



**CLEVER
Cities**

Barriers and success factors for effectively co-creating nature-based solutions for urban regeneration

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Executive summary

This deliverable describes the barriers and success factors to successfully co-create nature-based solutions (NBS). The potential positive interactions of environmental, economic and social systems lie at the heart of NBS. The interventions planned within the CLEVER Cities projects therefore embrace the concept of NBS. Such a comprehensive approach, however, causes special technical, economic, financial political and social challenges for the successful implementation of the envisioned interventions.

The factsheet draws on the experiences of past and ongoing projects in the field of nature-based solutions and urban regeneration. Evidence was gathered not only from sources explicitly focused on nature-based solutions, but also from those dealing with the related topics of urban regeneration, ecosystem services, green (and blue) infrastructure and climate adaption in cities more broadly.

Ten key barriers were identified through the review and include: the limited knowledge base for nature-based solutions; the inadequate governance structures for NBS; the balancing of the multiple goals NBS can deliver; effective citizen involvement; insufficient social inclusion and social acceptance; lack of political and financial support; the challenges for monitoring NBS; and, the difficulties in upscaling NBS.

The presented solutions to these challenges show that the interactions of environmental, economic and social systems have to be considered at all stages of co-creation, implementation, evaluation and upscaling.

1. Introduction

1.1. Objective

This factsheet identifies ten common barriers to the effective co-creation, implementation, evaluation and upscaling of nature-based solutions (NBS); it also highlights potential success factors for overcoming these, which can be applied in the CLEVER Cities project. The findings are intended to guide related activities taking place in the project's front-runner and fellow cities.

1.2. Context and approach

While the term 'nature-based solutions' has only emerged in recent years, the idea of utilising nature as a tool to address a range of urban challenges while also supporting resilient, sustainable and inclusive city development has a far more established history. The European Commission is amongst those advocating for the use of such solutions¹ and has financed various projects to research and implement NBS, not least in the field of urban regeneration.² CLEVER Cities is itself such a European Commission funded project and recognizes the value of knowledge and experiences emerging out of related research and practical implementation endeavors.

This factsheet focuses its research on the experiences of NBS-related projects funded and delivered in recent years by the Commission and its partners, and has identified the barriers and success factors that need to be understood to ensure to more successful co-creation and implementation of NBS in cities (a full list of consulted and further projects of relevance are listed in Annex 1). Published literature from these projects, as well as other scientific and grey literature plus the experience of CLEVER Cities project partners has informed the research. Evidence was gathered not only from sources explicitly focused on nature-based solutions, but also from those dealing with the related topics of urban regeneration, ecosystem services, green (and blue) infrastructure and climate adaption in cities more broadly.

2. Key barriers to successful implementation of NBS and factors for improving success

Key barriers that were identified through the review include: the limited knowledge base for nature-based solutions; the inadequate governance structures for NBS; the balancing of the multiple goals NBS can deliver; effective citizen involvement; insufficient social inclusion and social acceptance; lack of political and financial support; the challenges for monitoring NBS; and, the difficulties in upscaling NBS. The following

¹ <https://ec.europa.eu/research/environment/index.cfm?pg=nbs>

² An overview of projects started in 2017 can be found here: <https://ec.europa.eu/easme/en/news/nature-based-solutions-are-helping-address-urban-challenges>

subchapters explain these barriers in more detail and describe possible solutions and success factors. In addition, the table in Annex 2 offers an overview of the identified barriers and success factors.

2.1. Knowledge gaps

Successful implementation of NBS is largely dependent on having sufficient scientific and technological knowledge of their function performance and benefits. This includes having a solid understanding of the complex processes of natural systems, as well as the appropriate NBS design features and options in order to ensure that the solutions are resource-efficient, resilient to change, and adapted to local conditions (1). Even though there is a growing body of knowledge and experience of NBS, information is often scattered and hard to access (2).³ Moreover, existing evidence is often presented in such a way that is challenging for policy and decision-makers as well as the general public to understand, and frequently not in a 'ready-to-apply' format, or tailored to the specific local challenge (3).⁴ More awareness of the potential business opportunities offered by NBS in cities is also needed as the implementation of NBS can be constrained by the lack of high-performing private companies operating in the field of urban forestry, sustainable drainage and landscape management.⁵ The limited numbers of firms available to implement innovative NBS can also complicate public tendering processes (4).

One solution to close the knowledge gap within city departments is to identify, integrate and utilise the capacity of local stakeholders in the project design and delivery, including the qualified technical staff, engineers and landscape architects employed by or available to these local stakeholders (2,5,6,7). In addition, staff from city departments such as planning, highways or parks management can attend bespoke education and training programs on green infrastructure (2).

To address existing knowledge gaps, a number of research and practice projects are focusing their efforts on generating and centralising targeted information for easier access and increased uptake by various user groups. Areas of focus include: identifying available types of NBS; producing targeted guidance; developing methods for evaluating NBS impacts and benefits; generating digital knowledge platforms; supporting events for discussion and exchange; and, translating scientific evidence into policy briefings. These resources can be utilised by city planners, practitioners, NGOs or other interested stakeholders to promote improved planning, implementation and monitoring of NBS. Several resources of key importance are listed below.

- [NBS catalogue by URBAN GreenUP](#) (8): lists solutions by ecosystem provision, budget and intervention scale and provides evidence on their effectiveness
- [Methodological guide for identification and mapping of NBS by Tecnalía](#) (7): helps local authorities to identify their potential for NBS
- [Urban Green Infrastructure Planning Guide by Green Surge](#) (9): describes case studies of existing NBS projects with a planning guide for replication
- [Oppla website](#): Case study finder and knowledge exchange platform
- [ThinkNature platform](#): Knowledge dialogue and overview of existing projects

³ Comments by Tecnalía also mention municipal knowledge gaps in designing green infrastructure.

⁴ Follows also comments by Green4Cities based on their work in Nature4Cities.

⁵ Based on comments by Tecnalía.

- **EKLIPSE** (10) and **ThinkNature Task Force on impact evaluation**: Measurement of NBS benefits and effectiveness

These efforts to improve information flows between policy makers, experts, businesses and society on best-practice solutions, and previous mistakes and lessons learned, are largely taking place on a higher (often European) scale, but they also need to be systematised at the city level for maximum impact (11). In particular, as NBS aim to achieve multiple benefits such as increased climate adaption, improved human well-being and socially inclusive growth, the perspectives, experience and knowledge of various experts and citizens groups have to be included in a holistic planning approach (8,12). Hence, city planners, urban designers and parks managers might need to identify ways to involve external experts or a public exchange of ideas as concrete steps within the design process. The promotion of successfully realised pioneer projects and official certification can also help further increase the general awareness of NBS.⁶

Even with the best generic technical guides and information at hand, dealing with dynamic natural systems implies the presence of unexpected site-specific local constraints. For instance, the effective installation of sustainable drainage systems depends on the adequate soil type while guidelines and regulation for green roofs should recognise the implications of local climatic conditions (4,13). In the same vein, other region-specific framework conditions, like city structures or regulatory laws etc., might also influence the impact of NBS. Hence, evidence building should always be based on locally sourced knowledge.

2.2. Governance of multifunctional green infrastructure

NBS emphasise the potential positive interaction of environmental, economic and social systems. In doing so, they can deliver multiple benefits. For example, multi-functionality green spaces can support adaptation to climate change while also being used for sports and recreations, serve as a place for local distinctiveness, increase the aesthetic appeal of a neighborhood, and provide a sense of community (14). However, such multifunctionality requires that appropriate governance structures are in place. This can be a challenge for local authorities, as they have traditionally worked in departmental structures, yet NBS are relevant for various departments simultaneously (e.g. planning, economic development, environment, transport, and innovation) (4). As a result, single objective grey or green infrastructure solutions (so-called 'silo-solutions'), which only meet the objectives of one single department, are often pursued over hybrid (green-grey infrastructure) or multifunctional green solutions (5). Further tensions can arise in the coordination between local, regional and national governments when they have different political ambitions and the legal responsibilities between governance and management of NBS are separated (4,15).

Effective governance is likely to require authorities to break out of their traditional structures and collaborate on cross-departmental planning strategies, asset management, and budget delegation (9,16). Clear responsibilities and coordination across departments are needed to help foster successful collaboration (4). The integration of independent external experts (e.g. from universities) can support collaboration as they can certify the usefulness of cross-departmental solutions and mediate between departments (1,9). Ideally, city governments should create new, horizontal positions in both their political and management structures to achieve coordination and policy integration, as has been the case in the city of Genk (17).

⁶ Based on comments by Green4Cities.

2.3. Balancing trade-offs while delivering multiple goals

NBS try to deliver environmental, social and economic goals simultaneously. An additional challenge of planning and implementing NBS is taking account of and addressing the potentially conflicting interests of the stakeholder groups involved in decision-making who may have a specific focus on only one of these goals

One possible solution is to encourage the active participation of the widest range of stakeholders early in the process (see section 2.4) to increase the understanding of the diversity of goals and priorities of interested parties (5,12). Furthermore, the planning stage of NBS requires the identification of both the possible synergies and conflicts between various economic, environmental, and societal interests and the potential trade-offs that might need to be negotiated; this information must be clearly communicated amongst all the stakeholders involved (14,18). Spatial mapping and assessment tools can be used to locate, identify and quantify the different functions and services of green infrastructure within a city (9). For instance, such a tool has been developed and applied in Liverpool⁷ and further adapted in Adelaide (19). In London an interactive Green Infrastructure Focus Map has been developed and will be published by the end of 2018. In some cases, hybrid solutions which include elements of both green and grey infrastructure can be helpful to address multiple priorities while limiting trade-offs as they are based on existing infrastructure (9).

2.4. Citizen involvement

Better delivery of the social, economic and environmental benefits of NBS will only occur when the interests of the public are fundamentally incorporated in the planning process. This requires that user groups and other interested stakeholders are consulted and ideally involved in the planning, implementation and monitoring processes, which can also serve to build personal connection with the project and a sense of community ownership. However, achieving inclusive and active participation can present a challenge.

Public participation can be fostered by: maximizing the flow of targeted information to stakeholder groups and organizing consultations, workshops and opportunities for feedback (2) and communicating the multi-functionality of NBS (20,21) to increase awareness and support. Volunteers can also be invited to help in the implementation and monitoring processes (21,22,23) or in maintenance activities (e.g. through formal contracts between the city and NGOs)(24). In some cases, citizen participation might be limited by the value they attach to public green spaces or NBS, which might depend on their socio-economic or cultural background or influenced by their experience with other green spaces (15).⁸ Here, designing NBS interventions that can cover both private initiatives (e.g. installing private green roofs and improving the ecological function of private gardens) and collective action (e.g. urban farming or improving opportunities for children's play) can animate a community across all income levels (28). In general, some evidence suggests that NBS focusing on the protection of ecosystems and wildlife have been especially successful in attracting public engagement (14,29).

⁷ www.gift-t.eu/manual/mapping-tools/gi-mapping

⁸ Women and the elderly show higher valuation (25), richer people and immigrants show lower valuation (26). Minorities, lower-income and elder people tend to have lower access to green spaces (14,27).

2.5. Social inclusion

An active civic role in the NBS planning does not alone guarantee social inclusive outcomes, as people with higher incomes or social status can dominate the planning processes. The interests of groups like women, ethnic minorities or disabled people might not be given equal consideration and some citizens might not have access to standard participation tools (11,30).

In an effort to combat these potential downfalls in planning, groups with less power need to be identified and targeted through the implementation of inclusive participation programs. In Aarhus, for instance, young people from different ethnic backgrounds have been employed as leisure time workers to inform the diverse population of the participative possibilities in the planning of NBS and the decision making (9,30). Moreover, realized NBS such as urban parks can become places for interaction between people with different socioeconomic backgrounds and thus help to further foster social cohesion in the long run (31).

2.6. Public acceptance

Lack of public support, beyond an unwillingness to participate in planning processes, can also be an impediment. Such resistance can be motivated by an underappreciation of environmental benefits, fear of heightened costs for the implementation and maintenance of green spaces and distrust in the publicly announced costs and benefits, or the fear of rising housing prices (a product of so-called 'eco-' or 'green gentrification'). As a result, the risk of vandalism can be a problem for the successful implementation of NBS (7).

Consequently, NBS must be sensitive to their location and to the social dynamics they may inadvertently trigger (32,33). Regarding gentrification fears specifically, expected impacts on property values can be estimated⁹ during the conceptualization and planning process, and the local population can be actively involved to support processes which can achieve neighborhood stabilization (33). Social policy experts and economists should therefore be included in the planning of NBS. Environmental education and capacity building linked to the project can serve to inform the public about the benefits of NBS while offering opportunities for actively involve children and the youth on the project site can also increase community support (2). From a technical perspective, landscape architects should be involved in the co-design of NBS to combine ecological functionality with aesthetic principles as this increases acceptance and reduces vandalism (6,28).

2.7. Political support

Implementation of NBS is often hindered by a lack of continued political support. Most benefits from NBS are 'public goods' and the economic benefits of these, plus the non-economic benefits (such as aesthetics) are underappreciated by politicians, policy-makers and the wider public (21,35). Moreover, the process of urban planning and regeneration takes place over a long time span and positive results, especially social and economic benefits such as improvements in public health often only emerge in the long-term. NBS suffer therefore from politically-driven short-term action and decision-making cycles (4). Private entities can

⁹ Votsis (34) provides an empirical study on the effects of urban green on property prices in Helsinki.

be more agile; however, they also have to respond to the policy-frameworks and are reluctant to act until the policy direction is clear and consistent.¹⁰ Furthermore, environmental and heritage protection laws, and building regulations and planning permits can limit the number of potential opportunities for NBS (7,28,36,37) that may already be limited by existing competing land-uses and utility infrastructure such as water pipes, electric wires and underground structures (4,30).

It is crucial to integrate and consider NBS in every planning tool, adjusted to the details needed and to answer to the step in decision making. It should be considered as part of the strategy, going beyond the relevance of greenery on traditional urban regeneration processes, that otherwise is only considered at the very last step of the process.¹¹ The economic value of NBS can be revealed or made more transparent through natural capital accounting which has been done in London.¹² Subsidies to install NBS solutions in private houses or buildings can mitigate the long planning and amortization process.¹³ Green-grey integration can be a remedy for competing land-use, while planning laws e.g. for habitat preservation and compensatory measures for unsealing make greening policies mandatory (30).

2.8. Financial support

Budget constraints are also a frequent barrier for NBS projects. Long-term financial plans have to be put in place for the implementation period as well as for later maintenance of the site (2,11,12). Where maintenance costs count as discretionary services, they are especially vulnerable to budget cuts (4). The cost of enhancement (e.g. retrofitting a public park to improve its functionality) can also reduce political and civic support if the existing space is perceived to provide basic functions such as recreation and play. Furthermore, because NBS are still novel interventions, financial commitment is also needed for the monitoring and evaluation which increases the apparent cost of the project (2,11).

In anticipation of possible budget cuts, NBS can be planned in a way that the technical specifications can be adapted to the budget (e.g. number of the trees, green roofs, surface covered) while the quality of the project as such is not influenced (4). A coherent and consistent planning policy or regulatory regime can help to ensure a more stable programme of financial support by providing certainty about what is required from particular actors (e.g. developers). The integration of ecological indicators in fiscal transfers between municipalities can incentivize the implementation of green infrastructure (22). Public-private partnerships channel private capital into NBS both at the implementation and maintenance stage and allow for efficient risk and benefit sharing (2,21,22).¹⁴ Green barter, where businesses, such as cafés located in parks, commit themselves to maintenance activities in exchange for monetary gains from green spaces, are another solution (38). Moreover, NBS can strategically be planned and delivered on third party land, where the owner values the intervention and accepts the maintenance costs over the long-term (4). Citizen involvement in maintenance brings in people with knowledge about the individual site and local population. Citizen-led initiatives might need technical support by a local authority and flexible application of municipal regulations, but might also be eligible for external government money denied to the municipality (4,39).

¹⁰ Based on comments by Tecnalia.

¹¹ See for example the [London Environment Strategy](#).

¹² See the [London Natural Capital Account](#) and the [London Borough of Barnet Natural capital Account](#).

¹³ Based on comments by Tecnalia.

¹⁴ There can be potential drawbacks of public-private partnerships (35).

Likewise, volunteers and ‘citizen-scientists’ can participate in monitoring activities and thus limit monitoring costs.

2.9. Challenges for Evaluation

NBS aim to improve the environment while providing sustainable economic growth, improved health, social cohesion and security for the population, amongst other benefits. Monitoring and evaluation of these impacts is needed to assess the effectiveness of specific interventions, increase comparability across different NBS, improve NBS design into the future, and create a robust evidence base which will help to mainstream NBS as an alternative or complement to traditional grey solutions. However, while efforts have and are being made to generate an overarching NBS evaluation framework (e.g. [EKLIPSE](#) (10), [MAES](#) (40), [UNALAB](#), [Naturvation](#)), there is currently no commonly accepted and easily implemented monitoring framework.

Efforts for a common indicator base are being pursued on the European level via the [ThinkNature](#) taskforce “NBS Impact Evaluation Framework version 2.0”. One major challenge in this process is the aspect of measuring intangible values. Better indicators for sustainability and social outcomes are needed (12). Due to the concerns regarding the right measuring approach, multiple methods might be applied (41). However, if results are not robust across approaches, trust in the results might be weakened. The combination of high resolution geographic and land-use data with preferences and behavioral data of people can provide helpful insights (15). More generally, cities can work with available city level data and – where possible – conduct targeted studies focusing on the e.g. socio-economic value produced by NBS interventions. It is important to gather baseline data before the intervention and then conduct monitoring after the implementation is completed.

2.10. Challenges for upscaling

For the systematic replication of NBS on a broader base and scale, the barriers described above apply to their co-design and implementation. Furthermore, planning for the upscaling of NBS is hampered by the lack of quantitative evidence of upscaling successes (42). Upscaling also increases the pressure on governance structures as different actors and departments have to cooperate (4,11) and the knowledge, practices and technologies have to be transformed to and be made applicable at a larger scale (43). Moreover, the ownership and use of land will become a larger barrier (14) as land can be overwhelmingly owned by actors who put their financial interests over environmental goals (4).

Guidance documents like the one on sustainable drainage systems by the London Borough of Tower Hamlets (44) and municipal strategies that mainstream NBS can help to institutionalize the process (45). For this, multiple actors and their interests have to be included: city objectives and policies, stakeholder views, and the expected benefits from NBS have to be aligned with spatial plans, business models & financing mechanisms and delivery & maintenance mechanism, while monitoring and evaluation feed back into the planning.¹⁵ Regulatory measures such as mandatory constructions of green roofs on new buildings (e.g. in Copenhagen and Toronto) foster the proliferation of this NBS. Financial incentives for the building

¹⁵ Taken from a presentation by Johnny Sadler from Grow Green, <http://growgreenproject.eu/wp-content/uploads/2018/06/Delivering-NBS-city-wide-Knowledge-Exchange-Platform.pdf>

of green spaces such as subsidies for green roofs, storm water fees and blue-green factors give incentives for the installation of green infrastructure (21,46,47) Strategic collaboration with business incubators can attract and nurture promising start-ups (43). Finally, the conflict between place specificity and replicability requires the design of marketable NBS to be flexible in order to adapt to specific needs (43).

3. Concluding remarks

The potential positive interactions of environmental, economic and social systems lie at the heart of NBS and have to be kept in mind at all stages of co-creation, implementation, evaluation and upscaling of the interventions. CLEVER Cities can draw on the experiences of past and ongoing projects in the field of nature-based solutions and green regeneration of cities in general. In co-designing, implementing and evaluating CLEVER Frontrunner and Fellow Cities will add to the knowledge base on NBS. This will further help to mainstream the concept of NBS within city governments which is essential to transform NBS beyond single interventions into city-wide planning processes.

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Annex 1 – Overview of relevant projects

Project info	Topic	Selected resources
ARTS	Accelerating sustainability transitions and to create opportunities for innovation by coupling, rescaling and accelerating sustainability initiatives in European city-regions. (2013-2016)	Transition Read No.2 – Nature-based solutions (16)
Connecting Nature	Deliver large scale nature-based solutions. Develop policy and practices necessary to scale up urban resilience, innovation and governance. (2017-2022)	
EKLIPSE	Establishing a European Knowledge and Learning Mechanism on Biodiversity and Ecosystem Services (2016-2020)	An impact evaluation framework to support planning and evaluation of nature-based solutions projects (10)
EnRoute	Enhancing Resilience of urban ecosystems through green infrastructure. (EU Commission)	
Green Surge	Green Infrastructure and Urban Biodiversity for Sustainable Urban Development and the Green Economy. (2013-2017)	Urban green infrastructure planning. A guide for practitioners (9) Innovative governance for urban green Infrastructure. A guide practitioners (29)
Grow Green	Create climate and water resilient, healthy and livable cities by investing in nature-based solutions (2017-2022)	
MAES	Mapping and Assessment of Ecosystems and their Services (EU-Commission)	Mapping and assessment of ecosystems and their services: An analytical framework for ecosystem condition in EU (40)
NAIAD	Operationalise the insurance value of ecosystems to reduce the human and economic cost of risks associated with water. (2016-2019)	
Nature4Cities	Creating a platform for Nature-based solutions, offering technical solutions, methods and tools to empower urban planning decision making. (2016-2020)	
Naturvation	New governance, business, financing models and economic impact assessment tools for	Nature-based solutions in European and national policy frameworks (48)

	sustainable cities with nature-based solution. (2016-2020)	Review of Economic Valuation of Nature Based Solutions in Urban Areas (49)
OpenNESS	Operationalisation of natural capital and ecosystem services (2012-2017)	OpenNESS case studies (50)
Oppla	Knowledge platform on ecosystem services, natural capital and nature-based solutions	Case Study Finder
proGReg	Productive green infrastructure for post-industrial urban regeneration (2018-2023).	
REMOURBAN	Develop a sustainable urban regeneration model leveraging the convergence of energy, mobility and ICT to transform European cities into Smart Cities. (2015-2019)	Inventory on Innovative PPP Solutions and Approaches (51)
RESIN	Climate Resilient Cities and Infrastructures. (2015-2018)	
ThinkNature	Multi-stakeholder dialogue platform and think tank to promote innovation with nature-based solutions. (2016-2019)	
URBAN GreenUP	Develop, apply and validate renaturing urban plans to mitigate the effects of climate change, improve air quality and water management and increase the sustainability of cities through innovative nature-based solutions. (2017-2022).	NBS catalogue (8) Barriers and boundaries identification (4)
Urban Nature Labs	Crate urban living labs for innovative, replicable, and locally-attuned nature-based solutions to enhance the climate and water resilience of cities. (2017-2022).	
URBES	Urban biodiversity and ecosystem services. (2012-2015).	
URBiNAT	Healthy corridors as drivers of social housing neighbourhoods for the co-creation of social, environmental and marketable NBS. (2018-2023)	

Annex 2 – Overview of key barriers and solutions

Barrier	Potential solutions
Knowledge gaps	Integrate local stakeholders and experts. Use the existing knowledge base. Promote successful pioneer projects.
Governance of multifunctional green infrastructure	Collaborate on cross-sectoral planning and decision making. Create new cross-sectoral positions. Use external experts as mediators.
Balancing trade-offs while delivering multiple goals	Involve diverse stakeholders. Apply spatial mapping and assessment tools. Integrate grey and green infrastructure.
Citizen involvement	Communicate benefits of NBS. Engage volunteers. Combine private and collective action.
Social inclusion	Apply targeted participation programmes for less powerful residents. Encourage the interaction of people with different socioeconomic background.
Public acceptance	Be aware of the social dynamics of greening strategies. Foster environmental education. Involve landscape architects.
Political support	Integrate NBS in planning tools. Adopt planning laws for NBS proliferation.
Financial support	Make NBS resilient to budget cuts. Impose regulatory instruments. Apply public-private-partnerships. Rely on citizen-led initiatives.
Challenges for evaluation	Engage with the ThinkNature taskforce “NBS Impact Evaluation Framework version 2.0”. Combine geographic and land-use data with preference data.
Challenges for upscaling	Adapt and/or compile guidance documents. Institutionalize the NBS process. Consider regulatory measures and financial incentives. Support start-ups.