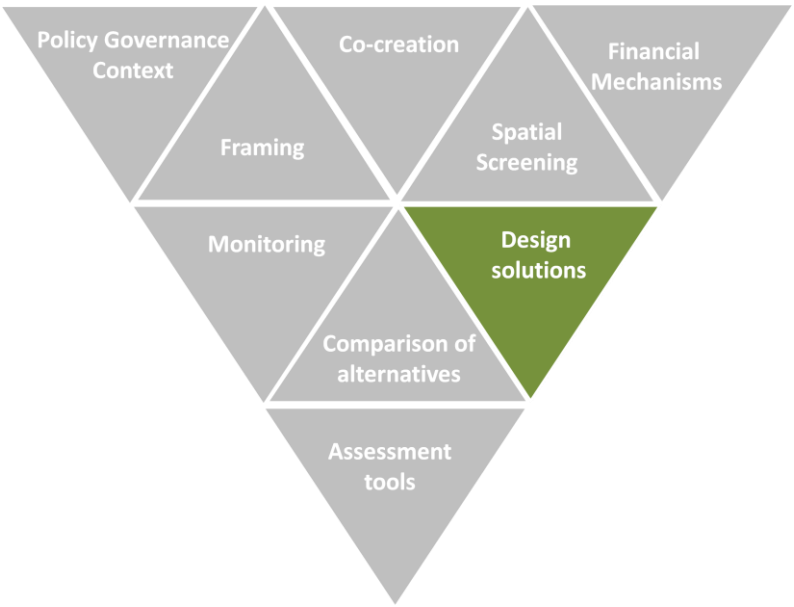
Exogenous framing. Finance mechanisms as an a constraint or incentive external to the design and implementation cycle of NBS



Endogenous framing. Finance mechanisms as an internal to NBS design and part of the implementation cycle of NBS

Figure 12. Alternative framings of the role of financial mechanisms in NBS implementation

2.6. Module VI: Design of NBS



- Design methodologies
- Diagnosis
- Inspiration
- Modelling
- Definition of NBS alternative/scenarios

The NBS design stage is at the heart of the assessment framework as it builds on the initial stages (*Governance, Framework, Co-creation, Spatial screening*) to materialise solutions that will best meet the objectives, which will be evaluated in the "downstream" phases of the assessment framework (*Comparison of alternatives, Monitoring, Assessment tools*). In this respect, the design process should lead to the emergence of pragmatic and effective solutions in a continuous interaction with the other stages, bearing in mind that it is recommended for these interactions to be constructive, recurrent and result-oriented, in accordance with the principles of the *AGILE* methodology recommended in INTERLACE (Mortelmans et al., 2021).

Design is characterised by the use of technical modelling, visualisation and simulation tools that facilitate the understanding of problems, feed the co-creation process and enable the potential impacts of the solutions studied to be assessed a priori, as well as their feasibility. It operates at the 'appropriate' scale, i.e. from the provincial or regional scale for which the ecosystems to be restored are marked by their geographical context as well as by their influence on the territory, to the scale of the intervention, for which it may be necessary to specify the technical details that optimise the functioning of the solution adopted.

The design has to rely on the current knowledge of NBS and, although it has long been limited to a small circle of experts in ecological engineering, it is now spreading to other sectors - in particular to urban planning - through the many projects, experiments, guides and technical publications that allow today's practitioners to consider replacing grey techniques with green solutions. Case study platforms (e.g. OPPLA, Urban Nature Atlas) complement this dissemination of knowledge through the presentation of documented examples that allow both to inspire the initial design phase, as well as to measure a priori the feasibility and potential impact for the implementation of a similar solution.

Finally, design can follow a traditional process based on the stages of diagnosis, proposal and validation, or it can be based on contemporary methodologies which allow the effectiveness and relevance of the proposed solutions to be optimised.

We address these different points within the INTERLACE pilot assessment framework in the following steps.

2.6.1. Design methodologies

Depending on the complexity of the issues to be addressed, the size of the stakes, the importance of co-creation and the time allowed for design, different approaches can be used, each of which integrates different creativity techniques, focussing and problem solving. Methodologies to consider:

Design thinking

Design Thinking is a methodology that combines an emotional and intuitive approach with a scientific, technical and analytical approach in a balanced way. It is ideal for complex problems where the needs and specifications are not clearly defined or even understood. Based on four principles and five typical steps, this methodology is strongly oriented towards the user, whose needs it seeks to understand and how the proposed NBS can bring value to them. Design Thinking promotes a pragmatic, solution-oriented approach, where experimentation facilitates dialogue with the user and understanding of the issues and solutions to address them.

In the context of urban design, the plurality of visions and the often vague nature of potential impacts in an early stage are an invitation to use methods that are open to creativity. In this respect, *Design Thinking* is an interesting approach to explore a completely open field of solutions, as it allows to combine the contribution of diagnostic, multidisciplinary scientific knowledge with the more creative processes of reflection, brainstorming and ideation of solutions with the final user - whom can be a citizen, technical staff and/or elected representatives of the city.

Agile design

The *Agile* methodology is another interesting technique for the design of urban spaces because it is comfortable with uncertainties and evolving frameworks in which the initial definition of problems and needs remains unclear. Compared to *Design Thinking*, *Agile Design* focuses more on the process. Its approach is marked by a permanent exchange with the end-user, through which the design evolves iteratively and constructively, focusing on specific aspects in each of the iterations. It is a process that allows us to free ourselves from the initial specifications by defining potential solutions step by step and validating at each stage with the end-users. *Agile Design* therefore allows us to respond precisely to the end-users' needs by adapting the details as the process unfolds. Beyond these basic principles, *Agile Design* is accompanied by a wide range of management techniques that enhance the autonomy of the design team, reduce the need for planning and promote short and focused cycles towards a limited number of objectives. Various tools are used to facilitate dialogue with the end-users, to define priorities, to identify the most appropriate solutions and to accelerate design times.

Although for a long time design was not considered an iterative process, the use of *Agile Design* has recently shown its power for this type of projects. In the context of urban design or NBS design, it allows an interesting approach between the design team and local actors, who all contribute little by little and together to the emergence of the preferred solutions.

Systems Thinking

Systems Thinking is a methodology that seeks to complement the *Agile Design* and *Design Thinking* approaches; both, bottom-up, with organisational and practical aspects translated into a top-down "systemic" vision (Arnold et al., 2015). Indeed, iterative design approaches lead to successful and tested solutions, but there can be a gap in the effective implementation of these solutions. This aspect is particularly relevant in the case of urban interventions where the transition from project to implementation is in itself a challenge. *Systems Thinking* therefore proposes to organise the change and integration of the proposed solutions, mainly through "the big picture" visual presentation techniques, where specific processes are defined for: managing partnerships, funding, communication, approval processes, etc.

2.6.2. Diagnosis

Taking into account the contextual elements related to NBS by collecting, analysing and prioritising the key factors that will influence the design and associated decision processes. In the case of ecological restoration projects in an urban environment, the diagnosis is carried out at several scales, starting with a geographical analysis (see *Module IV: Spatial Screening*) which defines the macro context of the project and the related territorial issues. This geographical analysis is then complemented by studies at local scale, either on the object of the intervention itself or on potential relations with its natural and urban surroundings. The integration of NBS in an urban environment requires a good understanding, and therefore a good diagnosis, of nature, place and people as three interacting dimensions:

Nature

This involves understanding the issues related to the restoration or ecological preservation of the ecosystem involved. This implies identifying the natural areas that will play a key role, the valuable natural components and those that are endangered, along with the dynamics between them and between these natural components and urban flows. The cartographic analysis is complemented by site analysis - global or by transects - taking into account natural cycles - seasons, exceptional events - and distinguishing between natural and anthropogenic evolutions.

Place

The urban space should be analysed in order to assimilate how the ecosystem services of the proposed NBS will impact the urban environment. Some basic parameters such as density, land use typologies, accessibility or green space density should be systematically investigated. They can be supplemented by more detailed analyses, depending on the nature of the intervention and the information available on: urban rhythms; the use of spaces; specific problems (e.g. air quality, noise, landscape); deficiencies in equipment; or opportunities for urban operations.

People

The social dimension completes the diagnosis for the implementation of NBS, by analysing the existing and future relationships of residents, users, neighbours or local actors involved in the restoration process with nature. In particular, it is a question of understanding their perception of nature in the

urban environment in order to identify their expectations for a new space of which they could become users or from which they could benefit directly or indirectly (or which might negatively affect them). This analysis must take into account multiple local particularities and the various factors influencing the perception of nature, urban space and relations with the local authorities, all of which can affect the process of dialogue and the construction of proposals. Among these factors, it is advisable to be vigilant about cultural aspects, gender, social inequalities and unequal power relationships in place.

The diagnosis must be able to cross-reference the contributions of the three dimensions in order to deliver a clear vision of the challenges of restoration and the main contributions of the NBS to be implemented. The aim is to have the most complete initial programme specifications possible.

2.6.3. Inspiration

Through technical or landscape references, problem analysis diagrams or integration sketches, the inspiration process is essential to guide the first stages of reflection based on the analysis of the diagnosis and in relation to the co-creation processes implemented. Inspiration is not only necessary for the design team, but also important to be able to communicate about the project in an early stage with the highest authorities. References of similar projects or past experiences can support establishing a concrete dialogue, based on real perspectives and results, and avoiding misunderstanding in the perception of the project. The inspiration phase is also directly linked to *decision framing* (module II). Various tools now facilitate this stage and multiply its potential for defining relevant solutions to previously identified challenges. For instance, *Pinterest* or *Archdaily* are commonly used in the architecture and urban design sector. Although these sources of inspiration already include large quantities of NBS examples, these examples are mostly not valued as such, i.e. for the ecosystem services they can generate, but rather for their aesthetic or landscape contribution. In the NBS expert sector there are also various platforms for the dissemination of experiences and project results; *OPPLA* is probably the most comprehensive collection with project examples and scientific and technical information. These platforms are full of enriching information when choosing NBS and analysing its potential impacts, although they are limited in facilitating the inspiration stage for designers due to the lack of high quality visual information as commonly used in the urban design sector.

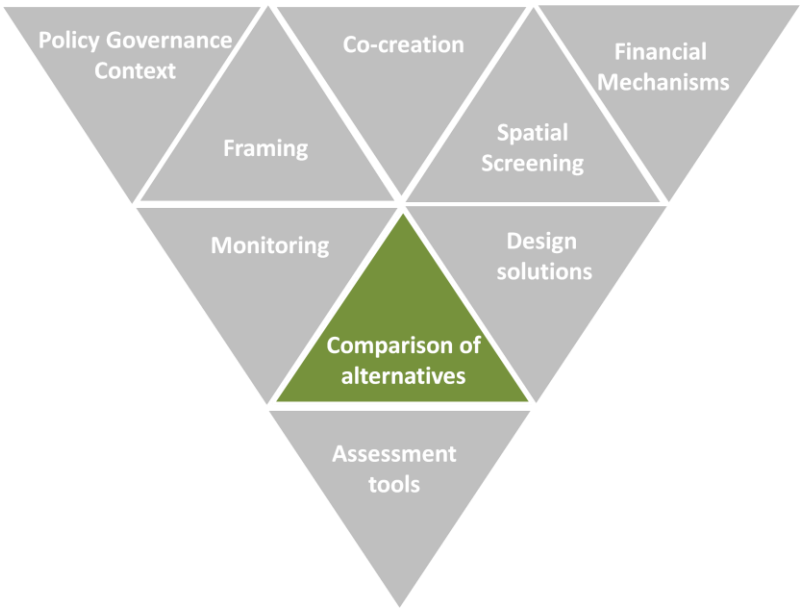
2.6.4. Modelling

The creation of digital models makes it possible to quickly move from simple and limited supports (photographs, plans, diagrams, reports) to a realistic and faithful representation of the study area, without altering its complexity. The 3D models are also the support of multiple uses that facilitate the design process, whether by co-creation for the ideation of solutions, or by simulation for the evaluation of their impacts. In the case of ecological restoration projects in urban areas, the first modelling elements are cartographic (GIS) in order to understand the macro territorial scale and the area of influence of the project. Depending on the size and type of project, it is often necessary to develop a 3D model of the intervention site in order to integrate key elements such as topography, neighbouring built infrastructures and existing natural elements into the design. This can be done with tools such as *Sketchup* or, on a smaller scale, *REVIT* or *ArchiCAD*, which will then allow the project to be easily designed in the same environment. 3D modelling allows for an efficient and pragmatic exchange with all project stakeholders, and is an ideal support for most simulation or rendering tools.

2.6.1. Definition of NBS alternatives/scenarios

NBS interventions often require the selection between different potential NBS design alternatives/scenarios (see Module VI: *Design of NBS*). Hence, the evaluation of NBS relies on limited number of detailed NBS alternatives (De Lange et al., 2012). Depending on the design methodology applied, this step may take different forms and occur at different times, and with different levels of stakeholder engagement. For instance, these may consist in fundamentally different land-uses (e.g. Birkel et al., 2012), such as restoration of forest or water bodies, or NBS alternatives based on different combinations of NBS features, such as lawns, trees and water elements (see Grêt-Regamey et al., 2013 for an example used for the design of an urban park in Masdar City, Abu Dhabi). The definition of alternatives may also reflect diverging stakeholder objectives (see e.g. Karjalainen et al., 2013; Cork & Proctor, 2005). However, it is essential to be able to agree, based on the decision processes identified or defined elsewhere (see Module II - *Decision framing*), on the alternatives/scenarios to be analysed in order to optimise the simulation stage which can consume a large part of the time and resources of this design process. The alternatives/scenarios will have to be chosen on the basis of basic considerations of feasibility and realism, and then diverge on secondary criteria for which it is necessary to be able to assess the impacts in greater detail. Module VI: *Design of NBS* provides further instructions for the development of NBS alternatives/scenarios.

2.7. Module VII: Comparison of NBS alternatives



- Selection of evaluation criteria
- Selection of indicators
- Weighting
- Simulation (impact assessment)
- Evaluation and reflection
- Final design

The **Comparison of alternatives module** is laying out an NBS evaluation tool, based on multiple objectives, multiple evaluation criteria and peoples context-specific preferences. It can thus help in a rigorous selection of different restorative NBS design alternatives/scenarios with regard to local challenges and under consideration of multifunctionality and trade-offs. This module proposes a step-wise and hierarchical approach (Saaty, 1980) to support decision-making in an inclusive and transparent manner.

2.7.1. Selection of evaluation criteria

Following an analytical hierarchy process, the selection of criteria is closely linked to the **overarching challenges** (defined in Module II: *Decision Framing*); more generally speaking, evaluation criteria are the operationalization of the overarching objectives related to restorative NBS, which again are closely linked to the *deliberative co-creation* process and the consideration of different stakeholders' needs and wants (Module III). The establishment of evaluation criteria helps to break down abstract objectives into concrete goals. It is hence strongly recommended to conduct the selection or definition of criteria under consideration of or in collaboration with (key) stakeholders (see Module III: *Co-creation* for guidelines to select stakeholders). In order to create a common understanding of the base of the evaluation, the battery of criteria must be agreed upon by all relevant stakeholders (although their relative importance "weights" might differ from different stakeholder perspectives). This requires defining criteria in a tangible and intuitive way, and limiting technical or scientific jargon. Each criterion's impact is further defined (and measured) through a set of indicators (see 3.7.3). We further recommend an explicit weighting approach to establishing relative numerical weights for each of the criteria (see 2.7.4).

2.7.2. Selection of indicators

Indicators are linked to the evaluation criteria in order to make them measurable. Each criterion requires at least one **explicit indicator**, whereby there is (theoretically) no upper limit for the number of indicators; neither must the criteria have the same number of indicators. The indicator selection is in general less sensitive for the final evaluation; an expert approach might therefore be justified, especially when working with lay stakeholders and if the selection and weighting of evaluation criteria has been 'legitimized' through a stakeholder engagement process (see *5.2 Module III: Deliberative co-creation*). Yet, even an expert-driven indicator selection shall be based on the state-of-the-art literature; it might further be backed up by a deliberative approach among experts, for example applying the 'Delphi method'. Finally, relative numerical impact factors of each indicator in relation with the criteria must be established; impact factors can - but do not have to be - of equal magnitude but always have to sum 1; in case of a single indicator attached to a criterion the weighting factor = 1. In a context of low data availability (typical for complex social-ecological systems especially at smaller scales), it is a common approach to rely on expert or even stakeholder panel estimations as an indicator for potential impacts of NBS. Depending on the context, this might be a pragmatic way forward with explicit consideration of existing uncertainties.

2.7.3. Weighting

In MCDA, weights are understood as **relative importance**. The analytical hierarchy followed here supports an explicit consideration of weights at each hierarchical level. Weights (or *impact factors*) determine with which power single indicators influence evaluation criteria and with which power each criterion relates to the overarching objective(s) of the evaluation. The establishment of weights in an explicit way helps to make the assessment framework more transparent and replicable. Yet, weights may differ with regard to the study context, and different stakeholder groups. Weights are the way diverging or even conflicting viewpoints might be expressed within the assessment framework. The elicitation of criteria weights is generally conducted through individual surveys or preferably through deliberative group exercises (e.g., Karjalainen et al., 2013; Srdjevic et al., 2013; Zhang and Lu, 2010; Zia et al., 2011). The establishment of weights parallels the selection of evaluation criteria and the selection of indicators. The establishment of criteria weights is strongly recommended to involve stakeholders, while the establishment of indicator weights is a somewhat more technical task that might require a certain level of expert knowledge.

2.7.1. Simulation (Impact assessment)

The impact assessment requires indicator scoring under each alternative/scenario. Although simulation tools are not yet common practice in the urban planning sector with NBS, as is the case now for example for the energy performance of the built environment, tools exist and are in development to facilitate the quantitative analysis of impacts generated by NBS on key criteria and related indicators, such as green cover, water management (flooding, runoff, peaks, soil permeability, etc.), generated shadows, ambient temperature, albedo, GHG emissions, air quality or noise mitigation, etc. These tools initially support a decision for one NBS alternative/scenario rather than another, but also support design by feeding into the definition of the technical details of intervention to generate maximum impact.

2.7.2. Evaluation and reflection

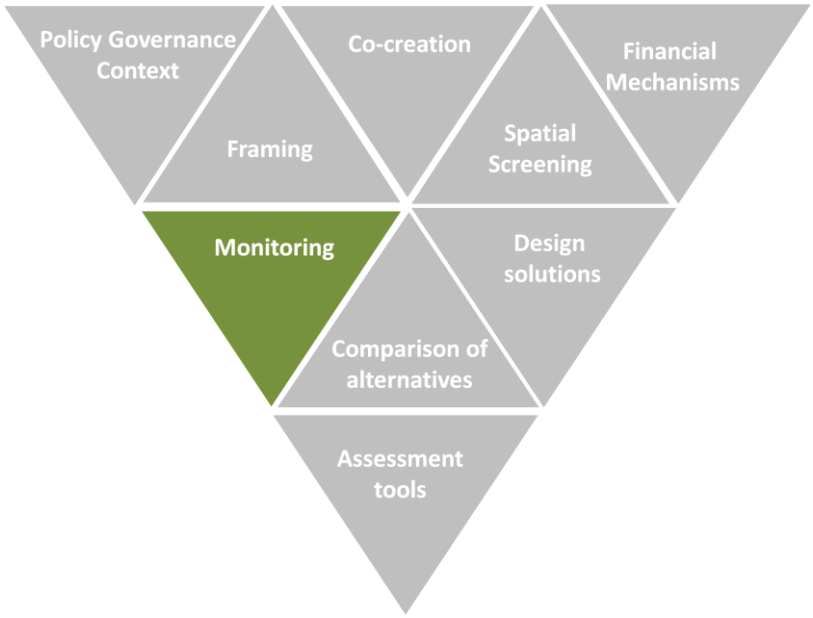
MCDA offers different integration models. Weighted summation or value functions are the simplest model to integrate different criteria. To apply a weighted summation, first, a normalized evaluation matrix is produced where all criteria scores (based on the indicator performance and their relative impacts on each of the criteria) are expressed in the same value range (typically, between zero and one). Weighted summation is then simply adding the normalized performance scores of each criterion multiplied by the weighting factors of criteria, derived through deliberative co-creation. (Note: even if weights are not made explicit, putting criteria in relative importance to another does always mean to weigh them. When referring to simple summation in the literature, considering equal weights between criteria can be understood.)

An important advantage of weighted summation, especially when working with lay stakeholders, is its intuitiveness and simple understanding. It avoids "black-box" effects often described for MCDA exercises, where assessment results are not transparent and comprehensible for the stakeholders. On the other hand, it bears the risk of oversimplification and it allows single criteria to be fully traded-off (compensation by others); this is especially problematic when stakeholder interests strongly diverge and conflicts are given about incommensurability of single criteria (Saarikoski et al., 2016). In these cases other integration approaches, especially those based on *pair-wise comparison* (Oikonomou et al., 2011), are recommended.

2.7.1. Final design

This stage consists of transforming the 3D models of the selected solutions (see module VII: *Comparison of NBS Alternatives* for a comprehensive evaluation and selection process) into execution plans validated by the respective engineering departments. This stage must consider the practical parameters of implementation as well as the living character of NBS, such as their sensitivity to seasons and their evolving nature over time. This step also specifies the most appropriate implementation methods.

2.8. Module VIII: Monitoring



- Selection of criteria
- Weighting of criteria
- Selection of thematic indicators
- Monitoring action plan
- Impact assessment
- Evaluation and reflection

Monitoring has a variety of definitions and applications. In general terms, monitoring is defined as the "systematic and repeated collection of data, observations, surveys, studies, sampling, mapping, etc., which allows and provides the basis for measuring and quantifying different processes and variables" (Vos et al., 2000). In the context of evaluation of a SES dynamics or management, it can be understood as the collection and analysis of repeated observations in order to assess changes in conditions implemented to achieve an objective (Elzinga et al., 2001). Monitoring serves to detect, quantify and provide trends in the system and to measure the effectiveness of management actions (Werner et al., 2016). Ultimately, it provides the basis for the evaluation of planning goals and effective management by providing key information and evidence to make informed decisions.

Monitoring the effectiveness of a given intervention focuses on measuring the effects of actions over time to evaluate management objectives (Werner et al., 2016). In the context of the assessment framework for restorative NBS proposed by INTERLACE, the **Monitoring module** is designed to measure the effectiveness of the NBS to address specific challenges, in terms of its socio-environmental impacts or co-benefits and how these change over the course of its intervention. In this sense, the effectiveness of NBS is measured in terms of their ability to generate co-benefits (environmental, social and economic, including the contribution of social value and cost savings compared to traditional solutions) (Garcia et al., 2018).

When selecting the **Monitoring Module (MVIII)**, it is understood that the solution to be implemented is already defined, while challenges, objectives and the associated budget are to be addressed. The INTERLACE Monitoring Module is structured into six steps, including: *selection of criteria* (MVIII.I) *selection of thematic indicators* (MVIII.II), *weighting* (MVIII.III), *definition and implementation of the action plan* (MVIII.IV) *impact assessment* (MVIII.V), and *evaluation/reflection* of the results in order to incorporate changes (MVIII.VI), if necessary, in the next monitoring cycle (Figure 13). This monitoring

module is adapted from the *monitoring cycle* designed by the Humboldt Institute, the so-called "participatory monitoring cycle between scientists and the general public", which includes the processes of planning, implementation and evaluation of (biodiversity) monitoring strategies (Sanchez-Clavijo et al., 2018; Werner et al., 2016). The approach is based on *adaptive management*, which again is in line with the principles of participation and co-creation proposed in the present document. Each of the sub-modules is further defined below.

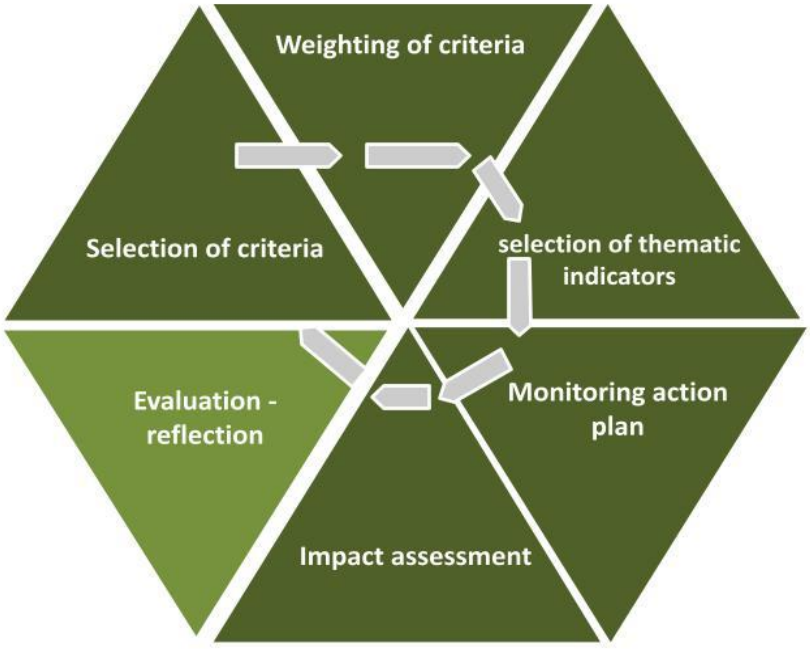


Figure 13. Steps to monitor NBS (Tier 2 of Module VIII). Adapted from Sanchez-Clavijo et al. (2018).

2.8.1. Selection of the criteria

At this point, it is assumed that the NBS to be implemented has already been decided, as well as the challenges it will address and the associated objectives. Nevertheless, there is space for refinement and co-benefits identification for the sake of monitoring. It is recommended to structure the monitoring objectives in a way that relates to both the challenges and associated co-benefits. For this, it is useful to define monitoring questions that include thinking about the reason why monitoring is needed.

Guiding monitoring questions shall be asked for each of the challenges and should be associated with the capacity of the NBS to improve the current state in one or more of its components related to **effectiveness**; i.e. How does the implementation of a restorative NBS will affect different objectives (address challenges) over time.

In the next step, a set of indicators will be defined for each of the criteria. While it is key that the definition of criteria are co-produced with stakeholders, the initial indicator identification may be done with a selection of stakeholders based on literature review or may be expert-driven. In any case, stakeholder involvement is suggested, from validating to actively participating in the selection, depending on the context of each case.

2.8.2. Indicator selection: Response-Pressure-State-Benefit approach

Indicators are quantitative variables used to represent a system characteristic of interest (Tate, 2012). During the monitoring cycle of any intervention, it is key to define a set of indicators that allows for appropriate and robust measurement of its impact and effectiveness. The International Expert Workshop on post-2010 Indicator Development held at Reading, UK in July 2009 (UNEP–WCMC, 2009) recommended a simplification and modification of the *driver-pressure-state-impact-response* (DPSIR) framework for monitoring biodiversity and ecosystem services. Sparks et al. (2011) adapted this framework into a *Response-Pressure-State-Benefit* (RPSB) approach to emphasise the guidance of policy and other practical actions, and differentiated four types of indicators. In Table 8, we adapted this approach for selecting indicators for monitoring and evaluating NBS. Sparks et al. (2011) proposed a scheme with four interrelated categories to select the set of indicators – response indicators, pressure indicators, state indicators and benefit indicators. However, it is important to keep in mind that the time scale on which the benefits can be reflected may take longer than the NBS implementation period. For this reason we include, unlike Sparks et al. (2011), the relationship of pressure and state indicators with the response indicators to illustrate that these can influence decisions about response, i.e. improvements or adjustments to the NBS (Figure 14).

Monitoring indicators following Sparks et al. (2011): *Response indicators*, which in our case are the indicators directly related to NBS or their associated actions. These influence the causes of the problem that are measured through the second category: *pressure indicators*. The NBS is expected to exert a positive influence on such causing factors, as they are the drivers of the problem that the NBS is intended to solve. Consequently, by decreasing the pressure factors, the condition and state of the system is expected to improve, which is measured through the third category: *state indicators*. Likewise, the improvement of the system state will be reflected in the benefits obtained (for example in ecosystem services or co-benefits), measured through the fourth category: *benefit indicators*. At the same time, the benefits obtained will influence the evaluation of the NBS and the generation of adaptive actions to implement new solutions or improve existing ones.

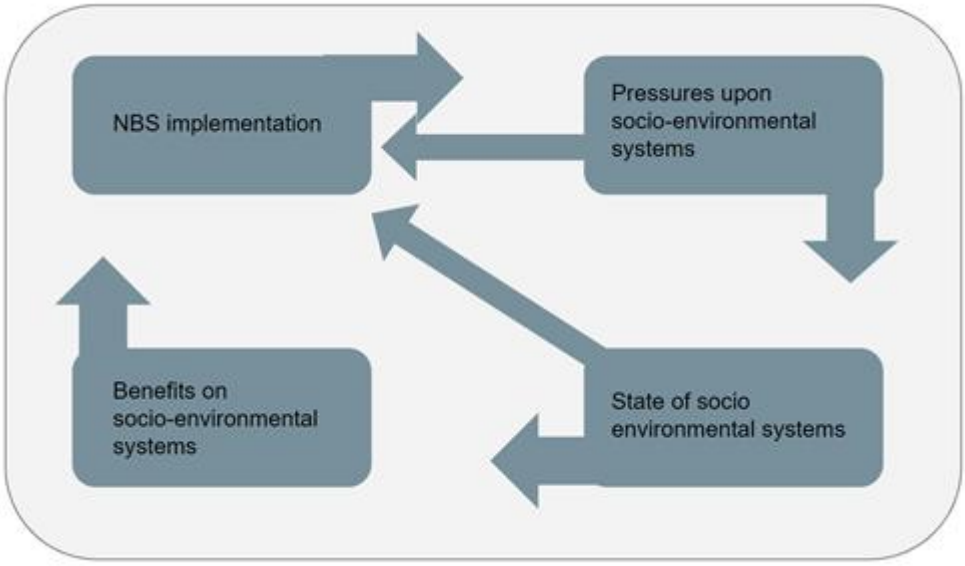


Figure 14. Diagram of RPSB scheme, illustrating the relationship of the four categories to define the set of indicators to evaluate NBS. Adapted from Sparks et al. (2011).

Table 8. Definition of indicators according to the RPSB framework (adapted from Sparks et al., 2011

Indicator type	**Sparks et al. (2011) definition**	**INTERLACE adaptation for NBS**	**Example:** Urban forest for biodiversity enhancement
Response	indicators measuring the implementation of policies or actions to prevent or reduce biodiversity loss	indicators measuring the implementation of NBS or its actions to **prevent or reduce** impacts on environment, society or economic benefits.	Response indicators should be able to measure the implementation, for example restoration area (# of native species planted)
Pressure	Indicators monitoring the extent and intensity of the causes of biodiversity loss that responses aim to address	indicators monitoring the **extent and intensity of the causes** of impacts that NBS aim to address	Grey areas density, Green areas per unit in the city
State	Indicators analysing the condition and status of aspects of biodiversity.	Indicators analysing the **condition and status** of socio-environmental aspects that have been affected by the problem to be solved.	Native bird species richness/abundance Migratory bird richness abundance
Benefits	Indicators quantifying the benefits that humans derive from biodiversity.	Indicators quantifying the benefits of NBS or its actions on the environmental, social, and economic benefits.	Increase in flowering plant species pollinated by insects Increase in native bird species richness/abundance Increase in migratory bird richness abundance

2.8.3. Weighting

The weighting of the criteria and indicators should follow the **MCDA** approach, as explained in MII and MVI: weights are understood as **relative importance**. The analytical hierarchy followed here supports an explicit consideration of weights at each hierarchical level while weights determine the power with which each criterion relates to the overarching objective(s) of the evaluation. Weights may differ with regard to the study context, and different stakeholder groups, and are the way diverging or even conflicting viewpoints might be expressed within the assessment framework. See **Module III** for guidance on how to perform the weighting in a participatory way.

Through participatory workshops the first selection of criteria and indicators will be presented and weighting will be performed. For each criteria and indicator, evaluation standards are defined, such as their perceived effectiveness in answering the associated monitoring question, the feasibility of their measurement, the costs of data collection and analysis, etc. (these factors must be clearly stated before a weighting is made). An example of the indicator definition is presented in Appendix C.

2.8.4. Impact assessment

At the planning stage of the NBS an initial impact assessment will be performed to finalize defining the set of criteria and indicators that are going to be measured during and after the NBS implementation phase. The assessment takes into consideration the criteria and indicators weighting. The final set of thematic indicators selected will provide a snapshot of the responses, pressures, state and benefit of the system (depending on the selected set). These snapshots should be analysed taking into account the given weights for each criteria, in order to make informed decisions in the next steps.

2.8.5. Definition and implementation of the monitoring action plan

Based on the set of indicators selected, a monitoring plan is defined, and once the NBS enters into the (pre-) and implementation phase, it is implemented. Monitoring requires several sampling events, the first event performed in time zero, which will generally measure the state of the system before the intervention. Thereafter, a fixed periodicity should be defined to examine the same indicators, in a consistent manner, with minimal variation in methods to ensure comparability over time. At this point it is important to clarify that the proposed adaptive management allows for changes, based on evaluation and reflection on the results obtained. If it is necessary to change sampling methods or incorporate new indicators, this should be carefully evaluated to minimise the loss of comparability. Measuring the same indicators consistently ensures the observation of trends in the system, in order to know whether the implementation of the NBS has been effective.

Planning

The action plan should include the number of samples to be taken, the data collection and data analysis methods, taking into account financial factors, the committed people to collect and analyse data, among others. This step should also include standardised protocols for data collection and consider the training of the people participating in the collection and analyses of data (Sanchez- Clavijo et al. 2018).

Data collection

Ideally, data will be collected according to the plan set out in the previous step, bearing in mind that the need for changes to improve monitoring without compromising comparability must be weighed against the need for changes.

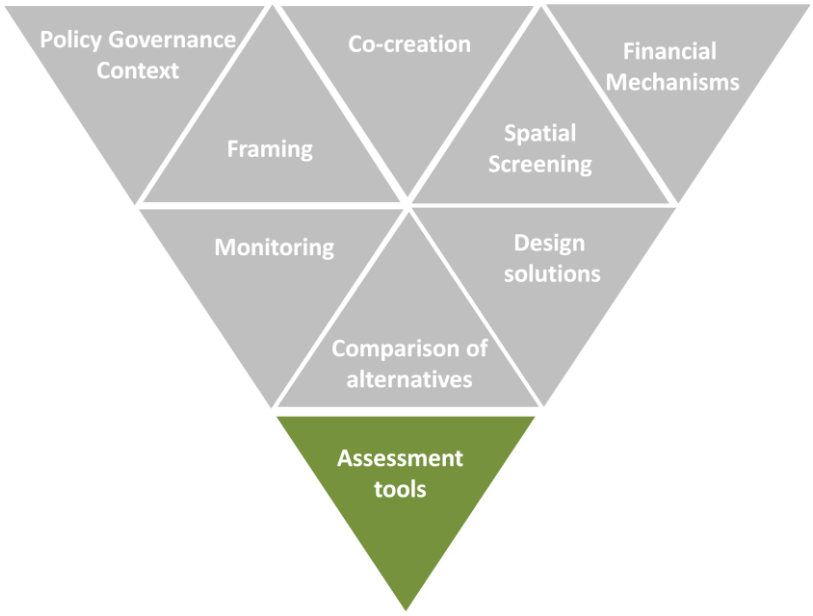
Data analyses

After each monitoring event, the data should be analysed according to the action plan, the raw data as well as the results of the analysis should be stored in pre-established formats. The results obtained from the analysis of each monitoring event will serve to get an idea of the response of the system to the intervention (or NBS).

2.8.6. Evaluation and reflection

It is important to establish regular evaluation and reflection sessions (e.g. every two or three monitoring events), to which expert advisors can be invited, in order to jointly evaluate the monitoring process and the effectiveness of the intervention or necessary actions. Based on the results of these sessions, changes can be incorporated as necessary, or solutions to unexpected events can be sought. Partial results of the monitoring should also be presented at these sessions, in order to evaluate the possible implementation of necessary changes to the NBS. The frequency of reflection session might be reduced over time.

2.9. Module IX: Assessment tools and thematic indicators



- NBS tools by module
- Thematic indicators for assessing different challenges

This section provides a selection of tools of best practises, organised according to the modules of the assessment framework (Table 9). It also provides a list of possible thematic indicators according to the identified challenges in INTERLACE case studies (Table 10). Both tables are based on the INTERLACE Deliverable 3.1 (Melo et al., 2021), a database consisting of 130 NBS tools (e.g. criteria, models, decision-support systems, methodologies, strategies, guidelines, and standards). For Table 9, filtering was done based on the modules of the assessment framework.

2.9.1. NBS tools by module

Table 9. Selection of tools to use in the Modules of the INTERLACE Assessment Framework

Module	Tool	Brief description
Governance	Policy investments in Nature and Green Infrastructure	Biodiversity and green infrastructure contributing to cohesion policies and policy objectives.
Governance	Municipal Governance for Nature Based Solutions	Guideline for governance of NBS implementation.
Governance	Manual y Caja de Herramientas de Gobernanza metropolitana	The main objective of the Governance Manual and Toolbox is to offer methodologies with simple and dynamic formats, which allow improving the governance processes in the different metropolitan areas of Mexico.
Governance	Climate-resilient biodiverse cities in Latin America and the Caribbean 2020	A 10-step toolkit that is aimed to help Latin American Mayors and key decision makers to include and prioritise biodiversity in their agendas, fostering sustainable and climate-change resilient urban landscapes. It offers decision-makers a road map to design

Module	Tool	Brief description
		strategies that generate tangible benefits from fostering biodiversity in Latin American cities.
Framing	Urban Health Indicator Tools of the Physical Environment: a Systematic Review	The article reviews tools and indicators regarding Urban Health. Provides evidence about the health impacts of the physical urban environment which can be used in built environment policy and decision-making.
Framing	Panorama Partnership	PANORAMA – Solutions for a Healthy Planet is a partnership initiative to document and promote examples of inspiring, replicable solutions across a range of conservation and sustainable development topics, enabling cross-sectoral learning and inspiration.
Framing	A framework for assessing and implementing the co-benefits of NBS in urban areas	The paper developed a holistic framework for assessing co-benefits of NBS across elements of socio-cultural and socio-economic systems, biodiversity, ecosystems and climate. The seven stages include: 1) identify problem or opportunity; 2) select and assess NBS and related actions; 3) design NBS implementation processes; 4) implement NBS; 5) frequently engage stakeholders and communicate co-benefits; 6) transfer and upscale NBS; and 7) monitor and evaluate co-benefits across all stages.
Framing	Disaster and Climate Change Risk Assessment Methodology for IDB Projects: A Technical Reference Document for IDB Project Teams	The Bank has developed a methodology to facilitate the identification and assessment of disaster and climate change risks and resilience opportunities in all relevant projects in the identification, preparation, and implementation phases.
Co-creation	Stakeholder Mapping to Co-Create NBS: Who Is on Board?	The paper analyses 16 NBS and 359 stakeholders and presents a systematic stakeholder mapping method to support co-creation.
Co-creation	INTERLACE Stakeholder engagement strategy (Deliverable 1.5).	Stakeholder engagement strategy (Deliverable 1.5). This document is a stepwise guideline to the stakeholder identification and the co-production of INTERLACE deliverables and other products, based on the AGILE approach. It describes in detail the participation mechanisms and the necessary stages, adapted to the context of the project.
Co-creation	MSP guide (Brouwer and Brouwers, 2017)	The MSP (Multi-Stakeholder Guide) is a compilation of 60 tools serving different purposes that help with the practical framework for the design and facilitation of collaborative processes that work across the boundaries of business, government, civil society and science.
Co-creation	Participatory Methods	Participatory Action Research Methods would help with inclusive decision-making and co-production approaches to project implementation that could empower local communities to take ownership and leadership in the project.
Co-creation	Gender in Multi-Stakeholder Partnerships (GIZ, 2019)	Since the 2030 agenda for sustainable development, with the motto “leaving no one behind“, and Sustainable Development goal (SDG) 5 - The report is a compilation of support for integration of gender aspects in MSP (multi-stakeholder partnership), learning experiences from existing initiatives, and

Module	Tool	Brief description
		raw materials for step by step instructions for action.
Spatial screening	Copernicus Climate Change Services.	Thematic information services provided by the Copernicus Earth Observation Programme of the European Union. It is an operational programme building on existing research infrastructures and knowledge available in Europe and elsewhere.
Spatial screening	Copernicus Urban Atlas- Land Monitoring	The Urban Atlas provides pan-European comparable land cover and land use data for Functional Urban Areas.
Spatial screening	Climate ADAPT- Urban Adaptation Map Viewer	Overview of the current and future climate hazards facing European cities. It includes information about observed and projected spatial distribution and intensity of high temperatures, flooding, water scarcity, wildfires and vector-borne diseases.
Spatial screening	Urban Multi-scale Environmental Predictor	UMEP is a climate service plugin for QGIS that can be used for a variety of applications related to outdoor thermal comfort and climate change mitigation.
Spatial screening	World Urban Database and Access Portal Tools (WUDAPT)	The World Urban Database and Access Portal Tools project is a community-based project to gather a census of cities around the world, making accessible information on form and function of urban morphology relevant to climate, weather, and environment studies on a worldwide basis.
Spatial screening	LANDSAT Programme	Satellite images from four generations of sensors.
Spatial screening	Urban InVEST: Designing resilient cities by nature model	InVEST is a suite of free, open-source software models used to map and value the goods and services from nature that sustain and fulfil human life.
Spatial screening	Carto	CARTO is a Location Intelligence platform. It enables organisations to use spatial data and analysis for more efficient delivery routes, better behavioural marketing, strategic store placements, and much more.
Spatial screening	Catalan Water Agency interactive applications	The Catalan Water Agency website includes interactive applications useful for NBS implementations. Among them: ACA Map Viewer, Real-time water - Hydrometeorological viewfinder, SDIM (consultation of data and historical analytical results of the Monitoring and Control Program and, measurements of hydrological data of level and flow of rivers and absolute level and volume stored in reservoirs), and WEB DMA (evaluation of the state of water bodies and interpretation of results).
Spatial screening	Environmental Geographic Viewer	The Environmental geographic viewer is a tool to make environmental information from Bogotá city available to citizens, academia, the public and private sectors.
Spatial screening	NBS for local climate adaptation in the Basque Country	Guide for practitioners to identify the potential for deploying NBS and to elaborate NBS opportunity mapping in urban contexts for climate change adaptation.
Financial mechanism	Handbook for the Implementation of NBS for Water Security: guidelines for	Guidelines for designing, implementing financing arrangements regarding NBS.

Module	Tool	Brief description
	designing an implementation and financing arrangement	
Financial mechanism	Water Funds toolbox	Water Funds are organisations that design and enhance financial and governance mechanisms which unite public, private and civil society stakeholders around a common goal to contribute to water security through NBS and sustainable watershed management.
Financial mechanism	NBS Handbook	Guidelines about NBS, their multi-scale benefits, different stages of NBS project development, financing, policy and decision making, and recommendations for NBS uptake.
Financial mechanism	State of Finance for Nature	This report provides information about public and private sector finance directed to NBS, excluding marine environments. It estimates current NBS investment, future investment needs to meet societal objectives, and lays out evidence and hypotheses that explain current levels of underinvestment, identifying opportunities to scale up NBS.
Financial mechanism	Approaches to financing nature based solutions in cities	This Working Document, prepared by Trinomics for the GrowGreen project, provides an overview of financing approaches that can be used to deliver green infrastructure and NBS.
Design of NBS	Guía para la Integración de las Soluciones Basadas en la Naturaleza en la planificación urbana. Primera aproximación para Colombia	Provides steps to support the planning and design of NBS in urban contexts, including urban and peri-urban including diagnosis, NBS prioritisation, design guidelines, financing strategies identification, and identification of NBS monitoring options.
Design of NBS	Compendium of Nature-based and 'grey' solutions to address climate- and water-related problems in European cities	Report presenting a variety of nature-based and 'grey' solutions to address climate- and water-related challenges in European cities.
Design of NBS	A guide to support the selection, design and implementation of natural water retention measures in Europe	Report aiming at supporting the selection, design and implementation of natural water retention measures in Europe.
Design of NBS	iTREE-Tools for assessing and managing forests and community trees-E	i-Tree is a set of free, science-based tools that quantify the benefits and values of trees around the world, aid in tree and forest management and advocacy, and show potential risks to tree and forest health.
Design of NBS	NBS Selection Tool	Helps choose the right NBS from the NBS catalogue.
Design of NBS	Nature4Cities Platform	Comprehensive reference Platform for NBS, offering technical solutions, methods and tools to empower urban planning decision making. This will help address the contemporary environmental, social and economic challenges faced by European Cities.
Design of NBS	Healthy urban living	Report that provides guidance for designing green and blue infrastructure to support healthy urban living.

Module	Tool	Brief description
Design of NBS	Flood Green Guide	Natural and Nature-Based Flood Management: A Green Guide was developed to support local communities around the world in using natural and nature-based methods for flood risk management.
Design of NBS	Nature Based Solutions – Technical Handbook	Technical catalogue of NBS, divided in eight categories: 1) Greening interventions 2) Public Green Space 3) Vertical Greening 4) Green Roofs 5) Water sensitive urban design measure 6) (River) Restoration 7) Measure of Bioengineering 8) Other NBS.
Design of NBS	NBS for cities in Latin America and the Caribbean	This guideline provides practical methods for identifying, designing, implementing and monitoring NBS in CELAC urban contexts. It provides tools and examples to effectively apply NBS, build capacities, and facilitate resilient urban planning and development.
Comparison of alternatives	EnviMET	Facilitates information/data for definition of alternative scenarios. ENVI-met is the most evaluated microclimate model available, proving its capabilities to accurately simulate the outdoor microclimate for any place on the Earth.
Comparison of alternatives	URBAN GreenUP	Helps local governments to choose from the many NBS options in a NBS catalogue. It is designed to give suggestions that may help improve the selection of appropriate NBS, based on both the city's capabilities and the outcomes it would like to achieve.
Monitoring	Trends.Earth Indicators	Thrends Earth was produced as part of the project “Enabling the use of global data sources to assess and monitor land degradation at multiple scales”, funded by the Global Environment Facility. It is a toolbox with two indicators: Land degradation indicator and Urban change and land consumption indicator. It is a QGIS plugin supporting calculation of indicators, access to raw data, reporting, and production of print maps.
Monitoring	Copernicus Urban Atlas-Land Monitoring	The Urban Atlas provides pan-European comparable land cover and land use data for Functional Urban Areas.
Monitoring	MUKLIMO	Used to investigate urban heat island effects and to carry out sensitivity simulations of climate adaptation measures. The model simulations, performed at a horizontal resolution of 100m, are based on Copernicus Urban Atlas land cover data combined with local data to consider city-specific structures.
Monitoring	Resolution Imaging Spectroradiometer MODIS	MODIS is a key instrument aboard the Terra (1999) and Aqua (2002) satellites launched by NASA to scan the Earth’s surface and atmosphere with a 36-band spectrometer and provide global coverage every one to two days. MODIS records its images at a spatial resolution of 250 m (bands 1–2), 500 m (bands 3–7), and 1 km (bands 8–36). Thermal images are captured in the 1 km resolution.
Monitoring	LANDSAT Programme	Satellite images from four generations of sensors.
Monitoring	Green City Watch	A free, open-source software to create AI-enabled tree inventories. Collective building geospatial software to map, monitor, and manage urban trees.

Module	Tool	Brief description
Monitoring	Monitoring strategy in the FR interventions	Guidelines on co-monitoring strategies of social aspects of the NBS projects.
Monitoring	CITYkeys indicators for smart city projects and smart cities	Indicators definition for smart cities and projects, and Inclusion of different social groups in NBS processes.
Monitoring	Evaluating the impact of NBS: a handbook for practitioners	A new handbook aims to provide practitioners with a comprehensive NBS impact assessment framework, and a robust set of indicators and methodologies to assess impacts of NBS across 12 societal challenges: Climate Resilience; Water Management; Natural and Climate Hazards; Green Space Management; Biodiversity; Air Quality; Place Regeneration; Knowledge and Social Capacity Building for Sustainable Urban Transformation; Participatory Planning and Governance; Social Justice and Social Cohesion; Health and Well-being; New Economic Opportunities and Green Jobs. The accompanying Appendix of Methods provides a brief description of each indicator and recommends appropriate methods to measure specific impacts, along with guidance for end-users about the appropriateness, advantages and drawbacks of each method in different local contexts.

2.9.2. Thematic indicators for assessing different challenges

NBS monitoring of restorative NBS is unique for each city as it depends on the *Decision context*, the particular challenges, and the specific social, economic, and environmental characteristics of each city or implementation site. Considering this, a list of possible indicators for the initial selection is presented according to the challenges identified for the INTERLACE cities (Figure 15). It is important to note that more challenges can be added, as well as new indicators, depending on the context of each case.

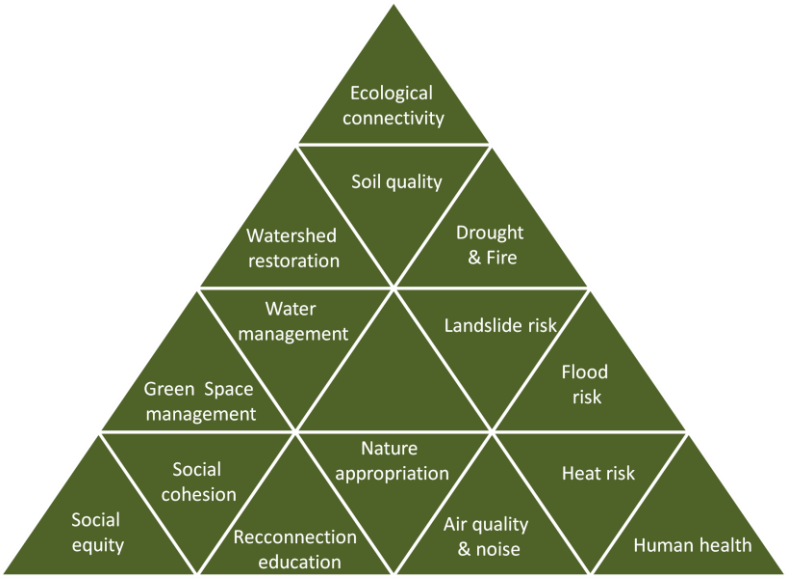


Figure 15. Diagram of the 15 challenges selected by the cities, from which groups of indicators can be selected for monitoring the effectiveness of the NBS.

For Table 10 the filters were applied in order to find tools for specific challenges as in Deliverable 1.3 (Knoblauch et al. 2021), categorised as indicators or indexes, as an example of indicators that can be considered for the initial selection. After filtering, a screening of the results was done in order to make an initial selection (for an extended list of tools see Deliverable 3.1).

Table 10. List of selected indicators by challenge.

Challenge	Tool	Indicator	Unit
Heat stress & heat island effect	**The Urban Nature Navigator: NATURVATION**	Heat mitigation	average heat mitigation and carbon storage per Functional Urban Area
Air Quality and noise	**European Air Quality Index**	Measuring parameters: Particles less than 2.5 µm (PM2.5) Particles less than 10 µm (PM10) Nitrogen dioxide (NO2) Ozone (O3) Sulphur dioxide (SO2)	µg/m^3
	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Annual amount of pollutants captured by vegetation	pollutant per ha / per year
Soil Quality		Area under protection / identified brownfields	km2 or m2
Water management	**CLEVER cities**	Expenses for stormwater treatment facilities and erosion control measures, expenses of property owners to protect their property, predictions of flooding occurrences and their levels, potential impacts on property, infrastructure	currency

	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Economic benefit of reduction of stormwater to be treated in public sewerage system	Cost of sewage treated by volume(currency/m^3)
Ecologic connectivity	Fragstats, ArcGIS	Spatial analysis to estimate the configuration of green areas in the urban landscape. E.g.. Euclidean distance between patches of urban green areas, patch aggregation index, distance to protected areas, fragment size index, among others.	various
	Circuitscape, connectivity analysis software	Designed to model species movement and gene flow across fragmented landscapes, and to identify areas important for connectivity conservation.	various
	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Richness of indigenous species	A count, magnitude or intensity score of indigenous species per unit
	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Urban regeneration - Index of ecological connectivity (integral index of connectivity)	Probability that two dispensers randomly located in a landscape can reach each other
Green space management	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Richness of indigenous species	a count, magnitude or intensity score of indigenous species per unit area
	CLEVER cities	Walking and cycling in and around areas of interventions	Proportion (%) of people using NBS for walking, cycling outdoor activities (gardening)
	CLEVER cities	Share of people using green space (formally or informally)	Proportion (%) of people using green by: age; gender; ethnic or cultural group; socioeconomic status
	CLEVER cities	Frequency of green space use	Proportion (%) of people visiting green space:
Flood risk	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Coastal resilience - area remaining for erosion protection	km^2 or m^2
Social Cohesion	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Accessibility to public green space	% of people living within a given distance from accessible, public green space
Social equity	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Accessibility to public green space	% of people living within a given distance from accessible, public green space

Nature appropriation and stewardship	CLEVER cities	Green jobs related to NBS (gardening, maintenance)	Number of employees or full time equivalent jobs
	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Economic oppurtunities, and green jobs - net additional jobs in the green sector enabled by NBS projects	new jobs/ specific green sector/year
Reconnection education	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Participatory planning and governance : Quality of the participatory or governance processes	perceived level of trust, legitimacy, transparency and accountability of process
Human health and wellbeing	CLEVER cities	Overall mortality	annual mortality rate per 100 000 population
	CLEVER cities	Change in lifespan	life expectancy at birth
	A framework for assessing and implementing the co-benefits of nature-based solution in urban areas	Level of involvement in frequent physical activity in urban green spaces	number and % of people being physically active in urban green spaces

See also the RESIN PROJECT for a library of NBS and their effectiveness for climate adaptation and other challenges:

https://resin-aol.tecnalia.com/apps/adaptation/v4/#!/login?redirect=%2Fapp%2Fsummary

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4. Appendices

Appendix A. Stakeholder groups to involve in the assessment framework.

Stakeholder groups	Preliminary sub-groups
Political representatives: those who are elected in public office and make political decisions within governmental settings *For example: mayors, city council members, ministers, elected officials, political leaders*	• National • Regional • Local
Governmental authorities: those who develop laws, strategies or plans and administrators who are controlling and maintaining these laws *For example: policy makers, urban planners, public administration, public servants, municipal departments*	• National • Regional • Local
Civil society: Those who hold the space for collective action around shared interests, purposes and values, generally distinct from government and commercial for-profit actors. The first group is highlighted as it needs to be an active part of any participatory process. Efforts on having them on board are worth making, and this is not always easy. *For example: see sub-groups.*	Groups that consist mainly out of citizens / more informal: • Community groups • Neighbourhood associations • Indigenous groups • Women organizations • Children and youth (imperative for the long-term sustainability of any project) • Representatives from informal settlements
	Groups that have employees / more formal: • NGO's • Environmental and social movements • Trade unions (env. sector) • Charitable organizations • Faith-based organizations • Professional associations • Cultural institutes
Academia, research and education: Those doing research and wanting to advance knowledge and/or share knowledge to students and interested parties *For example: research institutes, universities, (high or primary) schools, training centres, environmental education projects*	• Scientific institutes • Education institutes According to context, particularly important for Latin America: • Traditional Ecological Knowledge holders • Indigenous Knowledge holders
Private sector: Those who make part of a country's economic system and run individual and company businesses with the intention to make profit *For example: local industry, companies, consultancies, design agency, architecture offices, SMEs, co-operatives, landowners, land managers, farmers*	• Private companies • Landowners and managers • Nature-Based Enterprises (NBEs)
Media: Those who produce and spread news and stories *For example: (local) newspapers, magazines, radio, television, social media*	• News media companies • Leaders of opinion • Influencers
Networks: Where a mix of audiences connect/meet *For example: 'Cities Talk Nature', national and regional associations of municipalities/local governments*	

Finance sector and funders: Those who have access to financial resources and want to invest in promoting NBS / achieving sustainability goals *For example: banks, foundations, corporations*	

Appendix B. Questions to collect stakeholders feedback based on Participant feedback form for INTERLACE events

1. How would you rate the engagement activity in terms of content? (provide a Likert scale response ranging from 1 to 5, where 1 means “poor” and 5 means “excellent”).
2. What did you find most interesting?
3. Have you learnt anything new? And if so, what?
4. How would you evaluate the structure/format of the engagement activity? (provide a Likert scale response ranging from 1 to 5, where 1 means “poor” and 5 means “excellent”).
5. In case you evaluated the format as ‘poor/fair’ (1 or 2), please indicate why. In case you particularly liked a specific format, please indicate it.
6. On a scale from 1 to 5, in your opinion, to what extent did the moderation promote an open and respectful discussion? (provide a Likert scale response ranging from 1 to 5, where 1 means “closed-minded, fixed viewpoints” and 5 means “open, respectful, consensus-oriented”).
7. How would you rate the opportunities for networking and exchanging idees at the event?
8. How would you rate the heterogeneity of the workshops participants (in terms of expertise, affiliation, views, background, gender)? (provide a Likert scale response ranging from 1 to 5, where 1 means “poor” and 5 means “excellent”).
9. In case you evaluated the group as unbalanced, which group do you consider to be underrepresented (e.g. city government/administration, urban planners, business/industry, universities/research centres, NGOs/civil society organisations, women, other underrepresented groups)?
10. How would you rate this event’s logistical organisation? (provide a Likert scale response ranging from 1 to 5, where 1 means “poor” and 5 means “excellent”).
11. What would you have done differently in terms of event organisation?
12. Other general comments

Appendix C. Participatory definition of indicators.

For the selection of monitoring indicators, we suggest a simple multi-criteria or summative approach. With technical assistance or literature review, thematic indicators associated with selected criteria will be pre-selected. Through participatory workshops, this first prioritisation of indicators will be presented and the weighting of the indicators in relation to the criteria will be made; this weighting is evaluated by groups of indicators in relation to each challenge. For each indicator, evaluation standards are defined, such as its perceived effectiveness in answering the associated monitoring question, the feasibility of its measurement, the costs of data collection and analysis, etc. (these factors must be clearly stated before a weighting is made).

First of all, the standards that will be taken into account for the selection and scoring of indicators are established and an importance value is given. For this example, we will use values from 1 to 3, where 1 is low, 2 is moderate and 3 refers to high importance. Table 11 illustrates hypothetical given values:

Table 11. Standards and hypothetical given values

Standard (Std.i)	Agreed weight
Effectiveness in answering the monitoring question	3
Feasibility of measurement	3
Possibility to be done in a participatory way	2
Ease of data analysis	1
Sampling costs	1

Subsequently, each indicator (Ind.i) is evaluated separately according to the established standard. For the sake of the example, we will be focused in biodiversity indicators, responding to the green space management challenge (Table 12).

Table 12. Indicator alternatives to monitor diversity in the urban forest

Standard (Stdi.i)/Indicators (Ind.i)	Shannon index for bird richness	Shannon index for mammal index	Number of migratory species reported by visitors
Effectiveness in answering the question	2	3	1
Feasibility of measurement	3	1	3
Possibility to be done in a participatory way	3	1	3
Ease of data analysis	2	1	1
Sampling costs	2	2	1

The weighting is then calculated for each alternative (Table 13): the value given to each factor of each indicator (Ind.i) is multiplied by the weighted value for each standard (Std.i), and finally the values of each indicator are added to obtain a total score per indicator (Pt), which will be compared with the considered alternatives, using the following formula:

$Pt = \sum(Ind.i * Std.i)$

Table 13. Selection of indicator set to monitor diversity in the urban forest

Standard (Std.i)/Indicators (Ind.i)	**Shannon index for bird species richness**	**Shannon index for mammal species index**	**Number of migratory species reported by visitors**
Effectiveness in answering the question	2*3 = **6**	3*3 = **9**	1*3 = **3**
Feasibility of measurement	3*3 = **9**	1*3 = **3**	3*3 = **9**
Possibility to be done in a participatory way	3*2 = **6**	1*2 = **2**	3*2 = **6**
Ease of data analysis	2*1 = **2**	1*1 = **1**	1*1 = **1**
Sampling costs	2*2 = **4**	2*1 = **2**	1*1 = **1**
Sum (Pt)	6+9+6+2+4 = **27**	9+3+2+1+2 = **17**	3+9+6+1+1 = **20**

After having a score for each alternative, in this case for each indicator, the indicator(s) with the highest score is selected. In the case of the example, this would be the **Shannon index for bird species richness**.

In this way, the perceptions of importance of the different actors can be incorporated in the monitoring plan in a transparent and systematic way. Once the indicators to be measured have been defined, an action plan is formulated.

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Project Partners

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