



D7.1 State-of-the-art Report on Good Practice for Co-governance of NbS

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ABBREVIATION LIST

Term	Description
CiPeL	City Practice Lab
CONEXUS	CO-producing Nature-based solutions and restored Ecosystems: transdisciplinary neXus for Urban Sustainability
Naturvation	NATure-based URban innoVATION
NbS	Nature-based Solutions
D	Deliverable
EU	European Union
GHG	Greenhouse gases
GREEN SURGE	Green Infrastructure and Urban Biodiversity for Sustainable Urban Development and the Green Economy
PHUSICOS	'According to nature' in Greek
R&I	Research & Innovation
T	Task
UNaLab	Urban Nature Labs
WP	Work Package

EXECUTIVE SUMMARY

As part of Work Package 7 (WP7) within the Horizon2020 project **JUSTNature** (SEP-210687519), this deliverable offers a systematic qualitative review of the **state-of-the-art of co-governance of nature-based solutions (NbS)**, to provide a comprehensive theoretical background on what are the principles, barriers, and enablers for “good” co-governance processes to reach just low-carbon cities.

Chapter 2 builds a theoretical framework, addressing “How co-governance of NbS can be improved to reach just and low-carbon cities.” It provides the definition, rationale, modes, dimensions, and evaluation criteria (principles, barriers & enablers) for the co-governance of NbS. The definition of co-governance within this research is therefore proposed as the *process of various actors across the public, civil society, and private domains working together to formulate, promote and achieve shared objectives for positively transforming the urban environment, through the planning, design, implementation, and management of a nature-based intervention.*

To evaluate the extent to which co-governance arrangements for NbS are successful, the concept of governance needs to be unpacked into its constituent parts. Based on previously studied governance dimensions, we developed **five dimensions** focusing on the governance processes: **Actors, Politics, Processes, Policies, and Institutional Technology** (Figure 1). These five dimensions are not strictly separable from one another, but rather co-exist.

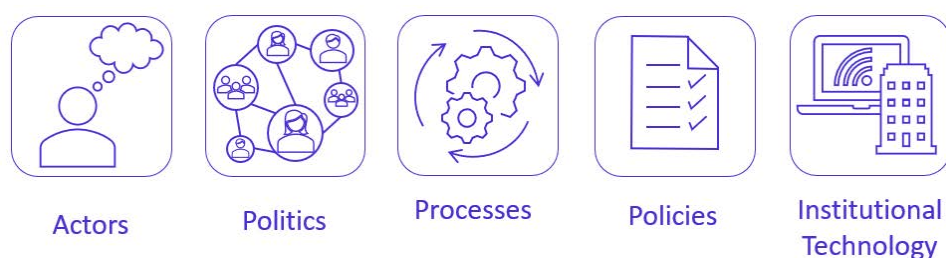


Figure 1: Governance dimensions

Chapter 3 explains the methodological approach of this study. We adopted a **systematic (qualitative) literature review** to archive and distilled state-of-art knowledge of good co-governance to activate NbS. Based on the co-developed search string, articles are identified in two academic sources, SCOPUS and Web of Science strategy. Based on inclusion and exclusion criteria, screening was conducted, resulting in a total of 467 articles

that were eligible for the analysis. The analysis focuses on identifying co-governance principles in each dimension as well as their enablers and barriers.

Chapter 4 illustrates the analysis results and presents insights into the dimensions of co-governance for achieving just low-carbon and high air quality cities. We analyse the role of each governance dimension; identify their main activating principles and describe the barriers and enablers influencing good co-governance in NbS.

Within the role of **actors**, we consider their perceptions, their values and their knowledge of individual and organisational actors in the course of governance processes. We prioritise four as their top principles:

- Empowering
- Inclusive
- Knowledge diverse
- Collaborative/Participative

We understand **politics** as a constellation of actors, assuming public and private actors are involved, and we consider specifically the power relations between them. The five principles developed for the politics dimension are:

- Recognising and empowering
- Integrative
- Democratic and representative
- Responsive
- Participatory and collaborative

In the case of the **processes**, we highlight their importance in decision-making within the institutional framework in which actors and the relationships between them are situated. Five principles are key to support good co-governance:

- Integrative and comprehensive
- Transparent and deliberative knowledge exchange
- Strategic and incremental
- Adaptive and reflective
- Context-sensitive

Policy instruments play a dual role in co-governance. While they are the result of decision-making processes, they also directly influence decision-making once they are enforced. The three main principles for policy instruments to support good co-governance of NbS are:

- Accessible
- Evidence-based
- Legitimate

Finally, the last developed dimension is **institutional technology**, which is based on the notion of a complex, bilateral relationship between technology and society, the selection of specific artefacts, infrastructures, design choices, and adoption to specific contexts to co-create institutional dynamics. Five main principles for the deployment of institutional technology in NbS co-governance were identified:

- Adaptive
- Collaborative
- Effective
- Legitimate
- Participatory

Chapter 5 discusses the main findings and presents a shortlist of principles most relevant to the JUSTNature project and CiPeLs. We aggregate the 22 principles introduced above into 5 key principles through which good governance can be broken down (Figure 2). These 5 prioritised principles will be useful in defining our future assessment protocol. To define our key principles, we drew on definitions of subordinate principles, to ensure precision and depth in our final set of key principles and avoid losing important guiding information. In this way, we arrived to the following shortlist:

- Collaborative
- Empowering
- Responsive
- Adaptive
- Legitimate

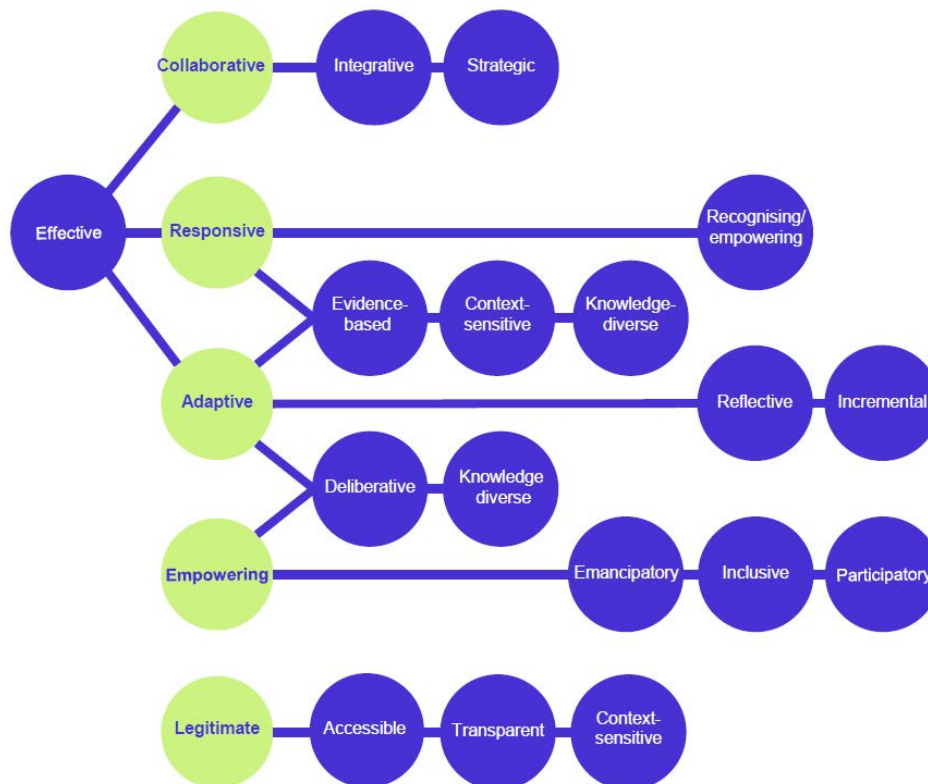


Figure 2: Principles for good co-governance of NbS

Our analysis of the principles and their associated barriers and enablers tells us how to make a shift to better co-governance: **Empowering**, where institutions, rules, actor relations and technologies are designed and implemented in a way that allows individual stakeholders to assert their interests. **Collaborative**, so that all these new and pre-existing interests avoid becoming a gridlock of unresolvable clashing self-interests, but rather serve a common good. **Adaptive**, since NbS assets are complex, prone to uncertainties, sensitive to changing circumstances, planning and management should then be capable of absorbing knowledges from different sources, and leveraging it to course-correct. None of the above should come at the expense of democratic **legitimacy**. Co-governance should maintain democratic norms in the inclusion of members, providing transparency and fairness in decision-making, and accessibility to policies. Finally, co-governance should be **responsive**. Its decision-making should be evidence-based, but not devalue tacit, local, and indigenous knowledges versus technical information. Institutions should be able to assess fidelity to the perspectives and needs of stakeholders and be accountable for their ability to do so.

1. INTRODUCTION

1.1. Background

This research is part of Work Package 7 (WP7) within the Horizon2020 project [JUSTNature](#) Grant Agreement No. 101003757). The JUSTNature project aims to deploy nature-based solutions (NbS) to support just transitions to low-carbon cities, based on the principle of the right to ecological space. This encompasses the right to clean air and indoor/outdoor thermal comfort for human health and well-being, as well as thriving biodiversity and ecosystems. It also highlights the duty of not constraining the ecological space of others in relation to the mitigation of climate change, indoor/outdoor thermal comfort for human health and well-being, and measures required for reducing GHG emissions.

In considering the just deployment of nature-based solutions, earlier work on the conceptual basis of this project (D2.1) indicated a need to address justice in procedural decision-making. A premise was established in which justice is applied not only to distribution of nature-based solutions, but also to inclusion and recognition in decision-making processes. This work, subtask 7.1.1 (see Table 1 and Figure 3), builds on studies that explore ideas of co-design in the deployment of nature-based solutions (e.g. Arlati *et al.*, 2021; Martin *et al.*, 2021) to reflect on the role of co-governance and identify good practices. In this deliverable D7.1, a systematic review of the [state-of-the-art of NbS co-governance](#) is conducted, to provide a comprehensive theoretical background that builds on existing experiences and knowledge of [how co-governance processes can be improved to reach just low-carbon cities](#). Emphasising governance dimensions, an analytical framework with principles of “good governance” was identified, which formed a basis to scrutinize approaches, strategies, and methods for the enhancement of co-governance.

Table 1: Overview of Subtask 7.1.1

Item	Description
Start Date	01.09.2021 (M1)
End Date	14.10.2022 (M14)
Responsible Partner	ISOCARP
Participants	TUM, ABUD, EURAC

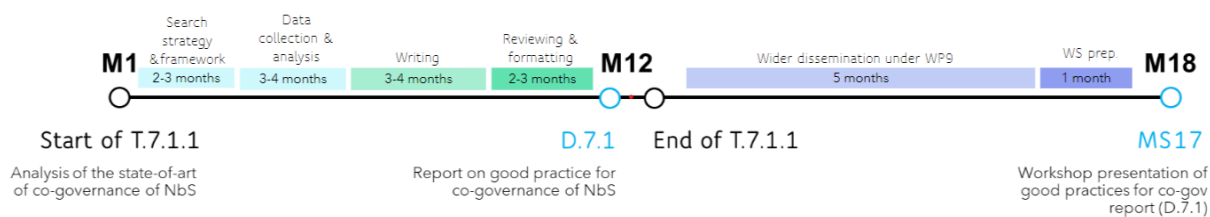


Figure 3: Timeline for subtask 7.1.1

1.2. Aims and Objectives

The state-of-the-art review under Subtask 7.1.1, and resulting output D7.1, target both research-based and practice-based objectives.

From an academic perspective, D7.1 aims to summarise the existing literature on good co-governance of NbS, in particular aiming to:

- Explore the concepts of good governance and co-governance of NbS and arrive at a definition to be applied within the project
- Define/explore existing modes of co-governance of NbS
- Establish principles that support “good” co-governance of NbS
- Identify barriers and enablers (based on these principles) to achieving good co-governance of NbS
- Identify exemplary case studies demonstrating the above principles, barriers and enablers in practice.

From a practice perspective, it aims to:

- Support the seven partner cities in the JUSTNature project (City Practice Labs or CiPeLs) to reflect on their own governance arrangements and opportunities to implement co-governance, in particular as relates to co-design, implementation, and management of one or more nature-based interventions in the course of the project.
- Inform a protocol to assess, monitor and seek ways to improve governance in each of the seven cities (subsequent task T7.1.2)
- Support the design and generation of tools to inform the implementation of co-governance for nature-based solutions in Europe and beyond.

Moreover, the content in D7.1 is designed to support the work of JUSTNature project partners. This includes:

- **Staff from scientific research organisations** whose practice-based research strategies and planned outputs need to take into consideration corresponding governance arrangements in European cities;
- **Staff from European city administrations** who are engaged in implementing NbS and will be supported to reflect on related governance arrangements and ways to improve these.

Potential 'spin-off' outputs from this Subtask include journal papers, conference presentations, policy briefs, infographics, presentations at local events, project website news bits, etc.

1.3. Interlinkages with Other Project Activities

Previous and ongoing projects funded by the European Commission, such as GREEN SURGE, PHUSICOS, CONEXUS, Naturvation, and studies such as "Biodiversity and nature-based solutions (Directorate-General for Research and Innovation [European Commission], 2020)" provided important references. Special emphasis was put on the implementation and management processes of NbS. Insights on aspects of procedural and recognition justice from global development studies can support finding innovative new strategies to be more inclusive, give marginal groups a voice, and define measures to countervail power imbalances.

The insights in this report build on the conceptual basis established already in the project's Conceptual and Action Framework (D2.1) and its four-tier system as a framework for planning and implementing NbS, made up of 1) Challenges, 2) Action hierarchy, 3) Principles and 4) NbS categories and measures. These insights will be shared with other partners and involved actors at the 1st Collaborative CiPeL workshop (M18, February 2023) to provide input for co-designing and co-implementing the NbS (T5.2) as well as the CiPeL overall process and strategy (T4.2). Emerging insights from this activity will form the basis for subsequent Subtask 7.1.2, which begins in M6 (February 2022).

2. CONCEPTUALISING CO-GOVERNANCE FOR JUST LOW-CARBON CITIES

2.1. Defining Co-governance of NbS for Just | Low-carbon Cities

We set out to address the question “How can the co-governance of nature-based solutions be improved to reach just, low-carbon cities?”. Our exploration begins by defining the concept of co-governance of NbS, followed by reflecting on the rationale for co-governing, and outlining different modes of governance.

2.1.1. Definitions of Co-governance

Within JUSTNature, the concept of co-governance is central to deploying NbS in the interest of just transitions to low-carbon cities. This objective is based on the concept of a right to ecological space, and a corresponding duty to not constrain the space of others, which departs from conceptions of rights defined by physical limits (e.g. property rights or political power) to take an expanded systemic perspective. It sees humans and non-human nature as together occupying a rich and complex, yet finite realm, defined by environmental conditions, social and economic conditions, individual circumstances and vulnerabilities, and the built environment (Gantioler, 2018). The right to ecological space is discussed in detail in the JUSTNature project’s Conceptual and Action Framework (D2.1), which establishes a conceptual basis for the project, and indeed this report, including in-depth exploration of the key theme justice on the one hand, and nature-based solutions on the other – as well as the relationship between the two. While D2.1 primarily addressed the substantive, or outcome-based, aspects of activating NbS for a just transition, this report builds on that previous work to actively focus on the nature of process-based aspects, and specifically, co-governance. Notwithstanding that the JUSTNature cities may differ in their motivations and imperatives for exploring co-governance, a shared definition of the concept and in particular its core aims is essential, given that different definitions exist in both theory and practice – some of which may not serve the project’s ambition. For the purposes of our analysis, we use the terms co-governance and collaborative governance interchangeably.

In order to define what we mean by co-governing NbS, we begin with some of the wider scholarships on governance more broadly. It is important to note that the term governance has been interpreted and addressed differently by a range of disciplines, including political science, sociology and public policy. A full review of the literature on governance is outside of the scope of this report – rather, our purpose is to clarify what distinguishes co-

governance from traditional approaches to governing, and to arrive at a shared understanding of co-governance to be applied by JUSTNature partners.

Kooiman (2003, p. 4) defines governance as “**the totality of interactions, in which public as well as private actors participate, aimed at solving societal problems or creating societal opportunities**”. From this starting point, various scholars have explored and sought to define a kind of governance that departs from the classic, state-led model, to acknowledge and indeed to foster the involvement of other actors. An early forerunner to contemporary discussions on alternatives to state-led governance

Emerson *et al.* (2011, p. 2) define collaborative governance as: “...the processes and structures of public policy decision-making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished”. The imperative for co-governance, according to Emerson *et al.* (2011) is that multiple actors are essential to achieve the intended purpose. However, they remain vague as to who is involved, whether non-governmental actors need to be involved at all, and what the nature of their possible involvement is (*ibid.*). A more restrictive definition is proposed by Ansell and Gash (2008), as they argue that broader definitions have limited the ability to build robust theories around the concept of collaborative governance. They define collaborative governance as “a governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets” (Ansell & Gash, 2008, p. 544). Their reference to consensus, in part, addresses the gap left by Emerson *et al.* (2011) suggesting that all engaged parties have a voice in the decision-making process. In contrast with the definition of Emerson *et al.* (*ibid.*), Ansell and Gash (2008) assert that public agencies always play a role in collaborative governance processes and that these processes are formal (*ibid.*). The assumption, however that governance is solely enacted through formal processes, and indeed that public actors are always involved, was challenged as early as 1990 by Elinor Ostrom in her book *Governing the Commons: The Evolution of Institutions for Collective Action*. Ostrom cast doubt on the prevailing wisdom that either public or private operators are best placed to govern common pool resources, asserting that ‘communities of individuals have relied on institutions resembling neither the state nor the market to govern some resource systems with reasonable degrees of success over long periods of time (Ostrom, 1990, p. 1).

Toxopeus *et al.* (2020, p. 3) after Skelcher *et al.* (2013, p. 1) further clarify the role of engaged parties in their definition of hybrid governance as “businesses and/or civil society actors that have the authority to formulate, determine and implement public policy within a specified policy and spatial domain’. This definition implies that non-public actors are not simply ‘engaged’ but share a position of influence with a public authority for decision-making and implementation. However, Gupta *et al.* (2015) point out that *ALL* governance is necessarily hybrid, as government actors cannot avoid engaging with others, hence the qualifier ‘hybrid’ perhaps rather betrays a conventional public policy view that the involvement of non-public actors is somehow novel, rather than substantially expanding the frame of analysis. As an alternative, Gupta *et al.* (2015) propose replacing ‘hybrid’ with ‘interactive’, entailing “...the complex process through which a plurality of social and political actors with diverging interests interact in order to formulate, promote and achieve common objectives by means of mobilising, exchanging and deploying a range of ideas, rules and resources” (Gupta *et al.*, 2015, p. 34 after Torfing *et al.*, 2012, p. 2). Examining collaborative governance in the context of watershed management, Dobbin and Lubell (2021, p. 563) point out that “a consistent critique of the theory and the empirical research on collaborative governance is a lack of conceptualisation and analysis of the role of political power and inequality.” This is of particular importance for the JUSTNature project, which seeks explicitly to address justice in the context of green space planning, design and management.

While these definitions are largely process-focused, in the context of the JUSTNature project, it is essential to consider our orientation towards a just transition, which demands co-governance not for its own sake, but rather in the context of transformation towards equitable and environmentally sustainable social change. The definition of Patterson *et al.* (2017) is helpful, for whom governance refers to “the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development”.

For the purposes of our analysis, we draw on the above definitions, with particular emphasis on the common good as an explicit aim in a co-governance process, on the pre-existing reality of unequal power dynamics between collaborating actors, and on the aim to transform existing systems on the journey to a just transition. Our understanding of co-

governance is not equivalent to all known forms of collaborative governance, such as public-private partnerships, that redistribute risk and reward without active concern for the democratic nature of the process or its beneficiaries. As such, we define co-governance as **the process of various actors across the public, civil society and private domains working together to formulate, promote and achieve shared objectives for positively transforming the urban environment in the context of a broader shift towards a just and sustainable future, through the planning, design, implementation and management of a nature-based intervention.**

2.1.2. The Rationale for Co-governance of NbS

Co-governance is not without its challenges and may represent a significant disruption to 'business-as-usual' in the city administrations of the JUSTNature city partners. The extra effort that might accompany co-governance, therefore, needs sound justification. Arguments for the value of 'doing' co-governance can be broadly divided between two camps: a technical, efficiency-oriented rationale and a political, transformation-oriented rationale aiming at the common good.

In terms of the first, it is argued that the pooling of resources and expertise involved in tackling a problem collaboratively supports the achievement of better solutions to problems and more scope for innovation that would otherwise not be possible (Klijn & Koppenjan, 2015, p. 35). Collaboration is particularly important in the face of increasingly complex problems that demand diverse perspectives (Chatterton *et al.*, 2018). This advantage may become an imperative in situations where city administrations are confronted with the need to do more with less, whether through austerity politics (Chatterton *et al.*, 2018), multi-level political struggles resulting in resource reductions at local level handed down by higher levels of government, or unexpected budgetary demands and shifting priorities brought about by the ongoing impacts of the Covid-19 pandemic.

Where the concept of co-governance is deployed based only on the techno-efficiency rationale, the involvement of non-state actors in traditionally government-led fields of action may be encouraged, but in service of economic growth over the public interest (Gupta *et al.*, 2015). In contrast, co-governance in pursuit of transformation for the common good is valued for its potential not only to achieve better technical outcomes and target resources more efficiently, but also for its transformative scope to further democratise the decision-making process by which outcomes are reached. This means

moving beyond top-down approaches in service of a public interest aim, through the process of working collaboratively (Gupta *et al.*, 2015, p. 219).

Within the two broadly defined rationales above, there are likely other contextual arguments depending on local circumstances, and we recognise that the city administrations involved in JUSTNature may bring different motivations with them. Equally, while political transformation may be an inherent aim, it is not guaranteed to resonate with all actors, and there may be instances where gains in techno-efficiency serve as a more persuasive argument. For example, where an influential – but sceptical – decision-maker is on the receiving end of a case for integrating co-governance into a department’s modus operandi. However, processes of co-governance that wholly exclude a transformational aim do not align with the definition we outline above and would similarly fail to serve the JUSTNature project’s stated purpose. As such, it is crucial to foster within the project team a mutual understanding of transformative visions within the partner cities, and to develop a structure for guiding collaboration, to which this current report serves as a starting point.

2.1.3. Modes of Co-governance of NbS

Although no common definition of “governance mode” exists, the main commonality between the different interpretations is that governance modes characterize the relationships between governmental and non-governmental stakeholders (Arnouts *et al.*, 2012; Driessen *et al.*, 2012; Kooiman, 2003; Lange *et al.*, 2013; Treib *et al.*, 2007). More specifically, governance mode refers to the governance mechanisms that structure the relationship between state and non-state actors within the different dimensions of governance (Kooiman, 2003). In other words, governance modes are the various forms through which governance can take place (Pahl-Wostl, 2019). This focus on relationships makes this concept relevant for co-governance, as it might help to assess and understand the different collaborative arrangements in cities. Deeper comprehension of governance modes might support improvement of future governance processes for just low-carbon NbS (Arnouts *et al.*, 2012).

Often these governance modes are described as archetypical forms, classifications, or types. Driessen *et al.* (2012) defined five archetypical types of governance modes: centralised, decentralised, public-private, interactive and self-governance. In centralised and decentralised governance modes, the state takes the lead, while civil society is the recipient of state incentives. Governance arrangements in which equal cooperation occurs

between the state and market actors are referred to as public-private partnerships. Interactive modes refer to collaboration between state, market actors, and civil society on an equal-rights basis. Governance arrangements in which private actors take a major role in decision-making is named self-governance. These five modes differ mainly in how state, market and civil society play a role in decision-making, whether active or passive, or leading or following. Also, with Arnouts *et al.* (2012) and (Hysing, 2009), this range from governance modes with strong state intervention to governance modes based on societal autonomy can be seen.

What the archetypical modes also show is that these collaborative arrangements are not only defined by the set-up of interactions between actors, but also reciprocally by other dimensions of governance, such as policy levels, instruments, power or rules. Hysing (2009) and Arnouts *et al.* (2012) both develop governance modes based on three dimensions, while Driessen *et al.* (2012) also consider three dimensions, but breaks these down into features. Arnouts *et al.* (2012) consider the actors and their constellation. Hysing (2009) looks at the relationships between state and non-state actors, but Driessen *et al.* (2012) add three more features to describe the actor dimension; the initiating actor, the policy level in which the actors are active, and the power base. The latter forms the second dimension for Arnouts *et al.* (2012), while for Hysing (2009) the policy level forms the second dimension. The third dimension for Hysing (2009) governing instruments and styles, which Driessen *et al.* (2012) put in the content-related dimension together with the features goals and targets (e.g. uniform, tailor-made etc.), integration of the policy (e.g. sectoral or integrated) and policy-science interface (e.g. trans-disciplinarity, dominance of site-specific knowledge etc.). Driessen *et al.* (2012) pack the third dimension of Arnouts *et al.* (2012), rules, in the institutional dimension and adds model of representation (e.g. pluralist, partnership etc.) and the way the social interactions are arranged (e.g. top-down, bottom-up etc.).

The different dimensions that are taken as a basis for classifying the modes of governance in these three examples can also be applied to identify different governance modes in practice. However, it should also be noted, that these governance modes usually do not exist in a purely archetypical form. In reality, it is more likely to encounter hybrid forms, which combine features of different types of governance arrangements. This multiplicity is also acknowledged in the mosaic governance framework (Buijs *et al.*, 2019). Yet instead of acknowledging hybrid forms, mosaic governance recognises that different governance modes can exist in the same time and place and that this plurality is needed to address the

societal and environmental challenges at different scale levels and actor constellations, from top-down hierarchical to self-governance modes (Buijs *et al.*, 2019). 2016

Besides an analytical approach, in which governance modes are presented as factual arrangements, a normative approach can also be taken (Lange *et al.*, 2013; Pahl-Wostl, 2019). In the normative approach, governance modes refer to “what ‘should be’ rather than what ‘is’” (Hufty, 2011). Here the performance of the governance system is based on a set of norms and principles that guide the professionals in the process of policy making at different levels (e.g. local, national etc.). For the purpose of this study, we rely on the normative approach to define ‘good’ governance (Osborne, 2010, p. 6) for just low-carbon cities, and to identify how existing collaborative governance arrangements need to be changed or improved.

2.2. Defining Dimensions of Co-governance of NbS

In order to evaluate the extent to which co-governance arrangements for nature-based interventions are successful, the concept of governance needs to be unpacked into its constituent parts. For this purpose, several analytical frameworks can be found in the literature, which differ dependent on their aim and perspective. Governance is a broad concept encompassing different notions about what governance is and what it contains. For example, in their analysis of governance modes, Driessen *et al.* (2012) define governance as an ensemble of actors, institutions and policy content. Treib *et al.* (2007) identify that studies on governance modes, due to the broadness of the concept, often emphasise one specific focus of governance, namely **policy, polity or politics**. Below, we look at different analytical approaches to the governance of NbS that scholars have deployed, before defining the dimensions that underpin our own analysis.

Studies on the governance of NbS often take a socio-ecological systems approach (e.g. van der Jagt *et al.*, 2020) in which the role of the social and cultural context in governing natural environmental systems is acknowledged. Within the JUSTNature project, NbS development is considered from an even wider perspective, namely a **socio-ecological-technological system’s perspective**. In this context, the nature-based Innovation System Framework by van der Jagt *et al.* (2020) is one of few existing frameworks linking the socio-ecological system with the socio-technological system approach by comparing frameworks for NbS with the Technological Innovation Systems Framework.

These three frameworks, also address the constituent elements characterised by Driessen *et al.* (2012), however, they still take a wider view. For example, the Technological Innovation Systems Framework also includes physical infrastructure linked to technologies such as machines and cables, while the nature-based Innovation System Framework, in line with other frameworks for socio-ecological systems approaches, include contextual factors. Another socio-ecological framework, the Institutional Analysis and Development framework (Mekala & MacDonald, 2018; Ostrom, 2005) defines contextual conditions as the biophysical characteristics, the socio-cultural factors, and the policy environment that interact with each other. These physical and social factors do influence governance processes. Yet, these contextual factors are beyond the scope of this report and were addressed in Work Package 2 (D2.1), while this report focuses on the governance processes.

We turn to other analytical frameworks, which focus foremost on the governance processes. For the study of environmental policy changes, Arts *et al.* (2006) developed the Policy Arrangements Approach (PAA). According to this framework, dynamics in policy arrangements are driven by the **dimensions, actors, resources, discourses and rules of the game**. More in line with our focus on co-governance is the framework for analysing the dynamics of collaborative arrangements by Coaffee and Healey (2003). They identified that power dynamics play out on three different levels. The first level is related to actors and their “arenas” or “institutional sites” in which “interpersonal relations” play a decisive role (*ibid.*, p. 1982). The second level of “governance processes” constitutes the “relations embedded in organised institutional practices”, which are defined by networks and coalitions, discourses, and practices (*ibid.*, p. 1982). The “level of governance cultures” with its “taken-for-granted assumptions, habits and routines” constitutes the third level (*ibid.*, p. 1982).

In line with Coaffee and Healey (2003) and Arts *et al.* (2006), we recognise the roles of individual actors, organisations and institutions in co-governance. Yet, in many studies on social-ecological systems, the role of the individual entity is neglected (Wamsler *et al.*, 2021). However, individual interests can hinder the deployment of NbS (Wamsler *et al.*, 2020), as citizen contestation of sustainability considerations (driven by expected personal benefits and/or a lack of environmental awareness) may have considerable negative impacts on their adoption. In order to understand the “individual and collective capacities” of actors fully (Wamsler *et al.*, 2021), we argue that an additional dimension is needed, namely that of individual **experiences, expertise and skills** as well as **personal and cultural**

values (see Gulsrud *et al.*, 2018) and **attitudes**. These factors influence the likelihood of just low-carbon NbS are being accepted and successfully implemented (Mok *et al.*, 2021; Randrup *et al.*, 2020).

Although Arts *et al.* (2006) cluster actors and their coalitions and interaction into one dimension, and separately the division of power and influence between them as another, we align here rather with the frameworks of Coaffee and Healey (2003), Hess and Ostrom (2005) and Mekala and MacDonald (2018). In this regard, we consider the **constellations of actors in partnerships, networks, and coalitions** as well as the **interactions between actors and within and between constellations** are considered as one dimension, which Treib *et al.* (2007) describe as the dimension of **politics**. Different factors influence the dynamics of politics, such as agency, capacity, communication, commitment, leadership, motivation, mutual trust and power (Emerson *et al.*, 2011; van der Jagt *et al.*, 2020). As mentioned earlier in Part 2.1.1, we pay particular attention to **power dynamics**, which have been under-explored in the literature on co-governance (e.g. see Ansell & Gash, 2008) and are essential in order to substantively address existing inequalities (e.g. see Gaventa, 2006) with a view to transitioning to just low-carbon cities. It is also for this reason, why power is set within the politics dimension and is not seen as by Arts *et al.* (2006) as part of the dimension of resources.

Following Coaffee and Healey (2003), each of the constellations and interactions are set within larger **processes** in which decisions and policies for a transition to just low-carbon cities are made. Due to this fact, we place emphasis on environmental and spatial planning processes. Processes are influenced by established **practices** and both **formal and informal rules and arrangements** (Arts *et al.*, 2006; Coaffee & Healey, 2003; Treib *et al.*, 2007) of not only governmental institutions, but also private organisations and civil society, as the different governance modes by Driessen *et al.* (2012) show. Although Arts *et al.* (2006) and van der Jagt *et al.* (2020) see knowledge as part of resources, we included **knowledge and knowledge exchange** with the processes dimension, as it forms the basis for solid decision-making processes.

These processes result in **policies** and **instruments** as defined by Hess and Ostrom (2005) and Emerson *et al.* (2011). Policies also support and steer decision-making processes, in that they “define how particular policy goals” and decisions could or should be achieved (Treib *et al.*, 2007, p. 4). These are not just **binding legislation and regulations** supporting and steering decision-making processes, but also formal and informal instruments (some

of which may be non-binding), programs, plans, strategies, market-based incentives, voluntary agreements, guidelines, information campaigns, and tools.

Another perspective, that of science and technology studies (STS), allows us to address how technologies, especially **digital technologies**, shape good governance. Digital technologies have significant potential implications for governance because their selection, design, and application, do not simply influence, but co-create institutional dynamics (Orlikowski & Barley, 2001). Just as the modern international system of governance is only possible because of long-distance and near-real time communication technologies (Buzan & Little, 1994), we can expect recent digital technologies to similarly disrupt and change environmental governance, such as distributed ledger technologies, immersive technologies, and artificial intelligence (Evans, 2014; Gartner, 2022). By combining such technologies, they can complement each other and create an ecosystem of tools fulfilling co-governance functionalities. To make this possible, we need to define normative criteria for technologies as well. Using Davidson's institutional innovation concept (2016), we define institutional technologies as material or digital artefacts or their combinations, which fulfil governance functionalities relating to the coordination of actions. In practice, anything is an institutional technology if it substitutes a functionality related to coordination from private companies, contracts, public authorities, or markets, or it introduces the capacity to coordinate actions not yet formally governed.

In conclusion, for the purposes of our analysis, we examine governance according to five dimensions. (Figure 4)

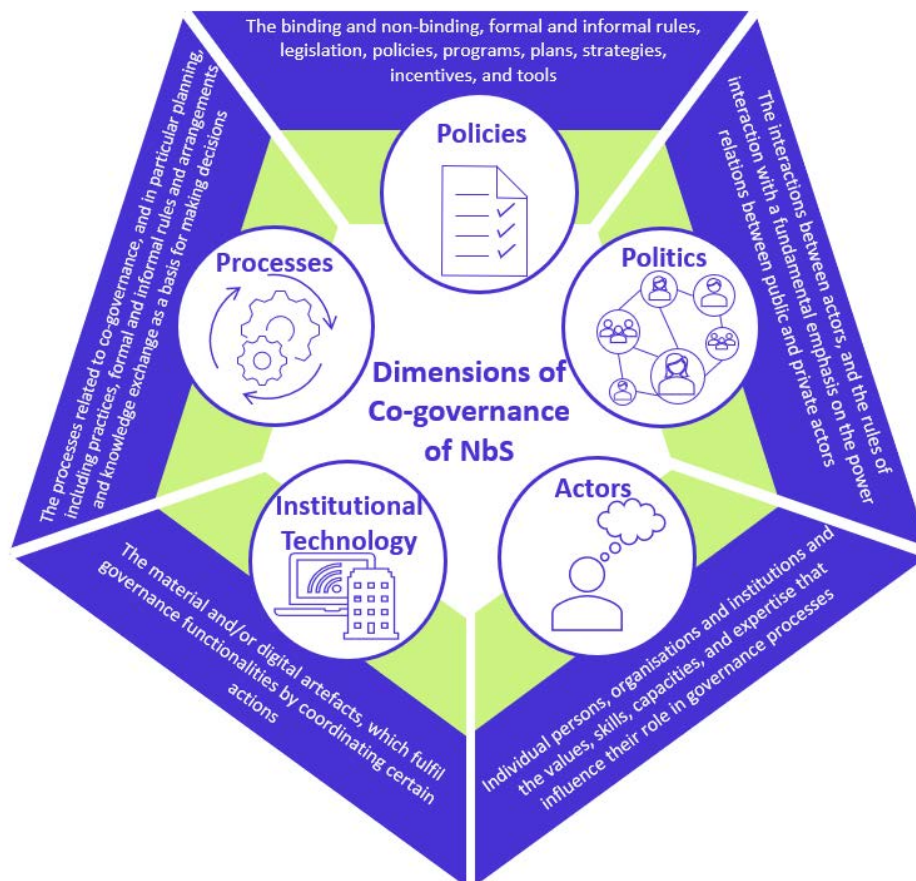


Figure 4: Dimensions of co-governance of NbS

These five dimensions are not strictly separable from one another, but rather co-exist. It would not be possible for political actors to achieve goals without steering policies, working independently from their institutional environments with its diverse actor constellations and arrangements. Despite this overlap, deploying this range of dimensions of governance is useful and indeed necessary from an analytical view, in order to sufficiently examine the complexity of the endeavour. For each dimension, we are interested in principles that facilitate ‘good’ co-governance, the barriers that prevent a successful employment of identified principles, and accordingly the enablers, that may be deployed to overcome these.

2.3. Shaping “Good” Co-governance of NbS

2.3.1. Principles

We understand “principles” of good co-governance as the set of normative criteria and collective goals that the governance framework is meant to serve. The concept is modelled

after similar statements on good governance at a higher level of abstraction. In Kabisch *et al.* (2022), principles are specified to the application of NbS in urban and peri-urban areas. The authors identify principles of the design, planning, policy, and governance of NbS, which should be followed to overcome specific challenges. They suggest that NbS should be grounded in “a systemic understanding, benefit people & biodiversity, have inclusive solutions for the long-term, consider the context, and communicate & learn” (Kabisch *et al.*, 2022, p. 1391). Similarly, Conceptual & action framework on Low carbon | High air quality NbS potentials (D2.1) for environmental justice and just transition recognises three main principles within the ecological justice framework: distributional (distribution of the environmental goods and harms), procedural (legitimacy of the environmental decision-making), and recognition (of the different needs, burdens, and opportunities in the community) (p. 47). As appointed by the hierarchical four-tier system proposed by this Conceptual and Action Framework, principles for activating NbS (located in Level 3) are described for the procedural dimension in this deliverable, while D2.1 addresses the substantive dimension.

The two core features of a principle in this study are (1) generalisation, and (2) normativity. A relatively high level of abstraction was chosen to limit the number of principles (around 4-6 per dimension) and allow flexibility when interpreting them from the perspectives of different governance dimensions (explained in Chapter Defining Dimensions of Co-governance of NbS). Normativity is required to express the collective aspirations, core values, norms, and ethical principles the governance mode shift is either expected to deliver, or to keep (Wiener, 2007). For our investigation, we are concerned with finding what improves environmental governance practices (i.e., activating “good” governance) in the context of shifting to co-governance. Identifying a set of corresponding normative principles that can serve as a robust basis for improving co-governance in the JUSTNature cities was hence central to our literature analysis approach, as described in more detail in Chapter 3. In Chapter 5, we explain how we then re-structured and reduced the principles that emerged from the literature to produce a shortlist that can be deployed for further practical use within the project.

2.3.2. Barriers and Enablers

Implementing the principles of good co-governance may be easier for some and more difficult for others. In this study, we sought out various barriers and enablers for each principle to describe the conditions that hinder or expedite their adoption. We define barriers as obstructions to goal-oriented actions that can be overcome, but at an increased

cost or effort which makes the action either less effective or efficient (Moser & Ekstrom, 2010). The goal-oriented action in this case refer to efforts to adhere to the good co-governance principles (while organising, making decisions, rules, policies, and coordinating NbS-related activities). Barriers can come from multiple domains, like financial deficiencies, limiting regulations, inertia of the stakeholders, lack of knowledge (Sarabi *et al.*, 2021). Enablers, on the other hand, are processes, conditions, or factors that accelerate and economise the transition to better co-governance, or increase the positive impact of such transition (Martin *et al.*, 2021). Enablers may include such instruments as an ease of permitting procedures, financial incentives, knowledge-sharing.

There are some caveats to interpreting barriers and enablers in this report. First, it should be noted that these factors are particular to different cities, stakeholders, and scales (Sarabi *et al.*, 2021). This study focuses on ones that are either systemic or recurring in the European context. It is not in our scope to make a comprehensive account of location- or stakeholder-specific barriers and enablers. Mapping these should be done case-by-case, to which our list can serve as a starting kit. Second, most barriers and enablers are not strictly limited to the context of NbS and their climate-related performances, but rather refer to environmental governance or governance in general (Biesbroek *et al.*, 2013). Overcoming or eliminating such barriers – such as inadequate interdepartmental cooperation, or knowledge gaps – can have spill over effects beyond NbS co-governance. Third, while some barriers and enablers are cross-cutting, others are specific to different phases of implementation, e.g. resources might be most limiting during NbS implementation, whereas disputed evidence is more relevant during problem diagnosis or monitoring (Clar *et al.*, 2013). The cited literature in this report does not always specify phase-relevance, which is why these must be critically reflected on when enacting co-governance principles. Lastly, many sources do not consider the interlinkages and stacking of barriers and enablers. Different individual and institutional actions can support or limit climate risk (including NbS) co-governance (Wamsler, 2016) which may carry over the barriers/enablers of one to the other. For instance, more climate risk-aware citizens create political pressure to enact NbS-supporting policies, but also create a market for NbS projects. It is thus necessary to consider if certain barriers have a common cause, or cascading effects to other obstacles and hindrances, to find good leverage points for intervention.

3. METHODOLOGICAL APPROACH

3.1. Systematic Qualitative Literature Review

Our methodology adopted a systematic (qualitative) literature review to identify state-of-art knowledge of good co-governance to activate NbS. A systematic literature review is useful to comprehend scattered knowledge and to have an overview of the field (Petticrew & Roberts, 2008). The collection and selection of articles was based on [Guidelines for Systematic Reviews in Environmental Management](#) set out by Collaboration for Environmental Evidence (2013) and further supported by protocols of [ROSES \(RepOrting standards for Systematic Evidence Syntheses\)](#).

Our methodology involved six steps (Livoreil *et al.*, 2017): 1) developing a theoretical base for the review, which guides the literature search and the literature analysis, 2) planning the search strategy, 3) testing the search strategy, 4) conducting the literature search, 5) screening the search results, and 6) analysing the literature, and summarising and structuring the outcomes. Since the theoretical base is covered in Chapter 2, this section starts with the search strategy.

3.1.1. Planning the Search Strategy

To answer our guiding question: “how can the co-governance of NbS be improved to reach just, low-carbon | high air quality cities?”, an initial list of relevant articles was developed. This list would function as a test list, through the following steps. The articles in this list are deemed relevant in relation to the guiding question and the corresponding key topics in the analytical framework (Livoreil *et al.*, 2017). To create the test list, each researcher added relevant articles (up to 10 articles) that fulfilled the selection criteria (Table 2) through hand searching, based on their expertise and knowledge.

To ensure a consistent search and screening process, selection (inclusion and exclusion) criteria were specified. The selection criteria include topic, literature type, languages, accessibility, and quality (see Table 2).

Table 2: Selection criteria

Item	Criteria
Topic	The article addresses substantially in the body one or more topics of the theoretical framework: <ul style="list-style-type: none"> Principles for “good” governance (e.g. collaborative, participatory, strategic, etc.) Dimensions of governance (actor, politics, polity, & institutional technology) Barriers and enablers for “good” governance (approaches, strategies, instruments, etc.) Assessment of “good” governance (indicators, methods)
Literature type	Scientific publication published at peer-reviewed international journals * Grey literature is included by hand search, considering wider access to relevant knowledge or information. Included types of grey literature are: white/green papers, PhD dissertations and theses, interviews, books and book chapter(s), case studies, reports and deliverables from EU-funded projects. In particular, outcomes from previous and ongoing EU-funded projects such as GREEN SURGE, PHUSICOS, CONEXUS, Naturvation, and studies such as “Biodiversity and nature-based solutions” are important references.
Language	English, German, Spanish, & Italian* * For non-English publications, at least two researchers in the WP7 team must speak the language to ensure double screening is possible.
Accessibility	Online accessible literature Hard copy literature (e.g. books, reports), which is not online available, should be made available for internal use.
Quality	Academic literature must be of sufficient quality. The quality of an article is checked by relevant reviewers, considering consistent and reproducible methodology and legible writing.

In addition to selection criteria, **exclusion criteria** were further specified to identify the articles that are highest-relevant to this research. Exclusion criteria were also used to identify exclusion reasons in screening process.

- Out of topic: the article does not substantively address in the body one of the governance topics from the theoretical framework.
- Wrong context
 - Context is not relevant to JUSTNature’s partner cities (e.g., brownfield redevelopment, siting of hazardous waste facilities, indigenous communities, informal settlements, disaster recovery, megacity, colonial/post-colonial contexts, nuclear waste disposal, etc.)
 - Primary focus is on non-local-government entity (e.g. social global movement rather than a collaboration with local governments)
 - Dimension of planning is not directly relevant to JUSTNature (e.g. vulnerability assessment, transport, energy efficient renovation, solar power, etc.)
 - Context is not related to urban or peri-urban dimension.
- Insufficient quality: very poor writing quality, poor methodology

- Wrong publication type: introduction to special issue, book review
 - In case of highly relevant books: review table of contents and extract relevant chapter(s)

For the search strategy, we decided to use two search methods: a **systematic search** through databases using search strings, and an integrative review with **hand searches**.

Considering the complex nature of social science, one keyword or search string is nearly impossible to comprehend the whole aspect of co-governance or NbS. Same terms are used in different contexts and meanings or different terms are used to describe the same idea (Livoreil *et al.*, 2017). Even an articulated search string may not be able to capture all relevant articles (Livoreil *et al.*, 2017). Therefore, an integrative review, in which articles could be included through a **hand search**, was used to complement the systematic search. By snowballing, asking experts, consulting citations lists, etc., additional articles that can produce meaningful insights were included. Researchers individually conducted hand-search following pre-defined rules. For the **systematic search**, the most commonly used research databases: the Web of Science and SCOPUS (Martín-Martín *et al.*, 2018) were selected.

3.1.2. Testing the Search Strategy

Based on an initial review of the test list articles as well as on brainstorming sessions, a preliminary set of search terms (keywords) were collected. These keywords were then clustered into key topics according to the guiding question and analytical framework in order to develop an appropriate search string. These keywords search strings are included in ANNEX 1.

The search string was tested to see if the test list was well reflected in the search results. For this reason, the outcomes of the searches were compared with the test list. More than half of the articles on the test list were not included in the search results. Therefore, the articles in the test list were linked to keywords in the search string to identify the keywords covering most test list articles. The search string was adjusted and tested accordingly, until the search string outcomes included approx. 50% of the test list. The search string for each database can be found in ANNEX 1.

An optimisation technique known as “elbow/knee detection” was used to define the cut-off for literature collection. In data science, “knees” and “elbows” refer to operational points, where the diminishing returns of additional investment (on data collection, or parameter

tuning) no longer translate to worthwhile benefits (in terms of more or better actionable knowledge). There are multiple methods to detect the knee- or elbow-points of any task. In this review, we relied on “Kneedle”, an algorithm relying on the mathematical expression of the curvature of the cost-benefit function (Satopaa *et al.*, 2011). We selected Kneedle for its ability to function without a live data stream, and because it is a generalised, context-independent algorithm. For this review, we plotted the year of publication on the cost axis, and the number of publications in each year on the benefit axis, following the logic that our cut-off should define the year where the scientific discourse became reliably mature (see Figure 5). Based on the local maxima below multiple threshold values (a hyperparameter controlled by the researcher) of the first derivative of this function, the year 2001 was defined as a cut-off point for all threshold values. Therefore, articles published before 2001 would be excluded from the search results.

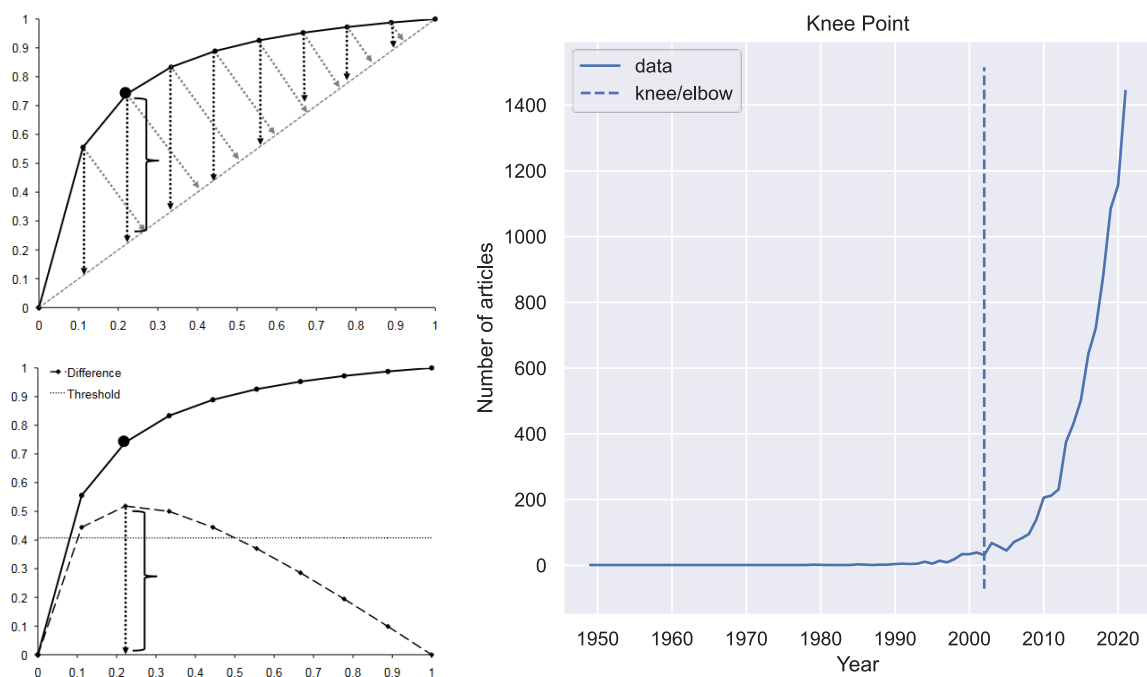


Figure 5: Graphic representation of the logic behind the Kneedle algorithm (top and bottom left, source: Satopaa *et al.* (2011), and the application to the literature review (right)

3.1.3. Conducting the Search Strategy

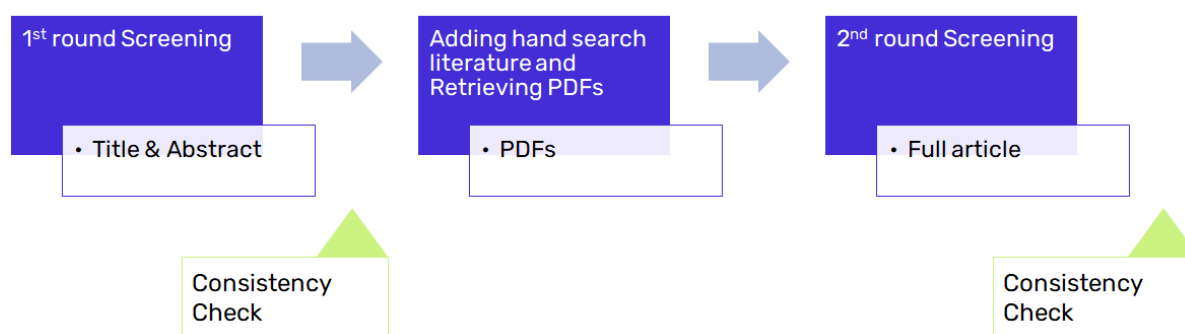
Using the final search string, a systematic search was conducted on Web of Science and SCOPUS. The search was conducted on 6th February 2022. As shown in Table 3, the total number of articles is 14,436, including duplicates from the two databases. The results for the search string were imported into Zotero, where duplicates were removed.

Table 3: Search Result

Database	No. of articles
SCOPUS (Title, keywords, abstract)	8,854
Web of Science (Topic=Title, keywords, abstract)	5,582
Total (including duplicates)	14,436
Duplicates	4,194
Total (excluding duplicates)	10,238

3.1.4. Screening the Search Results

Following the ROSES protocol, the screening was done in three major steps, as shown in Figure 6 and Figure 7. The full list of articles excluding the duplicates were uploaded in Rayyan¹ for rounds of screening.

**Figure 6: Screening sequence**

❖ Step 1: First screening based on title and abstract

From 3rd March to 21st April, a first screening round was conducted, starting with 10,238 articles. The articles were sorted in alphabetical order and given numeric codes to ease identification of articles. The articles were divided among reviewers by assigning the equal number of articles. Ten percent of the articles were assigned to two reviewers to ensure consistency in decision-making, in accordance with the ROSES protocol (e.g. Reviewer A reviewed article no. 1 to no. 100, reviewer B reviewed article no. 91 to no. 190, etc.). Reviewers decided whether to include/exclude the article by reading the title and abstract based on selection and exclusion criteria. When a reviewer was in doubt about whether to

¹ Rayyan is a free web tool to document and screen the articles for systematic reviews. Rayyan provides tools to mark inclusion labels and exclusion reasons by each reviewer, which enables coherent screening process, as well as tools for consistency checks. It also provides filter by keywords or labels options, which is useful to divide the articles among the reviewers.

include or exclude, they marked "maybe" and checked with other reviewers. Finally, conflicting decisions (reviewer A marked 'include' while reviewer B marked 'exclude') and articles marked "maybe" were resolved through group discussion.

After the first screening, a substantial number of articles (9,151) were excluded. Around 98.9% of those (9,050 articles) were excluded as they were out of topic. In those articles, strings were mentioned in title, keywords, and/or abstract, but the main topic of the article was irrelevant (see exclusion criteria). 42 articles (0.5%) were excluded because they were not available (no online access), while 38 articles (0.4%) were excluded because of the wrong publication type. There were six articles of insufficient quality and three articles written in a language not covered by the review team. An additional 37 duplicate articles which went undetected in Zotero were excluded. Those duplicate articles were mostly initially published in conference proceedings and later published in journals with the same content. In total 1,062 articles were selected for the second screening round.

❖ **Step 2: Adding hand search results and retrieving full articles**

After the first screening, each reviewer could add relevant articles through hand search. This step also allowed to add articles from the test list, which were not in the search results. In order to assure accountability of the hand search result, the hand searched literature was included in the second round of screening, which took place simultaneously. 155 articles were added by hand search.

Full-length PDFs for these 1,257 articles were retrieved and saved in Zotero, except for 62 articles that were not available due to accessibility issues. Finally, 1,195 articles were eligible for the second screening.

❖ **Step 3: Second screening based on full article read**

In the second round of the screening, we conducted critical appraisal. Critical appraisal is done to ensure the quality of the study and to check if the article provides sufficient information for the purpose of systematic review (Petticrew & Roberts, 2008). Since this review did not limit methodology used in literature, critical appraisal depended on individual characteristics of the article. General guideline for quality assessment is as following:

- Whether the research question is clear and well answered
- Whether the methodology is clearly defined and sufficient to answer the research question
- Whether results are based on evidence and data is well presented

A ranking system was devised to evaluate the relevance and quality of the articles, which supported decision-making regarding the most relevant articles. Each article was given a score from 1 to 3, with 3 indicating the highest appraisal. The ranking score was used to determine the final decision of inclusion/exclusion. In addition, the included articles were tagged if deemed relevant for one or more of the research interests (e.g. actor interactions, collaborative planning processes, instruments). About 20% of the articles were reviewed and tagged by more than two researchers to meet the consistency check in the ROSES protocol. After the second screening, around 60% (728 articles) were excluded, again mostly due to being out of topic or context. In total, 467 articles were considered eligible for the analysis.

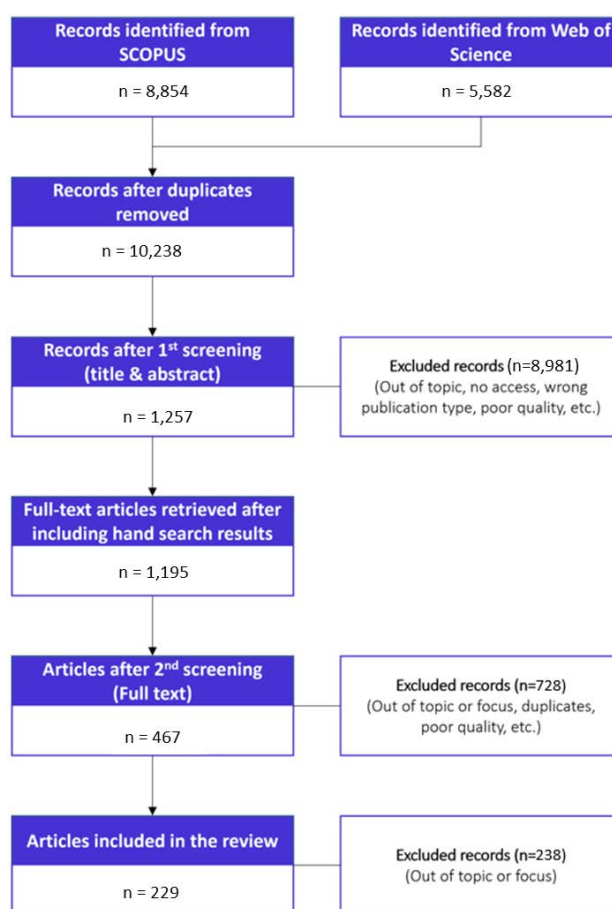


Figure 7: Process of screening

3.2. Analysis Strategy

To answer the guiding question, we aimed to identify main principles for “good” governance for each dimension of governance (see 2.3.1) as well as the accompanying

barriers and enablers (see 2.3.2). In addition, we wanted to highlight, through good practice examples, how principles could be applied in practice.

Based on previously assigned tabs for research interests, the selected articles were grouped for each dimension and analysed by teams of 1-3 persons. Each reviewer read assigned articles, extracted relevant information on principles, enablers, barriers, and case studies. The information was summarised in keywords and tagged by relevance to each governance dimensions. The latter allowed for information relating to other dimensions to be gathered, despite being tagged in previous screening rounds for only one or two dimensions. Based on the summaries in keywords, a list of principles for good co-governance was created. For each dimension, the team identified the most relevant and critical principles. To identify the most relevant principles, first, the reviewers gathered all identified principles in their governance dimension. Then based on literature and reviewers' expertise, up to five principles considered the most important were selected based on frequency, distinctiveness, and representation of the dimension. We limited the number of principles to stay concise and in order not to over-complicate the analysis. Ultimately, the aim was to use these principles to structure an accessible framework for municipal staff to evaluate their own governance arrangements. This framework needed to be composed of a manageable number of components and address the most salient issues. Once a maximum of five most relevant principles were identified, reviewer's the grouped barriers and/or enablers related to each principle and their examples within case studies. These are discussed in the next chapter.

4. INSIGHTS INTO THE DIMENSIONS OF CO-GOVERNANCE FOR ACHIEVING JUST LOW-CARBON CITIES

4.1. The Role of Actors

We understand an actor as “any social entity that is able to act” (Hermans 2020, in Holscher *et al.*, 2018, p. 134). This includes both individuals (as independent players or as members of an organisation) and organisational actors (e.g., policymakers, firms, NGOs, communities, municipalities) with the consideration of their values, skills, capacities, and expertise in the course of governance processes. There is extensive literature trying to classify actors and their level of aggregation, often differing in their conceptualisation. For instance, common distinctions are between “market”, “state”, and “civil society” (Durrant, 2014; Walzer, 1995), or the so-called “triple” and “quadruple helix”, which includes state, market, science, and civil society (Avelino & Wittmayer, 2016; Farla *et al.*, 2012). The JustNature project also introduces the quintuple helix to consider the influence of the natural environment on actors’ objectives and impacts.

Different actors can adopt different roles in sustainability transitions. Avelino & Wittmayer (2016) define roles as “recognisable activities and attitudes used by an actor to address recurring situations” (Kronsell & Mukhtar-Landgren, 2018, p. 990). The role of each actor defines their interactions and relations within the community and with other actors, although oftentimes these definitions are “ideal” and not exhaustive. For example, Kronsell & Mukhtar-Landgren (2018) identify three types of roles of municipalities in experimental governance: promoter, enabler, and partner as well as non-role. In adopting the promoter role, the actor is expected to initiate participation, allocate resources to the project, or provide leadership. The enabler role acts as a facilitator for space and opportunities for other collaboration with other actors, not necessarily leading any provisions. Finally, a partner role refers to participation in the project on equal terms with the rest of the actors, where collaboration is of utmost importance. Furthermore, some of these roles can overlap or vary in different contexts, for example a municipality can act as an enabler and then shift to a non-role (Kronsell & Mukhtar-Landgren, 2018).

Decision-making can take place through one or more stakeholder groups. This process is influenced by driving factors at different spatial and temporal scales and counteracts with cultural, institutional and individual perceptions, values and knowledge (Fernandes *et al.*, 2019). Moreover, subjective perceptions can often hinder sustainability considerations during citizen engagement processes due to lack of environmental awareness, political

issues, or individual interests (Wamsler *et al.*, 2021). For example, Wamsler *et al.* (2021) point out that citizen involvement in municipality-driven planning had resulted in negative impacts to NbS considerations in several projects in Sweden. This city-citizen interaction often took the form of explicit contestation, inaction, lack of civil engagement, and active ignorance of legal provisions. A constructive involvement that supports inclusive participation and sustainable outcomes in the co-governance process is necessary.

The goal of the United Nations' 2030 Agenda for Sustainable Development is the participation of marginalised groups in decision-making (Fors *et al.*, 2021). Yet there is the challenge to involve all citizens, as often only a certain number of people is willing or able to participate (Giaino *et al.*, 2019). Citizens with a weak voice are sometimes difficult to include, because they are often hard to reach or not willing to participate, and their interests are likely to be eclipsed by those of more powerful people (Giaino *et al.*, 2019).

Values have a multidimensional construct being of individual or societal nature, see also D2.1 chapter 2.1.4. They are the driving force for certain actions and differ depending on the social status of a person, the cultural context, and the purpose (e.g. ecological, economic) of actions. In relation to co-governance and the process of decision-making, the difference and the purpose of these values have to be considered. The recognition of values in such processes aims at improving the collaboration between differing actors (T. J. Mattijssen *et al.*, 2020), avoiding conflicts (Mok *et al.*, 2021) and allowing the incorporation of social and non-instrumental factors into the concept of NbS which reflects a shortcoming noticed by Randrup *et al.* (2020) As highlighted by Wamsler *et al.* (2020) stakeholder interactions must go beyond a "technocratic compromise" of citizen involvement and consider their underlying values, beliefs, motivations, concerns, perceptions of responsibility, and environmental awareness, as these personal spheres could be a more influential driver of participation in the co-governance process. Furthermore, inner changes, such as attitudes and values have been considered relevant to sustainable transformation. A shift in people's subjective values (e.g. a more openness on behalf of individuals to change, increased values of carrying, a sense of empowerment) can enable people to cooperate for a more sustainable future (Wamsler *et al.*, 2021).

Values, attitudes, roles, and interactions are important drivers behind the role that actors play in co-governance processes. Therefore, in order to activate good co-governance, we derived from the literature review the main four principles that have an impact on these considerations. We first collected all the principles relevant to the actor's dimensions from the selected articles and grouped them according to their commonalities. Through a

detailed analysis, we identified one principle from each group that would capture all the principles within that category, alongside their barriers and enablers. The top four (4) principles to activate good co-governance in the actor's dimension are described below:

- Empowering (engaged, social cohesion, stewardship, voice)
- Inclusive (equitable, fair, integrative)
- Knowledge diverse (communicative, informative, transparent)
- Collaborative/Participative (collective, democratic, partnership, shared responsibility)

4.1.1. Principle 1 - Empowering

This principle concerns the need to give trust and a voice to citizens in terms of their abilities to support the planning and implementation of NbS. Empowered actors activate “good” co-governance: the municipality facilitates, coordinates and encourages the community, private and NGOs through partnerships and helps to build new networks between them (Kronsell & Mukhtar-Landgren, 2018). “Mobilising local support” can be a way to connect the social and economic interests (Mok *et al.*, 2021). Empowering people is a way to ensure that they **take part in shaping their own sustainable environment** (Hölscher *et al.*, 2018) and that **values** are formed. If citizens are actively involved in the conservation or implementation of urban green, they feel valued, which leads to increased social well-being (Mok *et al.*, 2021). The feeling of empowerment is also strongly related to trust-building between citizens and city, it “is the first step, and it is a prerequisite for ensuring a trust in the experimentation process they embark in” (Frantzeskaki, 2019). Citizens, NGOs and others feel equal to the city administration and can identify themselves with the aim.

Empowering processes have the potential to reveal the immaterial struggles of different actors around NbS, that will move toward a more social-ecological approach for greening the cities (Randrup *et al.*, 2020). While ensuring empowerment it is crucial to do this as inclusively as possible, so that everyone can have the possibility to engage themselves in the process.

Barriers and enablers

Caution is needed when it comes to the distribution of power. Empowering ‘frontrunners’ who are already engaged and have a loud voice can lead to other actors being quiet, overlooked or disempowered (Hölscher *et al.*, 2018). Often it is also assumed that the government is responsible for the implementation and management of NbS (Mok *et al.*,

2021). That means that **unclear responsibilities** need to be uncovered and avoided early in the process and during the implementation. Strong collaborations between different parties and an **early involvement** can overcome this barrier (Mok *et al.*, 2021).

So-called *resident associations* have the ability to empower citizens, because they give a voice to their needs and wishes as well as they **share the workload and network** between society and government (Butt *et al.*, 2021). That means creating resident associations or interacting with existing local initiatives can foster empowerment of different societal groups. For someone or a group to take an active role in governance, more is needed than mere exchange: when residents spend time in urban forests and engage themselves in the protection and management of these areas, they feel attached to this place and are willing to engage themselves actively (Butt *et al.*, 2021). This process, in turn may trigger **feelings of stewardship and social responsibility**. It is therefore important to identify the stakeholders and characterize them, so to address their interests and values (Zingraff-Hamed *et al.*, 2020) which are important for the incorporation of the social factors into the management of nature.

Another way to empower citizens and different stakeholders follows the concept of **co-creation** which aims to conduct every step in the project together by establishing urban innovation partnerships, co-designing, co-implementing, co-monitoring and co-developing (see also BOX 3) (Arlati *et al.*, 2021). Providing '**acting spaces**' for different actors entails not only possibilities for the municipalities themselves but also "may include measures such as providing arenas for voluntary organisations, or providing financial incentives for private actors to provide services" (Kronsell & Mukhtar-Landgren, 2018).

4.1.2. Principle 2 - Inclusive

As evidenced by the literature, a key principle for good co-governance is inclusiveness, suggesting that inclusive approaches lead to better co-governance outcomes, including **environmental** and **social benefits**, and **civil and governmental institutions resilience** (Buijs *et al.*, 2016). We refer to the principle of inclusive as the **active consideration and involvement** of the different types of actors and social groups, their needs, knowledge, and initiatives. This entails an inclusive and recognition-based approach to both the actors that participate in co-governance processes and the decision-making process itself. Minorities, disadvantaged social groups, and grass-root movements are often overlooked and excluded from opportunities that privileged groups, experts, and traditional communities are more likely to take. Still, it is necessary that the **minorities have a direct role from the**

beginning of the process (Arlati *et al.*, 2021), in order to move away from the same type of narrow community involvement into a **broad range of partnerships** (Buijs *et al.*, 2016). Good co-governance must recognise and include the different types of actors, their networks, dynamics, and interactions across scales. At the same time, good co-governance should guarantee an inclusive decision-making process that can be carried out even outside the formal co-governance structures provided by, for example, governments and municipalities. This involves co-design and co-implementation activities occurring in places such as demonstration sites or stakeholder forums organised by NGOs or local networks (Gerlak *et al.*, 2021). Inclusive co-governance is concerned with the “who” gets asked which question. Prado (2020) denotes that “community” participation cannot be homogenised as one actor, as participation may come from different community members, and therefore the **need to recognise the diversity of social and cultural groups** becomes imperative. Moreover, research has shown that there is an **overrepresentation of professionalised community members**, NGO members, and of those who share similar demographic characteristics (DeSantis & Hill, 2004; Fung, 2004; Young, 2002 in Prado, 2020).

The lack of representation of residents who are not part of a community organisation is an example of recognition injustice (see also chapter 2.1), given that “when some community members are not recognised as stakeholders in the governance process, they are not considered in the outreach, and engagement for participation” (Prado, 2020, p. 14). If properly addressed, the issues of **inclusiveness could strengthen the role of NbS** in urban sustainability development, by avoiding them to create uneven landscapes that may undermine certain people’s identity or place attachment (Anguelovski *et al.*, 2020).

Barriers and enablers

As observed by (Buijs *et al.*, 2016), an often-recurring barrier for an inclusive co-governance practice when it comes to planning processes is a **narrow focus** of community involvement that does not recognise all the social groups affecting and affected by the project. This is evidenced in the power asymmetries exploited by developers and planning authorities, who often **value-engineer NbS out of projects** (Fisher *et al.*, 2021) **without considering possible benefits** for the rest of the community. For example, in the case of a tree-planting program, Carmichael & McDonough (2018) suggest to “explore the perspective of residents, especially in less affluent neighbourhoods and those that are predominately non-white, regarding preferred methods of engagement” (p.222) in order to account for the **values of all interest groups**. A **recognition-based approach** to community

participation, in order to recognise and include all the stakeholders in the process is an enabler of inclusive co-governance. **Ensuring the presence of often excluded groups** such as residents that do not belong to an organisation, older population (and ensuring also diversity among older individuals recognising for example, gender, class and life stage differences (Day, 2010), and members of groups outside the usual participants need to be involved. As with the examples set in Martin *et al.* (2021), this can be achieved through a **comprehensive communication strategy from the start** of the project and throughout all its phases. Stakeholder engagement plans and consultation processes that build on a trust relationship between those involved are also another tool. Ferreira *et al.* (2020) also suggest paying more attention to the incorporation of “local and indigenous knowledge” (p. 2) for the design and implementation of natural solutions. A shift from traditional incentive mechanisms to **innovative incentives** can also help to include marginalised groups. In the case of an NbS project in Wolong, China (Martin *et al.*, 2021), the implementation of “monetary incentives for households in consultation with villagers for community-based monitoring of illegal logging” (p. 11) by the local authorities provided to be an essential enabler for inclusion.

BOX 1 Landslide Risk Mitigation in Nocera Inferiore, Italy

This project was carried out in Campania, Italy, during 2015 – 2019. Nature-based solutions were implemented for landslide protection after a severe landslide, since residents prioritised and demanded measures with a low environmental impact over the traditional “grey” measures (Martin *et al.*, 2021).

Principle: inclusive, participatory

Enabler: A key enabler as a precondition was the residents and interest groups’ opposition to grey measures due to their high costs for building and maintenance, environmental impacts, and private land expropriation, based on the experience of the neighbouring town of Sarno. A three-year participatory process allowed the engagement of local stakeholders and networks in a co-designed landslide risk mitigation plan, which had positive effects on the community and resulted in the decision to implement green and natural remediation measures, such as gabions. Lastly, the limited available funds paradoxically contributed to the choice of NbS, given their lower maintenance costs compared to structural constructions.

Implication: This case-study evidences the importance of actor’s participation for the design, creation, and implementation of NbS. It also demonstrates how preconditions can influence (and in this case, enable) the adoption of certain measures. Residents were more aware of environmental issues, and interest groups (such as environmental associations and landslide victims) acted as agents of change to advocate for an “environmental agenda”. Political and institutional enablers played a big role for the NbS successful implementation too, since local politicians and the mayor were in favor of NbS, and municipal stakeholders had opposed to decisions of regional agencies twice. This implies that not only preconditions are relevant for a wider uptake of nature-based solutions, but participation from the interest groups (ensuring the inclusion of all stakeholders) can steer the decision-making process too.

4.1.3. Principle 3 – Knowledge Diverse

The principle concerns the **creation, collection and distribution of knowledge** among all actors in terms of a sensible planning and implementation of NbS. Communication is key for a good co-governance and a common understanding between different actors: citizens expect information from the city whereas in exchange the stakeholders responsible for the planning are dependent on local knowledge. Communication needs to go both ways; this of course depends often on the type and circumstances of a project. Having or creating knowledge was mentioned several times and must be considered from all stakeholders on all levels (D2.1). Butt *et al.* (2021) state that “understanding [...] what role knowledge plays allows both municipalities and those who engage to be more specific when implementing community programs.” In some cases, expert knowledge for community building and fundraising was necessary to ensure a successful project. For example, local NGOs can represent the “practical authority” (Gerlak *et al.*, 2021) when it comes to solving a problem. Not only the creation of knowledge is important, but also a comprehensive distribution. Different stakeholders have different expertise that needs to be shared to create a sustainable solution (Kabisch *et al.*, 2022). Van Riper *et al.* (2016) noticed that often there is even **hidden knowledge** about local circumstances that only citizens know about that can be crucial for a project. This means collaboration and **communication on all levels** is needed to ensure the exchange and distribution of knowledge and information from “ecology and landscape design and even environmental psychology” (Kabisch *et al.*, 2022).

The value-based framework (Figure 8) for stakeholder engagement developed by (Mok *et al.*, 2021) highlights the challenges and benefits around NbS, identifies the key beneficiaries and the potential financing options that could be involved in a NbS project. Through the consideration of the components of the framework, **consensus-building and mutual knowledge exchange** can occur informing decision-making around the NbS implementation. Furthermore, the framework advocates for the awareness over the “soft” benefits and techniques for more NbS inclusion in urban development processes to help surface the diverse **perceptions and preferences of actors**.

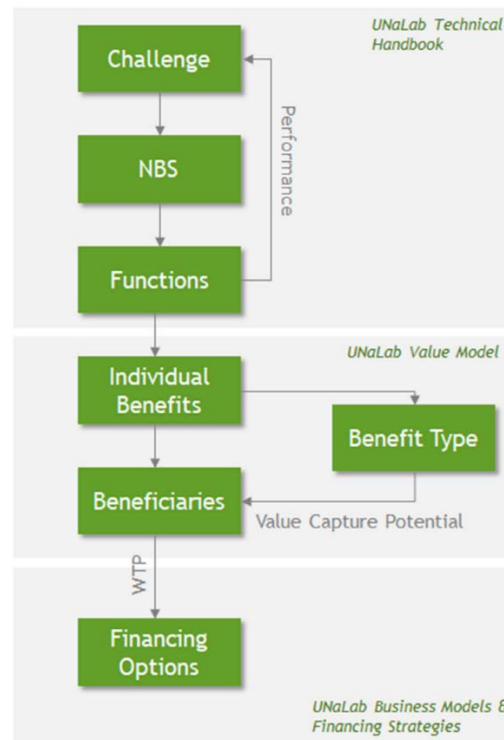


Figure 8: Value-based framework for stakeholder engagement around NbS
Source: (Mok et al., 2021)

Barriers and enablers

If the **willingness to learn** and to take the **local situation** into account is missing, it is difficult to develop a comprehensive approach. But often knowledge gets lost when there is a **change in staff** and special care must be taken to **transfer all information** (Butt *et al.*, 2021). This applies both to internal structures in the city administration, for example communication between different departments and hierarchies, as well as between the city and citizens, private stakeholders and knowledge institutions such as NGOs or universities. It is also important to ensure the interactions among different actors, if there is no collaboration, information might be lost (Frantzeskaki & Bush, 2021; Ramírez-Agudelo *et al.*, 2020).

Crucial for a comprehensive and informative co-governance is the **timing, management and distribution of knowledge**. Information in the beginning of a project is helpful, but often not enough. Actors and interests change in the lifetime of a project, it is important to repeat and collect the knowledge from and for different stakeholders. Since the municipalities often lack **resources and capacity**, it would be an elegant and more sustainable solution to **engage citizen in long-term** protection or management plans of urban green (Butt *et al.*, 2021). This facilitates the work of the municipality and creates more comprehensive

involvement. NGOs, local initiatives and resident associations serve as **networker** and can give support in this by structuring and distributing the knowledge and tasks (Butt *et al.*, 2021). Learning and education are key factors for every stakeholder in the development of NbS and **experimentation** often helps to create new knowledge as well as skills and understanding (Gerlak *et al.*, 2021).

Different components of the value-based framework have been assessed by Mok *et al.* (2021) by **conducting focus groups, interviews and surveys**. Its applicability is tested in NbS road development processes, where in a **workshop** setting, interdisciplinary groups identify benefits for the NbS development processes (e.g. alternative approaches to successful NbS realisation; different ways to identify NbS benefits) as well as governance issues (e.g. unclear responsibilities in NbS implementation). The usefulness of the framework is therefore proved as a structured approach that can be used when actors with different backgrounds have to commonly manage NbS planning and implementation.

BOX 2 H2020 Urban Nature Labs (UNaLab) project, involving eight European cities: Tampere (FI), Eindhoven (NL), Genova (IT), Stavanger (NO), Prague (CZ), Castellon (ES), Cannes (FR), Basaksehir (TU)

The UNaLab project is funded by the European Commission under the Horizon 2020 research and innovation program aiming to contribute to “the development of smarter, more inclusive, more resilient and more sustainable cities through the implementation of nature-based solutions” (Mok *et al.*, 2021). It comprises of a framework to highlight the multi-functional nature (benefits) of NbS, to identify the key beneficiaries and the potential financing options that could be involved in a NbS project (Mok *et al.*, 2021). The framework has been applied in NbS roadmap development processes in five UNaLab cities: Stavanger (NO), Cannes (FR), Castellón (ES), Prague (CZ), and Basaksehir (TU).

Principle: knowledge diverse

Enabler: An interdisciplinary and transparent dialogue from the early stage of a NbS project development and partnerships with different local actors coupled with the understanding of their perceptions may facilitate the success of planning and implementation of NbS projects as common goals are identified, common concerns are communicated and trust, ecosystem stewardship and social learning are encouraged.

Barrier: Unclear responsibilities about NbS stewardship, the fear of conflicting interests and a lack of consensus, along with the uncertainty triggered by the strong context-specificity are important barriers to multi-stakeholders’ involvement and NbS uptake.

Implication: The framework is useful to identify the “soft” values assessment tools as complementary to “harder” valuation techniques to encourage (i) awareness-raising amongst urban planners regarding the prioritisation of benefits, the impacts of NbS, inspiring them to include more nature-based elements in their planning; (ii) stakeholders engagement around NbS implementation in early stages of NbS development and (iii) mobilisation of local support with the aim of bridging the socio-economic interests. Such a framework supports communication

between various urban stakeholders and help in forming alliances and joint NbS projects by integrating other points of view, other types of benefits and their associated meanings.

4.1.4. Principle 4 - Collaborative/Participatory

Collaborative/Participatory (Co-creation/democratic/partnership/responsible)

As per our review, the principle of “collaborative/participatory” was found to be the most occurring one in the literature concerning NbS co-governance improvement across all dimensions (Figure 7), demonstrating its critical importance for good co-governance practices. We refer to collaborative governance as the collective process in which stakeholders involved come together and mobilise individual efforts through social-political engagement towards a common goal (Brink & Wamsler, 2018). Collaboration among actors helps in “facilitating information sharing, integrating decision-making authority, and promoting policy consensus and learning” (Swann, 2017, p. 2). Co-creation fosters **involvement opportunities** and enables participation. The willingness to collaborate with municipal decision-makers is a critical point (van der Jagt *et al.*, 2017). A **dialogue and an open and transparent participation** are important to foster and strengthen shared responsibilities between the different stakeholders (Arlati *et al.*, 2021; Carmichael & McDonough, 2018).

One can differentiate between **collaborative implementation and collaborative maintenance**. For example, the planting of a tree as part of an implementation of new green infrastructure is often a shared project between government and private individuals or NGO’s (Pincetl, 2010). For a long-term maintenance it requires **regular care-taking** that can be done by different stakeholders. (Arlati *et al.*, 2021) recommend the combination of “one planning (public administration) and one implementing body (local development agency) to implement co-creative processes”. Furthermore, a collaborative process, where sufficient attention is paid to all key stakeholders and to the wide range of benefits that NbS can hold, is at the basis of achieving the multifunctionality of NbS (Mok *et al.*, 2021).

As found by (Martin *et al.*, 2021), **early and proactive citizen participation** is a key success factor for the effective co-creation of NbS for urban regeneration. However, it is important that citizen involvement considers the high opportunity costs of participation for some social groups, such as livelihood, time, knowledge, funding, and capacity constraints. In this regard, mobilising participation from all interest groups should be a priority for co-governance processes, as the **participation of diverse stakeholders** increases the

acceptance of decisions and improves their implementation (Newig & Fritsch, 2009). Prado (2020) highlights the importance of community participation encouragement, as it “leads to better-informed decision-making as greater diversity of stakeholders become involved in creating solutions to policy problems” (p. 2). During our review, we found that participatory co-governance is also associated with the principles of democratic, engaging, citizen involvement, and decentralised, among others.

Barriers and enablers

"A common problem in public and especially citizen engagement is that NbS stewardship is often perceived by residents as sole responsibility of the government" (Mok *et al.*, 2021, p. 12). Residents tend to rely on government assistance, they become passive, they perceive to have **little influence** in the decision-making process, and they are also constrained by “different levels of socio-cultural, economic, environmental, and physical vulnerability” (Wamsler, 2016, p. 194). Other challenges for active involvement include the alignment of citizen interests with formal planning goals (whether from municipal or local governments or from any formal institution), and their unwillingness to contribute to the “institutionalisation” of NbS objectives (Buijs *et al.*, 2016). On the other hand, Prado (2020) suggests that some practices within governance institutions also inhibit community participation, such as the lack of policies that delineate participatory processes, the **lack of clear guidelines** for community participation, and the lack of binding outputs perceived by community members in governance processes. Community participation often faces capacity, structural, and knowledge barriers. **Capacity barriers** refer to the constraints of community members to participate in governance processes, such as lack of time, livelihood issues, and high opportunity costs (especially for women due to their domestic and productive workloads). **Structural barriers** include lack of funding, lack of access to transportation, childcare and work responsibilities, and no access to events or meetings. Lastly, **knowledge barriers** refer to a lack of shared understanding or limited knowledge: some social groups cannot participate in NbS governance when they do not understand how the process works. In addition, usually expert knowledge is valued more in governance processes than the local or “lay” knowledge that communities can provide (Prado, 2020).

Still there are complex relationships and **differences in the culture, history and local situation** that need to be considered. **Limited communication** (e.g. language barriers) often hinders the collaboration and the understanding between different actors with different background. Sometimes it is also the **lack of financial and personal resources or knowledge** that hinders certain collaborations (Mekala & MacDonald, 2018; Pincetl, 2010). Especially

regarding health and well-being Mekala and MacDonald (2018) discovered that specific agencies responsible to tackle these problems are not involved.

The **possibility to ask questions and give feedback** is a first step towards collaborative decision making. Additionally, **surveys to understand community values** can lead to the involvement of different stakeholders in the planning and development of NbS (BenDor *et al.*, 2018). Allowing **different viewpoints to be voiced** can create new coalitions that have a positive effect for the project. To overcome barriers (Arlati *et al.*, 2021) recommend “establishing contacts, **building relationships**, subscribing to formal and informal cooperation formats”, coming from the combination of one planning (public administration, municipality) and one implementing body (local development agency, local NGO) to enable collaboration and participation in a co-creative process.

Strategies can build on several approaches, ranging from basic **outreach tools** (such as public presentations or digital platforms), **inquiry-based methods** (such as residential surveys, questionnaires, and stakeholder interviews), to elaborated **co-creative arenas** (such as public interactive workshops and formation of community liaison committees). (Chu & Cannon, 2021, p. 5). Other factors that have a positive influence on citizen’s interest in participation are an increasing awareness of environmental issues, a **positive perception of influence**, and a systematic **support from the organising body** (such as transportation, childcare, or even the facilitation of phone-based meetings).

BOX 3 CLEVER Cities project (Hamburg, Germany)

The CLEVER Cities project in Hamburg (Arlati *et al.*, 2021) tested a strategy called “Co-Creation Pathway”, developed by Mahmoud & Morello (2021). It includes five phases of co-creation that are implemented during the development of NbS: urban innovation partnership (UIP), co-design, co-implementation, co-monitoring and co-development.

Principle: collaborative/participatory (co-creation, democratic)

Enabler: Innovative tool for digital participation (DIPAS), Theory of Change (ToC) method, CLEVER Corridor (connection of different NbS-interventions throughout the city, consists of a guiding system as an umbrella together with several small interventions).

Implication: useful method to connect different local interventions with a shared vision. A broad and diverse group of people can be informed and mobilised to develop the intervention. It supports the local work and communication of a project.

4.2. Matters of Politics

As mentioned earlier (see Chapter 2), in their discussion of modes of governance, Treib *et al.* (2007) consider the ‘politics’ dimension of governance as emphasising a constellation of actors, assuming both public and private actors are involved, and specifically the power relations between them. Power is an issue of central importance to our discussion, given the JUSTNature project’s concern with the right to ecological space, and the duty of not constraining that of others, to be achieved by the activation of NbS for low -carbon cities of high air quality. The concept of justice, and its relevance in the context of NbS, are described in more detail in the project output Conceptual & action framework on Low-carbon | High air quality NbS potentials (D2.1). In their comparative study of the relevance of justice to the governance of NbS, van der Jagt *et al.* (2021) note a relative silence in the literature on the matter of politics and related power struggles, despite scholars’ attention to actor-centred processes. They caution that “by blocking out the role of politics, one ignores the point that urban experiments are vulnerable to capture and domination by powerful interest groups” (van der Jagt *et al.*, 2021, p. 2). If politicisation is understood as “the process of giving voice to a wide circle of concerns and a transition of the discussion from the private to the public sphere... to build a bridge between self-interest and the common” (Patsias, 2021, p. 3), then an actor-centric approach risks obscuring or excluding the common good in favour of individual interests, and in turn limiting the scope for justice.

As defined earlier in Part 2.1.1, our starting point is an approach to co-governance that recognises existing power imbalances in urban development decision-making, and advocates power-sharing, actively seeking to shift the balance of power in conventional decision-making towards typically less-powerful actors. Here it is worth noting that attention to the politics of co-governance arrangements is far from self-explanatory, with Baasch (2020) observing a contemporary shift towards a post-political, or post-democratic, condition in processes of governing, that seeks to limit the opportunities for political debate and critique. Swyngedouw (2010) describes the exclusionary risks of depoliticising a governance process, specifically in relation to climate change policy, with the result being a “stakeholder-based arrangement of multi-scalar governance in which the traditional state operates institutionally together with experts, NGOs and other ‘responsible’ partners (while ‘irresponsible’ partners are excluded)” (Baasch, 2020, p. 80; Swyngedouw, 2010, p. 227). Similarly, in his analysis of power dynamics in relation to social change, Gaventa (2006) asserts that new institutional arrangements alone, such as participatory governance or co-governance, will do little to increase social inclusion or

reduce existing disadvantage, such as poverty, unless the limitations imposed by existing inequalities in resources and power between actors are addressed.

Top 5 principles:

- Recognising and empowering
- Integrative
- Democratic and representative
- Responsive
- Participatory and collaborative

4.2.1. Principle 1 – Recognising and Empowering

This first principle focuses on power relations and dynamics. The concept of power has been widely investigated in the past, and has different and often rival definitions according to the problem addressed and the underlying normative values of the author (Dowding, 2012). For example, ‘power over’ is perhaps the most common meaning given to power, with a negative connotation, as it is associated with a force or coercion performed by someone that wins over someone else that loses. This kind of power typically perpetuates inequality and injustice at the expense of powerless (or less powerful) individuals. In search of more collaborative ways of exercising power, we can speak about ‘power with’ consisting of having power through collaboration with others, gathering different expertise and knowledge, ‘power to’ referring to individual agency, i.e. the capacity to act, and ‘power within’, which is an individual’s self-awareness of their own individual worth (Dowding, 2012; VeneKlasen & Miller, 2002). In the context of ‘power over’ Gaventa (2006), building on the framework of VeneKlasen and Miller (2002) sheds light on the importance of understanding latent power relations and differentiates between three types of power, i.e., *visible*, *hidden* and *invisible*. Visible power is the observable and definable aspect of political power, such as the formal rules, structures, procedures of decision-making. Hidden power happens when the interest of certain powerful actors or institutions is privileged over others through the ‘rules of the game’ determined a priori. Invisible power works by shaping the ideological and psychological boundaries of a decision-making process, by influencing people’s beliefs, acceptance of the status quo and even their own status.

The principle we propose concerning power has two levels of importance to good co-governance: recognising and empowering. The first one concerns the **active recognition of differences between and within communities**, and in particular differential access to

power, which needs to be counteracted if decision-making in urban planning and development is to be made more socially just burdens reflect existing inequalities, and failure to address these can be expected to reinforce the status quo, and in turn prevent equitable outcomes from being reached. Although breaking down the concept of justice into constituent parts is useful from an analytical perspective (e.g. the commonly deployed three-dimensional framework of distributional, recognitional and procedural²), in practice it is also important to grasp the links between them and deploy strategies that address all three. For example, Ruano-Chamorro *et al.* (2021) posited that the concept of recognition should be understood as a fundamental basis for achieving procedural justice in the field of conservation. In the words of Schlosberg, "if you are not recognised, you do not participate" (Schlosberg, 2004, p. 519). Such differences, and the implications of failure in recognition or 'misrecognition' in urban environments (Day, 2010) have been explored in connection with urban green space in relation to, for example, elderly people (Day, 2010), homeless people (Koprowska *et al.*, 2020) and Latinx communities (Harris *et al.*, 2021). In their study of the trajectory of two urban agricultural projects in Toronto, Hammelman (2019), points out that a community garden development project resulted in "a significant reduction in the amount and quality of gardening space, reduced gardener autonomy and the reinforcement of social hierarchies that exclude traditionally marginalised individuals", despite the involvement of residents in the design process (Hammelman, 2019, p. 487). Citing Swyngedouw's 'post-political condition' (Swyngedouw, 2007) the authors caution against a reduction of politics to "technical decision-making without questioning potential impacts on different groups" (Hammelman, 2019, p. 492) and specifically point to the need to address power imbalances in participatory processes. Patsias (2021) raise a different problem, namely the potential for an undue focus on correct democratic procedure to avoid "questions of fairness in access to participation mechanisms and in the rules of said participation" (Patsias, 2021, p. 16).

Coming to the empowering level, it is acknowledged that the existence of power dynamics and relations should be firstly recognised, and then if power asymmetries/imbances are found **it is pivotal that through an inclusive decision-making process all needs and points**

² Scholars in the field of environmental justice often break down the concept of justice into three dimensions: distribution (who gets what), procedure (who is involved in decision-making) and recognition (whose needs, values and capabilities are considered, and how). For a more detailed discussion of these three dimensions, as well as other, less-commonly deployed dimensions, see Chapter 2.3.1 of Conceptual & action framework on Low carbon | High air quality NbS potentials (JUSTNature Deliverable 2.1).

of view are considered, finally empowering those stakeholders that were suffering of power imbalances. This principle cannot be linked to just one publication among those analysed, since it appears in several of the references gathered in the selected literature body. More than one author in fact highlights the existence of power dynamics in the relations among stakeholder in processes of governance of NbS, or green infrastructure more generally, and how they need to be acknowledged in order to achieve a good governance. Actual participation in the management of NbS can help less powerful social groups to gain a sense of empowerment in other fields of their life. In their research on gender roles and relations in community gardens in Missouri, USA, Parry *et al.* (2005) found that many women, as a result of their positive experience in the management of their community gardens, were empowered to seek new opportunities or responsibilities outside their garden, and Milbourne (2012) points out similar successes in a UK-based study.

Being powerful (or not) is always context dependent, and thus, it is impossible to provide uniform guidelines on who needs empowering in a certain decision-making context. Rather, a first step in any decision-making process is to find out exactly who this is. Based on our literature review, certain social characteristics are more likely to be linked to having less power in decision-making, such as a poor economic situation (Milbourne, 2012), being elderly (Day, 2010), and being of a foreign or minority ethnicity (Naiman *et al.*, 2019). Social groups with these social characteristics and other local vulnerable groups should be mapped. In the JUSTNature project, this will occur as part of the socio-economic status and disparities profiling (D2.2). Moreover, on local participatory workshops, power relations need to be actively mapped and counteracted, if needed (for mapping tools, see D4.5 forthcoming).

Moreover, recognising and making an effort to overcome power imbalances includes addressing gendered power relations. Gender relations³ are in themselves power relations; in most societies, women tend to have less access to power than men, and the field of sustainability is no exception (Lorber, 2010). Women have traditionally been more active in environmental topics than men, yet when it comes to decision-making, they are often silenced or ignored (Bell, 2016). McCall and Dunn (2012) explicitly refer to gender inequities defined by physical space (e.g. access to and ownership of resources) and spatial knowledge (e.g. gendered knowledge of resource locations), while Fors *et al.* (2021)

³ In JUSTNature, gender is defined as the socially constructed characteristics of women and men, girls and boys. For more on the approach of JUSTNature on gender empowerment and related concepts, see JUSTNature Deliverable 1.4, *Gender guidelines*.

underline that to create inclusive green spaces it is essential to involve groups marginalised by gender and other factors in decisions about local urban development.

Barriers and enablers

Recognising power structures and counteracting power imbalances is not straightforward, since power relations are often hidden, and are taken-for-granted even by the less powerful groups themselves. Another barrier to adequately recognising power structures is that power relations are dynamic, and thus they need to be reassessed from time to time. For example, van den Berg and Keenan (2019) highlight in the context of climate adaptation planning that certain groups might be highly vulnerable to a certain impact of climate change, but as time passes, this vulnerability might be reduced by means of increasing adaptation capacity. At the same time, social groups that are not vulnerable at the beginning may become vulnerable over time, independently from any the intervention. In the context of governance, similar dynamics can be expected.

Pointing to the risks of powerful actors dominating a green space development process, Harris *et al.* (2021) are critical of the city administration's role in the redevelopment of the Humboldt Park area as part of Chicago's 606 Trail, stating that "in allowing" developers to strip Humboldt Park of its namesake and promote gentrification, officials not only allow urban and environmental injustices to remain but also risk compromising the very identity of Chicago. As Moskowitz (2017) explains, "when urban environments lose their culture and diversity, they become banal, homogeneous mimics of surrounding suburbs that no one wishes to live in or visit" (Harris *et al.*, 2021, p. 26). Whether intentional or not, failures in recognition are twofold here: both the missed opportunity to acknowledge, reinforce and celebrate the culture and diversity among its community members, and lack of attention to the inherent powerful position of the developers, that allowed their interests to dominate over those of the community. Conversely, sometimes it is the public authority itself that holds the most power in the planning and development of green space (Kronenberg *et al.*, 2016), downplaying the role of the other stakeholders.

Finally, concerning empowerment, a barrier to this principle emerges when power asymmetries or imbalances are found in relation among actors (Fisher *et al.*, 2021; Mok *et al.*, 2021; van Riper *et al.*, 2016). Some actors in a powerful position may hinder the empowerment of others by preserving the status quo.

To even up imbalanced power structures, the first step is to understand the latent conflict of values and interests between participants of a decision-making process, for example by

studying their different narratives (Melanidis & Hagerman, 2022). A practical tool for this study is the workshop evaluation survey, being developed within WP4. Moreover, Gaventa (2006) and VeneKlasen and Miller (2002) define strategies to address the different types of power cited above. In the case of visible power, the strategy is usually to change the decision-making processes to a more democratic and accountable one, e.g. by means of lobbying, monitoring, negotiations and education. To counteract inequalities caused by hidden power, the authors propose deploying empowerment advocacy strategies that focus on vulnerable groups to change the political agenda and increase the visibility and legitimacy of their interests. To address invisible power, strategies for change should target the social and political culture as well as peoples' perception of others and themselves. As a positive example for this, the case of collaborative forest management in Uganda can be mentioned. Mukasa *et al.* (2016) highlights that gender norms, roles and cultural practices still constrain women in Uganda to access and control forest resources and limit their participation in related decision-making processes. However, by means of Adaptive Collaborative Management, a type of co-governance method, it was possible to solidly increase gender equality in forest management in multiple communities, and involve women in decision making in forest management, including leadership positions. Moreover, in the case of international R&I projects, like JUSTNature, it should also be considered that hidden power might be linked to the supposed change agents themselves, i.e. the JUSTNature consortium and the European Commission as funder. As Gaventa (2006) states, "reflections on power, and reflections by change agents on how their work affects power relationships in all of its dimensions, is perhaps the first step in making more visible power's most hidden and invisible forms" (2006, p. 31). Given that power relations can change over time (indeed, they should change, if empowerment strategies are successful), it is also necessary to iteratively monitor and assess the socio-economic factors known to influence relative levels of power, e.g. by conducting regular city employee surveys, community dialogue sessions and community surveys, as van den Berg and Keenan (2019) have suggested in relation to climate vulnerability and climate resilient planning.

Overcoming power asymmetries is challenging and enablers are scarce in the literature, however clearly a first step is to make such asymmetries visible. In this regard, Ruano-Chamorro *et al.* (2021) point to the 'critical companion' approach as "an example of how facilitators can deal with power inequalities during participative processes. It consists of making the underlying assumptions and objectives of the project and its designers explicit to all participants and promotes critical reflection and the co-construction of its legitimacy" (Barnaud & Van Paassen, 2013; Ruano-Chamorro *et al.*, 2021). Similarly, Treves

et al. (2019) advocate the “codification of capabilities or basic claims on a case-by-case basis... [e.g. through] trustee representation of nonhumans in constitutional courts given evidence that consensus-based stakeholder-driven processes usually disadvantage the voiceless” (Treves *et al.*, 2019, p. 5). These measures are important, but insufficient in their own right. As Hammelman (2019) points out, citing a development in Montreal, despite dialogue and consensus with community, “the interests expressed in these meetings by traditionally marginalised residents and civil society organisations did not produce sufficient concrete gains. As those interests were translated into projects, they were interpreted by the discursive power, priorities and actions of more influential local stakeholders in ways that reduced their transformative potential.” (Hammelman, 2019, p. 494). She argues for 1) a shift in discourse from individual interest 'wants' to collective 'rights', 2) the active formation of 'us and them' conflicts with a view to challenging power, 3) a focus on substantive aspects of outcomes - not just formal/process aspects, and 4) attention to social boundaries (informally shaped by differences between groups, norms and values) - over and above the 'symbolic' boundaries defined by formal institutions. Day (2010), after Fraser (2001) draws on the 'participatory parity', meaning “not just direct participation in decision-making processes, but full participation in the wider social sphere in all its complexities and multiple sites.” (Day, 2010, p. 2668). While achieving participatory parity in total is a task well beyond the scope of a single municipal actor, aspiring to achieve it in smaller-scale local participatory fora is also a valid aim.

To overcome power imbalances among stakeholders that may hinder the achievement of good co-governance, the recognition of the role of other stakeholders and their inclusion in the decision-making process is pivotal. However, there are also authors claiming that public authorities should keep in any case a leading position in the management of NbS, suggesting hybrid governance, with inclusive and participatory mechanisms (Toxopeus *et al.*, 2020). Mok *et al.* (2021) and Toxopeus *et al.* (2020) argue for the implementation of transparent processes and good moderation to overcome power imbalances in governance processes.

BOX 4 KasKantine (Amsterdam, The Netherlands)

In the disadvantaged neighbourhood of Nieuw West in Amsterdam, a group of social entrepreneurs have started a not-for profit cooperative, called KasKantine, that they run with a diverse group of local volunteers with different cultural and social-economic backgrounds. Together they are responsible for building and maintaining a mobile restaurant that focusses on urban farming, greenery and circular business. This is an experimental, multi-faceted project with explicit aims to collectively manage resources (produce, greenery and knowledge) and make them available to local community members. There are specific measures to enable access for lower income residents, e.g. food is collected from local restaurants and supermarkets, and a flexible payment structure for meals based on means. In addition, there is a political dimension which involves lobbying government to legislate for a rights-based approach to natural resources, and financial support for similar initiatives.

Principle: Recognising and empowering

Enabler: Grassroots project, initiated by a group of social entrepreneurs

Barrier: only short-term leases possible, due to high pressure on land in Amsterdam.

Implication: This project actively recognises power imbalances and seeks to redress them. Attention is paid to the democratic process (both in terms of the initiative's own management and to the wider political system), to recognising differences in need and opportunity in the local community (i.e. the deliberate choice of a disadvantaged neighbourhood to site the project), and to a more equitable distribution of resources (i.e. by removing financial barriers for low-income people to eat at the Kantine).

Source: (De Haas *et al.*, 2021)

4.2.2. Principle 2 – Integrative

This principle concerns the need for green space planning, design and management to be integrated with other disciplines and, in the case of local government, with the policy and practice of other departments. Valuable expertise and knowledge(s) required throughout the whole process of co-governing NbS (from planning and design to implementation and maintenance) are to be found in different stakeholders (Frantzeskaki & Bush, 2021; McCall & Dunn, 2012), hence the need to put them together through collaboration and coordination of different kinds of expertise. Working integratively is also crucial to achieving equitable outcomes, since projects related to green space can serve as vehicles for redressing existing inequalities and fostering opportunities for specific target groups: e.g. skill development, social capital or improved health and wellbeing (Anguelovski, 2013c; Milbourne, 2012). This relies on sharing data across departments, for example socio-demographic data on household income, employment status, immigration background; sharing expertise across departments that may not traditionally work together, e.g. health and park management (De Haas *et al.*, 2021) – as well as skills to engage with harder-to-

reach groups. Anguelovski (2013) cautions against the risk of green space project failure if aims for environmental quality, liveability and community development, traditionally housed in separate departments, are not coordinated. It is particularly important that departments responsible for environmental management and urban planning cooperate with municipal departments and officers specifically working for and with certain vulnerable groups, for example the gender equality officer or social service department.

Barriers and enablers

Siloed or inaccessible knowledge could hinder the positive outcomes of designing and implementing green infrastructure projects (Frantzeskaki *et al.*, 2018; McCall & Dunn, 2012). A similar problem is to resort to standard solutions, without eliciting site-specific knowledge (McCall & Dunn, 2012).

In order to put together interdisciplinary knowledge, as NbS as socio-ecological solutions require, it could be useful to introduce an intermediary (Frantzeskaki *et al.*, 2018; Onori *et al.*, 2018) fostering cooperation, collaboration and coordination among stakeholders and knowledge sharing.

Often integration is advocated in planning without specifics about which departments need to work more closely together, making this principle potentially difficult to put into practice. With a view to more liveable and just cities, Anguelovski (2013a) helpfully argues more specifically for “greater coordination between the Departments and Offices for neighbourhood development, public health, environmental protection, and youth and recreation” (Anguelovski, 2013a, p. 173). These departments should work together to coordinate funding programmes for community groups, ideally supported by a municipal program manager who would serve a specific neighbourhood. Also important, although perhaps less straightforward to put into practice, is her advice that intangible, value-laden qualities associated with places, such as community identity and place attachment, be actively addressed in planning (Anguelovski, 2013a, p. 173).

4.2.3. Principle 3 – Democratic and Representative

Although it might seem self-explanatory that an authority’s stated commitment to co-governance and implementation of some related mechanisms to implement it will result in a democratic process and outcome, several authors caution against reliance on rhetoric alone – whether in relation to the shortcomings of existing participatory mechanisms (Day, 2010) or new schemes (Dobbin & Lubell, 2021). Democratic participation in co-governance

must be actively fostered and efforts made to ensure that participants represent the actual cohort of communities with a stake in the issues at hand.

Failure to pay attention to the democratic process can have consequences that extend beyond the individuals whose concerns are overlooked or downplayed. Harris *et al.* (2021) look at the result of a failure to democratically represent a diverse cohort of residents in a green space redevelopment. Their qualitative study on recreational use of Chicago's 606 Trail, examines how, in the absence of active efforts to democratise a redevelopment process, neighbourhood stigma has caused white users to avoid certain parts of the trail and fuelled discrimination against Latinx users. Not only was this a missed opportunity for the greenway in question to serve as a vehicle to counteract existing social tensions, but the resulting redevelopment has already eroded some of the area's character, at least symbolically, with the re-branding of Humboldt Park. Looking at the representation of disadvantaged communities in sustainable groundwater management, in regard to new collaborative governance legislation in California, Dobbin and Lubell (2021) warn against "relying on collaborative governance alone to achieve representation, particularly in governance settings where resource and recognitional constraints could lead to significant harm to the marginalised actors" and note that genuine inclusion in the decision-making arena "requires constant oversight, assessment and planning" (Dobbin & Lubell, 2021, p. 582). Patsias (2021) draws a similar conclusion in her study of the intersection of democracy and environmental justice in Montreal, noting that "the broadening of democracy and voicing of environmental justice do not always go hand in hand; participatory democracy can increase, and yet environmental inequalities may remain unchallenged" (Patsias, 2021, p. 16). Examining three projects (the siting of a waste facility, removal of a small wood as part of a social housing development, and a project to pedestrianise and green Castelnau street in order to create a new public square in the Villeray neighbourhood), she observed that conflicts overly focused on issues of democratic process (particularly in the case of the woodland, where the conflict centred on a mayor's failure to respect a pre-election commitment) had the effect of limiting the scope for substantive debate and, in turn, a more equitable outcome. Clearly, the specific characteristics and accessibility of existing democratic institutions matter.

A democratic process also needs to be perceived as such. Baasch (2020) similarly highlights the need to consider both 'societal' and 'individual' (perception-based) aspects of environmental justice, pointing out that 'perceived injustices can trigger strong emotions and thus have a negative impact on participatory processes or negotiations, for

example, by leading to the hardening of conflicts and a refusal to act cooperatively' (Baasch, 2020, p. 84, after Müller, 2012).

Baasch does not offer specific enablers to address each of the above (although some are fairly self-explanatory), however she emphasises the need for justice 'evaluations' to be integrated into the design of a participatory process, along with "more differentiated definitions of environmental justice" (Baasch, 2020, p. 85). Baasch highlights the subjective and indeed emotional perceptions of justice or injustice that individual actors bring to an existing situation, and accordingly argues for the inclusion of multiple perspectives in defining the terms of participation, without which there is a risk of aggravating conflict or even derailing a project. By way of example, she cites the German example of SuedLink, a high-voltage power line planned to link offshore wind energy in northern Germany with production centres in southern Germany. The top-down participatory process run in this case allowed residents to contribute their opinions to the planning process, but only concerning specific locations and details of the route – omitting larger scale issues such as alternative decentralised renewable energy system transformations, and as a result faced considerable emerging resistance at the time of writing.

Barriers and enablers

Existing participatory/democratic arenas have shown limitations not only from a recognitional point of view, e.g. inclusion of older people in consultations and decision-making processes, but also from a procedural one, in the way such fora operate (Day, 2010, p. 2669). Moreover, Day (2010), studying the needs and interests of elderly people, points out that direct participation can also be perceived as a burden. In relation to community garden lease agreements in Canada, overly bureaucratic processes, as well as lack of expertise and other resources on the part of the community organisations involved were cited as major factors in delaying the process (Hammelman, 2019, p. 490). Participatory processes can break down if they are perceived as being unfair, and Baasch (after Baasch & Blöbaum, 2017, p. 19) identifies typical triggers deriving from the literature, which can also be interpreted as concrete barriers to a democratic process of co-governance:

- Inaccuracy of concepts and terminology (including inadequate definition of framework conditions and/or key concepts);

- Inadequate method selection “e.g. common participatory approaches like group discussions may not be suitable for all target groups because they often require specific skills like verbal abilities” (Baasch, 2020, p. 85);
- Selective actor involvement;
- Selective handling of different knowledge bases and role assignments;
- Selective production of results and/or lack of evaluation;
- Missing analysis of communication and group processes.

See also discussion on the principles ‘reflexive/adaptive’ and ‘legitimate’.

Looking at two urban agriculture initiatives in Toronto, Hammelman (2019) notes the value of city government ‘champions’ in enabling civil society groups to access meetings and be heard. In cases where residents prefer not to directly participate, it may be appropriate for a suitable advocate to represent their interests. In the UK, for example, “there are moves to strengthen the input of older people into service and policy development through the establishment of Older People’s Advisory Groups at local authority level” (Day, 2010, p. 2670).

Reflecting on the failures of a major urban greenway redevelopment project to represent the full cohort of residents’ interests, (Harris *et al.*, 2021) observe the genuinely negative socio-spatial impacts that may result. Based on field observations and interviews with users of the greenway, they find evidence of reinforced ‘neighbourhood stigma’ and corresponding negative perceptions among residents along racial and socio-economic lines, with residents avoiding certain sections of the trail on this basis. As a possible remedial measure, they suggest that “...focusing on program-related resources [i.e. organising events and activities in-situ] may be more effective than attempting to address perceived threats related to disorder” (Harris *et al.*, 2021, p. 26). Park programming would need to be backed up by targeted, multi-faceted communication channels to reach diverse groups: “a multilevel approach that includes expanding marketing on social media platforms, collaborating with local businesses and community influences to distribute information, and working with neighbourhood schools may increase program attendance” (Harris *et al.*, 2021, p. 26).

4.2.4. Principle 4 - Responsive

This principle concerns the recognition of place-based specificity, and in particular differences in need between and within communities. Looking at the experience of elderly people in public space in Scotland, Day (2010) notes that “the interests of different groups,

such as different age groups, may be in competition, even conflict...specifically older cohorts need to be given voice in consultation and inclusive decision-making” (Day, 2010, p. 2666). Where active efforts are not made to identify differential needs, it is unlikely that these will be addressed in the decisions made around urban green space development. Interestingly, need can itself be a driver of co-governed nature-based projects, as Milbourne (2012) points out in his study of community gardens in disadvantaged neighbourhoods in the UK. Of the 18 projects studied, “it was the abandonment, despoilment or absence of everyday green spaces, or the loss of control over people’s street spaces that had prompted the formation of most of these projects” (Milbourne, 2012, p. 952) with seven of the cases arising from “the closure of an existing community resource, such as a school or community centre, by the local authority, which prompted local groups to campaign for the continued use of the building and/or its surrounding green space as a community resource” (Milbourne, 2012, p. 950). The aims of such projects were found to similarly reflect the contextual social, cultural, environmental and economic challenges existing at the time of their establishment. Also of note, explicit environmental injustices were not necessarily to be found among the most pressing needs for attention, but rather the gardens were deployed as a medium to address other kinds of injustice – often social or economic. This phenomenon of nature as a vehicle to deliver improvements in wellbeing for specific disadvantaged groups can also be observed in the study of De Haas *et al.* (2021), looking at three nature-based civil society initiatives in the Netherlands, each targeting a different group: people with severe mental health issues, people with dementia, and people living in a disadvantaged neighbourhood. Which needs should be prioritised will be context-specific, but health and wellbeing are highly relevant in the context of the social benefits that green space can deliver, and the discrepancies between communities that may exist, depending on variables such as the distribution of green space, or environmental burdens like air and noise pollution. Anguelovski (2013b) advocates responsiveness not just to physical health, but also psychological health, in her analysis of neighbourhood mobilisation around environmental projects in Boston, Barcelona, and Havana, and cautions against the risk of undermining existing psychological wellbeing among residents if environmental improvements erase or erode existing valued places.

Barriers and enablers

Effective responsiveness to local needs may be hindered by a range of factors. An obvious one is the absence of procedures and mechanisms to systematically identify differences

in need within the community and their spatial distribution. Day (2010) recommends an assessment of residents needs at the outset of any planning or design project. Interviews or qualitative surveys could be used to identify not just functional needs (e.g. proximity of home, mobility limitations) but also psychological ones, such as existing attachment to places and their features (Anguelovski, 2013c), or the experience of being within an existing space (Day, 2010). Once certain needs are identified, however, it may be that additional specialist expertise is required to adequately address them, e.g. access for people with limited mobility may require an expert in universal design, or at least reference to universal design guidelines, potentially in a design brief for redeveloping public spaces (Day, 2010).

Insufficient funding can also hinder efforts to adequately respond to local needs, since either those best-placed to respond are not adequately resourced, or the remit of funding programmes fails to recognise the full spectrum of need. Milbourne (2012), for example, revealed the key role played by community garden project coordinators as intermediaries between a public authority and community members, well-positioned to understand and formulate suitable programme responses to local disadvantage. However, he also noted the barriers they faced in terms of finance, with a majority who “invest significant energy in pursuing funds and can plan only with relatively short time horizons as a result. Indeed, what emerged strongly from the interviews was the significant amount of work undertaken by project co-ordinators to secure sufficient funding to maintain their projects, with many unable to discuss their financial situations beyond the next financial year” (Milbourne, 2012, p. 951).

On a related note, Anguelovski points out that funding sources may not be readily available for projects that actively address psychological health in relation to neighbourhood development, especially in historically disadvantaged areas, which may point to either an imperative for an awareness shift among local government staff responsible for allocating funding, or an advocacy role for those who need to compete for it (Anguelovski, 2013c).

BOX 5 Food for Good (Utrecht, The Netherlands)

Food for Good is a community garden initiative in an underprivileged neighbourhood in Utrecht, targeting people with severe mental health issues. “Food for Good is a social care garden that emerged out of a partnership between the social care provider Stadsbrug, environmental foundation Eilandsteede, and a social entrepreneur from De Wending with experience of setting up social impact gardens and care farms. Together they developed the idea for a new food garden in Utrecht with the aim of providing social care and environmental education to vulnerable people. To facilitate access by vulnerable people, the social care garden was situated within a socioeconomically disadvantaged neighbourhood in Utrecht. In addition to providing care, the

ambition was to create a thriving ecosystem for local wildlife by applying organic gardening principles and nature-inclusive site management.” (van der Jagt *et al.*, 2021, p. 7)

Principle: Responsive, integrative, recognitional to empower

Enabler: Grassroots project, initiated by an alliance between non-state actors

Barrier: difficulties finding land, opposition of local residents once land found, complex rules and regulations regarding support or subsidies

Implication: Nature as a vehicle to address social disadvantage, not necessarily deriving from a specific environmental injustice. This project responds to a specific need (that of people with severe mental health issues), but also encountered opposition from residents, who apparently did not see their needs represented, and questioned the legitimacy of the project – pointing to the importance of individual perceptions of justice.

Source: De Haas *et al.*, 2021; van der Jagt *et al.*, 2021

4.2.5. Principle 5 – Participatory and Collaborative

Secco *et al.* (2011) when talking about forestry governance in Italy describe an innovative participatory governance approach that is “networking, multi-decision levels-based, with dynamic interactivity among actors, intersectoral links and less clearcut tasks” (Secco *et al.*, 2011, p. 105). Martin *et al.* (2021) refer instead to the need for and importance of “an inclusive and collaborative governance approach for co-creating NbS in urban environments” (Martin *et al.*, 2021, p. 2), as is the scope of the JUSTNature project. Secco *et al.* (2011) also refer to a specific governance mode: public deliberation, which they describe as a “dynamic and evolving process where public authority is only one of the actors (no longer the dominant one) while new social actors create new coalitions as well as civic capacity (i.e., social organisation) in influencing decision-making, and where new knowledge is created and shared among actors” (Secco *et al.*, 2011, p. 105). Often authors recognise the prominent role of public stakeholders in participatory/collaborative governance initiatives (Pincetl, 2010; Secco *et al.*, 2011). Collaboration among different stakeholders can and should be pursued at each step of the NbS co-production process, from planning to implementation and maintenance (DeLosRíos-White *et al.*, 2020; Frantzeskaki, 2019; Pincetl, 2010). Collaborative relations consent to gather different kinds of knowledge and experience that enhance the quality of the outcomes (DeLosRíos-White *et al.*, 2020; Ferreira *et al.*, 2020; Kronenberg *et al.*, 2016). Finally, participatory and collaborative approaches have also co-benefits, such as reduction of conflicts, enhancement of trust and learning (DeLosRíos-White *et al.*, 2020; Ferreira *et al.*, 2020). As

a matter of fact, trust is also a precondition for any participatory process (Frantzeskaki, 2019).

Barriers and enablers

Participation and collaboration can be challenging, it could be difficult to engage stakeholders in the first place due to their willingness or interest to engage due to lack of resources (e.g. lack of time) (Fors *et al.*, 2021) or to authorisation procedures (i.e., they cannot be involved) (Kronenberg *et al.*, 2016). Marginalised groups may experience even more and different barriers than those that stakeholders usually face (Fors *et al.*, 2021), finally leading to their exclusion from the process (Butt *et al.*, 2021; Fors *et al.*, 2021). This aspect is intrinsically linked to the first principle described in this section. Moreover, it can be also challenging to maintain good long-term participation levels and collaboration once the process has started (Fors *et al.*, 2021; Kronenberg *et al.*, 2016; Pincetl, 2010).

A risk to achieving a truly participatory governance is “participatory washing”, the implementation of a process, which is only participatory in appearance (Secco *et al.*, 2011). Another barrier to participatory governance is the fact that it is often implemented after a top-down decision and cannot be described as a bottom-up initiative (Secco *et al.*, 2011). However, in some contexts, also external obligations could be effective in introducing new governance approaches. Concerning the number and typology of actors/stakeholders involved, a large number does not necessarily imply quality (Zingraff-Hamed *et al.*, 2020).

The role of non-state actors should be recognised and valorised and they should be integrated in the process to succeed in an effective collaborative governance (Kronenberg *et al.*, 2016; Ma *et al.*, 2020), as they can provide knowledge and support throughout all co-governance phases. There are several participatory methodologies (e.g. public workshops) that can be applied to enable participation and collaboration (Janse & Konijnendijk, 2007). Moreover, to enhance citizens’ participation in NbS co-governance, direct and indirect incentives should be provided, also by increasing environmental awareness (Martin *et al.*, 2021; Wamsler, 2016). Finally, to overcome the risk of creating ‘project islands of public participation’, due to the application of a project-driven approach, (Gantioler, 2018, p. 244) suggests the creation of a more institutionalised framework or meta-governance that guides such public participation processes over a longer period of time.

BOX 6 Implementation of green infrastructure in primary schools (Melbourne, Australia)

Onori *et al.* (2018) report about two projects implementing green infrastructure in two primary schools in Melbourne, Australia. This case study could be of interest for those JUSTNature CiPeLs planning to implement NbS solutions in the premises of schools.

Principle: collaborative, integrative

Enabler: The planning and design of site-specific solutions, based on site-specific knowledge is pivotal for a successful implementation of NbS.

Barrier: the site specificity has not been taken into account, implementing standard solutions instead of customised ones, and this was also due to the lack of local knowledge by the involved stakeholders.

Implication: Successful implementation of green infrastructure projects in schools

Source: Onori *et al.* (2018)

4.3. The Importance of Processes

Decision-making processes provide the institutional framework in which actors and the relationships between them are situated (Coaffee & Healey, 2003). We define processes as the formal and informal rules and arrangements, established practices (Arts *et al.*, 2006; Coaffee & Healey, 2003; Treib *et al.*, 2007) and exchanges of knowledge that combine to influence the ways actors interact, and ultimately make decisions. Our analysis focuses in particular on the planning, design and management of NbS.

The following key principles emerged from the literature in relation to how processes can support good co-governance:

- Integrative and comprehensive
- Transparent and deliberative knowledge exchange
- Strategic and incremental
- Adaptive and reflective
- Context-sensitive

4.3.1. Principle 1 - Integrative and Comprehensive

Good co-governance is based on integrative and comprehensive processes. This implies different scales and levels need to be considered in a collaborative approach. In the words of (Giaino *et al.*, 2019) "multi-level governance is of particular relevance in the field of urban and territorial transformations because it deals with the uniqueness of the physical

space and the natural interdependence between the various environmental components”. Despite, or precisely because of, the usually separate tasks and departments in city administrations, an interdisciplinary team comprised of experts, facilitators and citizens is needed to face tasks and manage processes together. On a higher level the GI policies and regulations have to be prepared, while at the same time considering local knowledge (Vaño *et al.*, 2021).

Not only are different levels relevant for integrative co-governance, but also the scales. Implementing nature-based solutions on a local scale requires an expanded view of the larger context, particularly at the urban and regional scale (Pauleit *et al.*, 2019; Vaño *et al.*, 2021). In any case “the scale of governance institutions [should] be adapted to that of the environmental issue” (Newig & Fritsch, 2009), to respond properly to the project’s aim. One way is to promote the integration of environmental and social agendas at all levels, also with a view to better coordination of political and civil society initiatives (Mann *et al.*, 2018).

Barriers and enablers

Lacking interactions among the different actors involved in projects compromises the real perception of NbS and could lead to uncertainty and passivity (Ramírez-Agudelo *et al.*, 2020). Top-down approaches risk behaviours that could bring an end to collaborative projects. “Practicing multi-level governance means to implement actions, conducts, and attitudes that favour a process of decision-making avoiding an authority driven top-down approach. This implies that decision makers, primarily public, may not adopt behaviours that determine the stop to the implementation of the planning process” (Giaino *et al.*, 2019).

Timing can also be a limiting aspect when it comes to the “**integration** of local, national and international policy/decision-making processes” that are required for a “successful implementation of NbS” according to Kumar *et al.* (2020).

Effective communication on NbS could help to implicate different actors at different levels of decision-making (Ramírez-Agudelo *et al.*, 2020). The use of comprehensible terminology and understandable formulation supports understanding. Especially when it comes to making NbS replicable, evaluation and monitoring frameworks should be prepared in a comprehensible way (Frantzeskaki, 2019). Environmental associations and policy makers can facilitate information exchange on different levels by speaking the **language of multiple sectors** (Martin *et al.*, 2021), they help to provide interaction “across **multiple levels** (niche, regime and landscape) and across multiple scales and policy

domains” (Frantzeskaki & Bush, 2021). With this, gaps and lacking knowledge, resources and normative aspects can be avoided (ibid.). Anguelovski (2013b) recommends “greater coordination between the Departments and Offices for neighbourhood development, public health, environmental protection, and youth and recreation”. This should include knowledge-exchange as well as collaboration in joint projects.

BOX 7 ARTS Project, Accelerating and Rescaling Sustainability Transitions Project

Funded by the European Union, the Art project was launched in 2014 and ended in 2016. The main goal of the project was to better understand the impact of transition initiatives, and to identify conditions that contribute to sustainable low-carbon communities in five European cities: Brighton (UK), Budapest (Hungary), Dresden (Germany), Flanders (Belgium) and Stockholm (Sweden) (www.acceleratingtransitions.eu).

Principle: Integrative and comprehensive; Context-sensitive; Inclusive and collaborative

Enabler: During the project process, it became clear that in order to understand what enables transition, attention must be paid to both participants and local spaces. In this case, the Informed Cities Forum became a platform that brought together the public, policymakers, and academia in a specific space. It allowed for dialogue and collaboration among various stakeholders including local communities with diverse backgrounds through a number of conferences and site-specific field workshops that were co-organised by the ARTS Project together with a third-party company.

Barrier: Organising this type of event can be very complex in terms of processes, as well as time and financial aspects.

Implication: This example highlights two important aspects that must be considered in creating a supportive environment for experiential and place-based learning. First, there is a need to find ways to immerse participants in the environment first-hand, which gives users a unique learning experience that cannot be replaced by any other format. One way to do this is to provide opportunities to experience a place within the framework of local initiatives in a collaborative setting with members of the local community. First-person experiences rather than retellings of stories are the second crucial component to take into account.

4.3.2. Principle 2 - Transparent and Deliberative Knowledge Exchange

Data-driven decision-making and evidence-based planning are identified as important for NbS governance (Sayer *et al.*, 2013; Wirtz *et al.*, 2021). Based on Lexico (2020) in Butt *et al.* (2021), knowledge is defined as “facts, information, and skills acquired by a person through experience or education; the theoretical or practical understanding of a subject”. Yet, knowledge can also be interpreted more broadly as “includes understanding, comprehension, expertise, skill, capability, and mastery, awareness or familiarity gained by experience” (Butt *et al.*, 2021). Following this broader definition, NbS governance should include different knowledge types: scientific and expert and technical knowledge on NbS

performance as well as tacit knowledge, experiences, and understanding of NbS benefits and values including local and indigenous knowledge (Martins *et al.*, 2021; Mok *et al.*, 2021; Morgan *et al.*, 2022; Onori *et al.*, 2018). However, knowledge can be understood through different worldviews; through the lens of an indigenous worldview information might be interpreted differently than through a scientific worldview (Morgan *et al.*, 2022; Wamsler *et al.*, 2021), yet also within sciences there are different prevalent worldviews (Buizer *et al.*, 2011).

Knowledge sharing and exchange seems the way forward to fill gaps in knowledge, expertise and skills (Buijs *et al.*, 2019; Kumar *et al.*, 2020) and to move towards a shared understanding and cooperation (Morgan *et al.*, 2022). The latter requires one to go beyond “simply” providing information (Mok *et al.*, 2021; Wamsler, 2016), and to acknowledge **knowledge sharing as a social process** (Beunen & Opdam, 2011). This is a process of collaborative learning, which brings different actors, knowledge and knowledge interpretations together (Fernandes *et al.*, 2019; Ferreira *et al.*, 2020; Van Cauwenbergh *et al.*, 2022; Wamsler *et al.*, 2021). Multi-actor exchange spaces should be “safe” and allow for **“multi-way knowledge transfer”** (Emerson *et al.*, 2011; Morgan *et al.*, 2022, p. 5) of “ideas, dialogue on issues and solutions and interactions concerning targeted problems and their proposed solutions” (Frantzeskaki & Rok, 2018, p. 48).

According to (Buizer & Van Herzele, 2012, p. 7), this collaborative knowledge exchange is at the heart of governance and should be communicative and **deliberative**. Deliberation goes beyond communication and is defined as a “dynamic and evolving process”, in which various actors, often public and new social (private) actors together, create and share knowledge by **challenging existing ideas and reformulating problems** in order to come up with innovative solutions and influence decision-making (Buizer & Van Herzele, 2012, p. 5; Secco *et al.*, 2011, p. 105). Deliberative practices have been highlighted for their positive impact on “voting behaviour, on possibilities of learning and interaction, on the costs of government (preventing mistakes) and on achieving more creative and acceptable decisions” (Buizer & Van Herzele, 2012, p. 5).

To ensure the quality of deliberation, the perspectives, interests and knowledge of all involved need to be **equally represented** and the power disparities between them need to be acknowledged (Ansell & Gash, 2008; Barletti *et al.*, 2020; Emerson *et al.*, 2011; Innes & Booher, 1999; Van Cauwenbergh *et al.*, 2022). Such a **neutral** process involves good scientific practice, honesty, and fair treatment of people across time, while it reduces bias and favouritism (Ruano-Chamorro *et al.*, 2021). Effective deliberative practices include

“hard conversations, constructive self-assertion, asking and answering challenging questions, and expressing honest disagreements” (Emerson *et al.*, 2011, p. 12). Due to contradictory agreements and potential for conflict, collaborative processes need to be **transparent** (Fernandes *et al.*, 2019; Frantzeskaki, 2019; Kotsila *et al.*, 2021; Mok *et al.*, 2021). Transparency refers to a negotiated process in which **decision-making is visible and accessible**, processes are explained, responsibilities are clear, accountability mechanisms are set up and there is law enforcement and control (McCall & Dunn, 2012; Ruano-Chamorro *et al.*, 2021; Sayer *et al.*, 2013; Van Cauwenbergh *et al.*, 2022). Such a process requires an **open, “fair and civil discourse”**, shared aims and expectations set up through **early dialogue** and **clear communication** regarding decisions, reasoning, processes and activities to participants as well as the broader public (Arlati *et al.*, 2021; Emerson *et al.*, 2011; Ferreira *et al.*, 2020; Frantzeskaki, 2019; Ruano-Chamorro *et al.*, 2021).

Barriers and enablers

Lacking knowledge and understanding among actors is associated with the barrier on the way towards data-driven decision-making and evidence-based planning. This includes unawareness of: environmental issues; the potential of NbS; the ecosystem services they provide; the knowledge to justify their implementation as well as a lack of understanding on the processes associated with the management and implementation of NbS (Butt *et al.*, 2021; Hawxwell *et al.*, 2019; Mekala & MacDonald, 2018; Prado, 2020).

In addition to the lack of specific expert knowledge, one other aspect that makes clear communication difficult is the imprecision and different understandings of key concepts and terminology that are used in the processes of a project’s implementation (Baasch, 2020; Prado, 2020). This imprecision entails misunderstandings between involved actors and can negatively influence decision-making.

The representation of different actors is impacted by a lack of respect and recognition, which can result in their exclusion from procedures and their ineligibility to offer solutions for green infrastructure initiatives (Dobbin & Lubell, 2021). In other words: “if you are not recognised, you do not participate” (Schlosberg, 2004, p. 519). Also connected to this is another type of recognition challenge, which is related to the value of knowledge in decision-making processes, where expert knowledge is favoured over local knowledge (Prado, 2020) touching on an asserted lack of learning from other experiences (Sarabi *et al.*, 2021).

In order to achieve transparency, it is important that the actors involved have shared aims. However, strategic objectives may not be in line with citizen interests, and citizens' resistance to institutionalise and embrace predefined state goals may restrict their ability to contribute to the UGI implementation processes in the city (Buijs *et al.*, 2019; Mok *et al.*, 2021). Beside conflicting interests, a lack of public awareness on what opportunities there are to participate in decision-making processes is recognised as the barrier related to knowledge issues (Sarabi *et al.*, 2021). This relates to the forms of participation and communication chosen, which may not be available to all who wish to participate and thus may exclude some (e.g. access to internet). It also depends on institutional capacity, which lacks knowledge of the methods and tools for establishing strong partnership relationships with non-state actors (Prado, 2020). Another significant challenge that is connected to institutional capacity is knowledge integration that planning and policy continue to face. One reason for this is the fragmented structure of the municipalities by sectors and the distribution of data across several departments, which is difficult to change and limits cross-sectoral cooperation (Lindholm, 2017). The planning procedures and methods are not always successful in merging transdisciplinary data together, and knowledge transfer typically occurs just in one direction rather than numerous (Morgan *et al.*, 2022).

To reduce lacking knowledge and thus considerably enhance the UGI decision-making process, gathering more high-quality data, especially when applied to the local context, is needed (Pauleit *et al.*, 2019; Van Cauwenbergh *et al.* 2022). For effective knowledge sharing, this data should be accessible and methods for combining transdisciplinary knowledge should be expanded (Sayer *et al.*, 2013). One of the ways of doing this is through stakeholder platform formation, enabling meeting spaces for lateral knowledge exchange (van der Jagt *et al.*, 2019). Urban Living Labs (ULL) can be cited here as an example that foster knowledge development and exchange through participatory learning (Kronsell & Mukhtar-Landgren, 2018).

Extensive mapping of stakeholders, engagement with less actively involved stakeholders (Buijs *et al.*, 2019; Van Cauwenbergh *et al.*, 2022) with appropriate strategies (Kumar *et al.*, 2020) early on helps to develop “common language” and build long-term trust relationships. This is done by aligning shared goals and values from the initial stage of NbS projects, which reduces the risks of conflicts of interest in the future (Mok *et al.*, 2021; Ferreira *et al.*, 2020). The effectiveness of decision-making processes is greatly influenced by success in satisfying the interests of all parties involved (van der Jagt *et al.*, 2017).

Increasing the transparency of decision-making processes requires the development of knowledge and abilities that can link environmental understanding to the values of local actors (Pineda-Pinto *et al.*, 2022). The role of knowledge development facilitators can be played by so-called knowledge brokers - NGOs or any other organisations that support citizens in their learning processes related to NbS issues (Buijs *et al.*, 2019; Frantzeskaki, 2019).

Another important aspect that drives the improvement of decision-making in planning processes is the “structural learning by governments from active citizenship practices” (Buijs *et al.*, 2019). Recognition of knowledge, openness to listen and learn from others and, consequently, a willingness to change decisions accordingly lead to well-reasoned solutions (Barletti *et al.*, 2020).

BOX 8 Balij-Biesland forest, Netherlands

The Balij-Biesland forest was part of a strategy to expand forests on farmland in the Randstad area of the Netherlands with the main goal of timber production. Due to the fact that the forest was close to urban areas, it was included in urban greening strategies “such as Randstad Green structure and the Green-Blue Slinger” (Buizer & Van Herzele, 2012). In the process of project implementation, some issues were not discussed with the general public and were only the responsibility of local municipalities. In the latter stages, policy makers began to involve residents more, but only by providing information about the potential of the area to be developed, rather than through the form of discussions in which residents could delve more deeply into the project objectives and propose a well-reasoned solution reflecting different perspectives, in other words, a less deliberative form.

Principle: Adaptive and reflective; Transparent and knowledge-based

Enabler: Lots of studies emphasise the benefits of deliberative methods and state that in order to facilitate the formulation of new solutions and decisions, it is necessary to move to reasoned or deliberative planning processes among a large number of participants, even if the basis for discussion is already formulated one. Even without the high level of the participants' involvement, the example of the Balij-Biesland forest shows that some deliberation in the form of discussion was still present in centrally established planning processes.

Barrier: According to a number of studies, the voluntary nature of land acquisition and the lack of specificity in the spatial plans were the reasons for the lengthy process, which in turn led to speculation on future higher land prices. The process of deliberative democracy was also hindered by the failure to consider the arguments of some participants by others, the lack of necessary data to assess the strength of a particular claim, and the reluctance of individuals to weigh certain arguments.

Implication: The presented example shows that for effective decision-making processes it makes more sense to build deliberative democracy from the ground up through the deliberative democratic practices and capacities that are already embedded in given institutions. It is also necessary to take into account the distinction between institutional forms of deliberative democracy that respond to particular social circumstances.

4.3.3. Principle 3 - Strategic and Incremental

Many scholars see **strategic planning** as an important enabling factor for tackling the future challenges cities face and the realisation of NbS and more specifically green infrastructure (Hansen *et al.*, 2019; Hawxwell *et al.*, 2019; Mell, 2018; Pauleit *et al.*, 2019; Van Cauwenbergh *et al.*, 2022; Vaño *et al.*, 2021). Strategic planning is characterised by **setting long-term goals or developing future visions**, which form orientation points for future developments (Hawxwell *et al.*, 2019; Wiechmann, 2008). These goals and visions often encompass broad overarching themes, which span disciplinary boundaries. On the other hand, the goals and visions are often selective in the sense, that they indicate long-term decisions and, in such way, help to prioritise actions (Wiechmann, 2008).

Strategic planning focuses, however, not only the goals and visions, but on the process of working towards these goals and visions (Pincetl, 2010). This process is considered **incremental** as it consists of different steps including formal practices, top-down policies and planned projects as well as unplanned informal bottom-up actions (Wiechmann, 2008). Due to its incremental nature, the overall process, with planned and unplanned actions, asks for regular evaluation to identify new strategies (Wiechmann, 2008) and is needed to steer actions towards common goals. In addition, goals and visions need to be re-assessed for their relevance for societal challenges. Strategic planning processes therefore need to adopt an **iterative cyclical approach** without clear end point (Fors *et al.*, 2021; Sayer *et al.*, 2013).

To make strategic planning effective, it is important that these practices, policies, plans, projects and actions are **aligned towards a common goal or shared vision** (Barletti *et al.*, 2020). A strong vision brings clarity, which supports “the consolidation of a strong economic long-term investment” (Mahmoud & Morello, 2021). The process of collectively developing a strong shared vision can incentivise change (Hawxwell *et al.*, 2019; Ma *et al.*, 2020) by bringing different actors with different aims and values together (Morgan *et al.*, 2022). For this reason, Healey (2006) defines strategic planning as a **social process**, which according to (Albrechts, 2006) requires “broad and diverse participation”.

Barriers and enablers

One major challenge within strategic co-governance processes is to link top-down “long-term [...] planning objectives at higher spatial levels with [bottom-up] localised, fragmented and informal efforts by local groups of active citizens” (Buijs *et al.*, 2019). While formal top-down objectives “typically focus on formal and large public greenspaces, informal and

small (semi) private areas are much more difficult to include in strategic planning processes” (Buijs *et al.*, 2019). The local interests of landowners and citizens might not align with the planning objectives or fit the time frames of the long-term iterative process (Pinto-Correia *et al.*, 2006).

The multitude of ownerships and actors could fragment and complicate the collaborative governance process (Dwyer *et al.*, 2003). Developing a shared vision asks for “broad consensus on general goals, challenges, and concerns, as well as on options and opportunities”, while involved actors also “need to understand and accept the general logic, legitimacy, and justification” (Sayer *et al.*, 2013). Fully aligning actors with “different values, beliefs, and objectives” is unlikely (*ibid.*). Yet, engagement might further be hindered by a lack of trust in governmental institutions, reluctance to engage with bureaucracies and to institutionalisation (Buijs *et al.*, 2019; van Dam *et al.*, 2014).

Strategic processes mainly focus on planning, but Fors *et al.* (2021) plead to extend the process to include management, as management might have a longer effect on the green space quality than design, planning and implementation combined. An interviewee by Wirtz *et al.* (2021) mentioned his frustration with the focus on planning and the neglect of “direct day-to-day management”. The example by (Harris *et al.*, 2021) on the Humboldt Park in the City of Chicago shows that neglect of management might not only have an effect on the use of green space, but also on the well-being of adjacent residents. Currently, strategic top-down planning insufficiently addresses power relations and their impact on green space distribution, or the recognition and involvement of diverse and marginalised groups (Chu & Cannon, 2021; Hawxwell *et al.*, 2019; Pauleit *et al.*, 2019).

Although the alignment of top-down planning objectives with fragmented bottom-up initiatives is seen as a major challenge, **strategic planning** has also often been mentioned as a good way to bring these together (Buijs *et al.*, 2019). According to Puskás *et al.* (2021), the top-down approach provides support to tackle environmental challenges, but the involvement of local communities and citizens supports “equity and long-term sustainability”. To link local small-scale initiatives with top-down city-scale strategies, Vaño *et al.* (2021) propose to introduce an **intermediate level**. Based on their experiences in the *CLEVERCities* project, Arlati *et al.* (2021) suggest **combining smaller local meeting formats with larger comprehensive events** as it connected “various local interventions under a broader and shared vision”, while “informing and mobilising a broader and more diverse group of people” on the outcomes of the local interventions.

Co-creation processes, as described by Salmon *et al.* (2021) for the case study of Quito in Ecuador, can empower citizens and communities to take up a more active role and to envision more ambitious long-term goals for their community (see [Actors](#)). The set-up of a **small-scale local governance network** could promote exchange between communities as well as with higher governance levels (Tauhid & Zawani, 2018). Buijs *et al.* (2019) proposes **mosaic governance** as a perspective as it acknowledges and accepts the existence of different governance modes; top-down and bottom-up, hierarchical and egalitarian. Putting mosaic governance into practice also suggests adjusting governmental planning practices and routines, which do not favour specific governance modes (e.g. “an authority driven top-down approach” (Giaimo *et al.*, 2019, p. 63). Moreover, governmental actors need the capacities to be able to **switch between different roles** (e.g. leading, facilitating, following) (Westerink *et al.*, 2017) (see [actors](#)).

The operationalisation of NbS co-governance could be further enhanced by developing **supportive frameworks** (Frantzeskaki & Bush, 2021; Puskás *et al.*, 2021; Ramírez-Agudelo *et al.*, 2020). Such frameworks should provide a flexible structure for the strategic, cyclical and collaborative process by defining “a sequence of steps, a set of tools, [and] an inventory of stakeholders, making it easier to manage and facilitate participation in a project, while maintaining focus on the aims and expected outcomes” (Puskás *et al.*, 2021). These frameworks should encompass a long-term perspective including collaborative maintenance and management (Fors *et al.*, 2021; Mahmoud & Morello, 2021), and long-term commitment with secured resources (Fisher *et al.*, 2021; Sayer *et al.*, 2013).

Based on Davoudi *et al.* (2008), Fernandes *et al.* (2019) define the initial step as “**building organisational consensus**” by identifying and inviting potential involved actors, and developing an organisational structure. In this step, **political support** can be ensured by involving decision-makers (Barletti *et al.*, 2020) and **inclusion** ensured by involving a diverse group of key stakeholders. In the following step, process objectives, expectations and constraints as well as actors’ interests, values, and potential contribution are discussed (Emerson *et al.*, 2011; Fernandes *et al.*, 2019; Pauleit *et al.*, 2019). According to Hawxwell *et al.* (2019) introducing environmental justice as a challenge in this step would consolidate the topic throughout the process. The prior steps lay the foundation for the next step: “agreeing on a common vision for the future of their territory” (Fernandes *et al.*, 2019). To help define this common vision, **future scenario workshops** could be employed with **forecasting methods** to identify future challenges of the city and visions of how the city should become, and **back-casting methods** to identify potential actions towards the

shared vision (Lembi *et al.*, 2020; van Rooij *et al.*, 2021). Hawxwell *et al.* (2019) propose to visualise these visions and to employ visions for different levels and different themes. The **visualisation** would support the communication of the goals and vision.

To operationalise the common vision, **existing capacities for implementation** on different scale levels should then be identified (Barletti *et al.*, 2020) and the vision should be **linked to policies, milestones and actions** assigned to actors at the appropriate level (Hawxwell *et al.*, 2019). To verify, if the objectives of the common vision are met, targets need to be set and **performance need to be systematically evaluated** (Hawxwell *et al.*, 2019; Wirtz *et al.*, 2021). Targets and monitoring indicators need to be co-defined to be fit the local context and address concerns of local actors (Hawxwell *et al.*, 2019; van der Jagt *et al.*, 2022). Although such a process is time-consuming, according to Barletti *et al.* (2020) it will ultimately lead to more political will, consensus, commitment, while empowering and building the capacity of to participate in these processes. To support the long-term engagement, Sayer *et al.* (2013, p. 8351) propose to launch the implementation process by “focusing on **easy-to-reach intermediate targets**” as these “may provide a basis for stakeholders to begin to work together”, which in turn provide “opportunities for shared learning”. Fors *et al.* (2021) reason that a sequence of projects, which gradually build upon each other, can lead to long-term engagement, if the same actors participate time and again and projects outcomes are incorporated in the common vision.

BOX 9 Byhøst (City Harvest app) Copenhagen, Denmark

Byhøst - is a non- profit association that was launched by a voluntary group of active citizens and developed in collaboration with the local authorities (Buijs *et al.*, 2019). The main goal was to raise awareness of residents about local wild plants that can be eaten and to "develop greener, smarter and tastier cities" in Copenhagen. To do so the association developed the Byhøst app, which encouraged citizens to pay attention to the food that grows on public land in the city and to mark it on the map. At the time of writing, this app was high in popularity and used by the community and professionals alike as a link between citizens and urban planning (www.byhoest.dk).

Principle: Integrative and comprehensive; Strategic and incremental

Enabler: In the case of Copenhagen, the app that allowed users to map the urban harvesting possibilities played an enabling role in the planning and design phases to empower users for long-term engagement, as well as for knowledge sharing, as it was used as an advisory platform in the planning process, informing about the values associated with local food.

Implication: This example shows that *value mapping* can be used as an approach/tool to *increase the level of participation and the level of value perception* of urban biodiversity. It also gives users the opportunity to influence the appearance of the space, which is recognised as one of the

reasons for non-participation (Fors *et al.*, 2021). Beside this it created space for *long-term communication* between local authorities and citizens about foraging.

4.3.4. Principle 4 - Adaptive and Reflective

Working in a socio-ecological-technological system comes with various uncertainties, dynamics, nonlinear relationships and unforeseen interactions (Sayer *et al.*, 2013; Van Cauwenbergh *et al.*, 2022). These uncertainties are further intensified by the increasing climate change risks as natural phenomena become less predictable and knowledge is incomplete or imprecise (Pauleit *et al.*, 2019; Van Cauwenbergh *et al.*, 2022). The innovative nature of NbS brings uncertainty about its performance, while NbS governance needs to deal with different and changing perspectives, interests and values of various actors (Buijs *et al.*, 2016; Van Cauwenbergh *et al.*, 2022).

Adaptive and reflexive governance approaches are put forward by many to deal with uncertainties, rapid changes and surprises (DeLosRíos-White *et al.*, 2020; Kotsila *et al.*, 2021; Mann *et al.*, 2018; Pauleit *et al.*, 2019; Wirtz *et al.*, 2021). These approaches therefore incorporate **iterative cyclical processes** and **continual learning** arrangements with multiple **feedback loops** (Barletti *et al.*, 2020; Morgan *et al.*, 2022; Sayer *et al.*, 2013). According to Sayer *et al.* (2013), these approaches also provide potentials to learn from uncertainties and to improve decision-making step-by-step for the long run. Problems can be re-evaluated based on new insights or reframed based on new societal needs, new instruments and tools can be tested, and NbS can be assessed for their effectiveness (Mahmoud & Morello, 2021; Morgan *et al.*, 2022). Through **reflection**, new knowledge and understandings can be acquired, on which in turn decisions can be reversed and practices, projects and actions can be adjusted (Dwyer *et al.*, 2003; Ruano-Chamorro *et al.*, 2021).

(Ma *et al.*, 2020, p. 624) consider cyclical adaptive processes as particularly relevant for **"interactions between green businesses and cities"**. Buijs *et al.* (2019, p. 55) and Randrup *et al.* (2020) consider them relevant to facilitate synergies between formal long-term objectives with local community-based actions, as it allows to **"respond to the emergence of active citizenship"**. Such processes should include results and experiences from local activities and communities into continuous cycles of collective reflection and learning in which citizens and local communities can take a more active role (Djalali *et al.*, 2019; Mahmoud & Morello, 2021). By **allowing time** in these processes, people's capacity can be

built to participate in decision-making processes, while over time trust between participants and a sense of ownership is established (Barletti *et al.*, 2020).

Barriers and enablers

Monitoring and evaluation are key factors for successful adaptive and reflexive arrangements (Martin *et al.*, 2021), yet they are often a weak point in the process (Morgan *et al.*, 2022). Often there is no budget reserved for monitoring (Van Cauwenbergh *et al.*, 2022), which limits lessons learned, either positive or negative (Martin *et al.*, 2021; Sarabi *et al.*, 2021). When monitoring is in place, its quality is dependent on the responsibilities and capacities of the people involved; in how results are compiled and interpreted (Baasch, 2020). With NbS, the “outsourcing of maintenance operations to private contractors” often inhibits that experiences on maintenance are fed back to planning and policy processes (Suleiman, 2021).

Iterative processes require the engagement of different actors including civil society and citizens over a long period (Toxopeus *et al.*, 2020), yet they might be reluctant to commit to such lengthy processes (T. Mattijssen *et al.*, 2017; Tauhid & Zawani, 2018). Meanwhile many funding programs are project-oriented with clearly defined outcomes (Sayer *et al.*, 2013). From a governmental perspective, the long-term collaborative cyclical process might also be challenging. In many cases, “fast” and tested technical solutions are still preferred over the new long-term NbS processes with often uncertain impact (Barletti *et al.*, 2020; Kumar *et al.*, 2020; Mekala & MacDonald, 2018). In politics, there is often limited willingness to engage in new ideas and approaches, due to fear of negative outcomes (Hawxwell *et al.*, 2019), even though addressing uncertainty plays a big role in policy and planning activities (Morgan *et al.*, 2022).

Yet also in traditional planning approaches, in which governmental actors and planning and design experts take the lead, there might be difficulties in shifting from a project-oriented to a process-oriented approach (Puskás *et al.*, 2021; Wamsler, 2016; Willems *et al.*, 2020). The rigid “hierarchical organisational structure[s]” of governmental organisations inhibit such a shift (Sarabi *et al.*, 2021), as it will most likely have an impact on different levels, from the institutional structure to the individual governmental actors (Sayer *et al.*, 2013). Governmental actors might see themselves suddenly confronted with multi-stakeholder negotiation (Sayer *et al.*, 2013), while governmental policies and practices might not always support long-term processes (Butt *et al.*, 2021). Bureaucracy and the complexity of rules and regulation might hamper further implementation of flexible and

adaptive processes (De Haas *et al.*, 2021; Hammelman, 2019). Often the resources (e.g. financial, human resources, time) and capacities are lacking (Sarabi *et al.*, 2021), which further amplifies the fear of slowing down planning and decision-making processes (Mok *et al.*, 2021).

Implementing adaptive reflexive approaches starts with acknowledging and **being open about uncertainties** (Morgan *et al.*, 2022), and a **willingness to listen, learn and transform** processes and practices based on outcomes (Barletti *et al.*, 2020; Sayer *et al.*, 2013). According to Morgan *et al.* (2022, p. 5) such an attitude can “foster creativity, broaden knowledge bases, and create new pathways for action”. Yet, it also requires a supporting context, which provides financial, political and regulatory support (Suleiman, 2021). Support might also come from external actors, as the “Tree Cities of the World” program shows (Wirtz *et al.*, 2021). This program requires cities to take action to be accepted, for example by assigning responsible actors or agencies, dedicating budget for long-term monitoring and organise awareness-raising events (*ibid.*).

To tap into the various developments, practices, actions and initiatives on NbS, these processes need to be open to all (Frantzeskaki & Rok, 2018), while paying attention to those with different perspectives, information and knowledge and those with “weaker positions” in decision-making (Barletti *et al.*, 2020). Expert knowledge still plays an important role, but is one of many sources integrated into the reflexive process (Sayer *et al.*, 2013). Experts, such as urban planners, “need to be open to differences in preferences between their designs and citizens’ perceptions” and in receiving feedback (Frantzeskaki, 2019, p. 109). Governmental organisations might require restructuring to be able to respond to uncertainties, emerging bottom-up actions and to identify learning opportunities (Brink & Wamsler, 2018; Onori *et al.*, 2018; Vaño *et al.*, 2021).

4.3.5. Principle 5 - Context-Sensitive

Context sensitivity for local decision-making processes can be understood as referring primarily to three factors: the informal arrangements that co-exist with formal procedures, the kind of knowledge that enters decision-making, and the challenges that are considered most pressing in the local context. All three serve to enable and constrain the range of decisions possible. These are described in more detail below.

Barriers and enablers

Reform of a dysfunctional system for making decisions in government is often a precondition for shifting to a more collaborative mode of governance, but a new system cannot be imposed without considering the practices already established, including informal, unwritten rules, and intangible values, such as community identity (Anguelovski, 2013a; Butt *et al.*, 2021) (see actors). Established practices and rules, whether they are formally encoded, can serve to enable and constrain the range of decisions possible. Where these are not well understood, and efforts made to adapt to them, they may serve as a significant barrier to the kind of institutional change necessary to shift towards co-governance. Writing about the potential to incorporate a more deliberative, democratic approach into typically centralised forest planning, (Buizer & Van Herzele, 2012) suggest that an analysis of the local institutional context, including practices, patterns and opportunities for change, is a necessary step, and may be a more effective starting point than the imposition of normative principles.

Decisions are not just shaped by the interplay of formal and informal procedural arrangements, but also the kinds of knowledge that enter the process. In a local government setting, this means the ways that leaders and technical staff draw on knowledge to make decisions, and likewise the kinds of knowledge that are recognised as legitimate. While 'expert knowledge' in the form of e.g. consultant reports, grey and academic literature, statistics and modelling, is often undisputed as a sound basis for decision-making, local knowledge may not enjoy the same legitimacy, although engaging residents and their local expertise can be of great value, as Fors *et al.* (2018) found in relation to co-managing urban woodland areas, fostering acceptance of decisions and even mobilising resources for implementation (Salmon *et al.*, 2021). Even where the legitimacy of local knowledge is accepted, Wolfram (2019) notes that local government staff may face the barrier that they do not possess the requisite skills to obtain it, pointing out that: "Understanding the specific needs and value sets of various stakeholders requires insights, social networks, and skills not widely available in the public sector." (Wolfram, 2019, p. 491). Support from academic institutions and civil society organisations is cited as a means to overcome this barrier, acting as an intermediary between laypeople and policymakers, provided these third parties are financially and organisationally stable (Wolfram, 2019). Citizen science is another promising method that offers the potential to directly engage community members in collecting data that has been typically the domain of experts, and at the same time foster local environmental stewardship (Jordan *et al.*, 2019). Inclusion of different actor groups can be supported by local governments "through

situation sensitive support” (Pauleit *et al.*, 2019). Any process by which communities are engaged also needs to be locally informed (Barletti, *et al.*, 2020).

Finally, other local conditions (e.g. climatic conditions or economic stability) will inevitably also influence which kinds of needs and interests are prioritised in decision-making (Frantzeskaki *et al.*, 2018) and the extent to which shifting towards a more collaborative process is possible at all (Zingraff-Hamed *et al.*, 2021). This aspect of local context is typically much harder for actors in local government to influence, however certain issues that come to dominate public discourse may present opportunities to reform existing procedures, e.g. locally felt impacts of climate change or overt neglect of public space. Cities and regions have different capacity, culture and values, socio-economic and environmental situation, and political conditions. Context-sensitive decision-making processes are attentive to these conditions, which can reduce uncertainties coming from different institutional set-up by reflecting stakeholders’ concerns (Van Cauwenbergh *et al.*, 2022). For wider context-sensitivity, NbS concept can be embedded in existing urban policies and instruments including plan, building codes, and zoning (Hawxwell *et al.*, 2019).

Context-sensitive processes can be created by integrating local knowledge in the process of co-governance (Djalali *et al.*, 2019). Cities can utilise various existing tools and instruments (e.g. information systems, economic instruments, etc.) to influence implementation of NbS (Hawxwell *et al.*, 2019). Hawxwell (2019) asserted “all proposed measures, whether regulation or market incentives, should be tailored to the local environment and conditions, creating a realistic, attractive and viable context for the adoption of NbS solutions in future urban planning practices (p.26).” Understanding local conditions, not only socio-economic situations but also stakeholders’ perceptions and networks can support evidence-based decision-making (Neumann & Hack, 2020). However, this doesn’t mean blindly accepting existing social norms or assumptions as they may be already discriminating or hindering social equity (Hammelman, 2019).

Assessment tools like the Policy Feedback Cycle could help local to explore more in detail the local socioeconomic activities, perceptions and stakeholders’ interactions and provide a systematic framework for effective decision-making (Neumann & Hack, 2020).

4.4. Policy Instruments

Policies play a dual role in co-governance, in that they result from decision-making processes (Emerson *et al.*, 2011; Ostrom, 2005), however, once in existence, they also

directly influence decision-making. In the latter sense, policies establish processes or methods to achieve certain goals or decisions (Treib *et al.*, 2007, p. 4). According to van Riper *et al.* (2016), policies are “the techniques used to address objectives and represent the mutual interests of managers and stakeholders”, and exist on “a spectrum of regulation that spans formal and informal governance mechanisms (pp.2-3).” We apply a wide concept of policies that includes a range of both binding instruments: e.g. legislation, regulations, statutory plans; and non-binding instruments e.g. programs, strategic plans, incentives, guidelines, voluntary agreements, or information campaigns. Given that our focus is the governance processes that can be influenced by local government actors, specifically the city partners in the JUSTNature project, our primary interest is those policies that are created and managed by local government administrations. Our review found the following main principles for policies to support good co-governance of NbS:

Top 3 Principles

- Accessible
- Evidence-based
- Legitimate

4.4.1. Principle 1 - Accessible

Accessible policies are an important precondition for good co-governance of NbS. The accessibility of policies can be defined as two-fold: 1) they are written and presented in a way that is understandable for the general public, and 2) they are available for everyone. Policy information that is difficult to access can radically limit the extent to which community members are aware of issues at stake in the planning, design and management of green space in their city, and hence the opportunity to influence these decisions. Policies can in turn stimulate people to initiate and engage in actions (Frantzeskaki, 2019), however, only if they are accessible to everyone in the first place (Estrada *et al.*, 2020). At the same time, the policies need to provide legible and understandable information. To make clear and understandable policies, concepts and terminologies need to be clearly defined (Baasch & Blöbaum, 2017).

Barriers and enablers

De Haas *et al.* (2021) point out that overly complex rules can be a barrier to the uptake of policy instruments designed to encourage non-public actors to take part in developing NbS, even when said actors are highly motivated. In relation to a community garden initiative in the Netherlands, they note “the complex rules and regulations regarding

support or subsidies were a major challenge, especially when the initiator intended to include diverse groups of participants and wanted to pursue a variety of objectives...the rules tended to change every four years after each national and local elections round [and] became increasingly challenging, as they were accompanied by numerous administrative and other requirements" (De Haas *et al.*, 2021, p. 6).

For openly available policies, presentation and workshops can be organised to provide information to citizens and others stakeholders. Also, the information can be presented via social media and city websites to be accessible year-round. For that, efficient data management is critical. Establishing a data centre or an information forum where all relevant policies and regulations can be found can help this process (Hawxwell, *et al.*, 2019). However, this may raise issues with limited budget and time, as well as expertise within the local government. An accessible online platform that collects and connects all relevant information about regulations and policy instruments is recommended by Hawxwell *et al.* (2019) and can be integrated in the municipal website. Nevertheless, it is important to control which information is accessible to whom and which data may be used by different stakeholders and how (Hawxwell *et al.*, 2019).

4.4.2. Principle 2 - Evidence-Based

Evidence-based and scientifically adequate policies and instruments are critical in co-governance of NbS. Policies backed up by objective evidence and scientific research build credibility and in turn, improve legitimacy. Nevertheless, it can be questioned whether the evidence-based argument hinders the development of good and required policies, given the need for time intensive analysis which may result in avoidance of decision-making in unclear situations. By showing the tangible and visible benefits and beneficiaries of NbS, stakeholders can develop a common understanding of the policies and interventions (Mok *et al.*, 2021). Cooperating with different experts and institutions, especially from the science domain is crucial for sustainable and well-grounded legislation and the development of NbS which incorporates various disciplines (Hawxwell *et al.*, 2019). Wirtz, *et al.* (2021) also reports experts chose "Data-driven decision-making" as one of the most important factors for successful NbS.

Having evidence-based policies not only improve credibility but also legitimacy of NbS programs (Hawxwell *et al.*, 2019). When the general public do not have trust in public policies and other instruments, their implementation cannot be effective (Ma *et al.*, 2020). Therefore, providing evidence-based policies in an open manner is desirable. Credible

policies present transparent evidence which build up trust and invite critique from the public (Sayer *et al.*, 2013). This boosts discussion and critical reflection on policies so that they can be more suitable.

Barriers and enablers

Constraints to producing credible policies are often a lack of funding and knowledge (Wirtz, *et al.*, 2021). Within their limited budget, municipalities often face trouble to fund scientific research and develop and evaluate policy options and project cost and benefits. Due to hierarchy or political differences, NbS governance often faces a lack of collaboration and communication. Ineffective communication or collaboration can generate missing knowledge exchange that can lead to less credibility on evidence-based decision-making.

To overcome these barriers, gathering information and data can reduce uncertainties and support making evidence-based policies (Jordan *et al.*, 2019). Also, active collaboration with experts can overcome a lack of capacity and expertise within public agencies (Hawxwell *et al.*, 2019). In the process of policy making, open and clear communication strategies are needed. This entails sharing common understanding of concepts, policy goals, and actions.

4.4.3. Principle 3 - Legitimate

According to McCall and Dunn (2012), legitimacy is “the acceptability of the position of the ‘governing’ over the ‘governed’ (p.83).” For a policy supporting NbS to have legitimacy, it needs to 1) result from a democratic, decentralised and collaborative decision-making process that does not privilege certain individuals’ values or perspectives over others (Graham, 2015), and 2) be based on unbiased information (Suleiman, 2021). These two factors also need to be clearly and effectively communicated – hence legitimacy is closely linked with transparency and accessibility (see earlier discussion on the principle ‘accessible’ above).

Barriers and enablers

Experts tend to produce data that only facilitates the connection between problems and their proposed improvements, while obscuring other relevant information (Astuti & McGregor, 2015). As highlighted by Astuti & McGregor (2015), a dominant knowledge results in a selection bias that harms the democracy of decision-making processes.

As a result, targeted mechanisms to acquire, translate, and disseminate knowledge into new policies are critical for adaptive NbS co-governance (Gerlak *et al.*, 2020). Implementing

techniques like learning by experiment allows for testing of innovative ideas, development of adequate skills, and trust building among stakeholders, facilitating their interest and comprehension (Mahmoud & Morello, 2021). Therefore, a mutual acknowledgement of knowledge seems needed to legitimise NbS policy (Astuti & McGregor, 2015).

4.5. Institutional Technology

The premise of this section is that technology, the selection of specific artefacts, infrastructures, their design choices, and adoption to specific contexts co-create institutional dynamics (Orlikowski & Barley, 2001). This is due to a complex, bilateral relationship between technology and society. First, the design of technology is shaped by its political, sociotechnical context (Bucciarelli, 1994), resulting artefacts can be appropriated and interpreted socially (Orlikowski & Iacono, 2000). Second, they steer agency through what they limit and what they afford (Norman, 1999). In the science and technology studies discourse, this is captured in the concept called the “politics of design”, a claim that **technical design choices carry social and political meaning**, making artefacts political (D. J. Hess & Sovacool, 2020). For example, Buzan & Little (1994) described how the modern international system of governance is only possible because of long-distance and near-real time communication technologies.

Recent developments in digital technologies increasingly relate both to the shift in governance modes to various forms of co-governance, and to the co-governance of commons, such as the environment. Immersive technologies, the internet of things, and artificial intelligence form an ecosystem of knowledge production and dissemination (Gartner, 2022). Digital platforms are becoming disembodied social spaces for creating and maintaining communities and collaborations (Coelho *et al.*, 2019). Distributed ledger technologies can facilitate decentralised markets, institutions, and relational contracts (Ammous, 2016; Nakamoto, 2008). Therefore, good technological choices in any governance arrangement can facilitate ever-increasing degrees of participation without losing organisational efficiency (Ostrom, 2010), but bad choices can also corrode trust between co-governing actors.

This section thus focuses on the principles of co-creating governance through institutional technology.⁴ Based on Davidson *et al.*'s (2016) institutional innovation concept, and on Williamson's (1985) interpretation of transaction costs, we define institutional technology as: **material or digital artefacts or their combinations, which fulfil governance functionalities relating to the coordination of actions, characterised by their capacities to determine transaction costs.** "Transaction costs" here employed as a marker for technologies of interest, and it means that the technology makes transactions – i.e., informing, interacting, coordinating, mobilising, rulemaking, enforcing – easier, harder, or (im)possible (North, 1990). In practice, anything is institutional technology if either of the following is true:

- it substitutes a functionality related to coordination from private companies, contracts, public authorities, or markets;
- it introduces the capacity to coordinate actions not yet formally governed due to their high transaction costs.

While this section is also structured around governance principles, a linking concept is necessary to describe how institutional technology design choices interact with NbS co-governance. To do so, each principle is further broken down to affordances – the range of (inter)actions made possible and perceivable between a system and its user (Norman, 1999). Affordances are the things that can be done, or suggested to be done with something, in the context of goal-oriented actions of specific individuals. Design choices foreground specific actions for specific people (Yaneva, 2009), and therefore create social order (Volkoff & Strong, 2013). For example, an announcement on a bulletin board may exclude people based on distance, on a website based on habits, and via newsletter based on digital skills. Describing affordances instead of technological details alone allows us to evaluate their performance in the context of good governance principles.

The way principles are construed from affordances, is by evaluating them through a normative lens, as the affordance concept is on its own descriptive. The normative dimension of institutional technologies is built up of fulfilling main goals: social scalability

⁴ There is an argument to simply integrate institutional technologies to the polity dimension, as in STS, technology is simply a „standardised means to attain predetermined results“ (Rohracher, 2015), and as such, institutions are, in fact, „social technologies“ (Nelson & Sampat, 2001). However, digital and material technologies have a clear, unique back-and-forth relationship with institutions: social norms and institutional settings both manipulate how a material technology is appropriated, whereas the enacted technology feeds back to the institution, and indirectly to social norms (Fountain, 2001). It is thus more actionable to discuss institutional technologies separately.

and just digital transition. Social scalability is the degree to which the number, heterogeneity, and inclusivity of participants, and the scope and frequency of participation can be increased without compromising on transaction costs (Szabo, 2017). For example, a public consultation process for the design of a new park may (A) reach only a white upper-middle class audience, (B) include a poorer ethnic minority and result in deadlock because of conflicts, or (C) include both groups with sufficient mediation to mitigate conflicts. While (B) offers higher degree of participation, it does so at unsustainable transaction costs, thus (C) is the only arrangement that is socially more scalable than (A).

The second normative dimension relates to justice and is derived from Buchanan’s “justice in innovation” concept. On the distributional level, this means the fruits of technological innovation is fairly shared, and the digitalisation process actively seeks ways to eliminate pre-existing injustices (Buchanan *et al.*, 2015). On the procedural level, technology selection, specific design choices, and the specific application to goal-oriented activities in a given context should be judged on their justice-related risks, with ample involvement of those who could be losers of the transition process. The principles discussed in the following sections are the manifestations of either social scalability, or just digitalisation, in relation to specific affordances offered by digital technologies.

From the literature review, the following five main principles for the deployment of institutional technology in NbS co-governance were identified:

- Adaptive
- Collaborative
- Effective
- Legitimate
- Participatory

4.5.1. Principle 1 - Responsive

Table 4: Responsive institutional technologies

Affordance	Description	Example technologies
Articulating complexity	Empowering laypeople to make informed statements on complex matters by coupling information with their model of reality.	<ul style="list-style-type: none"> • 3D models • animations • GIS • quantitative data
En/decoding interest	Translating individual viewpoints, arguments, objectives into a shared symbolic space.	<ul style="list-style-type: none"> • feature engineering • PGIS • online surveys • open data standards

Knowledge production	Accessing or generating synthesised, structured information from a variety of sources that are immediately actionable in specific contexts.	<ul style="list-style-type: none"> • machine learning • IoT ecosystems • modelling & simulation • process mining
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The way digital technologies influence governance responsiveness, is through knowledge management. Digital technologies from a managerialist perspective already shift the basis of decision-making from pure power dynamics, conventions, and intuition to data, evidence, and knowledge (Esty, 2004). With the increasing role of knowledges, technological capabilities can translate information to actionable knowledges, which elevates one's capacity as a knower, and improves the understanding of individual needs and viewpoints (Hilbert, 2009). For social scalability, responsive technologies should reduce the risk of misinterpretation, and the probability of conflicts. On the side of justice, they should improve fidelity between policy objectives and stakeholder perspectives, including a better understanding of disenfranchised actor interests. Three affordances are relevant here: producing knowledge, articulating complexity, and en/decoding interests.

Knowledge production is probably the most self-evident affordance of digital tools (Møller *et al.*, 2019). It is important to note however, that this does not equate to data production. To meaningfully influence governance processes, the jump from data to knowledge, i.e., from signals to actionable syntheses (Wallace, 2007), is essential. A sensor alone is not institutional technology, but can constitute one, if it is incorporated into a larger system that facilitates actions on environmental issues (Delborne & Galusky, 2011). In the context of NbS co-governance, knowledge producing technologies should mainly focus on: (1) mapping impacts, (2) untangling interactions in social-ecological-technological systems (SETS), (3) tacit knowledges of different social groups, (4) dynamic/process information, and (5) translation to policy/stakeholder objectives. For example, remote sensing, small-scale sensors, modelling, and cloud-based analytics can be used to assess and compare green infrastructure impacts or the propagation of environmental hazards (Esty, 2004; Nitoslawski *et al.*, 2019). Computational analytic pipelines can be developed to disaggregate interactions and uncover synergies (Esty, 2004), discover processes (Møller & Olafsson, 2018) and link all to policy objectives (Observa Natura, 2019).

Second, **articulating complexity**, is a necessary bridge between evidence-based and decentralised decision-making. It allows people with different backgrounds to share and process complex information, a basic condition for collaborative decision-making (Ziegler, 2019). In the context of environmental planning, geographic information system (GIS) is

the most mentioned tool to manage and showcase large amounts of information efficiently (Kleinhans *et al.*, 2022; Lober, 1995). Spatiality (such as proximity, relations, topology) is an important factor in the distribution of environmental hazards and benefits, meaning any spatial representation will lead to a better understanding of how NbS function, especially in relation to specific stakeholders – which is likely to lead to greater public acceptance of NbS projects (Shulman *et al.*, 2005). More importantly, its layered data structure allows to co-view different professional and non-professional knowledges as well (McCall & Dunn, 2012). Better immersion can increase the complexity that can be transferred: animations can show long-term chronic environmental processes (Calabresi, 1991), 3D models can improve immersion when elevation matters (McCall & Dunn, 2012), quantified data and output measurement are more suited for appraisal (Esty, 2004), online discussion fora can allow people to articulate and clarify matters free of jargon (Afzalan & Muller, 2014), and metaverse environments offer the highest degree of interactivity (Nitoslawski *et al.*, 2019). When designing institutional technologies for articulating complexity, it is the format, the interface, and direction of information flows should be considered and fitted for purpose (Douglass, 2014).

Finally, the most transformative affordance of adaptive governance is the **ability to encode and decode interests**, perspectives, individual arguments into a shared symbolic space, making governance more reflexive (Gulsrud, Hertzog, *et al.*, 2018). Analytic capabilities that incorporate models of objective data, and stakeholder needs, are necessary to reduce risks in strategic decisions, and provide cost-benefit analyses to convince stakeholders with very different perspectives (Esty, 2004). There are multiple established ways to encode interests. For example, Astuti & McGregor (2015) map-based surveys, can automatically translate citizen perspectives into structured datasets (Møller *et al.*, 2019; Møller & Olafsson, 2018). GIS, in particular, when open for contributions, provides a powerful space for different perspectives, professional and non-professional knowledges to be collided (McCall & Dunn, 2012). If the shared symbolic space is computable, and governance decisions are based on computational analytics, then in/excluding different perspectives and the way they are codified, is a political act (Dobbe *et al.*, 2021). For example, common tools, such as sensors, maps, and remote sensing is notoriously bad at encoding what is important in indigenous cultures (Winschiers-Theophilus *et al.*, 2010). A bad artificial intelligence (AI) system design is no longer a technical failure, but a failure in democratic legitimacy. As such, the act of encoding and featurisation, should not be a purely technical step, but also an inclusive, value-based deliberation. It must consider sociotechnical fit, i.e., avoiding feature misuse, biases, discriminations of vulnerable groups (Dreyfus & Kelly,

Implication: Geo-surveying can become an effective, cheap, and accessible tool to encode citizen perspectives, when integrated into a larger engagement process, supported by city officials, and offering the freedom of counter-mapping.

Barriers and enablers

Digital transition and an increased reliance on institutional technologies will by design exclude those without the skills, resources, or time to take advantage of their opportunities – a phenomenon commonly known as the digital divide (Esty, 2004; Kleinhans *et al.*, 2022; Møller & Olafsson, 2018; Shulman *et al.*, 2005). Lack of appropriate human resources on the side of the administration limits the efficacy of adaptive governance affordances (Møller *et al.*, 2019). Also, in knowledge production, it must always be known that information will always be incomplete, political, and the credibility of analytic tools should not be overestimated. Even scientific advancement is socially bounded, steered through historical patterns, funding, academic incentives, and regulations (Frickel *et al.*, 2010) – which is why neither knowledge producing technologies, nor community decisions can be considered incontestable, final truths. Underlying inequalities can be amplified blindly, such as hardcoding gender biases in machine learning algorithms, or intentionally, by authoritarian statesmanship (Papaioannou, 2021). Monitoring data for specific performance indicators may give a false sense of surety in interpreting community problems, obfuscating more deep-seated reasons that would require qualitative reassessments to uncover (Gulsrud, Raymond, *et al.*, 2018). For example, distributed environmental health assessments using wearables may put too much attention on individual day-to-day choices, rather than chronic, socioeconomic health outcome determinants, like stress (Kenner, 2016).

Targeted training materials and a special attention to designing interfaces for different user experiences can empower marginalised social groups to leverage institutional technology for self-advocacy (McCall & Dunn, 2012; Shulman *et al.*, 2005). Second, more widespread “datafication”, an increased role of data and analytics in decision-making, gives the opportunity to enrich technical and environmental data with cultural, socioeconomic contextual information to allow for latent biases to be discovered (Astuti & McGregor, 2015).

4.5.2. Principle 2 – Collaborative

Table 5: Collaborative institutional technology

Affordance	Description	Example technologies
Disseminating knowledge	Communication and dissemination of relevant knowledges to inspire action and ensure trust.	<ul style="list-style-type: none"> • social media • websites • content sharing platforms
Interaction facilitation	Hosting, displacing, and simplifying collaborative work, day-to-day interactions, and managing group dynamics.	<ul style="list-style-type: none"> • virtual environments • social media • DAOs
Network mobilisation	Finding, reaching, and engaging relevant stakeholders, organising collective or coordinated actions.	<ul style="list-style-type: none"> • social media • messaging apps

Collaborative governance encourages and facilitates multiple stakeholders to invest time, effort, and resources to ensure fair and efficient management of natural resources. Better collaboration contributes to social scalability by reducing virtually all types of transaction costs, mainly through deepening trust (policing and enforcement costs), accessing a wide variety of community resources (search and information costs), and standardising exchange practices (bargaining and decision costs) (Krueger & McGuire, 2005). From a just transition perspective, the focus here will be on how technologies make collaboration more widespread, and how facilitating tools can open collaborative procedures and institutions to previously disenfranchised stakeholders. In general, digital technologies displace and simplify collaboration, allowing grassroots movements to place-independently form, grow, and divert resources to local projects (Shulman *et al.*, 2005). They can do so through to three main affordances: disseminating knowledge, facilitating interactions, and mobilising networks.

The displacement of communication to disseminate knowledge is an often-cited trait of ICT in science and technology studies. What digital technologies provide, is a variety of new communication channels (Innes & Booher, 2004; Kleinhans *et al.*, 2015), and better accessibility to these (Møller *et al.*, 2019). Access to information is a basic condition for democratic decision-making (Shulman *et al.*, 2005) and distributing the relevant technical and scientific know-how is needed to open decision-making in collaborative governance arrangements (Esty, 2004). Depending on the digital culture of target groups, government actors can pick from a multitude of information channels to minimise exclusion, such as phone forums, video or radio channels, and content platforms (Ziegler, 2019). The Environmental Justice movement itself built up their cause by nurturing an informed membership using websites – something that has become easily accessible for grassroots

movements via online templates (Shulman *et al.*, 2005). With the internet, it has become cost-efficient to find relevant, and previously out-of-reach environmental data and practical know-how, which can empower laypeople to effectively advocate for themselves (Esty, 2004). Furthermore, a significant chunk of the cost of restorative investment alternatives, such as NbS, are transaction costs, the cost of recognising and quantifying their complex performances (*ibid*). Informational websites, online repositories, and third-party labels offset these costs, making it easier to convince private and civil actors to partake in green infrastructural projects (Esty, 2004).

While knowledge dissemination is most influential in connecting distant resources and actors extensively, digital platforms provide the opportunity to connect local actors intensively (Cennamo, 2019). Some form of interaction facilitation is necessary for niches to sustain themselves and evolve over time. Digital platforms are online niches with a variety of functionalities, each contributing to sustaining and managing governance networks differently. The Indigenous Environmental Network, apart from being an information hub, also provides an interface for organising meetings, building coalitions, referrals, and other resources for indigenous environmental movements (Shulman *et al.*, 2005). Chat rooms, discussions on blogs, voice-messaging apps provide simple, low-cost tools to run the internal business organisations, and to democratise their decision-making (Esty, 2004). Collaborative working environments afford more complex collaboration, namely the co-creation and discussion of specific proposals (Kleinhans *et al.*, 2022). In an environmental planning context, participatory GIS offers a spatially explicit collaborative working environment for managing NbS, discussing priorities, and visually assessing conflicts (Rambaldi *et al.*, 2007). To select and design these functionalities, what kind of agency a stakeholder needs to have must be considered and verified, when it comes to asserting their voice in NbS-related matters (Dobbe *et al.*, 2021). Beyond technical requirements, platform design should include a codification of roles, core interactions, permissions, member, and platform added values, the ownership structure, and the platform evolution (Tura *et al.*, 2018).

The final affordance of collaborative governance is growing and mobilising networks. Here, the displacement and search cost reduction benefits give a role to digital technologies (Esty, 2004; Shulman *et al.*, 2005). The Environmental Justice movement itself is heavily reliant on social capital to effectively combat environmental hazards in local communities, which would hardly be possible without a robust, well-maintained online presence (Shulman *et al.*, 2005). The functionalities that allow mobilisation are arranging meetings

and other events, searching and engaging non-members, channelling resources to where it is needed, and maintaining member relations (Shulman *et al.*, 2005, Afzalan & Muller, 2014, Ziegler, 2019). It is also important to note that most, if not all these functionalities are readily available, and are used in countries with institutional deficiencies to assert community environmental interests effectively (Ziegler, 2019).

Barriers and enablers

One of the greatest risks of digitalisation is socially blind technocratic interventions, investing in sophisticated gadgets without the consideration of underlying socioeconomic tensions (Gulsrud *et al.*, 2018). Latent structural inequalities are prone to be magnified with the introduction of new technologies. Social groups that are missing from offline collaboration will likely be absent from online platforms as well, if the reasons for them are not responded to in the design of the online process (Nam, 2012). Even if platforms do attract an audience, they do have their unique information-related risks that needs to be addressed. Namely, as more and more data is generated, the data scarcity of today may turn into the data overabundance of tomorrow (Roe, 2000). It is becoming equally important to filter as it is to gather data (Esty, 2004), but any such selection must fall under the legitimacy standard of controlled representation. Justice-blind approaches to sifting will result in filter bubbles (Esty & Cornelius, 2002), which in turn increase susceptibility to disinformation (Noveck, 2003). Finally, digital divides also substantially blight collaborative technologies. This is partly driven by digital literacy disparities (Ziegler, 2019, Esty, 2004), partly by economic disparities, such as access to internet, or owning smartphones (Shulman *et al.*, 2005, Afzalan & Muller, 2014, Gulsrud *et al.*, 2018). On a more macroeconomic scale, disruptive innovations, such as many of the technologies discussed here, benefit those already in powerful positions, resulting in far reaching labour market implications (Gulsrud, Raymond, *et al.*, 2018; Papaioannou, 2021; Zehavi & Breznitz, 2017), and accentuate wealth inequalities (Papaioannou., 2021). The “winners” of digitalisation are typically wealthier, younger segments of the communities (Afzalan & Muller, 2014), but there are cases where the digital divide intersects with other aspects of injustice, such as racial discrimination (Gulsrud *et al.*, 2018).

The role of public actors is crucial in collaborations, due to their unique rights, democratic grounding, and position in the network of stakeholders. Anchorage of the participation process in democratic institutions can be a powerful enabler to overcome input legitimacy risks, build strong support networks, lend credibility to projects, and attract resources to community projects (Kleinhans *et al.*, 2022). There is also great potential in introducing

sensitivity to the “politics of design” to system designers. To avoid blindness to underlying structural inequalities, system designers should defer from a managerialist approach, do not treat stakeholders as data points or customers, and consciously avoid the depoliticisation of the development process of institutional technologies (Douglass, 2014). Such approach justifies greater involvement in the conception and design of these systems which can increase the chance that they will correct rather than exacerbate structural inequalities (Gulsrud *et al.*, 2018). Finally, in communities where culture and facilities for knowledge brokerage are already present, many of the information risks can be mitigated (Astuti & McGregor, 2015). Facilitating social learning can bridge capacity gaps related to digital divides, if the stakeholders are already engaged on the same platform (Meyers, 2017; Tesh, 2000). Centralised solutions, such as training programs and dedicated community centres, akin to libraries in the past, can become hubs for accessing institutional technologies, which mitigates both economic and capacity barriers for participation (Shulman *et al.*, 2005).

4.5.3. Principle 3 - Effective

Table 6: Effective institutional technology

Affordance	Description	Example technologies
Automated asset management	Prescription and/or execution of operational decisions on shared assets.	<ul style="list-style-type: none"> optimisation engines robotics smart contracts
Digital production of trust	Verification and safeguarding of the trustworthiness of disclosed information.	<ul style="list-style-type: none"> blockchain smart contracts DAOs

Because they embody the normative dimension of social scalability, all principles listed here relate to governance efficiency in some way. A dedicated efficiency principle specifically focuses one particular governance role – the management/regulation of common pool resources. Effective governance in this sense means better outcomes at lower costs from shared NbS. The social scalability implication of efficiency lies in the need to reduce administrative overhead when more and more actors either exploit a shared natural resource, is assigned to protection from environmental hazards, or is recruited to compensate for environmental benefits. From a just transition perspective, the role of improving efficiency is to reduce the economic barriers of participation and to mitigate the risk of unjust distribution of hazards and benefits. On the one hand, digital technologies are needed here to prescribe and execute resource management activities based on objective data, subjective preferences, and normative standards of justice. These are

captured in the affordance of automated asset management. On the other hand, there is a growing need to resolve the trust deficit inherent in unmediated partnerships, without the need for costly mediation, which can be addressed using distributed ledger technologies. The related affordance is digital trust production.

Automated asset management tools have the potential to break down entry barriers for co-government arrangements related to human resource deficiencies. For example, the complexity and time-consuming nature of forest inventorying prevents smaller organisations from participating (Ziegler, 2019). Image recognition and remote sensing tools have been developed to reduce this workload by automating much of the surveying workflow (Barré *et al.*, 2017; Morgenroth & Gomez, 2014). It should be explored what kind of operational task needs to be automated for the governance arrangement to be feasible, to avoid miring members in managerial minutiae (Gulstrup *et al.*, 2018), and to mitigate risks in the infrastructure (Dobbe *et al.*, 2021). Furthermore, even human-executed operations require machine support beyond a certain scale and complexity. Building up a robust monitoring framework is a necessity to reduce the human cost of enforcement (Ziegler, 2019) and to assign operational responsibilities to engaged stakeholders (Nitoslawski *et al.*, 2019). As the complexity of exploitation and interaction with the NbS increases, this monitoring information will have to be at the maturity level of a digital twin to facilitate access control systems that regulate individual actors when engaging with the NbS (Esty, 2004).

Digital trust production is a necessary affordance beyond a certain scale, because of the limitations of the two other options: social trust production and trusted third parties. Social trust production is a function of social networks, which are limited in size, and their composition rarely reflects the full range of stakeholders affected by an environmental issue (Toxopeus & Polzin, 2021). One common weakness of governance networks is input legitimacy, as they can exclude marginalised social groups outside their social networks (Sørensen & Torfing, 2007). Mediation by a third party on the other hand is an unwanted increase in transaction costs, and a centralisation trend counterintuitive to the shift towards co-governance. Distributed ledger technologies, through their capacity to produce trust in decentralised ledgers, are touted as disruptive to the way we coordinate economic – and any – actions (Davidson *et al.*, 2016). They are foremost seen as disintermediation tools, reducing the need to rely on centralisation, both in public and private sectors (Evans, 2014). For the purpose of decentralisation, they enable unique policies, such as self-executing smart contracts that monitor objective metrics to trigger

contracted policies automatically (Buterin, 2014), and polities, such as decentralised autonomous organisations (Santana & Albareda, 2022). In the context of NbS co-governance, a particular challenge is contracting intricately interlaced environmental performances. There are examples for distributed ledgers in natural resource management, namely for collectively tracing the resources in local supply chains (Nitoslawski *et al.*, 2019).

BOX 11 Digital asset management in real life (Nitoslawski *et al.*, 2019)

TreeMania is a Dutch firm, developing IoT networks of soil sensors for NbS management. When trees or crops are planted, the sensor is also installed, and registers data about moisture content, electrochemical properties, pH, and biogeochemical composition. In the village of Geijsteren, the system was deployed on the main square. The sensor data is not only plugged into a dashboard for monitoring, but also sends real-time updates to nearby residents, who are responsible for the maintenance of the green space. The system developers are working on integrating weather forecast data with accumulated sensor data to train predictive A.I. to enable alerts ahead of time.



Figure 10: TreeMania soil health sensors (left) and snippet of the dashboard (right). Source: TreeMania

Affordances: The Geijsteren case is an example of “knowledge generation”, “articulation of complexity”, and “disseminating knowledge” affordances facilitating the “automated asset management” affordance. It is the combination of real-time data production, structuring data into dashboards, assigning algorithmic rules for alerts, and a notification service that allows the local community to take over some routine maintenance tasks, and do so, without expert support, and with the reduced transaction costs of coordinating job assignments.

Enablers and barriers: barriers to implementation could be the cost of system deployment, the issue of data storage, capacities to maintain the system, and – depending on the kind of data included – sensitivity concerns.

Barriers and enablers

The development of institutional technologies is a serious infrastructural investment, requiring long-term commitment from actors with in-depth specialist technical and holistic sociotechnical knowledge. The relationship between developer(s) and clients is akin to a principal-agent relationship, and the management of this dynamic can substantially influence how just or socially scalable the resulting systems will be. Much of the digitalisation has been historically driven by ICT suppliers (Ziegler, 2019). The risk in this is implementing complex systems with limited knowledge on the client side, which can easily result in a dependency on particular suppliers and solutions, who are not motivated to give up on the propriety of their products (Gulsrud *et al.*, 2018).

Whereas supplier-driven digitalisation has its risks, it is not the only arrangement for developing institutional technologies. Open innovation can be a driver to avoid path dependency, allowing the absorption solutions from multiple sources in smaller doses, rather than a turnkey system developed behind closed doors (Papaoiannou., 2021). Furthermore, open innovation can channel in external resources to peer-review systems and solutions and supports their replicability (Esty, 2004). However, this should be balanced with appropriate protection of intellectual property – even in open-source licenses – not to disincentivise knowledge economy actors to invest in development (Mitchell, 2000).

4.5.4. Principle 4 – Legitimate

Table 7: Legitimacy in institutional technology

Affordance	Description	Example technologies
Accountability via transparency	Enabling scrutiny of actions and performances concerning shared resources and community decisions.	<ul style="list-style-type: none"> • monitoring • websites • dashboards
Informed consent	Provision of decision-relevant information for to those affected by a decision and updating with new information.	<ul style="list-style-type: none"> • smart contracts • monitoring • machine learning
Controlled representation	The capacity to judge, instruct, and recall digital representations of oneself and their interests.	<ul style="list-style-type: none"> • digital identity • privacy-preserving tools • participatory GIS

In this section, it is explored how digital technologies can help overcome the democratic legitimacy deficit of governance networks⁵. On the input side, this means limited constituency to make representative decisions, on the output side, there is a degree of opacity of the decision outcomes, whereas on the throughput side, the dangers are power asymmetries and managerialism (Sørensen & Torfing, 2005). For social scalability, monitoring and policing legitimacy can become unsustainably costly as more actors are involved in co-governance. On the side of just transition, legitimacy translates directly to procedural justice. Not all shortcomings of governance networks are addressed in the analysed literature, but three affordances reflect on each of the legitimacy sides. On the input side, we will discuss channels and strategies of informed consent to ensure the decisions uptake all the necessary citizen perspectives. On the output side, it is the transparency that digital technologies offer can be leveraged for accountability. On the throughput side, asymmetrical relationships are not covered, but a depoliticised, managerialist decision process can be averted by the affordance of controlled representation.

The normative basis for informed consent is that democratically legitimate decisions are not simply the ones accepted by the constituents, but do so in an informed manner (Muhlberger *et al.*, 2011; Ponterotto, 2005). This is already a higher standard than simply providing a hearing for opinions and that the result of this hearing is not inferior to expert opinions or powerful actors. Consent means making autonomous choices, free from arbitrary domination, on matters that affect the person (Ottinger, 2013). However, on matters that interest the community – most green infrastructural projects – this is not exercised on the individual level, but on the level of affected community members (Astuti & McGregor, 2015). This is further complicated by the “informed” part of informed consent. It is common that not all information is available at hand, which is why there must be a facility provided for renewed consent (Ottinger, 2013, Dobbe *et al.*, 2021). Providing this is difficult as the most important decisions, siting and design, is for the most part irreversible. Moreover, identifying the bearers of the right to consent, and the possibly different bearers of the right to renewed consent is a significant challenge. In the analysed literature, only a combination of monitored and contracted environmental rights (Cook *et al.*, 1996; Esty, 2004), traceable in a trust-free ledger (Nitoslawski *et al.*, 2019), and an analytic delineation

⁵ Governance networks here serve as a proxy for co-governance, as we expect the shift to more decentralised modes of governance to borrow traits from governance networks, which is already intensely studied from a legitimacy perspective.

of those affected by environmental hazards and benefits (McCall & Dunn, 2012) directly improve the capacity for giving renewed, informed consent rights to those who need it.

In a democracy, constituents should have avenues to select, instruct, challenge, and call back their representatives (Soerensen & Torfing, 2005). Given the increasing importance of computer aided, evidence-based decision-making, one could argue that data and algorithms, the specific way one's interests were featured, is in fact a form of representation, and the same criteria apply. On the one hand, this entails mechanisms to exercise ownership rights over certain data generated from and by the member stakeholder (Boyd & Crawford, 2012). On a community level, there is precedent for keeping certain layers on a GIS database confidential, or to apply measures used in identity protection, such as obscuring resolution (McCall & Dunn, 2012) – however there is a trade-off here between anonymity and analytic model performance⁶ (Dobbe *et al.*, 2021). One special case of representation is the digital identity itself. There can be arguments made for and against requiring a digital identification for participation – anonymity might encourage more substantial contribution, but registration may reduce noise – but a conscious, collective choice must be made where to prescribe which (Kleinhans *et al.*, 2022). The most complicated case, however, is featurisation. Choosing what kind of information represents one's viewpoint, what kind of symbols, semantics appear on GIS maps is not an easy question, especially for laypeople (Rambaldi *et al.*, 2007). It is thus necessary to provide and frequently use an interface for alternative representations to be asserted and for the shared symbolic space to be challenged. In the context of NbS, where most information is spatially explicit, this can be ensured by creating an option for “counter-mapping”, where the dominant interpretations of space can be challenged (McCall & Dunn, 2012, Astuti & McGregor, 2015). This not only gives an institutional technology for resistance, but also lends credibility to the claims of stakeholders who otherwise articulate their views due the limitations of the discursive space (Ziegler, 2019).

BOX 12 The Difference Technology Can Make in Affording Informed Consent (Douglass, 2014)

Informed consent in environmental matters can easily become a guarantor of health and can save lives. In Dickson, Tennessee, a manufacturing waste disposal practice, which was legal, contaminated the well-water of citizens. White families were offered alternative water sources, but the waste disposal continued, and black families were not offered the same alternative (in the early 2000s). Furthermore, despite the skyrocketing of pollution-related illnesses, they were not given information from the polluter, or from any level of government on the risks they were facing, and how to cope (Huang, 2011). Only after the death of her family members, an activist made

⁶ Not considering homomorphic encryption and other forms of privacy-preserving analytics, which is a field in its infancy.

investigations on her own, that fed an 8-year long court case, to reach a settlement. The case showed that public officials were inefficient in providing adequate information about the distribution of impacts (Eschenfelder & Miller, 2007). Conflicting interests (of represented social groups), power dynamics (e.g. needing information from actors who are sanctioned based on this information), and organisational inefficiencies push public authorities for aggregative rather than non-aggregative information regimes (Wagner, 2004).

Institutional technology potential: With adequate "knowledge production" and "knowledge dissemination" affordances, a well-designed e-governance system could have overcome the information barriers that resulted in avoidable death or reduced the effort the campaigners had to invest for retribution (Huang, 2011). Specifically for this case, this means information about the waste disposal permits, the distributed effects of pollution, pollution threshold levels, legal and procedural information about the industrial actor, and the actions to be taken. The format of the information also matters, as it can increase or decrease the effort needed to build a case from data. For example, pollution data should be shared in searchable databases, correspondence to be structured with timestamp and metadata, public hearings to be recorded, supplementary data like media coverage to be listed in links, and visual information to be added for enrichment.

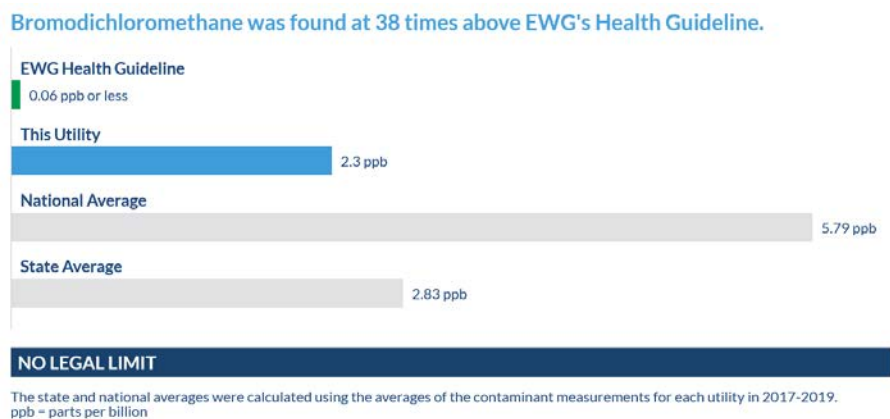


Figure 11: Dashboard snippet of monitored contaminants in Dickson, Tennessee. Since the incident, the Environmental Working Group NGO provides monitoring data, background information, health implications, and legal possibilities on water quality for the region. Source: EWG

Implication: The key for providing informed consent is giving the ability to find information related to a policy or practice of interest that facilitates personal decision-making, without unreasonable effort.

Finally, it is necessary to deploy technologies with the affordance to leverage transparency to improve accountability of actors, thus the output legitimacy of the governance arrangement. Continuous monitoring, clear presentation of the data, its dissemination for easy accessibility, and platforms where the veracity of claims can be challenged, is a crucial set of technological capabilities to establish wide public scrutiny (Shulman *et al.*, 2005, Astuti & McGregor, 2015). This scrutiny has multiple purposes and should be designed accordingly. It serves as checks and balances over public authorities (Esty, 2004, Douglass, 2014), a follow-up on polluters and providers of environmental hazards/benefits

(Shulman *et al.*, 2005), an internal watchdog of member stakeholders use of resources (Ziegler, 2019, McCall & Dunn, 2012), and an external watchdog to alert for external threats (Dupuy, 2017).

Barriers and enablers

The legitimacy principle raises the issue of the governance of data and A.I. If digital transition is necessary for the co-governance of environmental resources, then the transition itself introduces a new resource: data and decision-support models. As we established that institutional technologies are political, data and A.I. governance, or the lack thereof is an influential enabler or barrier to institutional technologies. Here, we need to consider intellectual property (discussed already under the “efficient” principle), digital identity, data ownership, and stakeholder agency in the A.I. lifecycle. Digital identity management, especially the level of detail asked from participants needs to be fine-tuned to handle the trade-off between authenticity and participation gap (Møller *et al.*, 2019). Data ownership and access rights, especially in the context of participatory knowledge creation, is a complex, fundamental issue, driven by the dynamics of privacy, digital citizenship rights, model accuracy, feasibility, and citizen inertia (Papaoiannou., 2021). Finally, A.I. governance should include stakeholder control opportunities in relation to the indeterminacies emerging during the system lifecycle, from scoping, through featurisation, model optimisation, deployment, to validation (Dobbe *et al.*, 2021). In the European context, the general data protection regulation provides a starting point, but more thorough data and A.I. governance framework is something every semi-digitalised governance arrangement must tackle sooner or later.

4.5.5. Principle 5 – Participatory

Table 8: Participatory institutional technology

Affordance	Description	Example technologies
Participatory knowledge creation	Distributed production and subsequent integration of environmental knowledge.	<ul style="list-style-type: none"> participatory GIS carried devices social media
De-collectivisation	Untangling interactions between environmental impacts and individuals.	<ul style="list-style-type: none"> machine learning IoT tracking

The final principle to be discussed is participation in governance, more specifically, two conditions of this participation that stem from a growing prevalence of computer-aided evidence-based decision-making. First, there is a need to predict and monitor environmental processes at a level of granularity that uncovers the basis of one's participation in any decision. From a justice point of view, this information is the condition to assess distribution, matched with the differential susceptibility to certain environmental impacts (Thomas *et al.*, 2019). From a social scalability perspective, this allows the creation of bespoke participation pathways and economic arguments that can increase the willingness to engage (Ürge-Vorsatz *et al.*, 2016). The second need is a procedural one, which has been already alluded to in the previous sections, and that is the involvement of relevant parties from the moment environmental issues are being made sense of. As decisions rely on knowledge, discriminatory epistemic injustices – being discredited as a knower – become a form of disenfranchisement (Fricker, 2013). This is both a procedural injustice in digital transition and a reduction of social scalability. The two affordances related to these needs are: de-collectivisation, and participatory knowledge creation.

De-collectivisation is a spectrum, the most radical degree of it would include having knowledge of every personal ramification of environmental hazards and benefits. A lesser degree would be disaggregation to smaller groups to increase relevance of the information for any individual. Having this information is the basis of informed consent, making the capability to individually consider an environmental decision a hard requirement for participation (Esty, 2004). Furthermore, higher degree of de-collectivisation means departing from one-size-fits all solutions for better suited place-based interventions, decreasing the transaction costs of post-hoc corrections (Møller & Olafsson, 2018). There are three components to de-collectivisation which should be achieved by institutional technologies: (1) the objective distribution of environmental impacts, (2) the objective susceptibility to them, and (3) the subjective experience and valuation of them. On the side of impact distribution, it has been shown that modelling and visualising environmental hazards spatially is a necessary basis for asserting right to consent to certain interventions, especially for disparate groups (McCall & Dunn, 2012). The same logic can be used as a basis to involve people based on a distribution of environmental benefits. However, the same impact interacts with individuals and social groups differently, based on their differential vulnerabilities (Thomas *et al.*, 2019). Carried and wearable personal devices and personal A.I. are crucial to discover and monitor personal vulnerabilities, such as health

repercussions of environmental hazards (Gulsrud *et al.*, 2018).⁷ Finally, it is important to allow experiences and values to be registered in the decision logic to avoid generalised assumptions about the embodiment and appropriation of environmental impacts. For example, gender-disaggregated mapping could uncover how personal safety or economic inequalities reduce the access of public spaces for women, thus excluding them from environmental resources (McCall & Dunn, 2012) – an information that would not be available from mapping distributions and susceptibilities alone.

Participatory governance is not possible without the participatory, in situ production of environmental knowledge a procedural justice requirement that is essential for citizens to become partners in governance (McCall & Dunn, 2012; Ottinger, 2013). It has been long asserted that communities can provide substantially different knowledges of environmental impacts (Di Chiro, 1997), proving citizens to be valuable data sources for strategic decisions (Goodchild, 2007), while also raising awareness for environmental problems (Meyers, 2017), and facilitating stakeholder dialogue (Møller & Olafsson, 2018). This “local spatial knowledge” consists of, (1) knowledge of latent, confounding factors, such as past events, resources, activities, (2) knowledge of local social context, dynamics, needs and priorities, and (3) spatial information of cultural relevance (McCall & Dunn, 2012). Local spatial knowledge is especially relevant to define and communicate environmental resource boundaries, to specify and monitor permissions (Ziegler, 2019). Furthermore, participatory knowledge creation is a necessary safeguard from disparate impacts and the inclusion of marginalised social groups (Barocas & Selbst, 2016; Shulman *et al.*, 2005). An equitable decision-process should actively seek out underrepresented groups outside the consideration of system designers and provide them with avenues to assert and validate the knowledges relevant for them to avoid reinforcing inequalities (McCall & Dunn, 2012, Dobbe *et al.*, 2021). There are often-cited technologies to facilitate participatory knowledge creation: participatory GIS and mobile data collection. The layered, spatially explicit data representation of GIS allows for amendments, commenting on existing data, or proposing new information layers in line with different mental models (Kleinhans *et al.*, 2022; McCall & Dunn, 2012; Møller *et al.*, 2019). Carried and wearable devices allow on-the-ground, cheap data collection at high granularity used in citizen science and citizen observatory arrangements, such as health or wildlife monitoring (Foster *et al.*, 2017; Gulsrud, Raymond, *et al.*, 2018; McCall & Dunn, 2012; Møller & Olafsson, 2018). The two technologies are often

⁷ This information does not necessarily have to be integrated in shared databases to protect privacy, but it is a necessity for the individual to have it to make informed decisions.

mentioned together (McCall & Dunn, 2012), sometimes the GIS being replaced with non-spatially explicit online environments, like social media groups (Nitoslawski *et al.*, 2019). These are two sides of the same coin – any institutional technology implemented for participatory knowledge creation should include a shared symbolic space integrating stakeholder inputs, and a preferably distributed interface to register them.

Barriers and enablers

Participation is heavily influenced by process design. A digital interface for participation cannot overcome lack of effective community engagement processes (Kamarck & Nye, 1999; Møller & Olafsson, 2018), and in fact may push to one-size-fits-all solutions, when citizen diversity would dictate an equal diversity in engagement strategies (Royo & Yetano, 2015). Stakeholder inertia is also a significant barrier to co-governance, which undermines input legitimacy, and can occur both on the side of citizens (Esty, 2004), and on the side of public authorities (Afzalan & Muller, 2014). Bad experiences can erode participation enthusiasm, potentially losing trust in the long-term. Principal-agent situations can make things worse. In the case of participatory knowledge creation, public officials and even experts can assume the role of the principal to the laypeople as agents and may resist ceding authority (Sieber, 2006). However, with appropriate management of expectations, the opposite can happen, where laypeople and experts reach middle ground and produce local environmental knowledges otherwise impossible (Shulman *et al.*, 2005). Finally, the prevalence of epistemic injustices determine which knowledges are valued and integrated during participation. Partly, epistemic injustices are already covered, as uneven access to information, the skills and resources to take advantage of knowledge producing and disseminating technologies constitute distributional epistemic injustices (Coady, 2010). However, it is also important to judge procedural epistemic injustices, whether the credibility of a knowledge provider is unjustly discredited due to discrimination, or whether experiences and perspectives are intelligible for the decision process (Fricker, 2013). For example, when participatory knowledge creation scales into citizen science arrangements, their results are often considered inferior to scientific data among decisionmakers (Gulrud *et al.*, 2018). In the above case, discrimination is on the side of the personnel, but a standardised form, scope, and channel of data collection and sensemaking can also artificially and pre-emptively devalue community contributions, such as limiting citizens to labelling existing points of interest in a participatory mapping exercise (Astuti & McGregor, 2015). Forcing citizens into the same channels as public officials may push them to produce knowledge the same way as officials, missing out on the opportunity to uncover

latent knowledges (McCall & Dunn, 2012). Discriminating knowledges can have deep-seated, long-term impacts, citizens themselves may not trust their own testimonies, or fail to understand whether some knowledge they possess is relevant (Noonan, 2008). This is especially true for marginalised citizens (Douglass, 2014), which makes tacit knowledges extremely hard to reach, risking the responsiveness and inclusivity of the governance arrangement.

There are some process-related strategies that can enable successful institutional technology development. Hybrid or “phygital” engagement, the combination of on- and offline participation activities is an often-cited enabler, essentially diversifying the tools of engagement to minimize exclusion (Afzalan & Muller, 2014; Buytaert *et al.*, 2014; Kahila-Tani *et al.*, 2016; Shulman *et al.*, 2005). Face-to-face meetings are essential to build trust (Afzalan & Muller, 2014), and weak on-offline conversion rates can be lethal to environmental movements (Shulman *et al.*, 2005). Phasing the engagement process into input, analysis, feedback, with reflection on participant expectations at each turn can mitigate and churn negative experiences (Kleinhans *et al.*, 2022).

4.5.6. Implications for city practice labs

As it was apparent from the case studies, institutional technology affordances are not independent, and rarely occur alone. In fact, when looking at practical conditions for certain ICT interventions, it becomes clear that even on the level of principles, there is a ladder to be climbed (Figure 12) It is not possible, for example, to give informed consent for decisions, if the personal implications of those decisions are not known, or at least the impacts are disaggregated to the closest social and spatial basket possible (de-collectivisation). Similarly, since many affordances rely on the use of actionable data, knowledge production will be a necessary steppingstone, and the scope and depth of knowledge produced will determine the quality of subsequent affordances. For example, if soil moisture content is logged, it allows for the assignment of watering duties, but if soil nutrients and contaminants are also part of the dataset, then more incidental, complex maintenance tasks can be given to a community of laypeople.

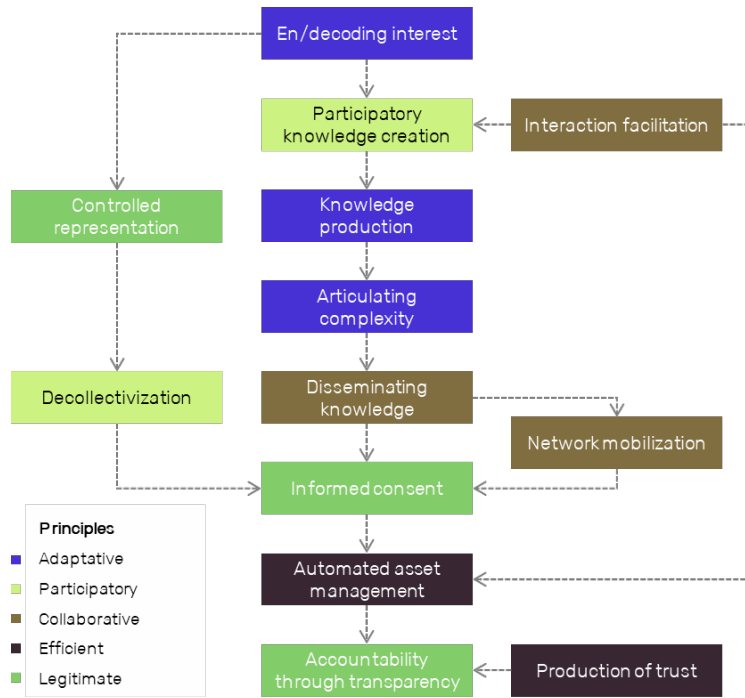


Figure 12: Relationship among affordances in institutional technology

5. CONCLUSION

We set out to unpack the concept of good co-governance of NbS as described in the literature, and specifically to identify key principles (and corresponding barriers and enablers) that characterise it. To deal with the sheer quantity and complexity involved in a complex concept, and to provide a framework for analysis, we conducted our review according to five dimensions of governance: actors, politics, processes, policy instruments and institutional technologies. As a final step, we explicate our results in a way that can ultimately be useful in practice for local governments, bearing in mind that this review is intended to serve as a theoretical basis for the coming practical task of monitoring, evaluating and improving on governance arrangements in the JUSTNature cities. This chapter thus includes an aggregation of the 22 principles introduced above into 5 key principles from which good governance can be broken down (section 2.2, a reflection of what this means for our definition of co-governance (section 2.1), and a checklist of recommendations for implementing these principles in practice (section 5.3).

Selection of key principles

Table 9: Summary of Principles by Dimensions

	Actor	Politics	Processes	Policies	Institutional Technology
Dimensions	Perceptions, values and knowledge of individual and organisational actors	Constellation of actors and specifically the power relations between them	Decision-making and planning process	Policies and instruments	Digital technology
Principles	Empowering	Recognising and empowering	Integrative / Comprehensive	Accessible	Adaptive
	Inclusive	Integrative	Transparent & Deliberative knowledge exchange	Evidence-based	Collaborative
	Knowledge diverse	Democratic and representative	Strategic & Incremental	Legitimate	Efficient
	Collaborative/ Participatory	Responsive	Adaptive & Reflective	-	Legitimate
	-	Collaborative and participatory	Context-sensitive	-	Participatory

In total 22 principles were identified as the most important across our five dimensions, as described in Chapter 4. In order to reduce this to a manageable number of principles that will be useful to define our future assessment protocol, we critically reviewed this list and clustered closely-related principles together. In several instances, principles were identified as synonyms, and a single term was adopted (e.g. adaptive and incremental). In

other cases, we selected one principle to serve as the over-arching key principle, which is in turn supported by other subordinate principles (the full process of clustering can be followed in Annex 3). To define our key principles, we also drew on definitions of subordinate principles in order to ensure precision and depth in our final set of key principles and avoid loss of important guiding information. In this way, we arrived at a shortlist of five key principles:

- Collaborative
- Empowering
- Responsive
- Adaptive
- Legitimate

These five key principles are intended to serve as a robust primary structure for an assessment framework that will be developed and deployed in each of the JUSTNature cities, in order to monitor, evaluate and iteratively improve governance arrangements over the course of the project (Task 7.1.2). (Figure 13)

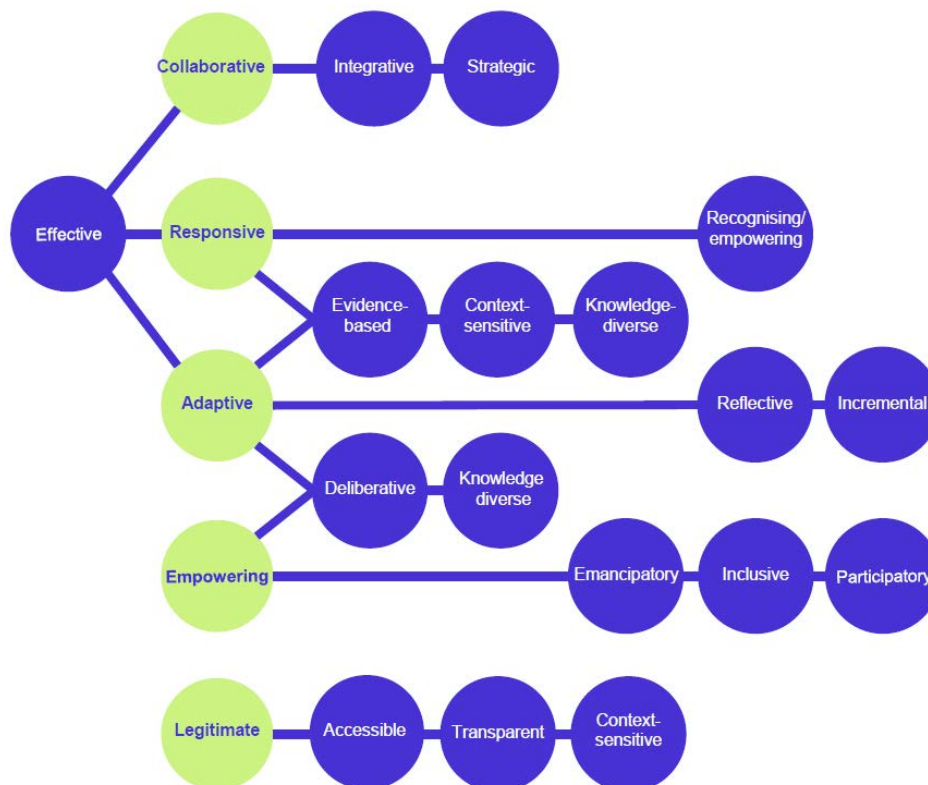


Figure 13: Interlinks of principles of NbS good co-governance

The five key principles are defined in the table below.

Table 10: Key principles and definitions

Principle	Definition	Source	Dimension
Collaborative	Governance includes seeking out, mobilising, and coordinating individual efforts – integrating multiple disciplines, relevant departments, multiple levels of governance, and non-governmental actors – towards long-term common goals, solving common problems adequately and meeting constituent demands at an agreeable cost.	Börzel & Panke, 2007; Frantzeskaki <i>et al.</i> , 2018; Harrison <i>et al.</i> , 2011; McCall & Dunn, 2012	technologies, politics, processes
Empowering	Equipping less powerful individual actors with the agency to assert their interests in matters of personal relevance. This demands a dynamic, evolving process of deliberation (beyond communication) in which public, private and civil society actors are afforded meaningful opportunities to create and share knowledge, to challenge existing ideas and to proportionally influence outcomes.	Buizer & Van Herzele, 2012, p. 5; Harrison <i>et al.</i> , 2011; Secco <i>et al.</i> , 2011, p. 105	technologies, politics, processes, actors
Responsive	Actively recognising and analysing the specifics of local context at the outset of decision-making, with attention to differences in needs, interests, values and power between and within communities. This means identifying the most pressing local challenges, understanding locally-specific (often informal), institutional arrangements, and enabling diverse kinds of knowledge to enter the process, including local and indigenous knowledge.	Martin <i>et al.</i> , 2021; Mok <i>et al.</i> , 2021; Morgan <i>et al.</i> , 2022; Onori <i>et al.</i> , 2018	politics, processes, policies, technologies
Adaptive	Planning and implementation are strategic, open-ended, and iterative. It involves continuous reflection on policies in a broad sociotechnical context; absorbing and learning from signals of multiple feedback loops and a diverse body of tacit and technical knowledges to improve governance processes and outcomes.	Barletti <i>et al.</i> , 2020; Morgan <i>et al.</i> , 2022; Sayer <i>et al.</i> , 2013	institutional technologies, processes
Legitimate	Trust and acceptance in institutions and decisions is ensured by adhering to democratic norms: i.e., (1) equal participation of those affected by policies, (2) fair, transparent, and accessible decision-making process, and (3) accountability for the decisions made.	Baasch, 2020; Graham, 2015; Sørensen & Torfing, 2005	policy instruments, institutional technologies, politics

Our definition of co-governance

Our concept of co-governance sees the common good as central to both the process and its outcomes (policies), and as is based on diversity, democracy, and equity (Fainstein, 2010). We advocate a process that recognises existing power imbalances at the outset,

seeks to make these explicit and shifts the balance of power in conventional decision-making towards typically less-powerful actors. In that sense, government maintains a central role, as both a facilitator and a key defender of the public interest, ensuring that the (economic) interests of private parties do not dominate over those of less powerful actors.

Co-governance goes beyond engagement or public participation, in that it demands a willingness of government to share some degree of power with those who are less powerful, at the 'collaboration' or 'empowerment' ends of the participation spectrum (IAP2, n.d.). We align here with Ansell and Gash (2008) in recommending going beyond "consultative techniques, such as stakeholder surveys or focus groups, although possibly very useful management tools, are not co-governance per se. Co-governance should mean two-way flows of communication or multilateral deliberation and that non-state stakeholders will have real responsibility for policy outcomes." (Ansell and Gash, 2008:546).

The principles and their associated barriers and enablers tell us how to make a shift to better co-governance. First, co-governance should be empowering, meaning that institutions, rules, actor relations and technologies are designed and implemented in a way that allows individual stakeholders to assert their interests. Compared to centralised hierarchies and market arrangements, co-governance enfranchises those who conventionally have disproportionately less or no voice in decisions of their interest, committing to a redistribution of powers on the basis of fairness. Second, co-governance should be collaborative, meaning all these new and pre-existing interests should avoid becoming a gridlock of unresolvable clashing self-interests, but rather serve a common good. Institutions governing NbS need capacities to facilitate collaboration among diverse actors (state and non-state actors), leverage their resources for the common good, and do so efficiently. Third, co-governance should be adaptive. NbS assets are complex, prone to uncertainties, sensitive to changing circumstances, therefore planning and management should be capable of absorbing knowledge from different sources, and leverage it to course-correct, if need be. Fourth, none of the above should come at the expense of democratic legitimacy, co-governance should maintain democratic norms in the inclusion of members, providing transparency and fairness in decision-making, and accessibility to policies. Lastly, co-governance should be responsive, and its decision-making should be evidence-based, but not devalue tacit, local, and indigenous knowledges versus technical information. Institutions should be able to assess fidelity to the perspectives and needs of stakeholders and be accountable for their ability to do so.

Finally, it is necessary to return to the definition we proposed in Chapter 2, and adapt it to reflect our five key principles. As a result, we propose the following definition for use within the JUSTNature project:

Co-governance in JUSTNature is the process of various actors across the public, civil society and private domains working together to formulate, promote and achieve shared objectives in service of a broader transformation towards a just and sustainable future, through the planning, design, implementation and management of a nature-based intervention. This involves understanding and responding to the needs, capacities and interests of all affected parties, empowering less powerful parties to voice and assert their interests, iteratively building on diverse knowledge to adapt to changing circumstances, effectively coordinating and integrating efforts across the collaboration, as part of a legitimate process based on the democratic norms of fairness, transparency, accessibility and accountability.

Checklist for city practice labs

The following checklist for the city practice labs provides a first insight into how the five key principles can be put into practice across the five different dimensions of co-governance. This list may be updated subject to future discussion with city partners and will ultimately be superseded by the assessment protocol under development at the time of writing.

Table 11: Checklist for city practice labs

Principle	Dimension and action
Collaborative	<p><u>Actors</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Conduct questionnaires, interviews and workshops to understand community values and opinions as well as to collect ideas and experiences. <input type="checkbox"/> Combine the planning body (e.g. administration) with the implementing body (e.g. NGO) and the local level (e.g. citizens) to establish contacts and build relationships. <p><u>Politics</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Sectors for e.g. neighbourhood development, public health, environmental protection, youth and recreation should work together to coordinate funding programmes for community groups. <input type="checkbox"/> Hire or nominate a municipal program manager whose mission is to support a specific neighbourhood in areas such as health, environmental protection, youth, recreation. <p><u>Policy instruments</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Collaborate with experts to gather information and data for objective and sustainable decision making and implementation. <p><u>Institutional technology</u></p>

Principle	Dimension and action
	<p><input type="checkbox"/> Conduct the digital twinning of all assets under shared management and all common pool resources, regardless of the designated owner of the resource. This will serve as a springboard for sharing management duties and make stakeholders accountable. Automation and computer-collected actuators can be leveraged to create responsive and self-maintaining environments.</p> <p><input type="checkbox"/> Create channels, interfaces, platforms for disseminating knowledge, forming, mobilising, and running governance networks. It should be easy to find and join networks for common environmental causes, and these networks should have the infrastructure to build member capacities, attract resources, and anchor themselves to democratic institutions.</p>
Empowering	<p><u>Actors</u></p> <p><input type="checkbox"/> Create local agencies/residential associations that are responsible for certain tasks within the project and can communicate and distribute these among the citizens. Make sure responsibilities are clear.</p> <p><u>Politics</u></p> <p><input type="checkbox"/> Make existing power imbalances visible in a participatory process using creative moderation techniques, such as the 'critical companion' (also known as companion modelling) approach. This technique seeks to actively expose the underlying assumptions and objectives of a project from the outset, inviting critical reflection on these and thereby building legitimacy among participants (Barnaud & Van Paassen, 2013; Ruano-Chamorro <i>et al.</i>, 2021). Evaluate workshops and meetings where this technique is applied in order to monitor its effects over time.</p> <p><input type="checkbox"/> Design and plan participatory workshop attendance to ensure a diversity of interests are represented. This starts with stakeholder mapping and outreach: first identify the groups that need to be involved, including those harder-to-reach, and deploy mixed channels to reach them (flyers in letterboxes, social media, newspaper ad..). Participants that are not already empowered may need to be addressed first in a smaller group to ensure their needs are foregrounded, while mixing small-group and plenary discussions helps enable a broader range of voices to be heard.</p> <p><u>Institutional technology</u></p> <p><input type="checkbox"/> Set up an ecosystem of tools for generating and representing actionable knowledge in a participatory manner. Combine remote, on-site sensing, objective and experiential data, formal and tacit knowledges, and process raw data into formats where they can directly inform goal-oriented actions of stakeholders from different backgrounds.</p> <p><input type="checkbox"/> Develop a robust data and A.I. governance framework. Create tools for citizens to exercise their rights of controlled representation and informed consent.</p>
Responsive	<p><u>Actors</u></p> <p><input type="checkbox"/> Address specific constraints that may hinder actors' participation in the decision-making process, such as access to basic services of transportation, communication, childcare, and material support. Increasing the outreach and accessibility of public consultations (sharing meeting details through broader media, ensuring online or phone-based access, or providing stipends) as a response to the community's needs.</p> <p><u>Politics</u></p> <p><input type="checkbox"/> Conduct a needs assessment (Day, 2010) of residents at the outset of any planning or design project. Use methods such as interviews or qualitative surveys to identify not just functional needs (e.g. proximity of home, mobility</p>

Principle	Dimension and action
	<p>limitations) but also psychological ones, such as existing attachment to places and their features (Anguelovski, 2013b), or the experience of being within an existing space (Day, 2010).</p> <ul style="list-style-type: none"> <input type="checkbox"/> Incorporate universal design guidelines into design briefs for public spaces (Day, 2010). <p><u>Institutional technology</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Upgrade data collection and analytic portfolio to produce distributed data in terms of spatial, temporal, and social distribution of impacts. Create a mechanism for stakeholders to assess their differential susceptibilities to environmental hazards and benefits, and a feedback channel to contest this. <input type="checkbox"/> Co-design a shared symbolic (digital) space, which is computable, and create tools that translate between this space and the different stakeholders. Balance the need to provide room for stakeholder creativity with the need for a common ground in shared discussions and data analysis.
Adaptive	<p><u>Actors</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Create, exchange and distribute knowledge for/with/between all stakeholders and citizens. Make sure there is an open and transparent dialogue. <input type="checkbox"/> Develop innovative incentive structures according to feedback loops from stakeholders (decentralised partnership, broad community support, or expertise building) (Martin <i>et al.</i>, 2021) <p><u>Policy instruments</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Establish an open and clear communication strategy. This entails sharing common understanding of concepts, policy goals, and actions.
Legitimate	<p><u>Policy instruments</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Provide an accessible online platform that collects and connects all relevant information about regulations and policy instruments, e.g. integrated in the website of the municipality. <input type="checkbox"/> Develop experiments that engage multi-stakeholders and test new ideas, develop new knowledge and skills, and build trust among the stakeholders. <p><u>Institutional technology</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> Deploy a combination of distributed ledgers, access/permission control technologies, and create an interface between them and the digitally twinned assets and resources. This is needed to fully disintermediate governance processes. Monitor the actions of stakeholders linked to common rules on the blockchain to ensure accountability.

The adoption of the principles should not neglect potential negative interactions between any two principles or between a principle and the overall objective of NbS co-governance i.e. ensuring the right to ecological space. It is important to point out that the implementation of the principles can lead to trade-offs. As Wamsler *et al.* found, “citizen engagement often hinders sustainability outcomes” (2020, p. 239) through explicit contestation of NbS considerations, inaction, or active ignorance, denoting the potential impacts of citizens’ excessive empowerment and lack of common goals. As the authors found, citizens’ personal interests may conflict with the municipality’s green considerations, resulting in opposition, disputes, and even organised appeals against

municipal plans, hindering collaboration opportunities. This is widely known as the paternalism-populism dilemma (Laessoe *et al.*, 2008), which warns of the dangers of empowering individual interests that are in conflict with common goals. This is not to say that participation inherently weakens the ability to meet community-level objectives, but points to a risk that needs to be managed by a process adhering to the collaborative principle, such as by focusing on informing and convincing the stakeholders in participatory planning (Luck, 2007). Similarly, the concept of social scalability describes how governance effectiveness can decrease when more or more diverse stakeholders are included directly (Szabo, 2017). The basis of the institutional technologies section is to overcome this trade-off. However, over-reliance on technologies can negatively influence inclusivity, a supporting principle of empowerment, due to digital divides (Shulman *et al.*, 2005). This report does not have a full account of all possible trade-offs and antagonistic co-effects, which is a limitation. Thus, these interactions must be mapped out and accounted for during the design of co-governance protocols, or more generally, when assessing NbS co-governance in any city.

Outlook for the project and next steps

The outcomes of the literature review will inform the subsequent Task 7.1.2, that will develop protocol templates for the CiPeLs to assess, monitor and eventually improve the co-governance of their NbS for the duration of the project and beyond.

Within T7.1.2, a preliminary collection of indicators of good co-governance was first carried out, based on the results of previous and ongoing projects and the literature review. When indicators to evaluate the principles were identified during this in-depth analysis, they were noted down and then used to inform the list of indicators that has been drafted within T7.1.2. Secondly, each indicator on the preliminary list has already been linked to one or more of the key principles that were identified through the literature review, as they should inspire to improve co-governance in the CiPeLs. Such principles will be hence operationalised by linking them to indicators to assess and monitor NbS good co-governance in the CiPeLs. This preliminary set of indicators will be adjusted to the local context of the CiPeLs, applying a participatory approach to indicators selection and prioritisation by the CiPeLs representatives. In future, the NbS co-governance assessment protocols will be documented in D7.2, an output that will synthesize the results of assessing and endeavouring to improve existing arrangements for co-governance of NbS in each of the partner cities.

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ANNEX 1 – KEYWORDS AND SEARCH STRING

For systematic search, researchers gathered keywords by topic and research interests of the authors as shown in the following tables.

Table 12: Keywords by Topic

Key topic	Keyword included (Boolean operator within group: or)	Keywords excluded (i.e not to be used in the search)	Keyword suggestions
Nature-based Solutions	„Nature-based solution“, „Nature-based solutions“, “NbS”, “green infrastructure”, “blue infrastructure”, “ecosystem based approach”, “ecosystem-based approach”, “urban forest*”, “landscape approach”, “landscape stewardship”, “ecosystem services”,	“best management practice”, “low impact design”, sustainab*, “Sustainable Urban Drainage System” (SUDS), “Water Sensitive Urban Design” (WSUD), “ecological engineering”, “natural resource”	<ul style="list-style-type: none"> • Ecosystem management (SP) • Living infrastructure (MvL) • Urban ecology (MvL) • Integrated landscape management (MvL) • Nature’s contributions (MvL)
	Nature-based solution” OR “green infrastructure” OR “blue infrastructure” OR “living infrastructure” OR “ecosystem based approach” OR “landscape approach” OR “landscape stewardship” OR “integrated landscape management” OR “ecosystem management” OR “ecosystem services” OR “nature’s contributions” OR “urban forest*” OR “urban ecology”		
	Results Scopus (Title, keywords, abstract)	62,095	01.02.2022
	Results Web of science (Topic=Title keywords, abstract)	48,797	06.02.2022
Co-governance	Governance, collaborat*, coordinat*, participat*, transformat*, “citizen engagement”, community	Power, politic*, policy, “knowledge transfer”, “capacity building”, decentralisation, network*, institution*, “system of rules”	<ul style="list-style-type: none"> • Management (MvL) • Decision-making (MvL) • Policy-making (MvL) • Implementation (MvL) • (co-)creation (MvL) • Hybrid • Participatory development (RB) • Community-based adaptation (RB) • Co-management (BV)

Key topic	Keyword included (Boolean operator within group: or)	Keywords excluded (i.e not to be used in the search)	Keyword suggestions
			<ul style="list-style-type: none"> Empowerment (BV) Polycentric (BV)
Governance	Governance OR "decision making" OR planning OR citizen OR community OR politics OR power OR policy OR institution*		
	Results Scopus (Title, keywords, abstract)	6,327,596	01.02.2022
	Results Web of science (Topic=Title keywords, abstract)	6,068,614	06.02.2022
Co	Inclusi* OR social OR collaborat* OR coordinat* OR participat* OR transformat*		
	Results Scopus (Title, keywords, abstract)	6,539,704	01.02.2022
	Results Web of science (Topic=Title keywords, abstract)	4,553,213	06.02.2022
City	City, cities, urban, landscape, "public space", "green space"		Local government (EC) Municipal* (EC) Parks (EC) Gardens (EC)
	City OR urban OR landscape OR "local government" OR municipal* OR "public space" OR "green space" OR parks		
	Results Scopus (Title, keywords, abstract)	1,905,703	01.02.2022
	Results Web of science (Topic=Title keywords, abstract)	1,244,875	06.02.2022

Table 13: Keywords by Research Interest

Research Interest	Keywords included	Keywords excluded	Keyword suggestions
Just governance	"Environmental justice", "Social justice", fair, gender-sensitive, Inclusi*, unequal*, "social cohesion"	Just*, capacities, Distribut*, Entitlement, Procedur*, Recognit*, "social capacity"	Social inequalit* (RB) Gender inequalit* (RB) Gender* (RB) Social injustice (RB) Discrimination (RB) Power relations (RB) Social exclusion (RB) Marginalised (RB) Vulnerable (RB)
Digital tools	Digital*,		Smart (YL) ICT (YL) Institutional technolog* (BV)
Values/ethics for decision-makers	Value*, ethic*, perception, attitude, "social norms"	"moral judgement"	Identit* (JM) Intrinsic, instrumental, relational (JM)
Actor interactions / Power relations	Power, network*, politic*, institution*	Power-sharing	"Governance structure" (LHV) "Governance mode" (LHV) Democratic legitim* (BV)
Collaborative planning and design	Design, planning, architecture, vision*	Regeneration	Collaborative design/planning (RB)

Research Interest	Keywords included	Keywords excluded	Keyword suggestions
			Participatory design/planning Community-centred design/planning (RB) Social architecture (RB) Gender-sensitive design/planning (RB)
Economic-political	Economy*, "green economy", politic*, "economic opportunities"	"Environmental goods"	Natural resource management (BV) Common-pool resource (BV)
Other		Iterative, Multifunctional*, Integrat*, Multilevel, multiscale, reflective, Transparent, Responsive, Strateg*, accountable, effective, efficient, challenges, legitimate, "complex interaction", "complex problems", expertise, feasibility, interdependency, sociology	

Based on the keyword, following search string was defined and tested.

Table 14: Search String

Search string	City OR urban OR landscape OR "local government" OR municipal* OR "public space" OR "green space" OR parks	
	AND	
	"Nature-based solution" OR "green infrastructure" OR "blue infrastructure" OR "living infrastructure" OR "ecosystem based approach" OR "landscape approach" OR "landscape stewardship" OR "integrated landscape management" OR "ecosystem management" OR "ecosystem services" OR "nature's contributions" OR "urban forest*" OR "urban ecology"	
	AND	
	Governance OR "decision making" OR planning OR citizen OR community OR politics OR power OR policy OR institution*	
	AND	
	Inclusi* OR social OR collaborat* OR coordinat* OR participat* OR transformat*	
	Results Scopus (Title, keywords, abstract)	5,539
	Results Web of science (Topic=Title keywords, abstract)	4,802
		06.02.2022
		06.02.2022

Final search string for each database is shown in the following table.

Table 15: Final Search String used for SCOPUS and Web of Science

Scopus (8.854 results)	(((TITLE-ABS-KEY ("green infrastructure") OR TITLE-ABS-KEY ("nature based solution"))) OR ((TITLE-ABS-KEY ("landscape approach") OR TITLE-ABS-KEY ("ecosystem based approach"))) OR (TITLE-ABS-KEY ("environmental justice")) OR ((TITLE-ABS-KEY ("environmental stewardship") OR TITLE-ABS-KEY ("landscape stewardship"))) OR ((TITLE-ABS-KEY ("green growth") OR TITLE-ABS-KEY ("green innovation"))) OR ((TITLE-ABS-KEY ("low-carbon transition") OR TITLE-ABS-KEY ("urban transformation") OR TITLE-ABS-KEY ("urban sustainability"))) OR ((TITLE-ABS-KEY ("urban ecology") OR TITLE-ABS-KEY ("urban forest") OR TITLE-ABS-KEY ("urban nature"))) AND (((TITLE-ABS-KEY (inclusiv*) OR TITLE-ABS-KEY (social) OR TITLE-ABS-KEY (collaborat*) OR TITLE-ABS-KEY (participat*) OR TITLE-ABS-KEY (actor) OR TITLE-ABS-KEY (community) OR TITLE-ABS-KEY ("public involvement"))) AND ((TITLE-ABS-KEY (landscape) OR TITLE-ABS-KEY (urban) OR TITLE-ABS-KEY (environmental))) AND ((TITLE-ABS-KEY (governance) OR TITLE-ABS-KEY ("decision making") OR TITLE-ABS-KEY (planning) OR TITLE-ABS-KEY (politics) OR TITLE-ABS-KEY (policy) OR TITLE-ABS-KEY (justice))) AND (LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "ARTS") OR LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "PSYC")))
Web of Science (5.582 results)	((((((((((((TS=("green infrastructure")) OR TS=("nature based solution")) OR TS=("landscape approach")) OR TS=("ecosystem based approach")) OR TS=("environmental justice")) OR TS=("environmental stewardship")) OR TS=("landscape stewardship")) OR TS=("green growth")) OR TS=("green innovation")) OR TS=("low-carbon transition")) OR TS=("urban transformation")) OR TS=("urban sustainability")) OR TS=("urban ecology")) OR TS=("urban forestry")) OR TS=("urban nature") AND (((((TS=(inclusiv*)) OR TS=(social)) OR TS=(collaborat*)) OR TS=(participat*)) OR TS=(actor)) OR TS=(community)) OR TS=("public involvement") AND ((TS=(landscape)) OR TS=(urban)) OR TS=(environmental) AND (((((TS=(governance)) OR TS=("decision making")) OR TS=(planning)) OR TS=(politics)) OR TS=(policy)) OR TS=(justice) and Environmental Studies or Environmental Sciences or Urban Studies or Green Sustainable Science Technology or Geography or Regional Urban Planning or Ecology or Sociology or Economics or Forestry or Development Studies or Geography Physical or Biodiversity Conservation or Political Science or Social Sciences Interdisciplinary or Geosciences Multidisciplinary or Engineering Environmental or Management or Public Administration or Multidisciplinary Sciences or Business or Ethics or Architecture or Area Studies or Social Issues or Computer Science Interdisciplinary Applications or Communication or Computer Science Information Systems or Psychology Multidisciplinary or Cultural Studies or Women S Studies or Computer Science Theory Methods or Ethnic Studies or Psychology Social or Computer Science Artificial Intelligence or Humanities Multidisciplinary or Telecommunications or Family Studies or Business Finance or Computer Science Software Engineering or Psychology or Art or Psychology Applied or Psychology Developmental (Web of Science Categories)

ANNEX 2 – KEYWORDS OF PRINCIPLES FOR GOOD CO-GOVERNANCE

From two workshops to develop conceptual framework of Task 7.1.1., researchers brainstormed principles for “good” co-governance. The initial list of principle keywords is presented in the following table (random order).

Table 16: List of Principles

Integrative
Multi-scale
Multifunctional
Strategic
Long term
Reflective, responsive, interactive
Context-sensitive
Empowering
Democratic, collaborative, participatory, inclusive
Fair, just, equitable
Gender-sensitive
Legitimate
Accountable, transparent
Effective
Competent
Evidence-based
Feasible
Efficient

ANNEX 3 – CLUSTERING OF PRINCIPLES INTO KEY PRINCIPLES

The following table accounts for our clustering process, principle-by-principle. For each initial principle, we constructed a working definition based on their treatment in Chapter 4. The actions we took were either relabelling, designation as key principle, or relegation under one or multiple key principles as a supporting one. The justification column explains our reasoning, and how overlaps are handled – i.e., which aspect of the supporting principle is emphasised depending on the parent key principle. In the justification cells of key principles, it is explained how the supporting principles were absorbed into the new definition of the key principle. All justifications should be read as discussions, relying on critically reflecting on the literature that is already presented in the main text.

Table 17: Clustering of principles into key principles

Principle label	Working definition (based on Chapter 4)	Action	Justification
Recognising and empowering	The active recognition of differential access to power between actors and taking steps to address this.	Relegated under "Responsive"	This principle is a narrower scope of recognising and incorporating socio-spatial differences covered in the principle of responsiveness.
Empowering	The awareness that empowering actors means to value different abilities and needs and fosters the trust.	Relegated under "Empowering" (relabelled from participatory)	This principle focuses on identifying the link between empowerment, trust, and actor needs, which is a necessary, but not sufficient condition of empowering people. The principle of participation was chosen as a broader baseline for empowerment, into which this definition is merged.
Inclusive	The active consideration of needs and consultation of social groups and actors conventionally disenfranchised from decision-making.	Relegated under "Empowering"	Inclusion is a redistributive aspect of empowerment, which is a necessary, but not sufficient.
Communicative	The creation, distribution, and exchange of knowledge.	Relegated under "Deliberative"	In the Habermasian sense, communicative action is a component of deliberation.
Collaborative	Capacity to seek out, mobilise, and coordinate individual efforts towards a common goal, solving common problems adequately and meeting constituent demands at an agreeable cost.	Key principle	Absorbs components from strategic (as more details into the common goal), integrative (as more details into the kind of individual efforts to be coordinated), and effective (as the objective of collaboration, to deliver satisfying outcomes at reasonable cost).
Participatory	Equipping individual actors with agency to assert their interests in matters of	Key principle, relabel as "Empowering"	Absorbs inclusive (as a special focus on previously disenfranchised actors), and

Principle label	Working definition (based on Chapter 4)	Action	Justification
	personal relevance and to proportionally influence related common decisions.		empowering (the old empowering principle, which focuses on trust-building and recognising values). The relabelling is necessary, as empowerment is the wider concept as a label, whereas the definition of the old participatory principle had the better basis to reflect this broadness.
Participatory/co llaborative	Participation refers to enfranchising individuals to assert their own goals in decision-making, whereas collaboration refers to reaching out to better reach common goals.	Eliminated	Duplicate of participatory and collaborative.
Knowledge diverse	Reliance of different knowledge types for evidence-based decision-making, including scientific, expert, technical knowledges, as well as tacit, experiential, local, and indigenous knowledges.	Relegated under "Adaptive" and "Responsive"	The principle refers to epistemic justice, cautioning against technocratic, managerialistic approach to governance. This is a relevant component of both responsiveness (by avoiding the devaluation of stakeholder experiences) and of adaptiveness (by enriching the knowledgebase from which to adapt from).
Transparent	Transparency refers to a negotiated process in which decision-making is visible and accessible, processes are explained, responsibilities are clear, accountability mechanisms are set up and there is law enforcement and control. Such process requires an open, "fair and civil discourse", shared aims and expectations set up through early dialogue and clear communication regarding decisions, reasoning, processes and activities to participants as well as the broader public	Relegated under "Legitimate"	Transparency commonly appears in the characterisation of throughput legitimacy, as a condition for a fair, open decision-making process.
Deliberative	Deliberation goes beyond communication and is defined as a "dynamic and evolving process", in which various actors, often public and new social (private) actors together, create and share knowledge by challenging existing ideas and reformulating problems	Relegated under "Empowering" and "Adaptive"	Communicative actions steered to enrich the common knowledgebase of the governed community can serve both empowerment (emphasising influencing decisions) and adaption (emphasising coming up with new solutions).

Principle label	Working definition (based on Chapter 4)	Action	Justification
	in order to come up with innovative solutions and influence decision-making .		
Strategic	Setting board, long-term goals encompassing multiple disciplines to steer and prioritise actions taken towards them.	Relegated under "Collaborative"	Strategy is one, but not the only component to coordinate individual actions, thus it fits the key principle of collaboration.
Incremental	The practice of regularly evaluating a process of working towards a long-term vision to identify new strategies and needs for achieving said vision, taking into account any changes to the broader societal context. Strategic planning processes therefore need to adopt an iterative cyclical approach without clear endpoint.	Relegated under "Adaptive"	An incremental, open-ended, or stepped planning process allows iterations of reflection, which can pivot development trajectories to adapt to new information or changing circumstances.
Reflective	A process of cyclical continual learning with multiple feedback loops and potential to learn from uncertainties and to improve decision-making step-by-step for the long run.	Relegated under "Adaptive"	In the plan-monitor-evaluate model, reflection refers to the evaluation phase, thus fitting the key principle of adaptation, which requires these cycles to course-correct.
Context-sensitive	Context sensitivity for local decision-making processes can be understood as referring primarily to three factors: the informal arrangements that co-exist with formal procedures, the kind of knowledge that enters decision-making, and the challenges that are considered most pressing in the local context. All three serve to enable and constrain the range of decisions possible.	Relegated under "Responsive" and "Adaptive"	The principle supports both the goal of better recognition of local needs and perspectives (responsiveness) and enriches the knowledgebase of decisions with higher specificity (adaptiveness).
Accessible	The accessibility of policies can be defined two-fold: 1) they are written and presented in a way that is understandable for the general public, and 2) they are available for everyone. Inaccessible policies limit the extent to which community members are aware of issues at stake in the planning, design and management of green space in their city, and hence the opportunity to influence these decisions.	Relegated under "Legitimate"	Both conditions of accessibility translate well to accountability by allowing people to scrutinize policies and their implementation, which is the core of output legitimacy.

Principle label	Working definition (based on Chapter 4)	Action	Justification
Evidence-based	Policies backed up by the objective evidence and scientific research builds credibility and in turn, improves legitimacy.	Relegated under "Responsive" and "Adaptive"	While the working definition does highlight the role of the evidence-base in legitimacy, we argue that this is conceptually more than democratic legitimacy (imagine a case where we are meant to choose between basing our decision on a sensor versus a testimonial). As key principles are meant to be implemented simultaneously, it makes sense to independently prescribe both a democratic process, and reliance on evidence. On the other hand, it is necessary to filter evidence-production through an epistemic justice lens to avoid disenfranchisement on the basis of technical knowledge. Thus, we relegate this principle under adaptive, and responsive, the two key principles that deal with knowledge integration.
Effective	Solving common problems adequately and meeting constituent demands at an agreeable cost.	Relegated under "Collaborative", "Responsive", and "Adaptive"	Conventionally, co-governance is often evaluated on the grounds of either legitimacy or effectiveness. It can be argued that responsiveness (by better understanding constituent demands), adaptation (by saving resources on avoiding harmful lock-in), and collaboration (by absorbing more assets and exploiting reinforcing interactions) can all make or break effective governance.
Integrative	The integration of green space planning, design and management with other disciplines and, more specifically with the policy and practice of other departments	Relegated under "Collaborative"	As a call for interdepartmental, and multi-level governance collaboration, the principle fits the broader key principle of collaboration, whereas multidisciplinary refers to knowledge diversity, which is already covered under the principle of the same name.
Emancipatory	The commitment to working with less powerful actors and actively sharing some degree of power with them	Eliminated	Duplicate of inclusive.

Principle label	Working definition (based on Chapter 4)	Action	Justification
	in the decision-making process.		
Responsive	The recognition and analysis of place-based specificity, and in particular differences in need, interests and values between and within communities. Responsive co-governance is also attentive to the local-specific, often informal institutional arrangements that affect decision-making, and what kinds of knowledge enters the decision-making process.	Key principle	Absorbs recognition of differences, knowledge-diversity (emphasising the importance stakeholder experiences), context sensitivity (emphasising place-based decisions and specificity to local context), and evidence-basis (as a standard for integrating local, tacit, and indigenous knowledges). A new definition is added to the main text accordingly.
Adaptive	An iterative approach to planning and implementation that involves continuous learning and improvement based on multiple feedback loops.	Key principle	Adaption absorbs supporting principles into a clear conditional chain. Context sensitivity and knowledge diversity are needed to set up a rich, place-based knowledgebase. This in turn is conditional to evidence-based decision-making. The evidence basis should then be continuously renewed to absorb new information in an incremental process of development. Incrementality intersects phases of action with phases of reflection, which in turn allows the process to be adaptive. A new definition is added to the main text accordingly.
Legitimate	A process that ensures decision-makers are trusted and decisions are accepted by fulfilling democratic norms: i.e. 1) appropriate representation of constituents' needs, 2) transparency and fairness in decision-making process, and 3) having mechanisms in place to hold decision-makers accountable for these outcomes.	Key principle	Legitimacy refers to democratic legitimacy in this document, which absorbs supporting principles by its main components: input (polity), output (policy), and throughput (politics) legitimacy. Thus, transparency refers to the throughput, whereas accessibility to the output side. The input side is adopted from the working definition, the main text definition is adjusted according to the supporting principles.