Municipal Governance Guidelines

D6.2 Deliverable

01/11/18

Tom Hawxwell[1], Sophie Mok[2], Ernesta Maciulyte[1], Johannes Sautter[1], Jill Ann Theobald[1], Ekaterina Dobrokhotova[1], Petr Suska[1]

[1]Fraunhofer Institute for Industrial Engineering (IAO), Nobelstraße 12, 70569 Stuttgart, Germany
[2]University of Stuttgart, Institut für Arbeitswissenschaft und Technologiemanagement (IAT), Nobelstraße 12, 70569 Stuttgart, Germany

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Author(s)	Tom Hawxwell, Sophie Mok, Ernesta Maciulyte, Johannes Sautter, Jill Ann Theobald, Ekaterina Dobrokhotova, Petr Suska				
Description of the related task and the deliverable. Extract from DoA	**T6.4 Municipal governance guideline (FHG, STU, EIN, GEN, TRE) M1-60** T6.4 will identify municipal governance structures which ensure widespread adoption and implementation of NBS in urban planning and development to generate practical guidelines for Follower Cities and cities beyond UNaLab. This guideline provides also material on how to avoid the negative aspects of gentrification. The adapted Fraunhofer Integrated Assessment Tool will be applied to assess the success of municipal governance recommendations provided for Front-Runner Cities in WP5. Municipal governance models and Actions that have proven successful and relevant for NBS implementation will be translated into a municipal policy guideline for application during roadmapping (T6.5) to ensure the creation of viable roadmaps for NBS implementation in the Follower Cities. This task outputs M6.1 and D6.2, and contributes to D6.8. In addition this task will co-operate with other SCC02 projects in identifying the municipal governance structures and how to avoid the negative aspects of gentrification. Moreover it will provide regular information of the progress, outputs and potential alignment of activities to task T1.7. FHG leads this task with assistance from STU and input from EIN, GEN and TRE.				
Participants	FHG				
Comments					

V	Date	Authors	Description
1	01.08.2018	TH, JS, SM, PS	Draft outlining structure and approach
2	01.11.2018	TH, JS, SM, PS	Final Draft
3	15.11.2018	Laura Wendling	Cross Check
4	29.11.2018	Tom Hawxwell	Final

About UNaLab

UNaLab will develop, via co-creation with stakeholders and implementation of 'living lab' demonstration areas, a robust evidence base and European framework of innovative, replicable, and locally-attuned nature-based solutions to enhance the climate and water resilience of cities. UNaLab focuses on urban ecological water management, accompanied with greening measures and innovative and inclusive urban design. The UNaLab partners aim to develop smarter, more inclusive, more resilient and more sustainable local societies through nature based innovation jointly created with and for stakeholders and citizens. UNaLab's 3 front runner cities: Tampere, Eindhoven and Genova, have a track record in smart and citizen driven solutions for sustainable development. They support 7 Follower Cities: Stavanger, Prague, Castellon, Cannes, Başakşehir, Hong Kong and Buenos Aires plus share experiences with observers as City of Guangzhou and the Brazilian network of Smart Cities. Therefore UNaLab results will impact on different urban socio-economic realities, with diversity in size, challenges and climate conditions. In order to create an EU reference demonstration and go-to-market environment for NBS, UNaLab will use and further develop the ENoLL Urban Living Lab model, and the European Awareness Scenario Workshop method for the co-creation of solutions, and the roadmap approach, in this way achieving an innovative NBS toolbox.

Partners

Table of Contents

1.1 Acronym list

- **BGT** Dutch national topographic register – 'Basisregistratie Grootschalige Topografie' (BGT, Key Register Large-scale Topography)
- **BGF** Blue Green Factor
- **BI** Business Intelligence
- **BID** Business Improvement District
- **BIM** Building Information Modelling
- **BIZ** Bedrijven Investeringszones
- **CBS** Central Bureau for Statistics
- **CDO** Chief Data Officer
- **CEB** Council of Europe Development Bank
- **CIO** Chief Information Officer
- **DBFM** Design Build Finance Maintain
- **EbA** Ecosystem based Adaptation
- **EIB** European Investment Bank
- **ESS** Ecosystem Services
- **FrC** Front-Runner Cities
- **GBI** Green and Blue Infrastructure
- **GDPR** General Data Protection Regulation
- **GIS** Geographic Information System
- **ICT** Information and Communication Technologies
- **IoT** Internet of Things
- **IT** Information Technology
- **MGG** Municipal Governance Guideline
- **MTN** Medium Term Note
- **NBS** Nature-Based Solutions
- **NIB** Nordic Investment Bank
- **NIMBY** Not in my Backyard
- **NGO** Non-Governmental Organisation
- **PUC** Municipal Urban Plan of Genova
- **SME** Small Medium Enterprises
- **SOPs** Standard Operating Procedures
- **TEV** Total Economic Value
- **UNaLab** Urban Nature Labs

2. EXECUTIVE SUMMARY

The Municipal Governance Guidelines aim to support cities in overcoming governance-related challenges in relation to the effective development of Nature Based Solutions (NBS). The deliverable can be divided into two main sections. The first section outlines the broad range of governance-related challenges related to NBS identified in the UNaLab partner cities and the second section outlines six proposed "Actionfields" comprising a range of actions cities can take to help overcome these challenges. This is an extended version of the deliverable and a more concise summary will be available in M24.

3. INTRODUCTION

3.1 Purpose and target group

The purpose of this document is to identify core governance challenges limiting the uptake of NBS in cities and propose a range of actions to help address these challenges. The deliverable contributes to the

UNaLab Replication Framework (D6.6), which brings together elements from the UNaLab project into a framework to support replication and upscaling of NBS. The framework will be tested in the UNaLab Follower Cities (FC) and eventually be made available for cities beyond the consortium to undergo their own process of NBS creation along the lines of the UNaLab approach. The Municipal Governance Guidelines (MGG) support in this process through the identification of supporting governance structures and processes to ensure the creation of viable roadmaps for NBS implementation in the FCs and beyond. Therefore, the target group of the deliverable is actors (primarily from public administrations, but also research and the private sector) from UNaLab Follower and Observer Cities, but also municipalities more generally.

3.1.1 Scope

Selection of the themes

These Guidelines build upon the Deliverable *5.2 Municipal Governance Recommendations.* The Municipal Governance Recommendations focused on four governance themes considered to be of particular importance in the context of facilitating the uptake of NBS in cities: Organisation and Structure; Policies (Regulations and Incentives); Finance and Procurement; and Data Governance. These governance themes were used to initially structure development of the MGG. There were, however, a range of potential interventions applicable to the defined challenges that fell outside these four themes. Thus, the additional themes of Municipal Strategy and Planning and Inclusive Urban Development were added to the framework. The topic of Inclusive Urban Development has been integrated explicitly to support cities in dealing with the challenge of gentrification.

Governance models for and municipal governance of NBS

The distinction between governance models for NBS and the municipal governance of NBS should be made. Whilst the former focuses on the development of innovative actor constellations around the development and maintenance of specific NBS interventions, the latter focuses on the structures, processes and "rules of the game" within the municipal organisation as enablers and barriers of NBS in cities. Governance models for NBS will be explored in more detail through the development of the *UNaLab Replication Framework* to help UNaLab FCs develop their NBS Roadmaps. As a logical extension of *5.2 Municipal Governance Recommendations,* the focus of the present deliverable is on the municipal governance of NBS on a city organisational level.

Urban Living Labs (ULLs), Co-creation and Stakeholder Engagement

Within the UNaLab project, significant time and attention has been devoted to the development of tools and knowledge generation around the development of ULLs, co-creation and stakeholder engagement. These aspects will be covered in more detail in other deliverables such as the *D2.1 UNaLab ULL Framework, D2.3 UNaLab ULL Online Tool Kit* (M30) and *D2.3 UNaLab Living Lab Handbook* (M36). For this reason, these themes are not explored in the same depth as the other themes, but will be outlined more intrinsically in *D6.6 UNaLab Replication Framework* (M24).

3.2 The Municipal Governance of NBS

In the past, urban development has had a clear top-down character, with public authorities responding to and managing urban challenges through the institutional framework organised along the lines of the services that public authorities provide. These "silos" established on different levels of government have been relatively effective in delivering public management with a clear distinction between "public" and "private" in terms of the actors engaged in policy making. A transformation in the role of public authorities can be seen in recent decades. This transformation can be understood as a shift from "Government" to "Governance", with a shift in the role of local administrations from top-down regulators towards providers of a certain governance context. This is reflected in the importance of other stakeholders in the process of urban development. Citizens, research institutions, companies and other urban actors are playing an ever-increasingly important role in the way cities are planned, built and managed.

Although not without controversy, these changing constellations present an opportunity to address some systemic challenges faced by cities. Topics such as sustainable urban development, nature-based solutions, smart cities, climate change adaptation and mitigation are cross-sectoral in nature and the success in pursuing such ambitions has been limited within the prevailing urban institutional context. This does not mean that the importance of public authorities is declining. In many cases, the contrary can be seen with cities emerging as leaders fostering a transition towards sustainability and resilience and municipal administrations playing a proactive role as transition managers (Frantzeskaki et al., 2018). However, in many ways, the role of the municipality is shifting away from top-down, ad hoc "problem solving" towards establishing effective structures that will better facilitate the desired transition.

As an emerging cross-sectoral concept, the successful implementation of NBS in the urban space builds on a combined effort of actors both inside and outside the municipal organisations. How can the city foster the creation of such new actor-networks? How can the city facilitate the evolution of the right structures and "rules of the game" to steer towards a sustainable and resilient future? The *Municipal Governance Guidelines* will explore a range of governance related challenges inhibiting the effective integration of NBS in cities, and highlight a range of actions that can be taken to help address these challenges. The relevance and further explanation of these themes will be elaborated below.

3.3 Approach to the development of the Guidelines

Municipal Governance Recommendations as a Starting Point

The *Municipal Governance Recommendations* (D5.2) provided an assessment of the UNaLab partner cities Eindhoven, Tampere and Genova in four key areas regarding the municipal governance of NBS. Based on this assessment, recommendations were provided to these cities regarding how city actors can act to change governance structures to better facilitate the uptake of NBS. The four key areas under observation included (1) cross-departmental communication and cooperation, (2) policies (regulations and incentives), (3) financing and procurement and (4) data governance. As a consortium-internal document, the target group included any municipal actors within the Front-Runner Cities, particularly those who are actively engaged in the themed areas mentioned below.

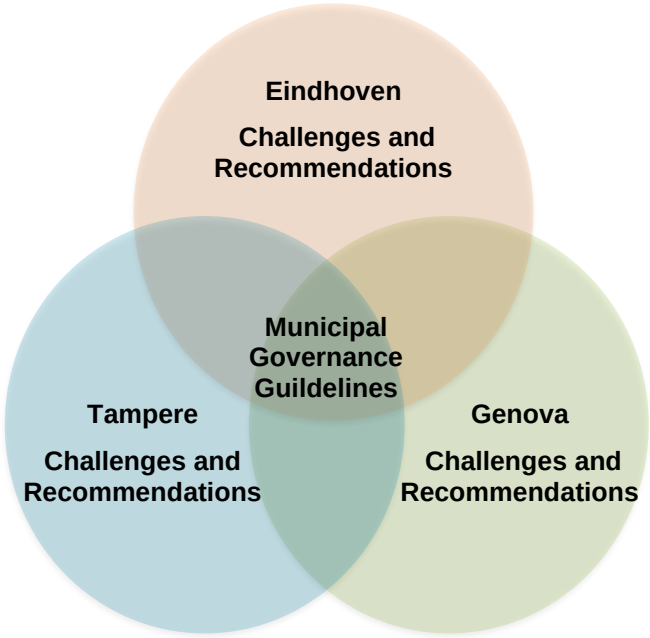


Figure 1: Development of Municipal Governance Guidelines through the Municipal Governance Recommendations.

Throughout the development of the *Municipal Governance Recommendations*, researchers collected and organised the findings (challenges and potential actions) relevant for the UNaLab FCs and cities beyond the consortium.

3.3.1 Definition of the Governance Challenges

From the beginning of the project, the topic of governance challenges have been incorporated into the approach to understand the broad range of challenges faced by cities in this context. Many of the identified governance challenges were relevant to the specific context of the city under analysis. Yet there are also patterns that emerge between the cities and common challenges shared by most, if not all partner cities, which are likely relevant for cities beyond the project consortium.

Prior to the first round of high level workshops (conducted in each FrC during the first 12 months of the project), a preliminary list of central governance related challenges were defined and elaborated. These findings were then organised to establish a good overall understanding of the types of governance related challenges cities are facing in the context of facilitating the uptake of NBS. Efforts were aimed at ensuring that the guidelines developed would be demand oriented and could be linked directly to the specific challenges cities face.

Linking the activities in the Follower Cities

Through the ambition workshops and systems assessments, significant knowledge has been generated about the specific governance-related challenges in each FC. These findings have been integrated into the definition of the Governance Challenges and Actions. After the FCs have defined their priority areas for interventions in the area of governance (M18), specific actions in this document will be defined and defined to reflect the specific demands of each FC as a part of the *NBS Replication Framework (Draft)* (D6.6, M24).

Linking with other SCC2 Projects

Through engagement through the cross SCC-02-2016-2017 Task Force on Governance Models and Financing strategies contacts have been established with representatives from other SCC-02-2016-2017 projects. Initial interviews were conducted with a selection of project representatives to gather feedback on the approach and identify potential for the alignment of activities. These contact persons also provided deliverables relevant to the development of the governance guidelines.

Municipal Governance Workshop

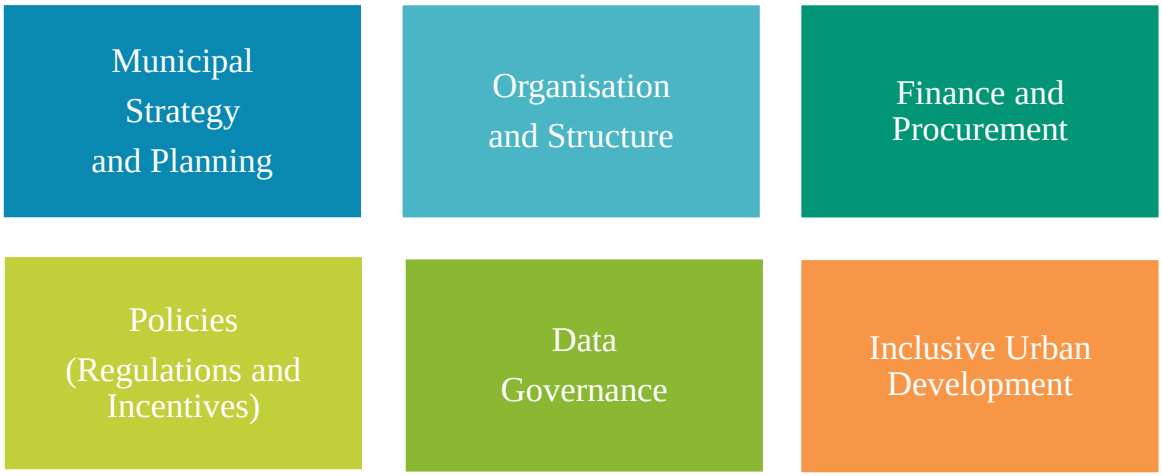
During the third UNaLab project consortium meeting in Eindhoven (M12), a municipal governance workshop was organised in order to receive feedback related to the initial collection and clustering of the governance challenges from partner cities. Firstly, the challenge clusters were presented briefly, then posters provided which included a brief description of the identified challenges, linked to an initial list of possible interventions that could help overcome the specific challenges taken from best practices from other cities. Participants were asked to comment on and add to the defined challenges, as well as vote for the ones that are relevant for their cities. The posters from the workshop can be found in the Annex.

Based on the assessment process the following governance challenge clusters were identified:

3.3.2 Definition of the Actionfields

Building on the four key findings of the *Municipal Governance Recommendations*, along with the feedback collected from partner cities and a collection of best practice from other cities, key Actionfields (comprising of actions that can help address these governance challenges) were identified.

The following Actionfields were identified:



3.3.3 Linking Challenges and Actions

Once the governance challenges and the actions were defined, a cross impact assessment was conducted to estimate the potential impact the actions would likely have on the respective challenges. This became the basis for prioritising the respective actions according to the identified challenges.

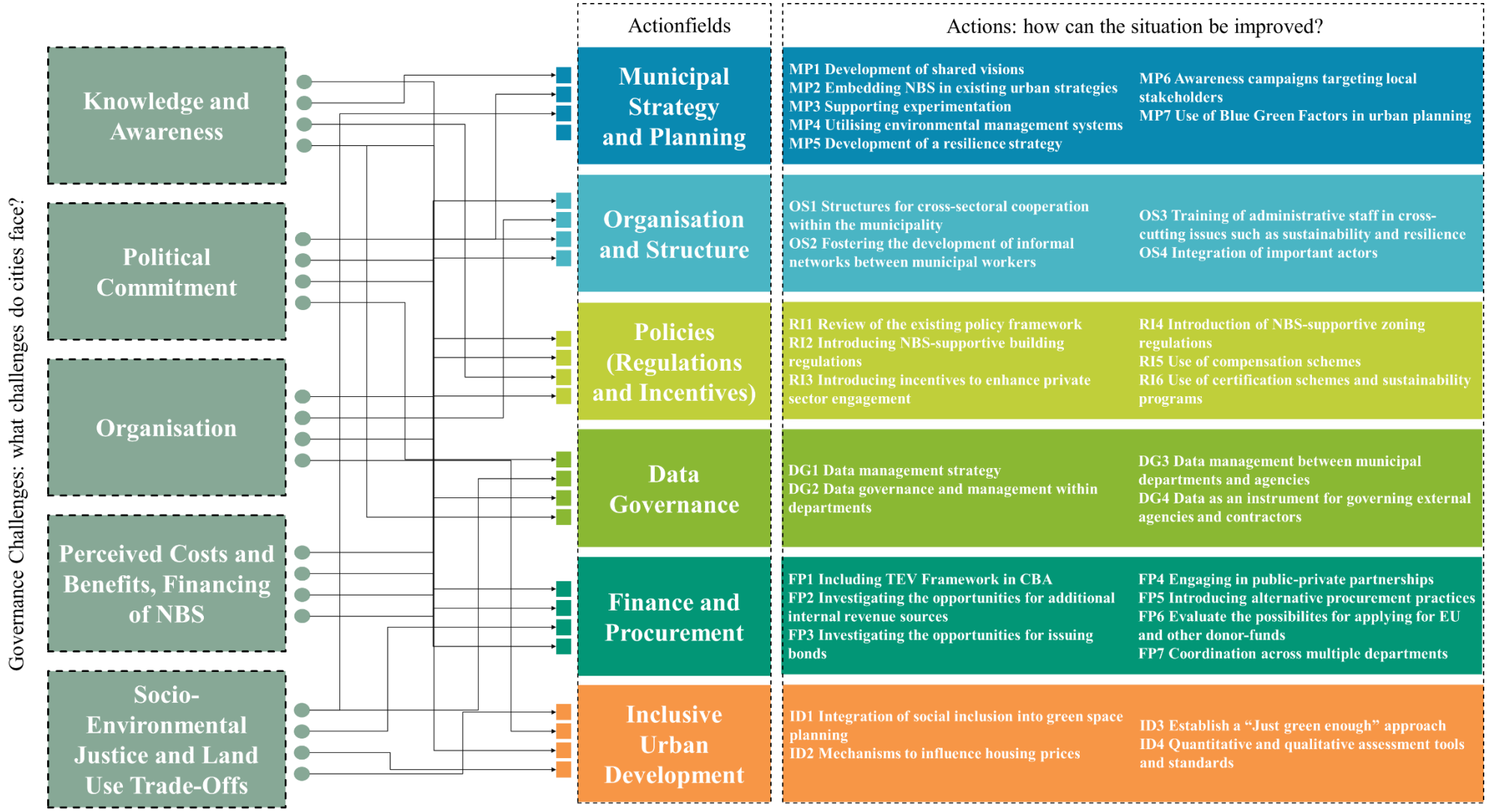


Figure 2: Linking challenges and interventions

3.3.4 Structure of the document

The deliverable can be divided into two main sections. The first section outlines the broad range of governance related challenges around NBS identified in the UNaLab partner cities, with the second section covering the proposed actions to help overcome these challenges. Both the challenges and actions are organised into clusters. After each challenge cluster is presented, a list of potential actions is presented, which are then described in more detail in the second section of the deliverable. The content of this deliverable will be organised in a logical easy-to-use format as part of *D6.6 UNaLab Replication Framework* to allow the user to easily manoeuvre between challenges and actions.

4. GOVERNANCE CHALLENGES RELATED TO THE DEVELOPMENT OF NBS

4.1 Lack of Knowledge and Awareness

Lack of knowledge and awareness was highlighted regularly as a key barrier to the uptake of NBS in cities. NBS is a rather new and interdisciplinary concept which takes time to embed itself in municipalities, yet a more nuanced perspective highlights some additional insights into this challenge. In particular, a lack of knowledge was mentioned:

- **Amongst municipal workers:** as a cross-sectoral topic, NBS requires the engagement of multiple departments (also see *Organisation*) In many cases amongst the UNaLab partner cities, the concept is placed more intrinsically within the departments responsible for green space and water management. In order to effectively deploy the concept beyond these departments, a broader level of awareness and exchange is necessary.
- **Amongst decision makers**: in many cases, politicians also do not yet see the potential of NBS to support the city in achieving long term objectives (also see *Leadership*).
- **Amongst local businesses and citizens:** for the effective implementation of NBS, the participation of the private sector is necessary (*Perceived cost and benefits and financing of NBS*). Multiple cities reported difficulty convincing local businesses to integrate NBS into their strategies (also see *Awareness raising*). Buy-in is also important amongst citizens, who on one hand can be present strong opposition to the implementation of NBS, but also should be considered central partners and co-creators of NBS in the city.
- **About the areas that are at risk of climate change**: in multiple cases it was reported that there is a need for more data related to climate change scenarios to better target and justify the development of NBS.

- **About the potential of NBS to address challenges, their co-benefits and the suitable types to employ:** Factors such as the limited evidence base for the ability of NBS to achieve climate related challenges, or knowledge about the potential co-benefits they can deliver.
- **About the functions nature provides to cities:** Awareness of the services that nature provides to cities is still considered insufficient amongst partner cities. A few of the partner cities have begun integrating ecosystem services into municipal accounting processes, but there remains limited awareness about the value of the services that existing and future NBS/green infrastructure can provide.
- **About the technical aspects of planning, building, and maintaining NBS:** In many cases, NBS present a fundamentally new way of conducting urban development. From a technical perspective, this presents challenges as it requires new processes and techniques to be integrated into engineering and land use planning processes. It has also been highlighted that poor or wrong implementation of NBS and the resulting negative effects are a threat to public perception, acceptance and support. In some cases, the technical knowledge is present but must be effectively distributed, emphasising the importance of learning between cities.

Knowledge and awareness should not only be viewed as a challenge to the successful implementation of NBS. NBS also present an effective tool to raise knowledge and awareness around climate change adaptation and sustainability related challenges. While concepts such as ecosystem services and green infrastructure can be more difficult for local citizens and companies to grasp, NBS has the potential to communicate the principles of these concept in a way that can be utilised by non-technical individuals. (See *MP7 Awareness campaigns targeting local stakeholders (including citizens*)).

4.1.1 Identified challenges: Lack of Knowledge and Awareness

Lack of knowledge among municipal employees	•Municipal employees arenot familiar with the concept and thus are not ready to mobilise around it
Lack of knowledge about the areas that are at risk of climate change	•Lack of reliable climate data to use as a base for NBS; different baselines used by different departments
Lack of knowledge about the potential of NBS to address the challenges and which to best implement	•Lack of evidence base for NBS
Lack of knowledge related to the potential co-benefits that result from NBS	•Many benefits are often abstract and hard to quantify in the short term, such as health effects
Lack of knowledge about the functions nature provides to cities	•NBS provide wide range of ecosystem services but the concept is not yet well known in cities
Lack of technical knowledge on how to plan, build and maintain NBS	•There are still gaps in the knowledge regarding the different stages of NBS implementation
Complex problems and terminologies make it difficult for stakeholders to discuss NBS solutions on equal terms	•How can a city make complex information easy to understand for non-professionals?

4.1.2 Relevant Actions

MP1 The development of Shared Visions

MP4 Utilising environmental and sustainability management systems

MP7 Awareness campaigns targeting local stakeholders (including citizens)

MP9 Development of guidelines related to NBS

OS1 Structures for cross-sectoral cooperation within the municipality

OS2 Fostering of informal networks between municipal departments

OS3 Training of administrative staff in cross-cutting issues such as sustainability and resilience

FP1 Including the TEV Framework in CBA

DG2 Data governance and management inside departments

4.2 Leadership

Urban leadership is seen as an imperative to facilitate the increased uptake of NBS. A clear directive and commitment to building a more climate resilient city and making a departure from business-as-usual is a necessary perquisite for the effective uptake of NBS.

City leaders are faced with a range of challenges at any given time and there is a tendency for emphasis to be placed on (often short term) challenges perceived as more "pressing" such as economic growth, jobs and housing, etc. Considering the long-term benefits that tend to be associated with NBS, this can present a further challenge in the context of short-term political cycles. It was reported that in some cases, NBS and greening solutions are perceived as expensive and luxury "nice to have" elements rather than being framed in a way that reflects their relevance for core political mandates such as climate change adaptation or improving the health and wellbeing of citizens. Therefore, the appeal of NBS can be low for some politicians.

In some cases the topic of "sustainability" has established some prominence on the agenda amongst decision makers, but NBS are not usually integrated into the agenda. More focus tends to be placed on climate change mitigation (rather than adaptation) through the reduction of carbon emissions, neglecting the wider benefits associated with NBS.

In addition, there is a still limited willingness to pioneer and take risks in testing new concepts in most cities. The potential backlash of negative outcomes eventuating from experimentation with a new approach lends to a risk averse administration, focusing on priorities that are tried and tested.

Experiences from the UNaLab partner cities demonstrate that if framed correctly, NBS and urban greening can be a very powerful topic for politicians during elections. In the case of Eindhoven, who experienced an election during the course of the project, it was reported that due to the popularity amongst citizens, no politician was willing to stand in opposition to projects that promoted urban greening, and there were some that actively promoted the topic as part of their campaign.

4.2.1 Identified challenges: Leadership

NBS are not seen as a priority	• Decision makers in the city prioritise liveability / climate resilience below (percieved) more pressing shorter term challenges (jobs, growth, housing, etc.).
Experimenting is first step but taking NBS into everyday use is even more difficult	• Administraions are often not willing to take risks associated with experimenting or being a pioneer if the concept has not been tested within similar environments.
Changes in political objectives in each political cycle undermines the long term planning of the city	• NBS bring long term benefits in the context of short term political cycles, which reduces their appeal for politicians
The concept of sustainability is often labeled as a luxury add-on	• NBS are often understood as being expensive and non-essential but "nice to have" elements, although NBS are typically cost-effective when all costs and benefits are considered

4.2.2 Relevant Actions

MP2 Embedding NBS in existing plans and strategies

MP3 Providing experimental areas for pilot projects

MP4 Utilising environmental and sustainability management systems

MP7 Awareness campaigns targeting local stakeholders (including citizens)

OS2 Fostering of informal networks between municipal departments

RI4 Introducing incentives to enhance private sector engagement

4.3 Organisation

How the municipality is structured and organised has been identified as a crucial factor determining the success of many sustainability or nature-based interventions. These themes are interdisciplinary in nature and thus require the cooperation of a range of actors who typically may not have worked effectively together in the past. NBS present a fundamentally different approach as compared with conventional urban development. A range of factors explain the novelty of NBS:

- As solutions, NBS tend not to be ad hoc - they are not developed to address one specific problem, but a range of interconnected challenges
- The benefits of NBS interventions tend to be abstract, i.e. can be difficult to quantify
- NBS tend to foster a high degree of public (rather than private) goods; therefore, these dispersed benefits cannot be easily allocated to one department or actor, but multiple departments and actors. At the same time, for the effective implementation of NBS at the required scale the cooperation of private actors is necessary.
- NBS benefits tend to relatively long term payoffs

For these reasons, NBS present an organisational challenge in terms of the necessity to get multiple actors on board to develop an effective coalition to support the uptake of NBS. Conversely, the concept presents an opportunity or "tool" to support and foster better cross-sectoral cooperation as a longer-term governance ambition in cities.

Two central perspectives could be identified:

1. **Cooperation within the administration:** On the level of the municipality, decision making and the management and monitoring of a complex system is required to effectively manage the planning, financing, building and operation of NBS, involving various departments and offices within the city administration. The challenges identified reflect the difficulties in deploying a cross-sectoral concept in the context of the existing silos that still largely characterise municipal governance structures. The identified challenges reflect these issues, highlighting aspects such as: data and knowledge sharing between departments and other municipal agencies; cross departmental financing of NBS; a lack of effective planning tools; aspects relating to the procurement processes; and, the effective inclusion of other themes, particularly "health", under the NBS umbrella in partner cities.

2. **Effectively engaging with actors outside of the administration:** An urban governance perspective reaches beyond the municipality to understand the ever-increasing importance of civil society, local businesses, and research in the process of urban innovation. Like any intervention that targets urban space there will likely be a wide range of stakeholders potentially be affected by a given NBS intervention. In order to increase acceptance of NBS on behalf of the citizens and other local stakeholders, it is important that effective mechanisms for inclusion of these stakeholders are present. In the context of the UNaLab project, an element of co-creation is seen as intrinsic to the development of NBS. The identified challenges in this context relate to the effective creation of networks and "communities of practice" around NBS, the need for effective integration of new co-creation formats in the context of old participation structures, and means of conducting effective impact assessment through the collection of data from citizens.

4.3.1 Identified Challenges: Organisation

Lack of data exchanges between the authorities, practitioners and society	• Lack of effective data management and/or sharing between departments and other actors.
NBS are typically cross-sectoral and require effective cooperation between departments and levels of government	• Ensuring effective vertical cooperation across different governance levels and horizontal cooperation between departments
Even when a cross-sectoral body is in place, funding is still largely allocated according to silos	• Cross-sectoral deparments tend to have limited budgets, with the majority of funds still allocated according to silos
Path dependency on procurement	• Cities tend to procure based on previous decisions, which tends to discourage the procurement of new and innovative solutions
There is a lack of planning tools to support the planning and development of multi-functional areas	• Many existing tools tend to focus on areas of high risk, whilst NBS should be integrated in all areas of the city
In terms of health, "prevention" needs to be more intrinsically linked to urban planning	• Connection between public space quality and the health and wellbeing of citizens is well established. Nevertheless, it is not integrated into urban planning practices
NBS require deep collaboration among different stakeholders	• New forms of collaboration and well connected networks are necessary, including local businesses, NGOs and citizens
Co-creation goes beyond traditional participation practices	• Integration of new formats requires learning, communication methods and tools
Lack of expertise on engaging citizens to ensure participation	• Communications, tools and skills of municipal employees often do not fit the methodology of innovative participatory methods
Lack of capacity and tools to collect meaningful data from citizens	• Should data come from municipal sources or can privately owned services deliver better quality at lower costs and more rapid response rates?

4.3.2 Relevant Actions

MP1 The Development of Shared Visions

MP2 Embedding NBS in existing plans and strategies

MP3 Providing experimental areas for pilot projects

MP4 Utilising environmental and sustainability management systems

MP6 Development of a resilience strategy

MP7 Awareness campaigns targeting local stakeholders (including citizens)

MP8 Use of Blue Green Factors in urban planning

MP9 Development of guidelines related to NBS

OS1 Structures for cross-sectoral cooperation within the municipality

OS2 Fostering of informal networks between municipal departments

OS3 Training of administrative staff in cross-cutting issues such as sustainability and resilience

FP5 Introducing alternative procurement practices

RI1 Review of the existing policy framework

DG1 Data management strategy

4.4 Perceived cost and benefits and financing of NBS

As discussed above, many of the benefits delivered by NBS are public and thus cannot be easily internalised by investors (Toxopeus and Polzin, 2017). For example, some of the ecosystem services provided by NBS are intangible public goods and thus their payoffs are not actualised as easily measurable financial streams to investors. Often, the direct and indirect impacts and payoffs of NBS require time to become evident, and the estimates of NBS costs and benefits are frequently dependent on individual value judgment (Nesshöver et al., 2017). At the same time there is a lack of user-friendly tools and methods to account for the benefits delivered by NBS and express these benefits in monetary terms that would in turn help develop the business cases for investing in NBS.

Since many of the benefits NBS deliver are public, the majority of NBS seem to be financed by local governments. In the short-term, local governments might not need to set up additional revenue collection and appropriation systems to fund NBS. However, long-term funding for NBS may not be stable if other obligations, especially those resulting in short-term benefits, are viewed as higher priorities. Budgetary constraints might imply prioritising other policy areas for funding that have more readily quantified and articulated effects on citizen wellbeing. Previous studies have found that local governments often are subject to short-term actions and decision-making cycles (Kabisch et al., 2016a). For this reason, local politicians may lack incentive to commit to interventions such as NBS that yield mostly long-term benefits.

Attracting private capital investment in NBS can help to ensure the continuous implementation and mainstreaming of NBS in the context of the limited public budgets. However, private sector investments are also based on potential profits. The intangible and public nature of the benefits delivered by NBS makes the developing of feasible business cases for NBS implementation difficult. This situation might contribute to the high risk perception of investments in NBS and steer potential investors towards less costly short-term technologies. To address this situation, local governments might be required to introduce incentive schemes and regulations that would make the business cases for NBS more feasible. At present, such NBS-targeted instruments seem to be rather rare.

Procurement practices may impose additional challenges to NBS implementation and mainstreaming in cities. Often, public procurement officers are subject to many pressures ranging from cutting costs to meeting the demands of internal users and the public. Since NBS lack straightforward business cases, demonstrating their cost effectiveness when compared to conventional solutions for urban development can prove challenging. For this reason, relying on the lowest cost indicator in the public procurement process implies an additional obstacle to NBS implementation.

4.4.1 Identified challenges: Perceived Costs and Benefits

Financial limitations leading to inadequate development and maintenance of NBS	• Budget cuts for implementation and maintenance of NBS during periods of financial stress, changes in funding priorities within a new political cycle and other barriers to applyication of new financial mechanisms to leverage funding for NBS
Stakeholders don`t often see the financial benefits of integrating NBS	• NBS tend to have longer payback periods and benefits which may direct private sector investments into less expensive short-term solutions
Insufficient incentives and regulations to encourage the private sector to include NBS in developments	• Private sector lacks incentives that would make the business cases for the NBS better defined and attractive
Lack of tools or methods to describe the positive effects of NBS	• Many positive effects are not taken into account when implementing NBS, such as social impacts like psychological wellbeing, that can have financial benefit
Citizens often do not see the long term benefits but are more concerned with the short term costs	• How can citizens be involved in the planning process to avoid 'NIMBY'? How can a city visualise the effects of projects to grasp the long term benefits?

4.4.2 Relevant Actions

MP1 The Development of Shared Visions

MP4 Utilising environmental and sustainability management systems

MP6 Development of a resilience strategy

MP7 Awareness campaigns targeting local stakeholders (including citizens)

OS2 Fostering of informal networks between municipal departments

FP1 Including the TEV Framework in CBA

FP4 Engaging in public-private partnerships

FP7 Coordination across multiple departments

RI2 Introducing NBS-supportive building regulations

RI5 Use of compensation schemes

4.5 Social and environmental justice and land use trade-offs

Any intervention in the urban space will have a range of intended and unintended social, environmental and economic consequences. Such impacts are highly context specific but some general tensions regarding NBS can be identified:

- **Green gentrification:** Oftentimes, urban regeneration can improve the lives of some at the expense of others. The term "green gentrification" has emerged to reflect the potential negative impacts of urban restoration. Green gentrification is a difficult challenge as one of the central "selling points" for NBS is that it increases the attractiveness of urban space: the objective of urban regeneration is to improve the environment in which local citizens are dwelling. With increasing attractiveness, the inevitable consequence is that demand for housing in the area will increase, increasing housing prices with it (for two examples see Lene-Voigt-Park in Berlin and the "High Line" project in New York (Haase et al. 2017)). In the context of financing NBS, a central argument (or at least a highlighted co-benefit) for developers to integrate NBS into their plans, is the likely increase in rents over time. This can lead to social exclusion and increasing inequality gaps, at times more strongly affecting those residents for which the green intervention was actually meant to be beneficial (Haase et al., 2017; Kabisch et al., 2017). This presents a significant challenge for planners to increase the integration of NBS and facilitate urban regeneration, as well as manage the potential negative social impacts of these interventions.
- **Uneven distribution of NBS:** There are a range of reasons for which cities might deploy NBS, and the targeted areas of their implementation reflect the challenges they are intended to address. For example, NBS interventions will often target areas that are more prone to flooding or urban heat islands. This can lead to an unequal distribution of the green space within the city if the strategy is not aligned with mechanisms to support green space equality (Kabisch et al., 2017). Lower socioeconomic areas are often associated with higher impacts of both air pollution and urban heat islands (Wolch et al., 2014). Different studies found out that especially ethnic minorities and low-income groups have less access to green space (especially parks) or are exposed to poorly maintained, vandalised or unsafe green spaces and thus more vulnerable to urban health and climate risks (Haase et al., 2017). This highlights the potential for the city to address socioeconomic disparities whilst addressing urban challenges related to climate change and ongoing urbanisation at the same time.
- **Competition for land resource (building compact cities vs green space accessibility):** With a rapidly growing population, many cities follow the concept of creating a compact city with short distances between services. The wider goal of this vision is to lower the environmental

footprint of the city and create sustainable communities by reducing the distances between points of interest, and establishing a critical mass of citizens in a given area (to justify the existence of bus stops, schools, supermarkets, etc.). Such an approach includes high density building, urban infill and functional mix, reducing car dependency and urban sprawl. However, a focus on urban infill creates competition for space and puts increasing pressure on existing green spaces. This is intensified in cities experiencing rapid growth, as pressure for housing becomes a highly political issue and a central priority. Therefore, the key challenge to realise a compact city with short distances between points of interest is for planners and decision makers to maintain and implement green spaces while at the same time increasing urban density and providing sufficient (affordable) housing for everyone.

- **Ecosystem disservices:** Ecosystem services play a central role in justifying investments in NBS. However, some negative impacts of increasing nature in the city has led to the emergence of the term "ecosystem disservices" (Döhren and Haase, 2015). Examples of this include planted trees intensifying allergies and urban wetlands creating an explosion of mosquito populations (Döhren and Haase, 2015), as well as a potential for increased water consumption and the emission of greenhouse gases by constructed stormwater treatment wetlands (Döhren and Haase, 2015). From an economic perspective, infrastructure damage by tree roots and increased maintenance can lead to additional costs. These aspects are often unavoidable and negative consequences are usually strongly outweighed by the long-term benefits, but it is important that they are taken into account when considering the development of NBS to avoid potential back-lash.

4.5.1 Identified challenges: Social and environmental justice and land use trade-offs

Increasing housing prices and gentrification might coincide in areas where NBS are implemented	• Districts that receive new NBS increase in attractiveness to investors, which leads to increasing housing prices and less socially compatible development
Effects of NBS that are already measured are not considered in business as usual pricing and land use policies	• More green space is lost to property development and NBS do not generate as much financial value as buildings
Cities should deal with / prevent ecosystem disservices	• NBS implementations are often highly technical and do not include the social expertise to better understand the potential negative effects of NBS
Competition for land resource	• In some cases there is a trade off between building a compact city and building a green city
Natural systems do not often correspond to the urban systems built upon them	• Natural water paths do not often align with the existing streets, pipes and wires. The roots of trees can come into conflict with underground wires and pipes. Aligning these infrastructures presents challenges for planners.

4.5.2 Relevant Actions

MP2 Embedding NBS in existing plans and strategies

MP4 Utilising environmental and sustainability management systems

OS1 Structures for cross-sectoral cooperation within the municipality

OS2 Fostering of informal networks between municipal departments

ID1 Integration of social inclusion into green space planning

ID2 Mechanisms to influence housing prices

ID3 Establish a “Just green enough” approach

ID4 Quantitative and qualitative assessment tools and standards

5. ACTIONFIELDS

5.1 Municipal Strategy and Planning

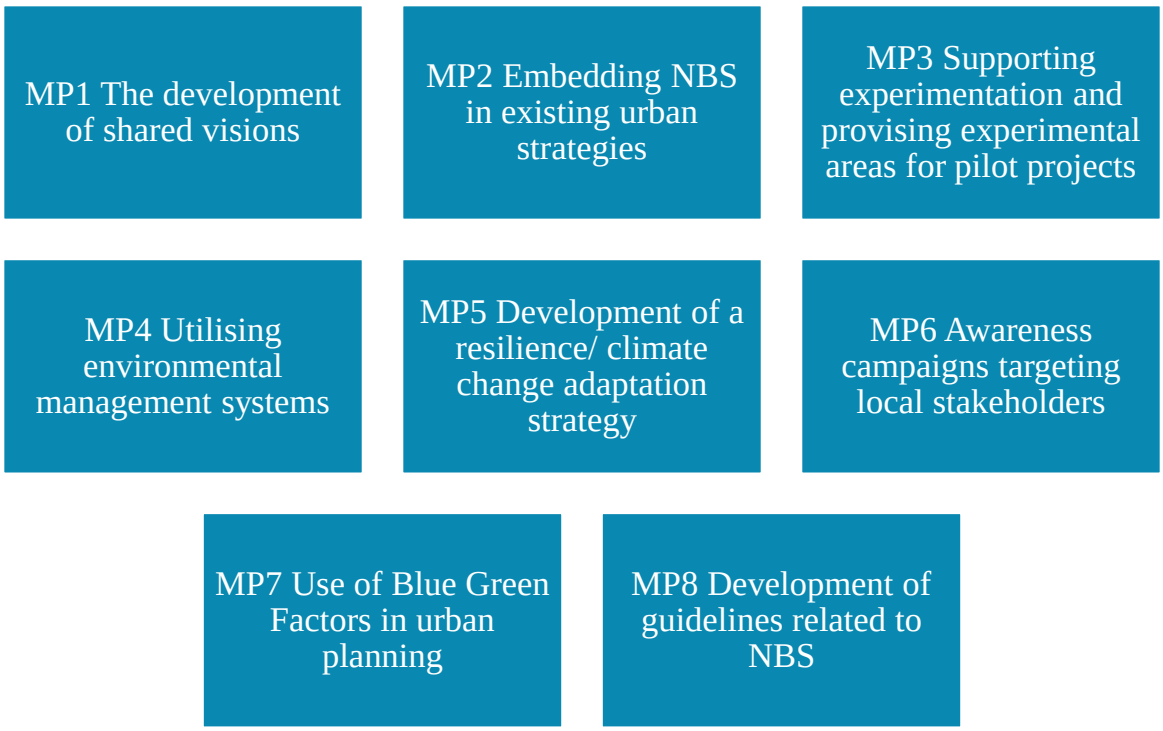
The success of NBS as a concept in supporting positive urban transformation will depend largely on the extent to which NBS become embedded in mainstream urban planning and development processes.

A central overarching challenge communicated by UNaLab partner cities was the being able to move beyond piloting and experimentation of NBS to the NBS concept being established as a principle in business-as-usual urban development. This demonstrates the importance of considering NBS in the context of wider urban development practices. In this regard, the intrinsic and strategic integration of NBS as a concept into the "DNA" of the city through elements such land use planning, building codes, and zoning is an important step in this process.

How can cities support embedding of the NBS concept more intrinsically in urban development processes? Each city is characterised by its own unique institutional and legal frameworks which govern urban development practices in cities, demonstrating the necessity of cities to pursue their own unique paths towards embedding NBS principles in these processes. Furthermore, such a complex endeavour merits more detailed explanations, which have been covered more directly in other publications. There are various guidelines available to support with the integration of NBS into land use planning, through the provision of principles and general guidance (Hanson et al., 2017).

Many of the actions highlighted in other sections (*Policies* and *Organisation and Structure*) will play a role in addressing this challenge, but there are a range of additional actions that have been identified within the context of municipal strategy and planning which can help embed NBS in longer planning processes in cities.

Actions:



MP1 The development of shared visions

In most cities, the planning of the urban structure is situational, project-based and often limited to the forthcoming 5-10 years. When considering the long-term planning of a city, it is difficult to take into account all the unforeseen changes that might occur over the longer-term. Planners have to constantly deal with shifting targets and conditions. This makes it difficult for cities to establish long-term plans using the urban planning tools available. An important building block of long-term planning approaches begins with the development of a collective vision. Cities will struggle to define precisely how the city will be 30 years in the future, but the process of actively and collectively defining what the city should become can act as an effective "guiding star" for urban actors to work towards. This can be an important mechanism to support the development of long-term strategy in the face of short-term political cycles, help justify policy interventions, communicate city priorities to citizens, and can provide an important basis to support performance management (see *MP4 Utilising environmental and sustainability management systems*).

The elements of this intervention might include:

- **Visions at different levels around different themes:** Visions can be developed at different levels from the whole city level, to local visions targeting specific districts, or even hyperlocal targeting specific streets or small-scale spaces. Furthermore, they can be developed around different priorities (e.g., car-free city, CO_2 neutral city, sustainable city, green city, smart city, climate resilient city, etc.). In Genova and Tampere, visions are targeted to the specific demonstration districts as beacons for future-oriented urban development, for which images (actual graphical representations depicting how the district might look) and concepts (e.g., circular economy, sustainability, NBS) act as important guiding images and principles, respectively. In Eindhoven, the approach is more conceptual rather than spatially defined, with the vision of creating a greener city with better connections and the creation of a green(er) city centre.
- **Integration of key stakeholders**: The development of visions between municipal departments can be an effective exercise in improving cross-departmental coordination. However, incorporating a range of (both municipality-internal and -external) stakeholders for both defining the vision and setting these objectives in the short, medium and long-term planning are of great importance. This could be either through a citizen-sourced input approach for vision creation, or the co-definition of key areas and priorities with local businesses or community groups. The inclusion of a range of stakeholders will give the objectives legitimacy and facilitate buy-in from those actors.
- **Linking to goals and milestones:** It is important that the city moves beyond abstract visions and makes the connection with specific targets and milestones. The collective development of SMART (specific, measurable, achievable, relevant and time-bound) goals will support the realisation of the defined vision. In Eindhoven, the "greening of the city centre" has been linked to a target of increasing the amount of green space in the city by 10%. This is an important target that is referred to by multiple stakeholders as an important mechanism of cooperation. It is important that related goals are defined as clearly as possible (i.e., go beyond such statements as "should be as green as possible" or "goal of enhancing biodiversity"). Clearly defined goals can also assist with the development of *MP4 Utilising environmental and sustainability management systems.*
- **Visual representation of the vision:** Often, words mean different things to different actors, which means they are sometimes not sufficient to encompass the elements of a complex vision. Therefore, the visual presentation of the vision in picture form is a powerful tool to ensure that all actors have the same understanding of the ambitions that are being proposed.
- **Communication of goals and visions:** Once defined, the goals and visions should be clearly communicated (e.g., on the city's website) and could be directly included in existing planning instruments (such as the planned GIS maps) so that they are easy to find.

UNaLab Stories: Visions for a Climate Resilient City

The UNaLab approach to NBS development emphasises the importance of co-creation of visions of a climate resilient future. Stavanger, Prague, Başakşehir, Castellon, Cannes and Buenos Aires have all developed ambitions and a vision for a climate resilient city for 2050 through workshops with various key city stakeholders. In future workshop rounds, these cities will each develop a roadmap planning the journey and clear actions toward the desired vision. Further information, along with the tools and knowledge required for cities do develop their own roadmaps, will be available in the Replication Framework which will be publicly available at the end of the project.

Figure 3: Stavanger's vision for a climate resilient 2050

Notes and links to further literature

- Roadmaps for Energy: http://roadmapsforenergy.eu/
- Citizen engagement in vision development: http://www.nexthamburg.de/#

MP2 Embedding NBS in existing plans and strategies

It is important that the NBS concept is understood in relation to other associated concepts. NBS is considered as an umbrella concept linking such established concepts as Ecosystem based Adaptation (EbA), Green and Blue Infrastructure (GBI) or Ecosystem Services (ESS) (see *Figure 4*). Sometime was required for these concepts to become established (to varying degrees, respectively) in cities around the world. NBS as a concept should not replace these related concepts, but build upon and support them (Potschin et al., 2015).

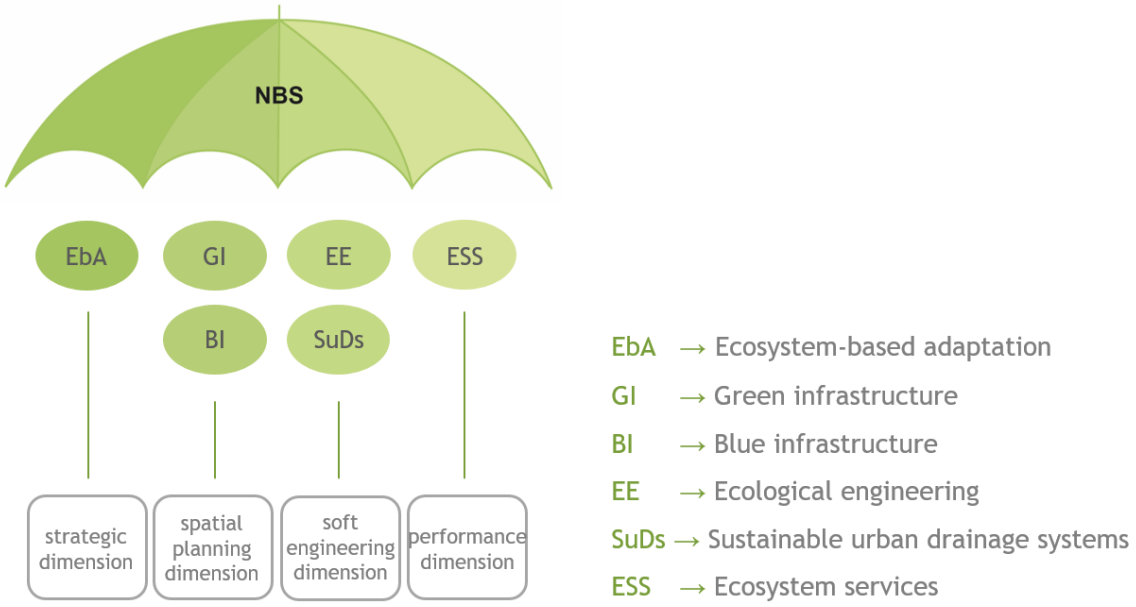


Figure 4: Nature Based Solutions relations to existing key concepts (Source: D5.1 UNaLab Technical Handbook (ILPÖ))

The action-oriented approach of developing "solutions" differentiate NBS from the other concepts in that it can be employed at a means for actors to achieve objectives. Therefore, rather than developing an individual strategy around NBS, there is significant potential to utilise NBS as a "tool" to achieve the objectives highlighted in existing or future strategies.

Some obvious links can be made to the following strategies:

- **Green/Blue Infrastructure:** If not integrated into a larger strategy regarding the maintenance and enhancement of green and blue infrastructure, there is a risk that NBS may be employed in a piecemeal and disconnected way. Co-benefits such as the effective delivery of ecosystem services and biodiversity protection depends to some extent upon the connectivity between green spaces. This emphasises the importance of establishing an effective strategy related to GBI as a basis upon which NBS can be deployed. In this context, NBS present a potential tool that planners can employ to negotiate the challenge of improving green space accessibility while promoting the "compact city" model for urban development. Through interventions such as green roofs and vertical greening, as well as multi-functional spaces, NBS can utilise the limited available space.
- **Climate Change Adaptation**: NBS have the potential to be employed in order to support the city to improve its long-term adaptive capacity, particularly in the context of climate change.
- **Social Cohesion**: The role of urban green space planning in promoting inclusive urban development and social cohesion has become more explicit in recent years (Haase et al., 2017). Social cohesion and inclusive urban development objectives should therefore be explicit in strategies utilising NBS and vice versa.
- **Biodiversity:** Green space connectivity is an imperative for effective habitat protection.

In addition, some less obvious links can be made to other urban strategies where NBS could be employed to achieve objectives such as those related to Smart City, Health and Wellbeing, Growth and Innovation, Mobility, Circular Economy, Climate Change Mitigation, and Participation and Citizen Engagement. A potential approach might be to establish a matrix of all the relevant plans and use NBS as a lens to identify actions that could be relevant for linking activities.

Existing Strategies and plans	Green/ Blue Infrastructure	CC Adaptation	Health and Wellbeing	Smart City	…
Green/Blue Infrastructure					
CC Adaptation					
Health and Wellbeing					
Smart City					
Circular Economy					
…					

Figure 5: Urban Strategy Matrix: A potential means to conceptually link existing strategies to identify common objectives and potential synergies

A similar approach or activity could be carried out to identify how current policy frameworks influence nature-based solution development and its implementation (see *RI1 Review of the existing policy framework*).

Notes and links to further literature

- Green Infrastructure - Studies and publications: http://ec.europa.eu/environment/nature/ecosystems/index_en.htm
- On NBS and relationships with related topics: Pauleit S., Zölch T., Hansen R., Randrup T.B., Konijnendijk van den Bosch C. (2017) Nature-Based Solutions and Climate Change – Four Shades of Green. In: Kabisch N., Korn H., Stadler J., Bonn A. (eds) Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Theory and Practice of Urban Sustainability Transitions.

MP3 Providing experimental areas for pilot projects

As the concept of NBS is new on most municipal agendas, uncertainties regarding the implementation, functions and effectiveness remain prevalent (see *Lack of Knowledge and Awareness*). This presents a significant challenge for cities as the risks of implementing new and innovative solutions are greater than opting for well-established approaches to urban development. Yet, in the endeavour to build sustainable and climate resilient cities, new and innovative approaches to urban development tested through processes of experimentation can be highly effective (Frantzeskaki et al. 2012; Smith and Raven, 2012). Experimentation can allow for the development of locally attuned interventions whilst facilitating learning processes between municipal staff, citizens, developers and other possible stakeholders. Providing test sites or piloting projects can help initiate learning processes while not interfering with the administrative day-to-day business.

Pilot projects can include geographically limited areas on municipal ground or they can consist of special organisational units within the municipal organisation. Both approaches can be combined. In some cases, experiments related to NBS are being developed in partner cities as part of the UNaLab

project. These were deemed important to demonstrate some of the impacts and co-benefits of NBS interventions and to allow citizens to experience alternative ways of building.

Experimental areas can also be important mechanisms for cross departmental cooperation, bringing together actors from multiple departments, municipal agencies and other urban actors to work on a specific project.

Elements of this intervention might include:

- **Experimentation with new formats for public space management:** Such sites can become platforms for the testing of new technical, organisational methods, as well as methods of co-creation and partnering with citizens and non-governmental actors, and new financing and governance models.
- **Exemption from certain codes and regulations:** The existence of certain rules and regulations often complicate project planning and implementation. Experimental areas could be set-up which allow greater freedom and serve as testbeds for innovative solutions and processes at a smaller scale. Such areas could, for example, be exempted from certain rules. They could also be used to test new incentive structures and participatory processes. Trial and error processes can be initiated and monitored and successful projects and mechanisms be rolled out.
- **Development of organisational units:** Even if the experimentation is not tied to a specific location, municipalities can establish a special organisational unit from within the municipal staff. For the implementation of NBS, municipalities are advised to consult a variety of different disciplines to ensure a broad representation of stakeholders and allow for budget sharing across the different disciplines. The newly created organisational unit needs adequate legal backing in order to perform tasks of relevance.
- **Temporary land-use conversions:** This approach enables the municipality to introduce and test potentially "uncomfortable measures" on a small scale and to assess whether the medium/long-term the benefits can be realised (such as through the temporary closure of roads or conversion of land-use in designated areas).
- **Scaling up:** For successful learning and scaling up, it is essential that results of pilot scale interventions and lessons learned are used to systematically inform mainstream urban development.

UNaLab Stories: Hiedanranta, Tampere[1]:

For the district development on the grounds of a derelict paper factory, the municipality of Tampere chose to establish a piloting site that is exempt from the municipal mainstream planning processes. The district was labelled "Hiedanranta – Smart and Sustainable City District of the Future" and the development phase started with an international ideas competition where international development agencies were asked to present possible development scenarios. Two ideas were selected by a jury and used in a new process of co-creation with citizens, local companies, the local research institutions and municipal employees. Together, the participants elaborated broad ideas and visions for the district. In a step-by-step process with the help of the Master Planning Department of the municipality, a detailed master plan was developed. From the beginning, the district development was given explicit funding in the city's budget plan. This distinct budget enabled the appointment of a dedicated project team consisting of a project manager and several project employees. The district budget also enabled financing of the international project call and the co-creation processes.

The new district was partly excluded from mainstream legal obligations, e.g., building codes, to allow for new and extraordinary interventions to be implemented. Among these interventions one can find new rooftop urban farming systems and a sustainable and decentralised sanitation system. The

[1] https://valiaikainenhiedanranta.fi/in-english/hiedanranta-smart-and-sustainable-city-district-of-the-future

combination of both experimental approaches – a distinct project team and funding, and a new and undeveloped municipal plot – allows for radically new technologies, management schemes and joint creation methods to be implemented. The municipality as a whole can now learn from the experiences of the project team in regard to the new processes and technologies.

Notes and links to further literature

- Hiedanranta - Smart and Sustainable City District of the Future: https://valiaikainenhiedanranta.fi/in-english/hiedanranta-smart-and-sustainable-city-district-of-the-future
- Paper on urban living laboratories: http://journals.sagepub.com/doi/abs/10.1177/0969776418787222?journalCode=eura

MP4 Utilising environmental and sustainability management systems

"What gets measured, gets managed": In order to track sustainability in the municipality it is important that the sustainability performance is tracked and assessed in a systematic way to ensure that objectives are being met. Performance monitoring can be linked to the visions and goals related to sustainability and resilience defined by urban actors.

A reorganisation of sustainability and environmental management systems supports not only the uptake of NBS, but also paves the way for wider reaching approaches towards more sustainable local practices. Well defined sustainability measures can be calculated and evaluated, thereby bringing about more efficient sustainability management. Only by monitoring and evaluation can the city effectively follow up on long-term sustainability goals and improvements in sustainability performance.

Elements of this intervention might include:

- **Environmental management systems (EMS):** Originally developed for private organisations, EMS have been adjusted for use within municipalities and have been adopted by a range of municipalities around Europe (for an overview, see (Salonen, 2010)). Some examples of EMS include: EMAS, ISO 14001 and ecoBUDGET.
- **Integrated management Systems:** The "Integrated Management System" (IMS) goes one step further than Environmental Management Systems to address sustainability across the municipal organisation as a whole. Cities are advised to follow established best-practice guidelines and learning networks on the topic. Among others, the municipal network "Managing Urban Europe 25" provides a step-by-step guide for municipalities interested in engaging in the topic (see further reading).
- **Indicators:** Indicators are measured variables or parameters to assess the performance of the city in meeting its objectives. Indicators should be SMART (specific, measurable, achievable, relevant and time-bound), and adapted to the city's objectives and local context.
- **Sustainability Reporting:** The performance of the city should be regularly published in a sustainability report and/or represented in a transparent way in an online form for the purpose of facilitating citizen engagement.
- **Linking budgets to sustainability goals:** Many sustainability objectives are inter-sectoral in nature. Thus, funding along departmental lines can inhibit projects with diffuse benefits. By explicitly allocating budgets to specific sustainability goals, assessment criteria linked to projects will be more targeted to addressing sustainability ambitions.

Notes and links to further literature

- The Integrated Management System for local and regional sustainability online guideline. Developed by the Union of European Baltic Cities alongside ICLEI and the EC: http://www.localmanagement.eu/
- For a comparison of Environmental management systems, see the Final research report: http://www.localmanagement.eu/index.php/mue25:downloads –
- For information on how to integrate biodiversity protection into EMAS: http://ec.europa.eu/environment/emas/pdf/other/EMAS_Biodiversity_Guidelines_2016.pdf

MP6 Development of a resilience strategy

Municipalities play a central role in the effective adaptation of the city to climate change, as well as a range of other potential future threats. In order to effectively respond to anticipated future changes, cities need to undertake strategic action today to enhance their resilience in the future. Cities are advised to start by adopting a comprehensive resilience strategy indicating all the risks (which need to be then re-assessed on a regular basis) and securing financial assets for resilience building in order to eliminate/reduce the identified risks.

NBS have been identified as an important tool to help improve urban resilience. By more closely aligning urban systems with natural systems that correspond with the city's location, the city can be made less vulnerable to external shocks and more adaptive to the effects of climate change (Kabisch et al., 2016a). Often, improved resilience is a primary objective behind the development of NBS such as the renaturing of rivers to reduce flood risk, the restoration of wetlands to buffer against heavy precipitation during storm events, or the enhancement of the city's green elements to mitigate the urban heat island effect. Some of the more significant advantages of these interventions will be likely seen in the coming decades, with the reduction in risk and damage costs in the future when the effects of climate change are fully realised. This distorts the true benefits of NBS interventions in the context of short-term assessment criteria to justify city projects.

Therefore, a good starting point to understand the true benefits of NBS is to look at the city through the lens of resilience. What are the main threats to the functioning of urban systems now and in the future? Which of these systems are crucial for the wellbeing of the citizens? How will climate change likely affect the city? What actions can be taken now to reduce potential shocks? These questions need to be answered through the development of a comprehensive resilience strategy. A resilience strategy can only be successful with a strong partnership approach to ensure the success of this plan. Principles and goals must serve the overarching vision and support it at any stage. For every goal, there must be multiple actions with a projected time frame and a business impact in order for the strategy to succeed.

Elements of this intervention might include:

According to (Bosch et al., 2017), the necessary steps for the development of an effective resilience strategy include:

- Assessment of risks and vulnerabilities of the city regarding climate change and resilience. This is an ongoing process: Regular risk assessment should be repeated within the city (on an annual or biannual basis)
- Identification and selection of adaption options among green and blue infrastructure
- Adoption of a comprehensive Resilience Strategy by the city leadership
- Development of an Action plan for resilience and climate change adaptation
- Implementation of the Action plan to tackle the identified risks
- Ensuring funds for risk assessment and risk reduction measures
- Assessment of potential NBS to reduce vulnerability to potential shocks

Notes and links to further literature

- Boston, United States (https://www.epa.gov/arc-x/city-boston-plans-adaptation)
- City of Windsor, Canada (https://www.citywindsor.ca/residents/environment/Environmental-Master-Plan/Documents/Windsor%20Climate%20Change%20Adaptation%20Plan.pdf)
- Melbourne, Australia (https://www.melbourne.vic.gov.au/about-council/vision-goals/eco-city/Pages/climate-change-adaptation-strategy.aspx)
- Project – 100 Resilient Cities: Cities that participate can be found here: http://100resilientcities.org/cities/

MP7 Awareness campaigns targeting local stakeholders (including citizens)

Raising the awareness of local stakeholders and citizens is vital to implement successful NBS programs. Increased public awareness and satisfaction with green infrastructure projects can lead to increased support for further projects as well as potential opportunities for private stakeholders to be a part of a wider transformation through NBS. As some of the benefits of NBS interventions can be more visible than their grey infrastructure counterparts (such beatification multi-functionality), effective awareness campaigns can communicate these benefits to the public more quickly in order to build support.

The elements of this intervention might include:

- Development of a communication strategy amongst municipal staff members involved with NBS/GI targeting internal and external stakeholders.
- Presentations and workshops that inform citizens and other stakeholders.
- Sharing information on the project stages in social media, city website etc. involving citizens by questionnaires, quizzes etc.
- Events for companies and researchers to increase their knowledge on NBS and related projects in cities.
- Pilot sites open for public, organised info walks, events, info sheets, signs close by informing about NBS, etc.
- Cooperation with schools and educational institutes and NGOs to educate public (urban farming, planting trees etc.)

UNaLab Stories: Inspiration book for NBS: Eindhoven

In order to spread awareness of the existing NBS in the city, Eindhoven has developed an Inspiration Handbook, showcasing the best practices regarding the development of NBS in the city. The process had a range of important outcomes:

- It allowed key stakeholders to develop a collective definition of NBS. This included key characteristics and objectives, supporting in a process of education and awareness raising.
- It praises local early movers providing incentives for local businesses to use NBS to improve their reputation in the city
- It provided the municipal workers with a document they could use to spread awareness of NBS and the city's objectives regarding CC adaptation and resilience.

MP8 Use of Blue Green Factors in urban planning

The operationalisation of certain regulations and incentives can be facilitated by the inclusion of specific management and planning tools. A prominent example in the area of NBS and green infrastructure, is the so-called Blue Green Factor (BGF). It is a factor-based policy instrument to ensure and maintain desired levels of green and blue in new development projects. As a non-economic valuation method, it scores the relative importance of different green or blue elements at a given site. This instrument allows developers and designers the freedom to decide how green or blue elements should be incorporated in the respective plans and, at the same time, can be used as evaluation criteria in public procurement or in the distribution of land (e.g., the higher the BGF in the development plan, the higher the chance of winning the project; or developments on a specific plot have to fulfil a minimum BGF). (Also see *RI3 Introducing NBS-supportive zoning regulations* and *RI4 Introducing incentives to enhance private sector engagement*).

Different cities are working on adapting such a tool in local planning processes, each highlighting different aspects:

- Berlin's green factor ("Biotope Area Factor", BAF) expresses the ratio of the ecologically effective surface area to the total land area. Different types of surfaces are weighted according to their beneficial impact on stormwater management, meaning that the same target green factor score can be obtained through very different plans. The different types of green surfaces are weighted based on, for example, their evaporative and retentive capacity, stability, connection to soil, and proportion of different habitats. The BAF has many similarities with the BGFs of Malmö and Seattle (described below), which are partially based on the BAF (BGMR 1990; Senate Department for the Environment, Transport and Climate Protection of Berlin 1990).
- Malmö's green factor ("grönytefaktor", GYF) is a calculation method based on the BAF, updated to make it applicable in the conditions of Southern Sweden. The City of Stockholm has since developed its own version with more ambitious targets for use in the pilot site of Royal Seaport, which is known as an ecological residential area. Stockholm's green factor is intended to more comprehensively take into account the climate impact, landscape ecology, diversity and social values of lots, which is why the method comprises more than 50 elements that affect the green factor score (Urban biologisk mängfald, 2017).
- Oslo municipality has developed a BGF which focuses on the function of urban flood control through blue green elements. Assessments take place on property scale and are conducted either by using an Excel spreadsheet or an android app, enabling a rapid assessment for property owners. Furthermore, pixel-based extrapolation of the BGF to assess whole catchment areas is being tested (Barton et al., 2016)
- The Seattle Green Factor scores a plot's vegetation and structures according to their capacity to trap and purify stormwater. Achieving the minimum green factor score set by the city is now a landscape requirement for new construction projects implemented in certain areas. In Seattle, exceeding the minimum targets set for land use classification makes it possible to negotiate on the permitted building volume for the plot; more area per floor can be built on a private plot (commercial or residential) if the amount of green surfaces in the area increases accordingly (La Clergue, 2007).
- The objective of the Toronto Green Standard, which is based on the previous methods, is to make both the building and the surrounding plot eco-efficient. The standard has two tiers; Tier 1 is a requirement for all new construction projects, whereas Tier 2 is voluntary. Individuals who attain the voluntary Tier 2 in their respective plot may be eligible for a refund on development costs based on, for example, the energy savings generated by the eco-efficiency improvement measures implemented. A similar green factor is also in use in Vancouver, Canada, (City of Toronto, 2018).

All the reviewed green factors use the same calculation principle: the green factor expresses the ratio of the weighted green area to the total area of the lot. However, the green elements, surfaces and structures included in the methods vary significantly, as do their weighted scores.

Figure 6: Screenshots from Oslo's BGF App (openness project; (Barton et al., 2016))

UNaLab Stories: Stavanger BGF

Stavanger has already established a blue-green factor to account for green spaces in urban planning. The city aims to upgrade and adapt this to improve its effectiveness. The following ideas have been discussed:

- As green spaces and NBS provide multiple benefits, a green factor should also involve more than just a quantitative and/or qualitative assessment of green and blue spaces on a plot of land. It could also **target multiple goals** and, for example, involve criteria around biodiversity, the use of native or pollinator-friendly species, the introduction of edible plants, etc.
- As each site has specific local preconditions and requirements, a green factor tool should be made dynamic and site-specific. This could be achieved, for example, through the creation of a **green factor map** where site-specific information is combined to determine the value and composition of the desired BGF.
- As requirements and sites change, the BGF should also be adaptive to future changes, e.g. through the establishment of regular and location specific criteria updates.

Notes and links to further literature

- Barton, David; Stange, Erik; Fongar, Claudia: Blue-green factor scoring. Openness Method Factsheet: https://www.nmbu.no/sites/default/files/methodfactsheetbluegreenfactor.pdf

5.2 Organisation and Structure

In light of the "siloed" nature of municipalities, with the respective municipal departments developing their own organisational dynamics, the cross-sectoral concept of NBS presents a challenge for cities in terms of the necessity to get multiple actors on board to develop an effective coalition to support NBS uptake. On the other hand, the concept presents a great opportunity to support and foster better cross-departmental cooperation as a longer-term organisational project. Like "sustainability" or "smart cities", NBS as a concept presents a potential tool to help break down silos between municipal departments as it can represent a common project and vision that multiple departments and actors can work towards. Thus, the cross-sectoral nature of the topic should be seen as an opportunity, as well as a challenge.

Every city has its own unique organisational and institutional structure. For this reason, it is difficult to define clear and generic guidelines for establishing effective organisational development. All three UNaLab Front-Runner Cities approached this challenge in very different ways. However, the identified actions highlight some of the central principles that will help cities improve their organisational structure in regard to NBS.

General principles to improve cross-departmental cooperation in municipalities:

- **Development of shared visions** (MP1)
- **Locate structures that enable or inhibit the cooperation of multiple departments:** Municipalities should explore the degree of interaction between departments and municipal agencies, both on a strategic and operational level. How often do meetings occur between heads of department? What opportunities do municipal workers from different departments have to meet and share ideas? What cross departmental projects are being worked on?
- **Adopt structural planning, i.e. unite people for a common organisational objective:** Define overall goals and departmental sub-goals so that everyone clearly understands their roles and how each contributes to realising overall objectives (also see *MP4 Utilising environmental and sustainability management systems*).
- **Facilitate effective inter-departmental communication and contact:** Bring departments closer through effective communication channels for exchanging ideas and information, and encourage mutual support rather than competition.
- **Sourcing, exploitation, and sharing of data is important:** consider the creation of common platforms for data sharing (also see
- Data Governance)
- **Develop OS1 Structures for cross-sectoral cooperation within** the municipality (OS1)
- **Utilising existing cross departmental structures:** many cities have already developed mechanisms to support cross-departmental cooperation under concepts such as sustainability and smart city. It may be possible to utilise these existing cross-departmental structures by linking existing initiatives with the concept of NBS, rather than developing new structures.
- **Committed leadership for coordination is a prerequisite.** Cross-sectoral cooperation is possible only if senior management invests effort in ensuring integration.
- **Include cross-cutting issues as part of job descriptions** and standard operating procedures in order to encourage staff to invest time on them (Burch 2010)
- With the goal to promote NBS, make sure that the **solutions are not only financed by one department** that has the main responsibility, but also by other departments that profit from it (van Ham and Klimmek, 2017).
- **The organisation of events** (round tables, seminars, open space, breakfasts, bar camps, mess up nights, etc.) between municipal departments around cross-sectoral topics such as

sustainability, resilience, climate change, NBS, etc. can be effective mechanisms to foster the development of networks and break down silos.

- The **establishment of flat hierarchies** within the municipality will improve communication flows between departments.

Actions:

OS1 Structures for cross-sectoral cooperation within the municipality

Municipalities tend to be organised along the lines of the functions and services they were established to deliver. The respective departments can have their own budgets, strategies, objectives, rules and organisational cultures. The cross-sectoral nature of NBS presents a challenge in the context of cities characterised by these "siloed" departments. One important step is the development of new structures that facilitate improved cooperation between departments.

Such structures can take different forms, such as ad-hoc teams, working groups with regular meetings and common work procedures, cross cutting programs based on city objectives, or new departments focusing on cross cutting themes or targeting a specific urban area. Formalised cross-departmental structures were identified in all three UNaLab Front-Runner Cities. These structures were different in all cities, reflecting the differing institutional contexts:

- Tampere has a sustainability department, and a specific department devoted to working on the lighthouse district of Hiedanranta.
- Genova established a cross-departmental body (Urban Lab) to support the co-creation and stakeholder engagement processes for the effective establishment of the demonstrated "Value Case" for Lagaccio Park, which resulted in the transfer of the land to the municipality from the national government. Beyond this, the city is undergoing a restructuring process to further break down silos through the establishment of project structures that integrate employees from multiple departments, rather than projects being placed in respective departments.
- Eindhoven has had a similar structure in place for around five years with cross cutting program structures linking departments based on defined strategic objectives of the city (see example below).

Cities should adopt the organisational structures that are best suited to their own institutional context. The following are some important aspects to consider when developing such structures:

- **Create a clear mandate for the working body.** This is usually achieved by linking the working body directly to the Mayor's office to achieve an obvious mandate, giving the body the power to enact change.
- **Create clear reporting structures for the cross-sectoral processes or bodies**. This ensures delivery of results, makes the work visible and enhances commitment to the work of the body/ies.
- **Physically locate relevant actors close to one another.** Reducing the time and costs involved with face-to-face meetings can be helpful in facilitating interaction between actors.
- **Providing common workspaces and meeting rooms for actors to utilise.**
- **Providing municipal workers sufficient time in daily schedules for effective collaboration.**
- **Effective feedback procedures, and vision and goal development within cross-sectoral bodies support establishment of a learning organisation.**

UNaLab Stories: Eindhoven's Organisational Web (adapted from (Radecki et al., 2017)

The city has restructured the municipality to take a more cross sectoral and agile approach to urban development. The former classical top-down organisation type was transformed into an "organisational web". In this web, programme managers work in an interdisciplinary way, connecting the different municipal-internal and external stakeholders of individual development projects. Through this process, the municipality has transitioned from a supply-driven approach of urban services to a demand-driven approach. This change increases the municipality's sensitivity to what is going on outside of the city administration. To be able to work from the outside in, Eindhoven needed to gain an understanding of and feeling for the developments and trends that shape the city society. These trends were translated into "themes" and "questions".

The transformation of the organisation was based on four key principles:

1. The reorganisation of departments and programs
2. The development of a cross-domain network of strategic advisors
3. The instalment of a strategic programming board
4. Linking of the budget cycle to the strategic programming

Reorganisation of departments and programs

The level below the Board of Directors was restructured into 15 departments corresponding to the three sections of **space**, **social services** and **municipal support services**.

These were underpinned with a range of cross-cutting programs identified through a cross-domain network of strategic advisers (see below) and through integrated meetings within the municipality. They ultimately reflect the development goals of the city:

1. Consolidating economic strength
2. High-quality public spaces
3. Climate adaptation and health
4. Urban densification
5. High quality facilities
6. Accessibility
7. Prevent social dis-integration / promoting co-habitation (different social groups are able to live together in the same city)
8. Enlarge independence
9. Preservation of quality of life in districts and neighbourhoods
10. Citizen's participation

Each program is run by a program leader, responsible for ensuring that the program is reflected within the operational work of the departments.

Cross domain network of strategic advisers

The development of a cross-domain network of strategic advisors - or similar positions – has helped the city understand trends and developments from outside the organisation and translate these for Eindhoven. This generates input for all the agendas in different domains, and also serves as input for the city level strategic document at a city level. With the development of an Integrated Strategic Advisors Team, Eindhoven laid the foundation for an integrated approach to urban development. Integrated cooperation is now a pre-condition for working on the strategic agenda. This has helped to create a common and shared vision. Every year the cross-domain network organises a **Strategic Table** together with the Executive Board of the Municipality as part of the budget cycle.

The Strategic Programming Board

Each year Eindhoven invests heavily in the development of the city, for the benefit of all. A large part of these investments is covered by a legal framework as required by law. Additionally, the city invests in specific projects, e.g., the city co-finances developments or becomes a risk-carrier in assignments. These investments are focused on the development of the city and are coupled with issues/themes that are deemed important. They are reflected through the 11 programmes defined as cross-cutting themes.

Eindhoven also seeks to understand other investments flowing into the themes. The **Strategic Programming Board** links the operations in the departments to the strategic agenda of the city, as reflected by the 11 programmes. During the Strategic Programming Board meetings real investments are matched with the strategic agenda. Eindhoven has been working with this operational approach since 2015.

Connection to the budget cycle

It is important that the Strategic Programming Board is connected to the budget cycle. This does not mean that the budget cycle should lead, but it is important that decision moments of the strategic programming table are connected in order that the themes, questions/issues and financial needs are included as the Executive Board make decisions. The budget cycle is therefore a key part of the Strategic Programming Board planning.

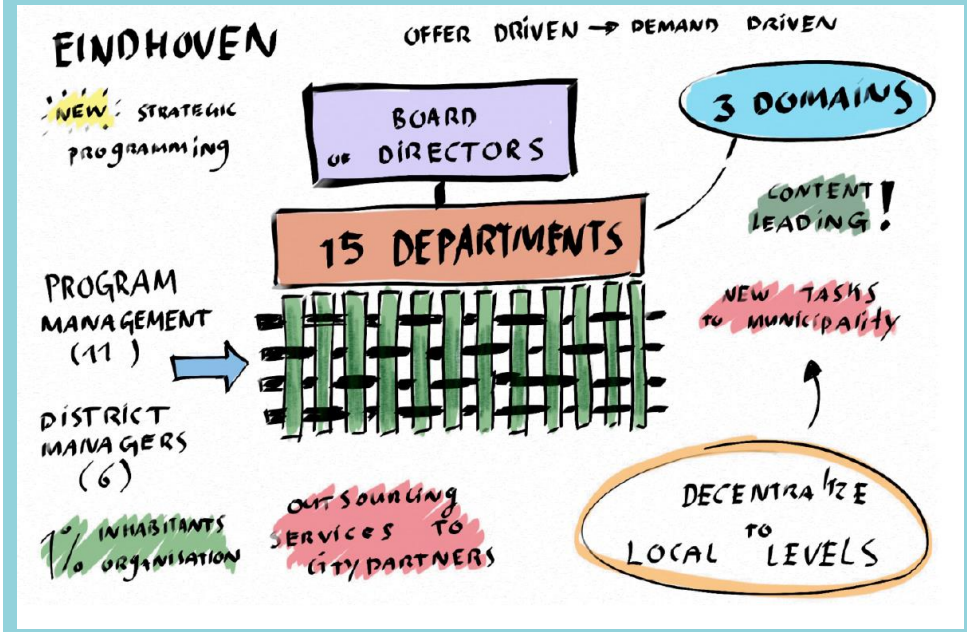


Figure 7: Eindhoven's Organisational Web

Notes and links to further literature

- Organisational development in Municipalities: Radecki, Alanus; Tommis, Martine; Bradley, Grainne (2017): Organizational Development for Smart Cities.

OS2 Fostering of informal networks between municipal departments

The establishment of formal cross-sectoral bodies is an important starting point for breaking down silos in the municipality. However, findings from the UNaLab Front-Runner Cit cities demonstrate the importance of the establishment of informal networks in promoting cross-cutting actions and working groups. It is important for local actors to know representatives from other departments personally and be able to contact them directly to organise a meeting or discuss relevant points. This is also important for the establishment of trust between actors.

Elements of this intervention might include:

- Spatially locating actors together (in some cases in the same building) to reduce the costs of interaction and facilitate 'natural' opportunities to interact.
- Providing opportunities for municipal workers potentially interested in NBS and/or similar cross-cutting topics to interact. Some cities organise events (seminars, workshops etc.) to bring potentially interested parties together to discuss the topic of NBS.
- The provision of time and resources to municipal workers to self-organise.

OS3 Training of administrative staff in cross-cutting issues such as sustainability and resilience

Personnel development and training in cross-sectoral issues is an essential part of a learning organisation. Training fosters knowledge transfer, enhances innovation among the employees and improves efficiency.

The elements of this intervention might include:

- **Training and capacity building, targeting processes and methods:** co-creation, design thinking, stakeholder engagement, project management, moderation, communication, etc.
- **Training and capacity building, targeting covering cross-cutting themes**: climate change adaptation and mitigation, sustainability, resilience or NBS. This approach can facilitate a change of perspective on an issue and raise awareness around a given topic while building relationships between municipal workers from different departments.
- **Mentoring programs** can be organised internally (e.g., to create understanding between those employees that work "outside" and the office workers) or voluntary mentors can be recruited from organisations that have knowledge on the topic, i.e. NBS. Mentoring is a good way to share knowledge and experiences and it allows for open discussion that is also fruitful for learning.
- **Staff-exchange between departments and municipalities** has several benefits for the organisation and the personnel involved. Well-planned job exchange acts as valuable skills development, good practices can be spread between departments and it enables gaining special expertise for a certain theme. The employee learns new ways of working, which they in turn will bring with them to their department and the exchange helps to keep up the enthusiasm and creativity of the employee.
- **Excursions to other cities.**
- **Excursions to certain sites** within the city to "experience" the transformation of the urban structure.

The following issues might act as obstacles for some of the skills development options that the city administration has to consider and overcome:

- Non-flexible governance structures may require revision
- Bureaucracy (it is made difficult in practice to get training or take part in job exchange)
- Insufficient resources allocated for skill development
- Perception at the management level that such training "takes time from actual work" or is considered a "waste of time". This requires a change in perspective through highlighting the potential productivity gains attained through staff training.

OS4 Integration of important actors

Every city is characterised by its own specific local constellation of actors, roles and procedures around the development of NBS. This makes it difficult to develop a clear list of actors who should be included in the development of NBS projects. However, some patterns emerged between the UNaLab Front-Runner Cities and there were a range of actors identified that were important to include early in the development of NBS. This list is not exhaustive and does not include the obvious local stakeholders (citizens, local businesses etc.) of a given intervention, but simply reflects some of the actors that should be taken into account when considering NBS development:

- **Green space and water management:** Often the topic of NBS is placed more centrally within the departments responsible for green space management and water management, respectively. These actors represent an important "core" of the network around NBS, but it is important that a certain degree of ownership of the topic is taken up by other departments and actors. Gaining support and access to the resources of other departments whose objectives can also be achieved through NBS is crucial for broad acceptance of the topic within the municipality.
- **Maintenance** departments were regularly identified as actors who should be integrated at an early stage. The success of an NBS often hinges on its effective longer-term management and maintenance. In some case, the interventions necessitated new skills and maintenance techniques. This emphasises the importance of effectively having these actors on board at an early stage.
- **Local NGOs** represent an important potential supporter of NBS, and cities should establish effective (formal) channels of communication with these actors. This can often be difficult in the context of the dispersed nature of local non-governmental initiatives. Eindhoven established an effective mechanism to deal with this challenge through the establishment of a NGO representative who acts as a spokesperson for local NGOs and offers a direct line of communication with the municipality.
- **Actors responsible for the promotion of health and well-being:** Improved health is generally promoted as an important benefit resulting from NBS. More effective integration of actors who can represent this perspective is an objective held by all UNaLab Front-Runner Cities, although the sufficient integration of these actors has not yet been established.
- **Marketing and communication:** NBS can play an important role in the branding of the city and, in turn, can act as an important communication channel to communicate the benefits of NBS to relevant actors.

5.3 Policies (regulations and incentives)

The challenge of integrating the diffuse benefits of NBS within existing administrative accounting schemes can limit the obvious "business case" for NBS, which in most cases promise social or environmental returns on investment. Furthermore, there is a need to involve the private sector in the successful implementation of NBS to create a connected network of green and blue infrastructure, considering that municipal resources and ownership of land are limited and the effective delivery of ecosystem services can only be achieved through holistic and connected developments.

With the right tools, policy makers can incentivise the implementation of NBS and strengthen their economic viability. As NBS is a topic that is linked to various disciplines and responsibilities, their realisation is influenced through a wide range of strategic documents and instruments, such as municipal green planning, urban planning, zoning, as well as building regulations, stormwater regulations and environmental levies. Additionally, cities are subject to numerous laws and regulations from different governance levels (European, national, regional and local level interventions) with direct implication for NBS uptake.

General policy principles cities could consider to improve the uptake of NBS include:

- **Using the right mix of policy tools and instruments for guiding behaviour and development**: Cities possess manifold tools and instruments, ranging from rather soft tools such as informational systems to harder command-and-control and economic instruments. These instruments allow policy makers to use them in different areas and urban contexts to influence and incentivise the implementation of NBS and to strengthen their economic viability. It is important to note that 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.

- **Effective communication of the policy objectives**: Policy objectives and targets should be well aligned with the cities' overall vision. The creation of easy-to-understand summaries, checklists and guidelines for the most relevant policy documents can help to better communicate these and make present them in an easy-to-understand way to different local stakeholders. Most importantly, the ultimate goal of the policy/law has to be clear. Furthermore, the inclusion of policy issues in (NBS-related) trainings may help to increase understanding and acceptance.

- **Linking all relevant regulations and their spatial relevance on an easy-to-use platform**: The creation of a space where all relevant policies are gathered and organised and can be found via user-friendly and targeted search options. This could for example be on the city's website.

- **Effective policy monitoring and evaluation**: To ensure the validity and practicability of new measures and evaluate their contribution and effect on NBS implementation, the city should ensure effective policy monitoring and evaluation schemes. These may also enable future improvement and learning opportunities and affect local uptake and perception.

- **Strengthening the science-policy nexus:** In light of the fact that NBS is a particularly interdisciplinary and cross-sectoral topic, cities need to cooperate with different experts and associations to make sure future legislation is effective and knowledge-based. In particular, the cooperation between science and policy making should be enhanced to ensure that new findings and innovative solutions can be quickly taken up and transferred into "real" projects. This approach could also improve the legitimacy of certain policies.

- **Creating opportunities for innovative solutions and pilots to be tested:** The lack of knowledge and pilot projects was mentioned as one of the fundamental barriers for NBS introduction. On the other hand, complex regulations and rules often complicate project planning and implementation. As it is difficult and risky to change the entire legislative setting, small-scale experimentation areas which provide greater freedom and serve as testbeds provide a good opportunity to explore future solutions and processes. Such areas could for example be exempt from certain rules or be based on more competitive mechanisms. They could also be used to test new incentive structures and participatory processes. Trial and error processes can be initiated and monitored and successful projects and mechanisms be rolled out (see *MP3 Providing experimental areas for pilot* projects).

Actions:

RI1 Review of the existing policy framework

As a rather new concept, NBS as such are often not explicitly targeted through local regulations and incentives. Still, as an integral and highly cross-sectoral part in the urban system, they are both supported and inhibited by various policies from different areas, including land and zoning, building and construction, water, air, nature conservation, social issues, etc. A more focused review and evaluation of the existing policy framework could help to:

- Gain knowledge on the impact the current system has on NBS projects
- Identify the bottlenecks which hinder successful implementation and uptake of NBS
- Identify opportunities for ways that existing schemes could be more explicitly used to support NBS implementation
- Eliminate obsolete regulations and policy artefacts which are no longer adequate to address the city's challenges
- Understand the multi-level interplay of European, national, regional, local level policies in the sectors relevant to NBS
- Identify opportunities where NBS should be further integrated
- Fuel discussions on policy trade-offs and continuous improvement
- Support the development of a holistic and interdisciplinary policy framework

When assessing the framework, the following aspects should be considered:

- In general, a good balance of regulations (command-and-control mechanisms) and incentives (market-based instruments) is beneficial to achieve specific goals in urban development. These instruments should complement one another and be consistent in the "story" they tell.
- The involvement of various stakeholders and actors in the review process will help to ensure different insights, knowledge and perspectives are respected and used. This could, for example, be realised through engaging a cross-sectoral task force or interdisciplinary working groups, organising public events and discussion forums, engaging external reviewers, etc. (also *see OS4 Integration of important actors*).
- When reviewing the framework, it is beneficial to pay close attention to the efficacy and the accompanying bureaucracy of existing instruments. Obsolete or redundant rules and regulations, as well as overly administered processes have been identified as a major barrier to successful NBS project realisation. These should be identified and amended where possible.
- As a thorough review process can be a significant undertaking, it should also be taken as opportunity to bundle and streamline national, regional, and local policies to better realise the overarching goals and targets.
- Regular review activities will help to keep track and adjust the course of the city's desired urban transformation

UNaLab Stories: Eindhoven Green Space Policy

The city of Eindhoven has a Green Space Policy Plan which is updated every 10 years. It describes the green history of the city, the local value of urban green, Eindhoven's ambitions for the future, and the supporting political policy framework. It thus represents the overarching green strategy and guiding principles for green developments in the city, whilst at the same time being used to inspire and inform local stakeholders and citizens. Several local initiatives such as "Trefpunt Groen" (integrator of local environmental NGOs) and the University of Wageningen have been involved in the review and updating process to respect local citizen and NGO perspectives, as well as up-to-date scientific advice. In the plan, NBS are explicitly mentioned as means to achieve the outlined goals and vision. In terms of policies, the Green Space Policy Plan provides an overview of all relevant laws and strategies at the national, regional and local levels and lists the main policy instruments which have been introduced or are currently being developed in this area.

The Green Space Policy Plan is freely available on the city's website.[2]

[2] *https://www.eindhoven.nl/sites/default/files/2017-06/LR_16112016_groenbeleidsplan_interactief_100dpi.pdf*

RI2 Introducing NBS-supportive building regulations

Buildings and new construction have a large impact on the natural water cycle as it involves the sealing of (new) surfaces, compaction of soils, and/or removal of natural vegetation. Also, other climate-related challenges in a city, such as urban heat islands, biodiversity and habitat loss, pollution, etc. are affected and may be worsened by such undertakings. Once built, these interventions are subject to long life cycles and result in significant path-dependencies, which makes careful planning, evaluation and regulation of these projects crucial.

In this regard, building codes are important instruments to steer urban development in a desired direction. These define and prescribe specific standards for constructed objects which development projects have to be conform in order to obtain building permission. Here NBS should be more explicitly incorporated. Instruments and mechanisms which could be deployed, include:

- **NBS-specific regulations:** regulations that explicitly require certain green infrastructure practices from developers. For instance, as part of the federal building code the city of Stuttgart requires that in areas with binding land-use plans, new buildings with flat roofs have to be equipped with a green roof (Mees et al. 2012; Kazmierczak and Carter 2010).
- **Target-oriented regulations:** Prescribing specific target values which have to be met. For example, in the Netherlands, a standard of 75 m^2 of green area per dwelling is requested. Districts which do not reach this target are considered green-poor areas (Municipality of Eindhoven 2016).
- **Preserving regulations:** Such as mandatory prefeasibility studies and respective water management plans which have to be handed in alongside development plans. Such are often part of a more comprehensive environmental impact assessment, but with special focus on demonstrating that the water retention capacity of the area is not negatively influenced and in best case improved by the proposed activities. Often, such feasibility studies have to meet specific stormwater retention requirements for the area under development.

Important aspects to consider when setting up NBS-supportive regulations:

- Revising existing regulations may have a better influence on the success of developments that the creation of new regulations would (Mees et al., 2012). Therefore, a thorough review and evaluation of existing regulations will be an important first step (see *RI1 Review of the existing policy framework*).
- It is important that affected stakeholders understand the rationale behind green infrastructure regulations. If there is support from the local ecosystem, the enforcement and operationalisation of regulations can be supported. In Copenhagen, for example, insurance companies refused to insure privately owned buildings in the neighbourhood Saint Kjeds that did not install backflow blockers from 2012 as required by the municipality (Wei Ping, 2016).
- Building regulations should also take the issue of retrofitting and building sanitation into account.
- In the case of NBS, maintenance plays a crucial role and should therefore be addressed early in the planning process. If NBS are deployed, maintenance plans should also be provided alongside with the building and water management plans.
- If regulation alone is deemed insufficient and can be combined with related incentives, sustainable building certification or other voluntary schemes might be considered. For instance, schemes like BREEAM and LEED are tools to assess the environmental performance of buildings that encourage developers to build better quality buildings and could be more widely adopted in mandatory norms and structures (*see RI5 Use of Certification Schemes and sustainability programs)*

Example: Policy measures for green roofs, Basel

An example for a successful integrated approach of NBS-supportive policy measures in the building area is the case of Basel: With a key motivation for the expansion of green roofs, which is to reduce the energy consumption of buildings and to protect biodiversity, the city uses a model to encourage the installation of green roofs that combines four funding streams and policies:

- Energy saving fund-incentives, which provide subsidies for the installation of green roofs
- Allocation of research grants to gain knowledge on biodiversity protection benefits from green roofs. The results were consequently used to shape green-roof regulations in Basel.
- Building regulation as amendment in the paragraph 72 to the Building and Construction Law, which establishes that all new and renovated flat roofs must be greened and also stipulates associated design guidelines.
- A contest to award the "best looking green roofs" as an incentive programme.

Thanks to these regulations and incentives, Basel enjoys one of the highest green roofs per capita ratios in the world (Kazmierczak and Carter, 2010b).

UNaLab Stories: River basin management plans, Genova

In 2001, the Liguria Region (Department of the Territory, Environment, Infrastructure and Transport) developed detailed **river basin management plans** which show individual features, associated risks, and future predictions, and carried out interventions in the area of soil and water management (see example *Figure 8*). Focus lies on hydraulic risk management in terms of flood and landslide prevention. They are used as urban planning instruments and are linked to **technical implementation rules** for the respective zones. Both municipal plans and proposed building interventions have to comply with these guidelines and be approved by the region. Furthermore, the Liguria Region also manages a budget of approximately 2 million Euros each year to spend on water management measures. Cities can apply for financing for their interventions if they conform to the river basin management plans and contain a maintenance plan. Larger risk mitigation interventions are being assessed and financed on the national level.

In terms of NBS, the river basin management plans state that "to maintain the natural characteristics of the territory, natural techniques such as renaturing and environmental engineering measures should be preferred whenever possible" (Provincia di Genova, 2014). Furthermore, each proposed intervention has to prove or introduce mitigation measures that soil permeability will not be negatively influenced as compared to the prior state.

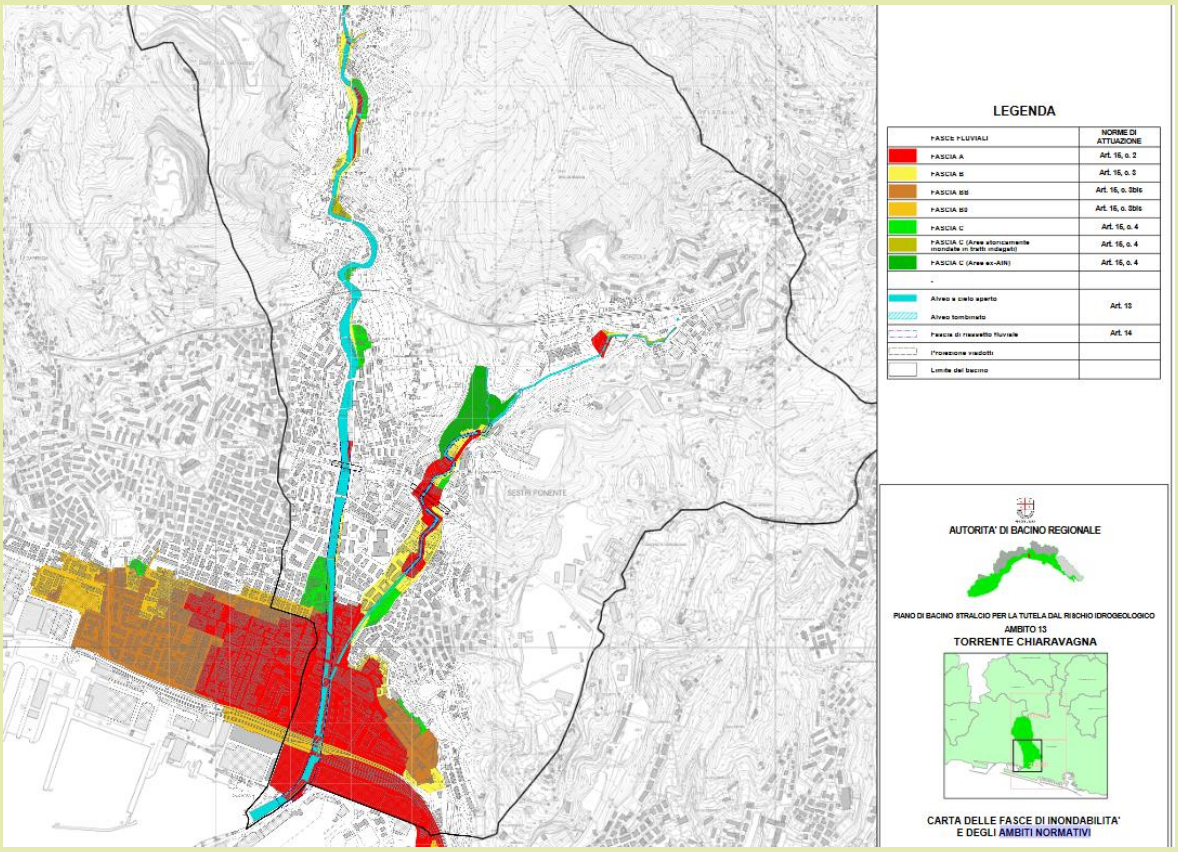


Figure 8: Example of river basin management plans in the Liguria Region, Italy. The map directly refers to specific (building) norms which have to be complied with.

RI3 Introducing NBS-supportive zoning regulations

Zoning plans are an important factor in green space planning and are a means to include site-specific preconditions in urban development. Zoning plans are thus often linked to site-specific regulations and norms. In terms of NBS they often aim at protecting green elements or natural features. They are often the basis for more concrete building codes and regulation (see *RI2 Introducing NBS-supportive building regulations*)

The following considerations may help to further promote NBS via zoning regulations:

- **Land ownership** is one of the key factors in project and site development and specific measures should be taken to identify and "reactivate" plots where time has led to an unclear state of ownership. Municipalities may also consider buying back land which is of strategic importance (e.g., in terms of green space connectivity or accessibility).
- The integration and synchronisation of zoning plans into **effective tools** can help to facilitate and support the uptake of important norms and requirements. As an example, GIS planning maps have been identified as key tool by the UNaLab partners.
- Zoning regulations and plans can be powerful tools to improve **green space connectivity**. For example, the Green Network Hamburg provides a masterplan for combining and connecting different green infrastructure elements and is an integral part of contemporary landscape planning and the formulation of new policies (City of Hamburg, 2018). In this

context, a close collaboration with regional, national, and even European initiatives (such as the Natura2000) is of importance.

In terms of **soil sealing**, construction permits can be a legally binding instrument to limit the state of sealing in a specific area or zone, e.g., for gateways, walkways, and parking areas, making the use of permeable surfaces compulsory. In the city of Dresden, for instance, it is compulsory the use of permeable surfaces when new parking areas are built, according to the Municipal Parking Space ordinance. An alternative could be as well calculating the sealing index – meaning calculating the most appropriate sealing rate for the particular construction and renovation projects in a specific zone or area (example of Province Alto Adige, Italy) (Prokop et al., 2011).

UNaLab Stories: Regulatory transparency through interactive planning tools, Eindhoven

The new Environmental Planning Act 'Omgevingswet' (2019) of the Netherlands requires cities to feed zoning maps and land-specific information directly into a national platform. By this, it "seeks to modernise, harmonise and simplify current rules on land use planning, environmental protection, nature conservation, construction of buildings, protection of cultural heritage, water management, urban and rural redevelopment, development of major public and private works and mining and earth removal and integrate these rules into one legal framework" (Ministerie van Infrastructuur en Milieu, 2016). In this context, the city of Eindhoven is currently developing GIS zoning maps which will provide an interactive planning tool with area specific information on relevant preconditions and policies.

Notes and links to further literature

- Further information on the Natura 2000 project on habitat protection and green connectivity: http://ec.europa.eu/environment/nature/natura2000/index_en.htm
- Overview of best practices and policies to limit and mitigate soil sealing in the EU: Prokop, Gundula; Jobstmann, Heide; & Schönbauer, Arnulf (2011): Overview of best practices for limiting soil sealing or mitigating its effects in EU-27. Final Report. Environmental Agency of Austria. Austria, last checked on 08.10.2018.
- How a green area ratio can be integrated in zoning regulations – background and technical guidelines from the Department of Energy and Environment in Washington DC: Cidlowski, Laine (2017): Green Area Ratio Guidebook., last checked on 08.10.2018.

RI4 Introducing incentives to enhance private sector engagement

Feedback from UNaLab partner cities suggests a strong impression of insufficient regulations and/or incentives in place that encourage local businesses to develop, implement or invest in NBS. Furthermore, whereas public green is mostly being financed and maintained through the city administration, there is a need to also encourage private land owners to develop and invest more in NBS. Incentives and market-based instruments are perceived as favourable option to create the necessary pull-factors and at the same time show the value that is being created through NBS. They help in conveying the message that "NBS are something desirable, which benefit all" instead of just making them "yet another requirement". This is perceived to encourage a more sustainable and voluntary behavioural shift. Financial incentives can attract investors and developers to invest in green and blue infrastructure and are an important income sources for projects supporting sustainability and climate resilience. But also non-financial incentive structures can induce behaviour change and promote NBS implementation.

Financial incentives that foster the use of green and blue infrastructure and NBS include:

- **Subsidies** can be used to encourage citizens or developers to use green infrastructure. Rotterdam, for instance, introduced a subsidy scheme for green roofs in 2008. Inhabitants

who want to construct a green roof can apply for a subsidy of up to 30 € / m² (Rotterdam Climate Initiative, 2010).

- **Grant programs** can be used to encourage e.g. building owners to install green infrastructure in their properties. For instance, the Green Improvement Fund in Onondaga County, N.Y. (USA), has a grant program for commercial properties that install GI in sewer districts. The grant holders can decide on the technique but the received grant depends on the amount of stormwater captured (Onondaga County 'Save The Rain', 2018a, 2018b).
- **Rebates** refer to funding tax credits or reimbursements to property owners that install specific green infrastructure practices. For instance, Maryland, USA, has implemented the "RainScapes Rewards rebate Program", which provides rebates based on the amount of stormwater runoff captured (Department of Environmental Protection 2018). In Maryland the incentive is part of the Storm Sewer System Permit goals (Department of Environmental Protection, 2015).
- **Fees** can also be understood as "negative incentives" or "disincentives" for undesirable actions that can be bound with regulations. In the Czech Republic, for instance, several measures have been undertaken to reduce water consumption. These included a policy that increased the water and wastewater tariff for households from 0.8 to 48 CZK/m^3, additional fees for the extraction of both surface and ground water, as well as for the discharge of wastewater. Overall, a reduction of household consumption by 40%, from 171 litres per capita per day in 1989 to 103 litres in 2002, was achieved (European Environment Agency, 2013).
- **Tax incentives** are combinations of regulation and incentive. For instance, the city of Wuppertal, Germany, has introduced a rainwater tax that encourages the use of permeable surfaces by providing a tax deduction (Dover, 2015). As an example, the tax incentive includes 3 Euros per parking space and year when permeable paving is established (Prokop et al., 2011). In the city of Stuttgart, a tax reduction of up to 50% incentivises green roof implementation (Mees et al, 2012).
- **Floor area ratio (FAR) bonus** can be offered for developments which implement green infrastructure on a certain floor area. This can ensure that a certain scale of intervention is achieved. The city of Chicago, for example, has introduced a FAR bonus for developments that include a green roofs (minimum cover of 50% or 2000 sq. ft.), pocket parks, planting terraces, or the like (Chicago Zoning Ordinance).
- **Premium and innovation vouchers** can be awarded to support implementation of promising NBS projects and elements. The city of Tampere is trialling the use of innovation vouchers for NBS in the development of the showcase district Hiedanranta.

Non-financial incentives that foster the use of green and blue infrastructure and NBS include:

- **Density bonuses** which grant more land and/or building volumes to projects which integrate NBS or tackle NBS-related challenges. As an illustration, the city of Chicago gives developers the right to build more units per square meter if the building features a green roof (Mees et al., 2012).
- **Application bonuses** which grant a higher likelihood of successful project application or development permit when involving green and blue elements. Here tools such as a Blue Green Factor can help to create and evaluate uniform criteria on the basis of which such bonuses are distributed (see *MP8 Use of Blue Green Factors in urban planning*)
- **Fast track processes** which give developers the opportunity to obtain their permissions earlier and be able to start projects sooner, if certain green elements or requirements are fulfilled.
- **Zoning upgrades** when significant requalification of an area is achieved, e.g. via the use of green and blue elements. These could, for example, lead to new opportunities, reduced requirements, and/or higher value of properties.

- **Reputation:** Offering recognition for sustainable design and corporate social responsibility, can be another important incentive to private actors. In UNaLab, for example, the use of certification schemes has been named as beneficial means to achieve transparency, continuous improvement and branding (see *RI6 Use of Certification schemes and sustainability programs).*

When introducing incentives, the following considerations may apply:

- (New) incentives should complement existing plans and strategies and fit in the overall policy mix to gain broad policy support. They should also go beyond simply supporting specific niche technologies and innovations and rather facilitate a more holistic and systemic transformation (goal/challenge-oriented rather than product-oriented).
- The municipality will need some kind of funds or other resource available to "reward" desired project ideas. If financially, these are optimally funds which have been obtained through regulations or taxes from related "polluter-pays" approaches. Other resources often refer to the use of land or material. This should be closely monitored to make sure no negative impacts are created (e.g., overexploitation).
- Cities also have to choose between giving a small amount of money to several properties or larger amount of money to fewer properties.
- Administrative burden and monitoring efforts should be kept as simple as possible to avoid unnecessary bureaucracy of incentive schemes.
- Incentives should be well communicated, accessible to all potential relevant actors and beneficiaries and be easy to find.
- When introducing new incentives (and/or regulations), the individual benefits and cost savings which arise from NBS implementation (e.g. energy savings, water retention, air purification, etc.) should be clearly communicated, highlighting the fact that there are more benefits and arguments for NBS implementation than the incentives provided by the municipality.

UNaLab Stories: Innovation Vouchers, Tampere

In Tampere, NBS are developed especially for quantitative and qualitative stormwater management. The largest NBS are located in parks and financed by municipality. Nevertheless, the city has identified the importance of including private land and gardens (green roofs, rain gardens, permeable pavement, etc.) as an important element of the stormwater management system. In the context of UNaLab, the city aims to encourage sustainable measures implemented on private plots through experimenting with innovation vouchers which support the inclusion of NBS in developments of the Hiedanranta district. They may be used to finance planning and/or NBS implementation on private land.

For more information see:

https://www.tampere.fi/asuminen-ja-ymparisto/kaupunkisuunnittelu-ja-rakentamishankkeet/hiedanranta/innovaatioiden-hiedanranta/unalab.html#.

Notes and links to further literature

- Chapter with examples and explanation of different economic-incentive or market-based policy instruments and their function within environmental management: Stavins, Robert N. (2005): Experience with Market-Based Environmental Policy Instruments. In: Karl-Göran Mäler und Jeffrey R. Vincent (Hg.): Handbook of Environmental Economics. Volume 2: Valuing Environmental Changes, Bd. 1. Burlington: Elsevier (Handbooks in economics, 20), S. 355–435

- Examples of incentives used in the context of NBS using the specific case of green roof implementation: Mees, Heleen L.P.; Driessen, Peter P.J.; Runhaar, Hens A.C.; Stamatelos, Jennifer (2012): Who governs climate adaptation? Getting green roofs for stormwater retention off the ground. In: Journal of Environmental Planning and Management 56 (6), S. 802–825. DOI: 10.1080/09640568.2012.706600.

RI5 Use of compensation schemes

Compensation schemes are mechanisms which ensure that the overall function (e.g. ecosystem services) of a specific site is being preserved. Such schemes are often coupled to compensation funds, which can be used to realise NBS projects throughout the city (if direct compensation at the same plot is not possible). For example, plot owners or developers might have to compensate for:

- **Sealing new surfaces** by enhancing green space and water retention capacity elsewhere on the plot. In this case, compensation measures build on the principle that soil sealing and hence the loss of soil function (habitat for multiple species, food production, drainage capacity, carbon sequestration, etc.) is compensated with restoration of soil functions somewhere else. Several countries have established mechanisms to compensate soil loss through payments (e.g., for changing agricultural soils into building land area) (Prokop et al., 2011). For example, the city of Dresden has a Soil Compensation Account to finance the removal of derelict buildings and soil unsealing. Any new development on undeveloped land has to be compensated either by directly unsealing soil, investing in greening measures nearby, or by paying a compensation fee to the Soil Compensation Account which covers the cost of unsealing an equivalent area of land elsewhere (European Commission, 2013).
- **Cutting down significant trees** by replanting species of similar ecological value (age, species, etc.) elsewhere on the plot or by paying a fee to a tree compensation fund. Such a fund has for example been implemented in the UNaLab city Eindhoven (Municipality of Eindhoven, 2016).
- **Causing ecological loss,** e.g., due to major infrastructure projects. For example, ecological compensation is a national policy in the Netherlands since 1993, especially for the construction of highways (Prokop et al., 2011).

Some of the lessons learned from such initiatives were that procedures should be simpler for investors and relevant actors, and that sanctions should be strengthened if compensation measures are not properly carried out. Furthermore, it has shown that having a pool of professionals or specialists supporting the measures will be beneficial to the overall implementation of such schemes (Prokop et al., 2011). Other important questions related to the effective establishment of compensation schemes include:

- **Compensation criteria:** Under which circumstances can a green element be compensated and when does it have to be strictly protected? Can new forms of urban green such as green roofs and facades be considered as compensation areas, and if so under what conditions?
- **Compensation Value:** What is the adequate amount for the compensation? How much does it cost to replace this element and/or restore the ecosystem services it provides? What ecosystem services and other values should be taken into account?
- **Monitoring**: How to ensure that the compensation measures are completed and are being kept after the plans have been authorised?
- **Bureaucracy**: How to minimise the administrative burden of such an intervention to make it efficient and "profitable"?

To facilitate the operationalisation of compensation schemes, these could furthermore be coupled to urban planning instruments such as a Blue Green Factor (see *MP8 Use of Blue Green Factors in urban planning*).

RI6 Use of certification schemes and sustainability programs

Several certification schemes and sustainability programs exist with direct or indirect links to urban green and NBS. The main value of such certifications is that if incorporated well, they stand for objectivity, transparency and trustworthiness and are perceived as beneficial by most parties (private, public and citizens). Especially in the area of targeting and activating private actors and civil society in NBS implementation, using and embedding certification schemes in the existing policy framework could provide additional incentives. Furthermore, such programs often come with tested and refined performance measurement systems and allow for direct comparisons. When using certification as criteria (e.g. for tax reductions or other benefits), cities are also saving on evaluation and monitoring efforts which the issuing organisation is already providing. A good understanding of the certification process will be necessary to evaluate whether it supports municipal targets (e.g. NBS implementation) and if it includes life cycle considerations for long-term validity. Furthermore, certification comes along with a threat of an increase in overall bureaucracy and the potential of favouring organisations who can afford such a process. Certifications can also be linked to building codes and regulations, or being tested by e.g. requiring that all publicly owned buildings have to be certified.

Concrete examples include:

- **BREEAM certification**[3]: Originating in the UK with local versions available and focusing on sustainable building, retrofitting and land use practices
- **LEEDs certification**[4]: Originating in the US and focusing on sustainable building practices. For example, Chicago has introduced a green permit program that processes permits more quickly for developments that meet specific LEED requirements (United States Environmental Protection Agency, n.d.).
- As a local initiative, Singapore has introduced a **Green Mark Scheme** (launched by the local government authority). The green building rating system has been managed by the Building and Construction Authority and sets benchmarks for energy efficiency and environmental performance. In 2013, Singapore set the target of 80% of the total building stock being Green Mark rated by 2030 (Singapore Building and Construction Authority, 2014).

Next to building or district certifications, cities have also been working with more organisation-related certification schemes such as EMAS, The Natural Step, or agreements such as the Aalborg Commitments to push sustainable and green practices and solutions (see *MP4 Utilising environmental and sustainability management systems*).

UNaLab Stories: Tax cuts for certified companies, The Netherlands

In the city of Eindhoven, all companies that are BREEAM certified (by the Dutch Green Building Association) are entitled to company tax reductions. Furthermore, the certificate is perceived as good marketing and communication tool by both public and private actors, as well as by the citizens. Parameters in the BREEAM certificate which are related to ecosystem services enabled by green infrastructure are for example credits for enhanced permeability or run-off capture measures, as well as credits for measures which provide habitat to native species, local food production, building insulation, or cleaner air (DGBC, 2012) .

[3] https://www.breeam.com/

[4] http://leedcert.com/

5.4 Data Governance

The emergence of NBS as a concept to support resilience and sustainability in cities has coincided with the wider transformation around "smart cities". The provision and effective management of high quality data is a central supporting mechanism for cities to effectively address their urbanisation challenges through NBS and other approaches. In addition to the implementation of adequate ICT solutions, cities need to organise their data management and data governance structures, which can ensure structural integration, availability and quality of data.

What is data governance?

Data governance includes all practices and decisions that aim to define roles and responsibilities, decision frameworks and the business rules for data management (Otto and Österle, 2016). As a central objective, data governance will ensure that "data can be trusted and that people can be made accountable for any adverse event that happens because of low-quality data" (Ritter, 2017). Principally, data governance in a city means to manage, regulate and stimulate the provision, use and exchange of datasets from various sources in order to provide a value-added service to all citizens and urban stakeholders. At the municipal level, this involves the provision of open data and dealing with questions about which datasets should be made open and which should not, but also the negotiation with third party data providers that may possess datasets with high relevance to drive a sustainable and resilient development of the city.

How can data governance support the uptake of NBS?

Good implementation of a data governance framework can facilitate the implementation, and enhance the sustainability and effectiveness of NBS-based projects. Effective data governance can support the implementation of NBS by:

1. **Providing effective monitoring**: one of the central challenges associated with NBS is the abstract and diffuse nature of the benefits created. Effective data management and innovative impact assessment mechanisms can make some of the value created through NBS more tangible and provide evidence of the benefits for such interventions.

2. **Helping to effectively target NBS**: through hyperlocal, real-time understanding of local conditions (e.g., air quality, flood risk areas, urban heating, biodiversity, etc.), cities are better able to effectively target NBS so that they have maximum impact.

3. **Improving the city's ability to respond to changing conditions**: particularly in the context of water management, the often-decentralised approach to water management through combined grey and green, mixed-use approaches can be significantly aided by the early warning signals and detailed monitoring that are made possible through effective data governance.

4. **Supporting the development of maps for effective green space management**: effective data governance is a prerequisite for the development of data based tools (such as satellite imagery or GIS mapping).

5. **Supporting citizen participation in the identification, protection and enhancement of ecosystem services**: citizen platforms can play an important role in both raising awareness about the services provided by nature, as well as collecting valuable understandings about existing ecosystem services in the city (through, for example, crowd-sourced environmental monitoring).

What can cities do to implement and/or improve their data governance?

Municipalities not only need to organise internal data processes, but also regulate what other stakeholders are allowed to collect and do with public space data. Subsequently, from a holistic city point of view, sustainable data management and governance happens on the following three levels:

- Inside departments and agencies (highest maturity in the three UNaLab Front-Runner Cities[5])
- Across departments and agencies (mostly low maturity)
- Between municipal departments/agencies and external parties (mostly low maturity)

There are multiple definitions of how data governance and management should be organised in an organisation. For this report, we follow a data governance reference model (Sautter et al. 2018), which is summarised below in *Figure 9*.

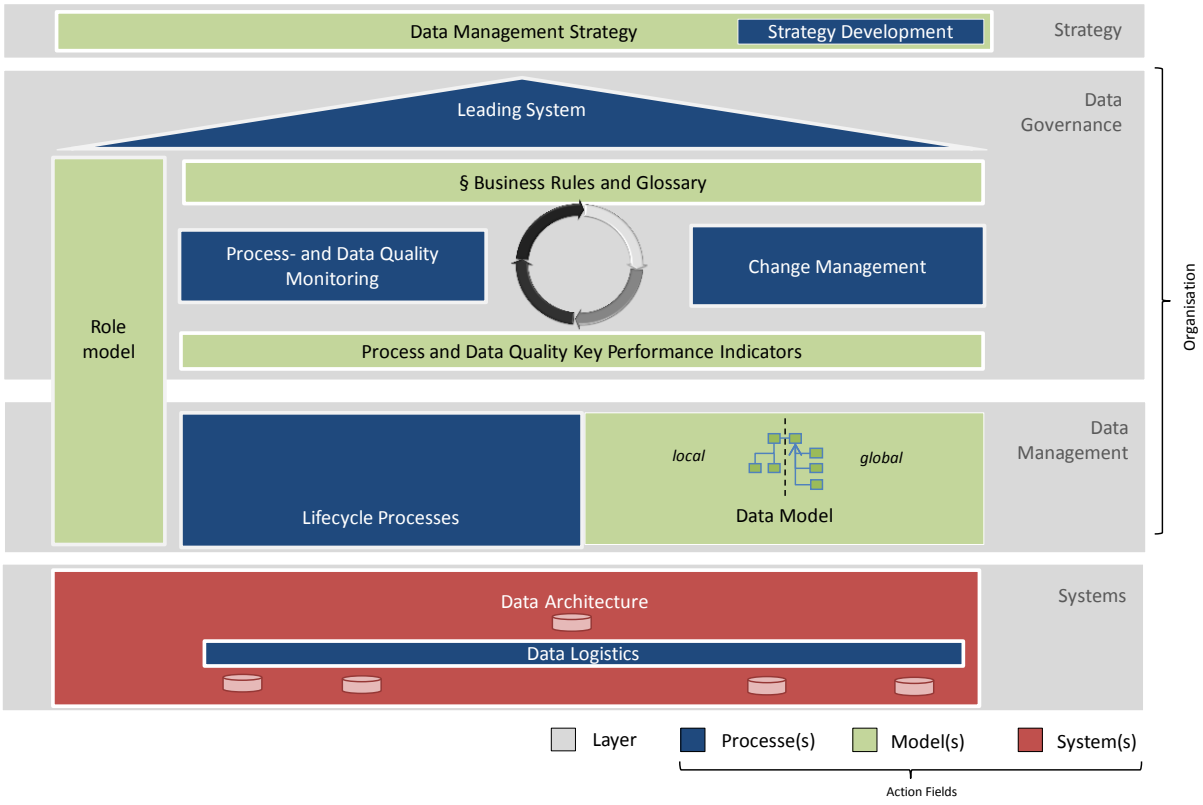


Figure 9: Data governance reference model (Sautter et al., 2018)

Reference model levels

1. Data Management Strategy

Every city needs to define a data management strategy that is systematically derived from long-term objectives and legal requirements. Open data should be defined and implemented by offering an open data platform to citizens and other stakeholders. In order to succeed, local governments need to integrate data structures on a city data model level taking into account standards and data platforms required by

[5] As assessed in a data governance status quo analysis in (UNaLab *D5.2 Municipal Governance Recommendations*) in Tampere, Eindhoven and Genoa

other governmental levels (e.g., regional, national or EU level). However, many of the data objects will still be defined on a department/agency level, as they are only needed and processed by one government unit. This must be accompanied by regular updates on data management requirements and the strategy itself. Furthermore, highly-ranked civil servants should support data management through political activities and drive its adoption.

The strategic level of the reference model formulates long-term guidelines regarding data-related goals and culture. The strategy should pay attention to the following aspects:

- Is the data management strategy systematically derived from long-term objectives and legal requirements?
- Is data regarded as of strategic value and managed accordingly?
- Does the city have an open-data-strategy? Are policies and regulations relevant for an open data platform observed?
- Are the city's data management strategy and data management requirements updated regularly?
- Do the Mayor, ministers and other highly-ranked civil servants support data management through explicit actions, decisions and supportive statements?

2. Data Governance

In order to monitor the realisation of the respective data strategy, indicators for individual processes must be defined. To guide and enforce data management, data governance should take into account the following aspects:

- Is the strategy’s implementation monitored regularly and in a systematic way (e.g., using data and process indicators)?
- Are data management roles, tasks and responsibilities documented, trained and executed by the role owners?
- Is data quality continuously measured by metrics or key performance indicators?
- Is the performance and progress of data management continuously measured?
- Do all employees have the possibility to initiate data management improvements?
- Are there business rules based on legal requirement, privacy and security issues?
- Are data objects defined in a glossary or a commonly known data model?

3. Data Management

Regarding data management itself, departments should focus on the definition of data lifecycle processes and corresponding rules. The development of a data model including metadata schemes is thereby a crucial step as it supports management between departments or agencies.

4. Systems

At the systems layer, data architecture and data logistics processes need to ensure that a single trustworthy version of each dataset is well defined and synchronised to related applications. This implies either the implementation of a single system that captures all cross-department dependencies or the integration of several systems dedicated to departments and data types. Furthermore, an interoperable and standardised open urban platform (DIN, 2017) set-up and management of an urban data platform could be an essential part of an IT architecture.

Actions:

DG1 Data management strategy

Data management is gaining importance in cities where there is an increasing adoption of new technologies as well as governance requirements. A comprehensive data management strategy should be derived from the local government's long-term objectives and legal requirements. A strategy can help cities to better encompass their data-related goals within sustainable development measures.

At present, cities are handling an increasing variety of data due to the implementation of Internet of Things (IoT) technologies and different types of planning tools and platforms that are being used to manage infrastructure, support planning and management of urban areas and offer new services to citizens. In addition, urban data are changing due to the use of social media, mobile services and citizen participation. Cities producing and working with good quality data are able to make better decisions that favour liveability and sustainability in the urban context. To guarantee good quality data, data management in public administrations needs to be efficient, cross-sectoral and to take into account the importance of data security and privacy. Finally, it is important that cities create new partnerships with a variety of stakeholders in order to ensure that data and related services are well maintained, and that the services address the citizens' needs.

Among the common obstacles local governments face when managing data are:

- Cities typically have many isolated, disconnected databases and platforms.
- Urban data are produced by a multitude of systems and distributed and collected through different channels and actors.
- Lack of data interoperability, a strong platform leadership and strategies that enable open and proprietary data providers to co-exist and co-operate, and the disregard of new data business models, regulations, policies, use and re-use.
- City-wide fragmentation in the logistical distribution of urban data.
- Provision of obsolete, non-valid, and non-value-adding data.
- Substantial human workload to prepare datasets for machine processing and to make them comprehensible.
- Lack of widely-accepted standards for expressing the syntax and semantics of urban data.
- No definition of policies, licences and regulations for urban data re-use and commercial exploitation.
- Non-realistic scale ambition for the implementation of data platforms (e.g., changes not occurring in small increments).
- The wide range of stakeholders involved in the delivery of a data infrastructure.

- Managing the tensions and conflicting expectations between the providers and consumers of urban data.
- Management of intellectual property and contracts with regard to data, data security, and privacy.

UNaLab Stories: Urban Data Centre - Eindhoven

Although data integration across the organisation is still in its infancy, Eindhoven has already started to make the first steps. Following the Smart Society Program developed in 2016, the municipality and the CBS[6] created an Urban Data Centre. According to the CBS official website, the UDC started with 10 projects which include a "compilation of neighbourhood-oriented information, enriching data on companies …, and charting visitor flows with the aid of sensors and Big Data sources" (Centraal Bureau voor de Statistiek, 2016). Through the combination of data from the CBS and the municipality, it is possible to measure how different variables evolve and to obtain information that can guide policy-making. As the Centre's project is still under development, environmental data are not yet integrated in its analysis, although it is expected to be in the future. The UDC still lacks a data owner who should be in charge of coordinating all projects and taking decisions about data science and its structures.

DG2 Data governance and management inside departments

Data governance is a key element for sustainable data management and includes several elements to which the city has to pay attention: monitoring, management roles, data quality measuring, and operational rules.

To realise an efficient data governance inside each department the following issues should be addressed:

- Defining data management roles and ownership for each data object.
- Defining a glossary for important terms and data objects.
- Defining rules for coherencies.
- Defining processes for data creation, e.g., supported by templates and checklists.
- Defining a departmental data model consistent with the city data model (and referring to standards from higher governmental levels).
- Continuously assessing data quality using metrics or key performance indicators.
- Continuously measuring performance and progress of data management.
- Clearly deciding and defining what belongs to departmental data models and to city data models, and who owns each dataset.

UNaLab Stories: Ownership – Eindhoven

After the creation of the Data Digitalisation and Classification, the CIO (Chief Information Officer) Office has determined new rules for data ownership. Essentially, all datasets should have an owner (person in charge), who is responsible for the maintenance and update. Every three months, data owners are asked about the datasets and, if changes should be made, to keep them up-to-date. They have also ruled that if a data owner leaves the municipality, the supervisor of that person becomes the

[6] Centraal Bureau voor de Statistiek – CBS, acronym in Dutch

new owner of that dataset. Thus, there are no datasets with no person in charge. Finally, the CIO Office is in charge of controlling these processes and that these rules are properly enforced.

Metadata – Tampere

As a first step to organise its data management, the Public Space Department assesses the data they produce and manage and create corresponding metadata. These metadata serve to locate datasets more easily and to know what kind of information they provide, increasing efficiency in process involving data use.

Notes and links to further literature:

- Stakeholder should be linked across departments by strengthening an operative moderating and conceptual role for data management/data governance.

DG3 Data governance and management between municipal departments

Data Governance plays an important role in all levels of a municipality. Therefore, to realise an efficient data governance between municipal departments the following issues should be addressed for urban data objects:

- The realisation of the strategy should be monitored regularly and in a systematic way (e.g., use data and process indicators).
- Operative data management roles should be strengthened and highly-ranked civil servants should be added as data owners.
- A city data model, corresponding business rules for data objects, and a glossary containing important definitions of urban data objects should be implemented.
- Special effort should be put into cross-departmental data management.
- In order to create awareness of interdepartmental dependencies, it is necessary to increase the transparency regarding internal procedures and policies adopted by the departments.
- Cross-departmental data owner-user relationships should be taken into account.

UNaLab Stories: Holistic approach – Eindhoven

Recognising the obstacles that working in silos poses to data sharing and governance, the municipality recently has established a roundtable dialogue with periodic meetings to discuss how to implement a holistic approach towards using, sharing and managing data. A facilitator, independent from all departments, and representatives from all departments including policy advisors and data scientists attend these meetings. Although it is a new procedure, the aim is that data processes are integrated and that data are managed in a smart way.

DG4 Data as an instrument for governing external agencies and contractors

As public space data can be understood as public property, several public authorities have defined data access as a precondition to public contracts (e.g., for the operating of public facilities or even for the sale of a space dedicated to a parking garage). This practice helps municipalities to gain access to data and to guarantee data quality, as well as citizens to use apps that contain data from public facilities via third party apps (e.g., based on an open data API offered by a public authority).

On the other hand, it is also crucial to gain access to specific data from third parties as it could help to optimise municipal services. As it is not always a simple task to convince third parties to share

their data, below are some options to ease the implementation of such measure. This guideline is the result of a discussion and assessment done in a SmartImpact[7] workshop (Radecki, 2018):

1. Identify and map your third parties. Who can provide what type of data (energy, environment, transportation, production, waste, labour markets, housing etc.)?
2. Understand how you / the city can provide a benefit to the data-producing company - what is in it for them?
3. Provide incentives for voluntary data sharing (e.g., tax reductions or access to restricted municipal data).
4. In some cases, it may be opportune to buy data from third parties. In these cases, costs and benefits need to be assessed carefully before purchasing datasets.
5. Some cities have experimented with urban data transaction platforms. These allow trade and exchange of data on an open marketplace.
6. Provide the city (public space and public infrastructure) as a testbed to create and analyse data. Many companies are keen to trying new data-based services and business models – but make sure access to the data is a prerequisite.
7. Create Data Partnership Agreements between companies, the municipality and research to create added value from the data and to develop pilot applications based on data. This can provide value to the company and the city. The requirement for receiving the value is that the companies share their data.
8. Provide checklists, APIs and pro-formats for data sharing. Make it easy to share.
9. Use regulations to gain access to data – e.g., on energy consumption of buildings (Tokyo) or shared bikes used in the city (Manchester).
10. Make the provision of data a condition for all city-related contracts (providing licenses, concessions, selling or renting land, awarding contracts etc.)

UNaLab Stories:

BetaBeta app – Eindhoven

The Department in charge of the green areas' maintenance is using an app called BetaBeta to control contractors' responsibilities. Citizens are the main users of this app, which allows them to report whenever a green area has not been well maintained. They can even take pictures and add them to their statements, which are sent to the municipality. Civil servants check the information received and evaluate whether or not is the contractors' responsibility to provide maintenance to the reported green area. If the contractor is responsible for the situation reported, then the information is sent to them, in order to be solved rapidly.

Data guideline – Tampere

Based on national regulations, the municipality developed a guideline that states how data from building projects should be shared with the municipality. The main goal is to agree on the formats in which data will be shared. This is one the first steps taken by Tampere to organise data-based relations with other units and contractors. Currently, they are assessing how to improve this guideline in order to make it more comprehensive.

[7] A European project, find more here: https://smartimpact-project.eu/

5.5 Finance and procurement

Since many NBS are in a demonstration phase, their funding is largely driven by the national and sub-national governments, as well as international institutions and donors, such as the EU. While for some cities the donor funding can be particularly important for initiating the innovative NBS interventions, others might rely extensively on their internal revenue sources to fund NBS. By any means, for NBS to reach their full potential in providing the environmental and social benefits, the continuity as well as a more mainstreamed implementation of NBS needs to be ensured. This in turn calls for sustainable and long-term financing models for NBS.

NBS benefits tend to have public good characteristics, while NBS interventions often concern public land and/or buildings. Subsequently, the majority of the funding schemes for NBS seem to follow a top-down approach and rely on the public budgets. Such a trend was observed in the UNaLab Front-Runner Cities. However, cooperation with the private sector should not be overlooked. Private sector stakeholders could bring more efficient solutions and additional resources for NBS implementation. Depending on the local context, engaging with private sector stakeholders could be crucial for the success of NBS projects (e.g., if the land envisaged for NBS interventions is owned by private stakeholders).

Another aspect that might potentially influence the success of the NBS uptake is public procurement. NBS implementation should call for extensive exchange and communication between the procurement office and other municipal departments to ensure the best strategy for the sourcing of NBS technologies and suppliers. However, financing and procurement aspects for NBS are very context-dependent and some cities might perceive this aspect as less challenging than others.

General principles cities could follow when considering finance and procurement strategies for NBS implementation:

- **Focusing on building a solid revenue base**: It could often mean seeking greater diversification of the municipal revenue sources. Both external and internal financing sources could be used by cities to maintain and/or increase the financing available for NBS.

- **Enhancing the external revenue base**: The municipalities might rely on the intergovernmental transfers from the national government or borrow from public and private actors. However, to be able to secure long-term financial sustainability, local governments need to align borrowing instruments with their capacity to serve debt and bear risks (Kamiya and Zhang, 2016).

- **Collecting more internal revenues**: By introducing new taxes, fees and charges, the local governments not only collect revenues but also have the ability to steer the behaviour of local businesses and individuals towards the strategic objectives of the cities.

- **Considering polluter-pays principle when designing new ecological fiscal instruments:** The principle implies that whoever bears the responsibility for the negative (environmental) effects should incur costs associated with the damaging activity (Pitrone, 2013). If polluters are taxed on their harmful activities, society is compensated. This way, not the whole society but only the polluting entities compensate for the negative externalities associated with their operations. Adopting this principle could have the two-fold effect of potentially discouraging harmful activities as well as providing additional revenues to the cities that could be spent to fund interventions like NBS.

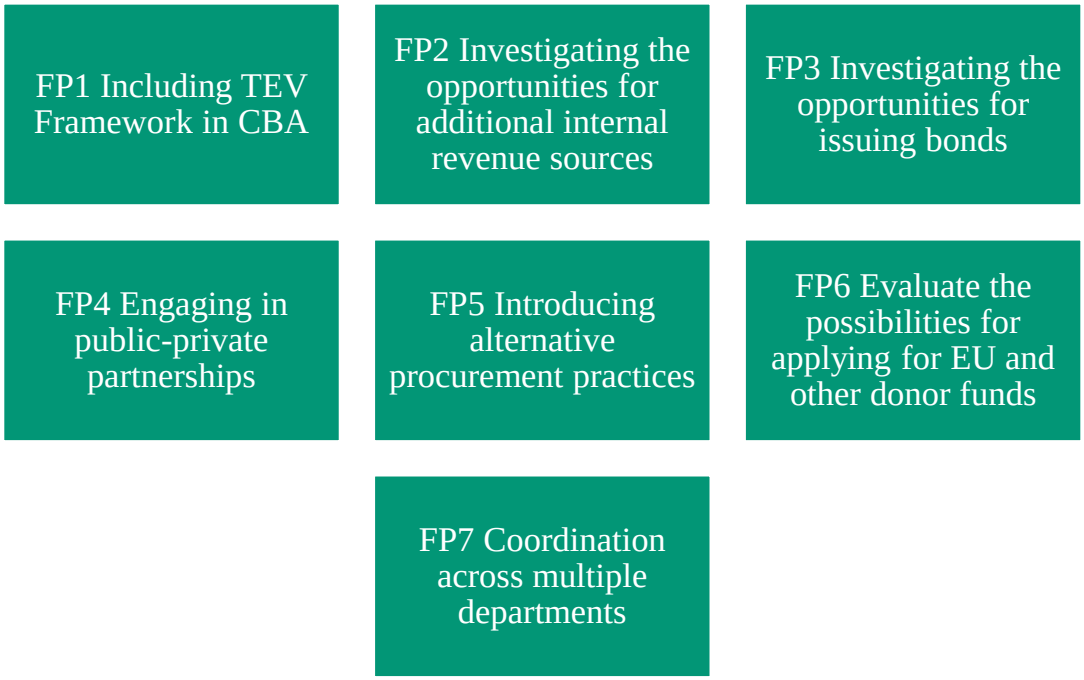
- **Targeting of the users of the municipal services:** By introducing targeted fees and charges the cities have the opportunity to relieve some of the burden from the general public and collect additional funds for NBS implementation. For instance, cities might choose to

introduce fees in relation to the new real estate developments that require additional public infrastructure investments.

- **Promoting the cooperation with private sector:** This can be done through public-private partnerships (PPPs) that would enable cities to gain access to additional capital and decrease the risks of implementing NBS.

- **Revising public procurement practices**: As NBS tend to exert a number of intangible benefits, the common "lowest-price" approach might provide additional obstacles for the uptake of NBS in cities. Hence, a more innovative approach to procurement is encouraged when sourcing NBS.

Actions:



FP1 Including the Total Economic Value Framework (TEV) in Cost Benefit Analysis

The application of a holistic cost-benefit scheme (analysis) could be applied to understand the value for money of NBS. Cost-benefit analysis (CBA) supports the economic case and generates data regarding cash savings, risk and financial impacts that feed into the financial case, and which inform the commercial case where procurement is required (Hm Treasury, 2014). This could potentially help with defining more concrete business cases for NBS, which in turn would attract additional capital investment. However, since many of the goods provided by NBS are intangible, incorporating them into CBA becomes difficult. One way to address the problem could be to adopt a Total Economic Value (TEV) framework. TEV is an approach designed to account for intangible benefits delivered through the ecosystem services. This framework accounts for the use and non-use values of an environmental good or service. By applying various methodologies, the TEV framework helps assign monetary values to the environmental goods, which could be incorporated in the extended CBA (Pascual et al., 2010). Adopting a holistic CBA would imply that not only the fiscal aspects of a project are taken into consideration, but also the project's effect on the social welfare.

This intervention has potential to:

- Account for intangible benefits provided by NBS, which in turn would better incorporate them into the municipal accounting systems.
- Draw insights into the economic value the society assigns to urban ecosystem services and the interventions that deliver those ecosystem services.
- Attract additional investors of capital in NBS implementation by providing monetary indications of the value of the ecosystem services delivered by NBS.
- Enhance communication among the stakeholders about the value of NBS.

Elements of this intervention might include:

- Mapping the relevant ecosystem services delivered by NBS.
- Identifying the potential goods delivered by the selected ecosystem services (including the use and non-use values)
- Selecting appropriate valuation methods for the environmental goods and services delivered by NBS. (Pascual et al., 2010) and (Badura et al., 2018) distinguish the following types of valuation methods that could be used for such purposes:
    - Direct market valuation that uses market price values
    - Revealed preferences approaches – examining behaviour of individuals and expenses they incur
    - Stated preferences approaches – investigate by conducting a survey on the willingness to pay for a defined environmental good
- Promoting cooperation with research institutions to carry out the valuation research
- Ensuring sufficient resources to carry out the valuation research

Example:

Singapore is starting a new project aimed at conducting the first national assessment that would quantify the benefits of the environment and account for its natural capital. The project is funded through National Research Foundation and will be implemented as a collaborative research project between Singapore-ETH Centre, Principal Investigators from the National University of Singapore (NUS), Nanyang Technological University (NTU), SEC, and ETH Zurich, with collaborators from the key partners in government including the Centre for Urban Greenery and Ecology (CUGE) at the National Parks Board (NParks) (Natural Capital Singapore, n.d.). The project aims to quantify the benefits delivered by the numerous surrounding ecosystems by using the stated preferences methodology, as well as the replacement cost for the different types of the natural capital approach (En, 2018). Since Singapore is small and densely populated, urban development and planning has substantial potential to deplete local natural capital. The project team plans to develop an interactive digital planning tool that would illustrate the data on the ecosystem services and their benefits as well as economic and socio-cultural value of urban green spaces. This tool is expected to inform the local policy makers on the possible impacts of the urban development plans in Singapore (En 2018). Natural Capital Singapore http://www.naturalcapital.sg/

Notes and links to further literature

- Valuation for Natural Capital and Ecosystem Accounting. Synthesis paper on the valuation methodologies for the ecosystem services and natural capital accounting: http://ec.europa.eu/environment/nature/capital_accounting/pdf/Valuation_for_natural_capital_and_ecosystem_acounting.pdf
- The Economics of Valuing Ecosystem Services and Biodiversity. A report on the TEV and various valuation techniques: http://africa.teebweb.org/wp-content/uploads/2013/04/D0-Chapter-5-The-economics-of-valuing-ecosystem-services-and-biodiversity.pdf

FP2 Investigating the opportunities for additional internal revenue sources

Taxes and fees charged to the residents of the cities for delivering the public services have long been an important source of revenue for municipalities (Kamiya and Zhang, 2016). By collecting additional internal revenues, the local governments could enhance their ability to introduce and scale up NBS implementation. Higher municipal revenues have potential to enable the municipalities to focus on enhancing urban sustainability and ensuring sufficient budgets for NBS implementation. The internal revenue sources could be enhanced by introducing new taxes and fees.

This is of course limited by the significant variation in powers municipalities have to create new taxes and fees. Furthermore, taxes and fees can lead to political backlash reducing their appeal to policy makers. However, cities should investigate the opportunities for potential adjustment or reconfiguration of existing fees and charges (e.g., through substituting a flat rate for a pay-by-use fee) or compensation for the additional financial burden on residents in other areas of life (e.g., through compensation for the added costs of congestion charging through cheaper access to public transport).

Taxes are usually used by the local governments to finance its core activities and could also be used to fund particular infrastructure projects (Kamiya and Zhang, 2016). A potentially effective means of promoting sustainability is using eco-taxation or applying the polluter-pays principle. This involves taxing environmental negative externalities for the purpose of generating revenue while at the same time providing a disincentive for behaviour that results in the environmental negative externality. In an ideal situation, a closed loop structure could be established whereby the revenues generated through the eco-tax could be used to finance more sustainable alternatives. An alternative could be to use the revenues of the tax to compensate those who suffer as a consequence of the implemented taxation.

In addition, charges and fees could be used by the cities to collect additional internal revenues. These instruments are typically determined based on the quantity of the public good consumed and are based on the principle that the "users" of the public good should pay for its delivery (Kamiya and Zhang, 2016). This way, the city could shift the costs from the general taxpayer to the beneficiaries of the interventions (American Planning Association, 1998). Cities might consider introducing the following charges and fees that would facilitate the implementation of NBS:

- Development exactions and impact fees. The fees are introduced based on the infrastructure developments carried out as a consequence of the new developments in the city (Merk et al., 2012). The municipality could impose area-specific charges that would enable them to vary the charge according to the different infrastructure costs incurred by each area on the city (Merk et al., 2012). Typically, these revenues are collected as a one-time payment from the developers (The World Bank, n.d.). These fees have potential to reduce the economic burden on the local governments when developing new infrastructure that could include such interventions as NBS.
- Business improvement districts (BIDs). BIDs are based on an additional tax that is accepted by a majority of business owners or tenants in a given area of the city in return for improving the infrastructure and environment. Revenues from BIDs could be used beyond the basic infrastructure upgrades and include more extensive partnerships between cities and private businesses aimed at, for example, improving the green image of the city. This could help attract more people to the commercial districts, which would imply greater revenues for the business owners as well as the city itself.
- Stormwater fees could be a possible source of revenue for the cities to address the increasing investment costs for managing stormwater runoff and sewer overflows (United States Environmental Protection Agency, 2008). Since NBS can help address the stormwater management issues in cities, they could also qualify for funding through the revenues of the stormwater fee (also see *RI2 Introducing NBS-supportive building regulations*).

Elements of this intervention might include:

- Determining the areas where new taxes and fees could be introduced
- Evaluating whether the new taxes and fees would have the desired effects on the public budget and enable the local government to finance desired NBS interventions
- Creating a technical roadmap for introducing the new fiscal instruments
- Enhancing the technical capacity of the municipal staff

UNaLab Stories: BID, Eindhoven

The BID in Eindhoven is the largest BID in the Netherlands as it includes the entire city centre of Eindhoven. It was created according to the national law, which enables local business entities to organise themselves and hold a vote for establishing the BID. Given that a sufficient turnover is reached as well as 50% of the business owners approve, a BID can be established. The income collected from the tax in the BID area is collected and managed by an association. It is spent on the local initiatives based on the proposals submitted by the local business community members. Even though the fund managing association is independent from the municipality of Eindhoven, the strategic city goals seem to be taken in consideration when allocating the funding. For example, projects aiming at improving the city image by introducing more greenery in the city have received financial support from the association. According to the municipal economic experts, the BID has proven to be a great instrument to mobilise the local business community members including local producers, retail chains and real estate owners and provide financial support for bottom-up urban greening initiatives.

Notes and links to further literature

- Managing Wet Weather with Green Infrastructure. Municipal Handbook. Funding Options: https://www.epa.gov/sites/production/files/2015-10/documents/gi_munichandbook_funding.pdf
- Financing Green Urban Infrastructure. Overview of the potential financial mechanisms: http://www.oecd.org/cfe/regional-policy/WP_Financing_Green_Urban_Infrastructure.pdf
- Finance for City Leaders Handbook. Overview of the traditional as well as innovative financial mechanisms: https://unhabitat.org/books/finance-for-city-leaders-handbook/

FP3 Investigating the opportunities for issuing bonds

As NBS can support biodiversity conservation, climate change adaptation and other environmental efforts in cities, green municipal bonds could serve as a means for cities to secure funding for NBS implementation. Green bonds are labelled as “green” by their issuer, because their proceeds are intended to be used to exclusively finance projects which provide environmental benefits to the cities (Kamiya and Zhang, 2016). So far, green municipal bonds have been used to finance projects focused on renewable energy, energy efficiency, waste management, sustainable land use, clean transportation, clean water, biodiversity preservation, agriculture and forestry, as well as various climate change adaptation projects (Kamiya and Zhang, 2016).

There are four types of green municipal bonds that municipalities might consider (Kamiya and Zhang, 2016):

- General obligation bond
- Revenue bond
- Project bond
- Securitised bond

While the proceeds of all types of bonds should be earmarked for the green projects, there is some variation in whether the proceeds are used for green projects in general or they are used for funding

specific underlying projects directly. The types of bonds also differ based on their debt recourse. For example, general obligation bonds are backed by the entire balance sheet of the issuer, while project bonds are backed by the projects' assets and revenue (Kamiya and Zhang, 2016).

Green municipal bonds have potential to attract large investors that would not typically buy municipal bond (e.g., institutional investors, such as pension funds). To make the green municipal bonds more feasible and attractive to the potential investors, cities might consider clustering similar, urban sustainability-enhancing projects.

Notes and links to further literature

- Finance for City Leaders Handbook. Chapter on green bonds: https://unhabitat.org/books/finance-for-city-leaders-handbook/

FP4 Engaging in public-private partnerships

For widespread uptake of NBS throughout the city, the inclusion of private actors is essential. Public-private partnerships (PPPs) are a viable option to achieve this goal. Public and private entities may enter contractual agreements aimed at creating, operating and maintaining NBS (Ambrose-Oji et al., 2017). PPP schemes yield benefits for both public and private actors. Public entities gain access to additional capital provided by private partners, while the private entities might gain additional business opportunities (Ambrose-Oji et al., 2017).

There are different forms of PPPs that cities and private partners can adopt to govern and co-fund NBS. These range from small-scale and short-term arrangements to multi-stakeholder and long-term arrangements. According to the World Bank (2017), PPP contracts can be characterised by three parameters:

- The type of assets involved. Private investors might help create new assets (such projects are often referred to as greenfield projects) or upgrade and manage existing assets that are transferred from the public to the private sector (brownfield projects).
- The role of the private actor. Under a PPP contract, private actors can take up various roles including designing, building or rehabilitating, financing, maintaining or operating the asset. The different functions and services provided by the private actors call for different types of contracts. Some examples of the typical PPP contracts include Design-Build-Finance-Operate-Maintain (DBFOM), Operations and Maintenance, and Rehabilitate-Operate-Transfer contracts, among other arrangements (The World Bank, 2017).
- The source of revenue for the private actors is organised either in a user-pays or in a government-pays scheme. In either case, the private actors' compensation should be linked to the performance of the asset in place. If the private actors provide poor service the remuneration in either revenue scheme should decrease.

PPPs could also include business improvement districts (BIDs), sponsorship schemes and green barter arrangements.

Forming a PPP for co-funding purposes in most cases implies establishing a Special Purpose Vehicle (SPV) – a specific company formed for the purpose of financing the project (The World Bank, 2017). The SPV raises funds through equity and debt by securing the funds from the shareholders of the company, bonds and credit institutions (The World Bank, 2017). The public actors might participate in the finance structure of PPP by providing debt, equity or guarantees (The World Bank, 2017). One of the most critical components of the successful functioning of a PPP is the bankability of its projects. This means that a SPV needs to demonstrate sufficient capacity to service its debt, which in turn implies adequate cash flows and risk variation (The World Bank, 2017).

Even though PPPs have been identified as one of the most promising financial cooperation mechanisms for NBS implementation, they remain highly project and context-dependent. This means that there is no one blueprint on how to successfully establish an effective PPP and replicate that across a variety of different NBS interventions and urban settings. In most cases private sector enters PPP schemes due to positive cost-benefit expectations from their investments. Since various NBS have a range of intangible public benefits that are not directly "monetizeable", it might discourage private sector to enter into such PPP agreements. To mitigate this situation (and prevent market failures), local governments might need to offer additional incentives for private businesses (e.g. applying separate tax rates, local tax exemptions for PPP projects) (Merk et al., 2012). Furthermore, the role of the local governments could be to highlight where positive ROIs arise and engage with the private sector on cost-benefit sharing. In sum, PPPs are often very useful to generate wider ownership and diversify investment risks. As such, PPPs facilitate a joint-up approach to sustainable urban development and planning and should be seen as both ways of raising additional sources of capital, while increasing stakeholder participation in particular NBS interventions. For a PPP to be effective in NBS implementation certain factors should be taken into consideration (Merk et al., 2012):

- It requires a long-term commitment.
- The city might require additional expertise to define terms of the contract that would establish the responsibilities yet at the same time enable the cities to account for a certain degree of flexibility.
- PPPs require extensive interaction, negotiation and trust between partners.
- Clear environmental objectives and goals should be set and communicated between the partners.

Notes and links to further literature

- An extensive Public-Private Partnerships Reference Guide: https://pppknowledgelab.org/guide/sections/17-finance-structures-for-ppp

FP5 Introducing alternative procurement practices

For effective adoption of the NBS concept and its integration throughout municipal structures, the often prevailing "lowest price offered" mentality in public procuring needs to be overcome within the existing legal framework. Benefits derived from NBS interventions often deliver values which cannot be measured in monetary terms. If NBS are to be adopted in the mainstream city development the municipal procurement scheme needs to be able to incorporate those non-monetary values.

Different procurement schemes are available which support the NBS approach – they are referred to as innovation based-, sustainable- or green procurement. The new processes apply the triple-bottom-line thinking of sustainability science to procurement procedures. They thus try to respond not only to questions about economic viability but also to questions of environmental and social sustainability and take innovation aspects into account. New ways of calculating the 'true costs' of a product or service that account for the intangible benefits and costs of NBS are implemented to help overcome the "lowest price mentality" (see *FP1 Including the TEV Framework in CBA*). New regulations and requirements for the public tendering schemes help to address the different needs of NBS in terms of construction and maintenance.

Municipalities are advised to follow established management schemes to transform their procurement processes step-by-step. Previous studies indicate that learning processes from established municipal networks can foster the uptake of those new practices. There are several networks which help to guide the possible transformation of municipal procurement processes. The European Commission supports European municipalities with their "Green Public Procurement" programme. On the "Green Procurement Platform", the European Commission provides suitable political and legal frameworks

for new procurement processes. Different publications, guidelines and toolkits help interested municipalities to find first entry points into the topic. On the platform, different criteria were developed to facilitate the inclusion of green requirements in public tender documents. For NBS, the infrastructure, construction and maintenance and gardening services criteria are the most relevant. The documents are available in the national languages of the EU.

The international city networking association ICLEI supports municipalities directly with their programme on sustainable procurement "Procura+". It provides step-by-step guidelines for municipalities on how to adapt their procurement processes. The guidelines holistically address the procurement process and help initiatives other than NBS to benefit from the proposed changes. There is a possibility for municipalities to join the network and benefit from direct strategic partnerships with procurement experts from other cities around Europe.

Some of the leaders among the cities in Europe in innovative procurement include Eindhoven, Manchester, Amsterdam or Stockholm. To follow their example, a city should:

- Put more emphasis on the innovation and overall quality of the tendered service or a solution rather than focusing on the lowest price-offering.
- Develop assessment criteria that enable precise evaluation of the quality of a tendered service or solution and its estimated impact on the lives of the target group.

UNaLab Stories: Lighting procurement, Eindhoven

Although not linked to NBS directly, Eindhoven is a good example of cutting-edge procurement and innovative approaches to public procurement in general. While it makes little sense to innovatively procure some things (office stationary, etc.), complex projects and solutions need a new approach to evaluation. This means that when it came to procuring the street lighting system, the city knew that tendering to the lowest price bidder would not ensure a sufficiently innovative and sustainable street lighting solution. Within the legal procurement boundaries, Eindhoven engaged in so-called "best-value procurement". This approach aims to get the best value for the money spent. Applying this logic, the City of Eindhoven engaged in a number of market consultations with potential suppliers. Rather than asking what is the lowest price a solution supplier could offer (this squeezes out any potential for innovation), Eindhoven asked what is the most (CO_2 savings, positive social impact, public engagement, etc.), that the potential supplier could deliver for a fixed amount of money. This small tweak in framing the procurement process means that rather than just savings, the city looks at the amount of positive benefits that could be created with that investment.

Notes and links to further literature

- Buying Green. A Handbook on Green Public Procurement: http://ec.europa.eu/environment/gpp/buying_handbook_en.htm
- "Procura +" network of the European public authorities regarding sustainable and innovative procurement: http://www.procuraplus.org/

FP6 Evaluate the possibilities for applying for EU and other Donor-funds

Cities that have limited resources might prioritise their budget spending on delivering essential public goods and thus have less funds available to implement interventions like NBS. Subsequently, cities that do not enjoy extensive financial support from the national government and do not have access to cheap borrowing options from local or international credit institutions and/or international markets could benefit from access to EU funding programs or donor funding to deliver NBS.

Available EU funding programs that cities could consider for supporting NBS could include:

- European Regional Development Fund (ERDF). Among other objectives, this fund focuses on ecosystems, bio-economy, SMEs, innovation, and climate change mitigation and adaptation. The eligible applicants usually come from the public sector, however, businesses are also encouraged to apply for funding. ERDF funded projects have high emphasis on public and private leverage and "additionality", i.e., the projects must not duplicate existing activities (Jones and Munro-McCarthy, 2015).
- The Natural Capital Financing Facility supports projects oriented at biodiversity and nature-based adaptation to climate change. However, the projects are required to generate revenues or demonstrate savings.
- LIFE provides funding for environmental and climate action including urban adaptation to the climate change (European Commission, 2017).
- European Fund for Strategic Investments (EFSI) supports economically viable, higher-risk projects focused on: strategic infrastructure; education, research, development and innovation; renewable energy and resource efficiency; and projects put forward by SMEs and small businesses (European Investment Bank, n.d.).

Other donor funding:

Although a large proportion of NBS funding to date has been provided by the EU programmes, it is important that the cities are prepared to face the termination of these sources and to apply to other funding sources for the maintenance of the current NBS interventions, as well as for the implementation of new NBS interventions. However, since the EU seems to be the leading organisation working on NBS, it is necessary to highlight that the alternative funding sources presented in the following text are not NBS-specific, and for that reason the application should be adapted to the requirements and vision of the funders:

- 100 Resilient Cities (100RC) is pioneered by the Rockefeller Foundation and aims to help cities to become more resilient to climate impacts through the provision of financial and logistical guidance for establishing an innovative new position in city government. The fund facilitates the building of a global practice of resilience among governments, NGOs, the private sector and individual citizens, among other benefits (100 Resilient Cities 2018). Until February 2018, 100 RC had leveraged more than USD650 million from national, philanthropic and private sources (100 Resilient Cities 2018)
- The Finance Dialogue is an organisation that leverages collective resources of private philanthropy in order to decarbonise the economy and achieve the Paris Agreement goal of a temperature rise well below two degrees Celsius (The Finance Dialogue n.d.).
- The Generation Foundation is the advocacy initiative of Generation Investment Management, which was established to strengthen its project of "Sustainable Capitalism" (Generation Foundation 2018). The strategy is to mobilise asset owners and managers, companies and others in financial markets in order to allocate capital for the Sustainable Capitalism Project (Generation Foundation et al., 2016).
- The European Climate Foundation (ECF) is a philanthropic initiative, considered a "foundation of foundations", that supports organisations in Europe which aim to move

towards a low-carbon society. Additionally, the ECF is a leading organisation regarding climate change mitigation (European Climate Foundation, 2013).

- We Mean Business is an international non-profit coalition focused on taking action on climate change, which works with some of the most influential businesses worldwide. The goal is to accelerate the low-carbon transition through business-leadership catalysis (We Mean Business, n.d.)
- The Cities Climate Finance Leadership Alliance. Led by the United Nations, yet founded in cooperation with other relevant organisations, such as World Bank, Bank of America and The Gold standard, this initiative supports urban investments into low carbon economy and climate resistant urban infrastructure (Gold Standard, n.d.).

In addition, financial support for NBS could come not only for direct funding but could also be for the capacity building - drafting bankable projects. The City Creditworthiness Academy, for instance, is a joint World Bank/C40 Cities Climate Leadership Group/Private Public Investment Advisory Facility (PPIAF) initiative that aims to improve the capacity of city authorities to work towards achieving the investment-grade credit ratings that would allow them to borrow on domestic financial markets or potentially issue municipal bonds. Climate funds should seek to involve themselves in such efforts where possible to seek out instances where they may be able to provide timely financial support to complement these capacity building efforts and facilitate implementation of ensuing programs.

To obtain financing from the funding institutions, cities should thoroughly analyse the eligibility criteria that might include:

- Project size
- Requirement for the cooperation with other public or private actors (e.g. research institutes, private companies, banks, other government agencies)
- Institutional and financial setting of the project (e.g., some donor funds might require their grants to be a part of the more elaborate financial schemes, such as credit guarantee funds, revolving funds, etc.)
- Bankability of the project
- Evaluation of own technical capacity to administer the application process (e.g., is sufficient capacity and expertise exist in-house or do external consultant need to be hired?)
- Ensuring enough expertise and resource to comply with the requirements on the funding activities as well as monitoring and reporting

Notes and links to further literature

- European Investment Bank. Natural Capital Financing Facility: http://www.eib.org/attachments/documents/ncff_terms_eligibility_en.pdf

FP7 Coordination across multiple departments

In addition to enhancing internal revenue base and exploring additional external funding opportunities, local governments might expand the pool of available funding for NBS by coordinating funding across the budgets of multiple municipal departments. This coordination has potential to enable cost sharing across the budgets of different municipal departments. Also, better coordination across departments could potentially reduce the costs for implementation of NBS. For example, the implementation of permeable surfaces could be matched with the timing of other street reconstruction projects (Georgetown Climate Center, n.d.).

In many cases, this type of coordination is carried out among the municipal departments of transportation, sanitation, green spaces, water management, housing and urban development, and

energy (United States Environmental Protection Agency, n.d.). However, involving other municipal departments might yield additional benefits.

Many studies are currently focused on demonstrating the measurable effects of the time spent in green spaces and nature on human health (Oregon Health and Outdoors Initiative, 2018). Both natural as well as built green infrastructure have potential to provide clean air, water, and cultural ecosystem services that could reduce stress, and improve the mental and physical health of city inhabitants. Establishing new and preserving existing green areas and elements in cities could help prevent heart disease, cancer, respiratory diseases, diabetes, and depression and address other contemporary health problems (Oregon Health and Outdoors Initiative, 2018). This could lead to lower healthcare costs in the long term.

Hence, the coordination of budgets among the more traditional departments that usually carry out the implementation of NBS (e.g., water or green space departments) with other departments, such as departments and agencies responsible for health and wellbeing may be an interesting avenue to explore to increase the available budgets for NBS implementation.

The coordination across different departments might call for:

- Definition of projects and their benefits as well as demonstration and communication on potential business cases for engaging in investment

Communication between departments on the need of financing and potential contribution that could be made by the departments

Example: Oros Street project, Los Angeles, U.S

The Bureau of Street Services and the Bureau of Sanitation collaborated to implement the Oros Street project in Los Angeles. Both agencies collectively provided around 1 million USD for the installation of bio-retention areas in the street parkway and a large infiltration basin underneath a nearby park. Completed in 2007, this project provides bio-retention areas in the street parkway, additional street landscaping and a large infiltration basin underneath Steelhead Park at the end of the block (Chau, 2009). Oros Green Street Project https://ourwaterla.org/oros-green-street-and-steelhead-park/

Notes and links to further literature

- Report on the potential link between the Green Infrastructure and Public Health: http://willamettepartnership.org/wp-content/uploads/2018/07/Green-Infrastructure_final_7_12_18_sm.pdf

5.6 Inclusive urban development

Ensuring that the improvement of life quality that NBS strive to achieve is shared by all urban inhabitants is a significant challenge faced by urban planners. NBS can be a powerful tool to improve health and wellbeing and support social integration for particular target groups. However, if not properly managed, urban regeneration can improve the lives of some at the expense of others through reinforcing pre-existing disparities between social groups (Haase et al., 2017). As outlined in *4.5 Social and environmental justice and land use trade-offs*, NBS have the potential to both increase social divides or act as a bridge improving social cohesion in cities. Whether interventions will tend to induce the former or the latter will depend on the strategy and priorities adopted for the improvement of green spaces.

The term "green gentrification" has become commonplace in planning circles around the world explaining the phenomena of increasing property prices pushing certain groups out as a result of urban regeneration, often through interventions associated with urban greening. A blueprint for avoiding green gentrification through the implementation of NBS does not exist. Indeed, many see gentrification as a natural progression within urban development processes, with trade-offs inevitable in any transition process. However, a range of principles have been identified that can assist cities in dealing with the negative effects of gentrification and uneven distribution of NBS:

- **Awareness:** An important starting point is to ensure that the potential for gentrification related effects remains present in the minds of planners, decision makers and developers when undertaking a strategy of urban regeneration. As such, the city should be able to anticipate the negative outcomes to a certain extent and develop mitigation mechanisms and strategies accordingly. Furthermore, bringing socio-spatial challenges into the forefront of urban regeneration projects should trigger an important discussion regarding these trade-offs whereby stakeholders can better identify priorities. Socio-spatial inequalities should be acknowledged at all stages of urban greening projects: planning, implementation and monitoring.

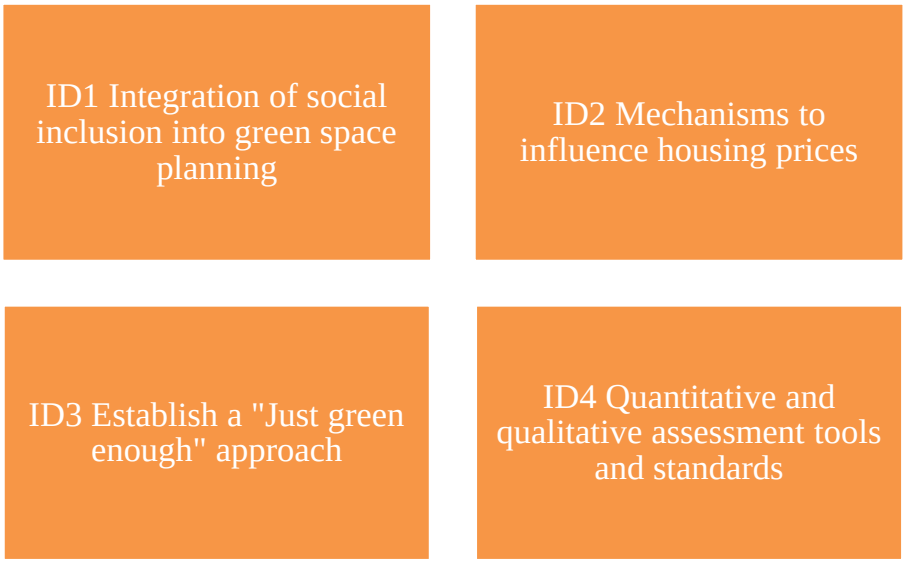
- **Linking NBS with strategies targeting social inclusion and development:** In many cases, lower socio economic areas and minority communities are associated with higher risk of exposure to air pollution, urban heat islands and lower green space accessibility (Wolch et al., 2014). There is significant potential for NBS to be utilised as a tool to achieve objectives outlines a wide range of different urban strategies (see *MP2 Embedding NBS in existing plans and strategies*). This highlights the potential for the city to address socioeconomic disparities whilst addressing urban challenges related to climate change and ongoing urbanisation at the same time if these strategies are effectively aligned. For this purpose, an important starting point is to identify target areas in the city that are characterised by particularly low socio-economic standards. This can be conducted through statistical analysis. Once these areas have been identified, they can become priority areas for interventions such as project funding schemes, or target areas for green space enhancement.

- **Understanding NBS as a tool to address social challenges**: Planners have to strike a balance between targeting NBS to the areas where the challenges (air pollution, urban heat island, flooding etc.) they are supposed to address are most pressing, on one hand, and ensuring that this does not worsen social disparities, on the other. A good approach is to see urban inequality itself as a challenge to be addressed through NBS and target these areas accordingly.

- **Maintaining municipal ownership over housing:** Municipalities can maintain influence over the price of housing through maintaining a high degree of ownership and thus control over a large portion of housing.

- **Study the cause of gentrification:** Evaluating the results of green gentrification is important, but it is also important to understand the roots and the processes as the drivers of gentrification. This means not the increasing housing prices itself, but the processes that lead up to this outcome. Reasons behind this issue could be, for example, increasing tourism, increasing incomes in some specific sectors amongst certain social groups, increasing living costs, or growing competition with other land-use, all of which can increase demand for housing and push up prices in a particular area. By understanding the central root causes of gentrification, it is easier to develop effective strategies and mechanisms suited to the specific urban context.

Actions:



ID1 Integration of social inclusion into green space planning

A central means of avoiding social exclusion is to actively foster social inclusion. Increasing the opportunities for different actors to take an active part in different stages of the planning process will foster inclusivity in green space planning. This can be supported by a variety of different plans and policies such as comprehensive urban development strategies or green space plans. By making social inclusion a key element of these plans, different perspectives can be integrated into the planning process. Such plans and policies need to be long-term and, considering fast-paced development, they need to be updated on a regular basis. By involving many different actors and groups, including non-government actors such as local businesses and local residents, more, and different types of knowledge can be generated and shared and awareness and interest will be generated at different spatial levels (Hanson et al., 2017).

Examples:

Malmö, linking social cohesion and green space: The Comprehensive Plan (approved by the municipal executive board) sets the goal for Malmö to have a compact and green urban structure in the future. Another important objective of the plan is to explore how green spaces can be used to bridge the gaps between the wealthier and the poorer parts of the city. While Malmö has been in the forefront of ecological sustainable urban development in Sweden for more than a decade, social sustainability has only recently been lifted towards the top of the agenda (Malmö stad, 2014).

Lisbon, Portugal: BIP / ZIP

The objective of the project is to improve social cohesion and active citizenship in the city of Lisbon. The approach was to identify the areas in the city that were lacking the minimal levels of cohesion and quality of life. Through gathering statistical information relating to the social, environmental and economic factors, the city was able to identify 67 target areas for interventions. The actions developed in these areas include the placing of local offices in the zones to as a symbolic and practical initiative. The areas have also become targeted for funding of small projects (up to €50,000 per project) through networks of local actors with conditions attached related to the actors involved and longevity of the proposal. There have been a range of successful projects that have achieved sustainability objectives. Some projects have directly enhanced ecosystem services in the area, particularly those targeting urban farming projects. However, perhaps the most valuable element of the initiative is the visualisation of lower socioeconomic areas of the city which would be a useful tool when considering urban regeneration and urban greening (https://cooperativecity.org/2017/05/07/bipzip/).

Notes and links to further literature

- More information on how to integrate social inclusion into green space planning: Green Surge http://www.e-pages.dk/ku/1337/html5/ (p. 50).

ID2 Mechanisms to influence housing prices

A potential step to counteract (green) gentrification is to use mechanisms to influence housing prices so they can remain affordable for certain groups. Many cities around the world have already experimented with different interventions to try to limit the displacement of long-term residents. These include different forms of rent controls and social housing, along with different regulations and policies. Such interventions are very much context, country and city specific and there is no one-size-fits-all policy for every case. But a range of mechanisms to influence housing prices can be identified:

- **Rent controls:** Rent controls have been utilised in a range of cities with varying degrees of success (O'Sullivan and Decker, 2007). The potential options at a city's disposal and their effectiveness will depend on a range of institutional conditions such as tenancy laws, degree of home ownership and the varying types of private rental agreements (O'Sullivan and Decker, 2007). O'Sullivan and Decker (2007) outline five common regulatory systems that operate in Europe:
    - **Type A:** Weak transaction cost related rent regulation. Protecting a sitting tenant against rents higher than the market rent.
    - **Type B:** Strong transaction cost related rent regulation. Protecting sitting tenants against certain types of increases in market rents.
    - **Type C:** Monopoly related rent regulation. Protecting all tenants against rents higher than the market rent.
    - **Type D:** Smoothing changes in market rents. Rent regulation related to overshooting.
    - **Type E:** Protecting all tenants against certain types of increases in market rents.

  Rent controls can have unwanted side-effects which can outweigh their anticipated benefits, such as run-down housing conditions (through declining incentives for renovation) and overall reduction of housing stock because building owners are encouraged to sell off individual apartments or attempt to avoid rent controls by redeveloping their property into housing not subject to rent control regulations (Diamond et al., 2018).
- **Social housing:** Some municipalities have been able to maintain influence over housing affordability through designating a high degree of housing stocking to social housing. Social housing can be delivered in different ways. In many cases, the city holds ownership of newly built apartments and thus actively controls not only rents, but also who moves into those

apartments. However, public authorities might also support private investors and municipal housing companies to provide low-cost rental housing for households facing difficulties to affording the normal rent prices, or directly financially subsidise the rents of residents. Particularly for new developments, by prescribing a minimum percentage of social housing the municipality has the chance to protect newly emerging districts from high rents and it can also help to foster social inclusion and achieve more heterogeneous residential population.

- **Foster innovative, bottom-up housing concepts:** Innovative bottom-up housing concepts, such as co-housing, building communities, cooperative models and intergenerational living, revive the urban structure and promote the social mix of residents. They adapt to the changing demographic structures of our society today, in which self-selected neighbourhoods and identification with the neighbourhood and the built environment play an increasingly important role. By providing institutional and physical space for such initiatives, the municipality can support their emergence.

Example: Munich, "Social and Fair Development of Real Estate":

Since October 1995 the municipal council of Munich integrated the "Social and Fair Development of Real Estate" (SoBoN) as a new regulation for a fair and affordable housing market, which was developed in dialogue with the local real estate industry. That model also prescribes that a minimum of 30% in new residential areas has to be reserved for social housing. The model is well established in the housing development processes in the city of Munich and has been an important contribution to achieving a high level of diversity in the cites districts (Hepperle, 2015).

Notes and links to further literature

- More information on financing and different forms of social housing:
- Social Housing in the European Union: https://www.researchgate.net/publication/308964157_Social_Housing_in_the_European_Union
- More information on rent controls:
- O'Sullivan & De Decker: Regulating the Private Rental Housing Market in Europe: https://www.feantsa.org/download/ejh_vol1_article4503024276336039592 1.pdf
- Cuerop et al. (2014): Rental Market Regulation in the European Union: http://ec.europa.eu/economy_finance/publications/economic_paper/2014/ecp515_en.htm

ID3 Establish a "Just green enough" approach

Curran and Hamilton (2012a), propose a "Just green enough" approach to establish green infrastructure while minimising the negative effects of green gentrification. By making an area "just green enough", social as well as ecological objectives can be obtained without necessarily increasing housing prices significantly. In this approach, interventions are focused on benefits for the existing population rather than making it attractive for new investors (Curran and Hamilton, 2012a; Wolch et al., 2014).

The idea is that the marginal improvements in life quality as a result of green/blue space upgrades is non-linear beyond a certain degree. (Bertram and Rehdanz, 2015), for example, identified an inverted U-shaped in regards to the relationship between urban green space availability and life satisfaction for residents in the central district of Berlin. This means that investments in larger green spaces tend to have limited advantages in terms of subjective well-being, while increasing real estate prices. More effective investments specifically targeting benefits for the local residents in the Berlin case were small-scale green sites that addressed local concerns (Wolch et al., 2014).

This knowledge has potential to initiate discussion about the aims and potential trade-offs of urban regeneration and potential target areas. Does it make sense to target a large green space in an affluent

area (perhaps with benefits relating to improved climate change adaptation, for example), or rather use the resources to target smaller green pockets? Which communities will be effected and how?

There are a plethora of actors and a range of vested interests involved in public space interventions. "Just green enough" approaches require the balancing of interests and an effective negotiation of trade-offs particularly in the context of powerful real estate interests (Curran and Hamilton, 2012b).

Example: Greenpoint Brooklynn:

Greenpoint is a former industrial area where the Newtown Creek, amongst others, generated substantial environmental concerns. The clean-up process involved long-term residents as well as recent in-movers to counteract green gentrification. By doing this, the cleaning process and greening strategies managed to maintain Greenpoint's image as a "blue-collar Polish neighbourhood" and avoided displacing the former inhabitants. The main actor in this process was the Newtown Creek Alliance, a group of activists who fought for environmental improvement in form of greening projects that created a greener neighbourhood while preserving the character of the district. As a result, small-scale green sites have been implemented that are being used by local inhabitants but are not a target location for tourists (Wolch et al., 2014).

Notes and links to further literature

Further information on the concept of "Just green enough":

- Curran W. & Hamilton T. (2012): Just green enough: contesting environmental gentrification in Greenpoint, Brooklyn. In: Local Environment. Vol. 17, No.9, October 2012, 1027-1042: https://www.researchgate.net/publication/263719413_Just_Green_Enough_Contesting_Environmental_Gentrification_in_Greenpoint_Brooklyn

ID4 Quantitative and qualitative assessment tools and standards

Quantitative and qualitative assessment tools and standards can be useful instruments to foster social inclusion of NBS. On one hand, specific tools can help to find out about the status quo of social inclusion, the distribution of NBS and the quality of already integrated NBS, on the other hand they can help to foster a more inclusive urban development by showing for example which areas are in the greatest need of NBS and by integrating certain standards for green space accessibility.

- **Accessibility Standards:** To foster an equal distribution of high-quality and safe green infrastructure cities need to make it binding that green urban space is accessible within a certain range. This can ensure that all residents are able to benefit from the positive effects of NBS. Many cities are experienced with the use of per-capita threshold recommendations or range values. Berlin, for example, recommends that every resident should have access to at least 0.5 ha of green space within 500 m. The city of Berlin also aims to provide 6 m² of urban green space per inhabitant as a per-capita threshold, whereas Leipzig recommends 10 m² of urban green space per inhabitant (Kabisch et al., 2016b; Kabisch et al., 2017). Focusing on per-capita threshold can be ineffective in some cases: areas with very dense population can show a relatively low per-capita value even though sufficient green space may already exist. Range values, on the other hand, oftentimes only cover the linear distance, not taking into account the actual walking distance or other potential barriers, which is of particular importance for vulnerable groups including the elderly and children. Furthermore, such approaches only focus on the quantity of urban green infrastructure, not on the quality of the green space itself and the actual accessibility for certain groups (Kabisch et al. 2017). Therefore, both values need to be treated with caution.

- **Environmental Justice Screening and Mapping Tool (EJSCREEN):** One tool to support municipalities target investment in green infrastructure through identifying variations in green space accessibility across a certain area is *EJSCREEN (Environmental Justice*

Screening and Mapping Tool) provided by The United States Environmental Protection Agency (EPA). It shows demographic and environmental information for a chosen area and also includes a method for combining environmental and demographic indicators into several EJ indexes. With the help of the EJSCREEN tool, the city of Philadelphia developed a Green Infrastructure Equity Index to determine which communities could benefit the most from investment in GI (Heckert and Rosan, 2016).

- **PPGIS (Participatory planning GIS):** PPGIS can be an effective means of better understanding the quality of green space from the perspective of the users. Utilising online and offline formats, citizens are able to make contributions to a map regarding use and satisfaction with green space. Such an approach can be used instead of or in addition to more traditional approaches (surveys, questionnaires etc.).

  Potential applications include (Hanson et al., 2017)

  - **Planning:** e.g., identifying hotspots of value, identifying potential development and redevelopment areas, anticipating reaction to certain interventions, and layering over other maps (better targeting green space functions).
  - **Management:** e.g., identifying areas of overcrowding/ lack of maintenance/ places where people feel unsecure; better allocating resources for maintenance; better targeting communication activities.
  - **Design:** e.g., protecting valued space; redesigning areas experiencing conflicts; providing inspiration for design of new public spaces (more of what people like).

Notes and links to further literature

- A good overview of green space quality and quantity assessment tools:
- Green Surge: Innovative governance for urban green infrastructure. A guide for practitioners: http://www.e-pages.dk/ku/1337/html5
- More information about the Environmental Justice Screening and Mapping tool:
- United States Environmental Protection Agency: https://www.epa.gov/ejscreen
- More information about Philadelphia's Green Infrastructure Equity Index:
- Heckert, M. & Rosan, Christian D. (2015): Developing a Green Infrastructure Equity Index to Promote Equity Planning. https://www.researchgate.net/publication/288919067_Developing_a_Green_Infrastructure_Equity_Index_to_Promote_Equity_Planning

6. APPENDICES

6.1.1 Contributions

Subtask	*Name*	*Organisation*	*Support*	*Contact*
Municipal Governance Challenges	Tom Hawxwell ; Sophie Mok	FHG/ STU	Selen Kus	Tom.Hawxwell@iao.fraunhofer.de sophie.mok@iao.fraunhofer.de Selen.Kus@iao.fraunhofer.de
Organisation and Structure	Tom Hawxwell	FHG	Niklas Effenberger	Tom.Hawxwell@iao.fraunhofer.de Niklas.Effenberger@iao.fraunhofer.de
Policies (regulations and incentives)	Sophie Mok	FHG/ STU	Sophio Konjaria-Christian	sophie.mok@iao.fraunhofer.de sophio.konjaria-christian@iao.fraunhofer.de
Finance and Procurement	Ernesta Maciulyte	FHG	Petr Suska	Ernesta.Maciulyte@iao.fraunhofer.de Petr.Suska@iao.fraunhofer.de
Data Governance	Johannes Sautter	FHG	Ekatarina Dobrokhotova	Johannes.Sautter@iao.fraunhofer.de Ekatarina.Dobrokhotova@iao.fraunhofer.de
Municipal Strategy and Planning	Tom Hawxwell	FHG	Moritz Kramer	Tom.Hawxwell@iao.fraunhofer.de Moritz.kramer@iao.fraunhofer.de
Inclusive Urban Development	Jill-Ann Theobald	FHG	Tom Hawxwell	Jill-Ann.Theobald@iao.fraunhofer.de Tom.Hawxwell@iao.fraunhofer.de

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