



# INTRODUCING NATURE-BASED SOLUTIONS IN YOUR CITY

A booklet to guide you on your journey

MAY 2020



This booklet gathers the experiences, key learnings and best practices from the Horizon 2020 UNaLab project on how to plan, develop and implement nature-based solutions in an urban setting together with local stakeholders and citizens.



**GET IN TOUCH FOR MORE INFORMATION:**

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# WELCOME

Modern-day cities are facing a range of urban challenges due to the effects of climate change and ongoing urbanisation. Many of these challenges are expected to worsen in coming years as a result of the continuous release of greenhouse gases into the atmosphere and the constant flow of people moving into cities.

The launch of the European Green Deal introduced the roadmap for the European Union's ambition to reach climate-neutrality by 2050. As producers of around 72% of the planet's greenhouse gas emissions and home to more than 50% of the world's population, cities play an imperative role in reaching this ambition. Nature-based solutions (NBS) represent green, innovative solutions where nature is used to address a range of socio-environmental challenges while simultaneously providing a multitude of economic, environmental and social benefits to the community. NBS can help cities to adapt to existing climate-related urban challenges whilst supporting them on their journeys towards climate-neutrality.

This booklet was produced to guide cities in their NBS endeavours by gathering the experiences, key learnings and best practices of the UNaLab project. The booklet will guide you on the journey, starting from the co-creation process where NBS are collectively developed with local stakeholders, through the set-up of urban living lab demonstration areas to test the co-created NBS, and finally to the large-scale implementation of the solutions. We will also touch upon some of the main concerns when considering the adoption of NBS, such as governance-related barriers, financing strategies and the set-up of a sustainable plan and roadmap for NBS implementation and evaluation.

With this booklet, we hope to inspire you and give you some practical advice and guidance on your journey towards a greener and more sustainable city!

## The UNaLab Team

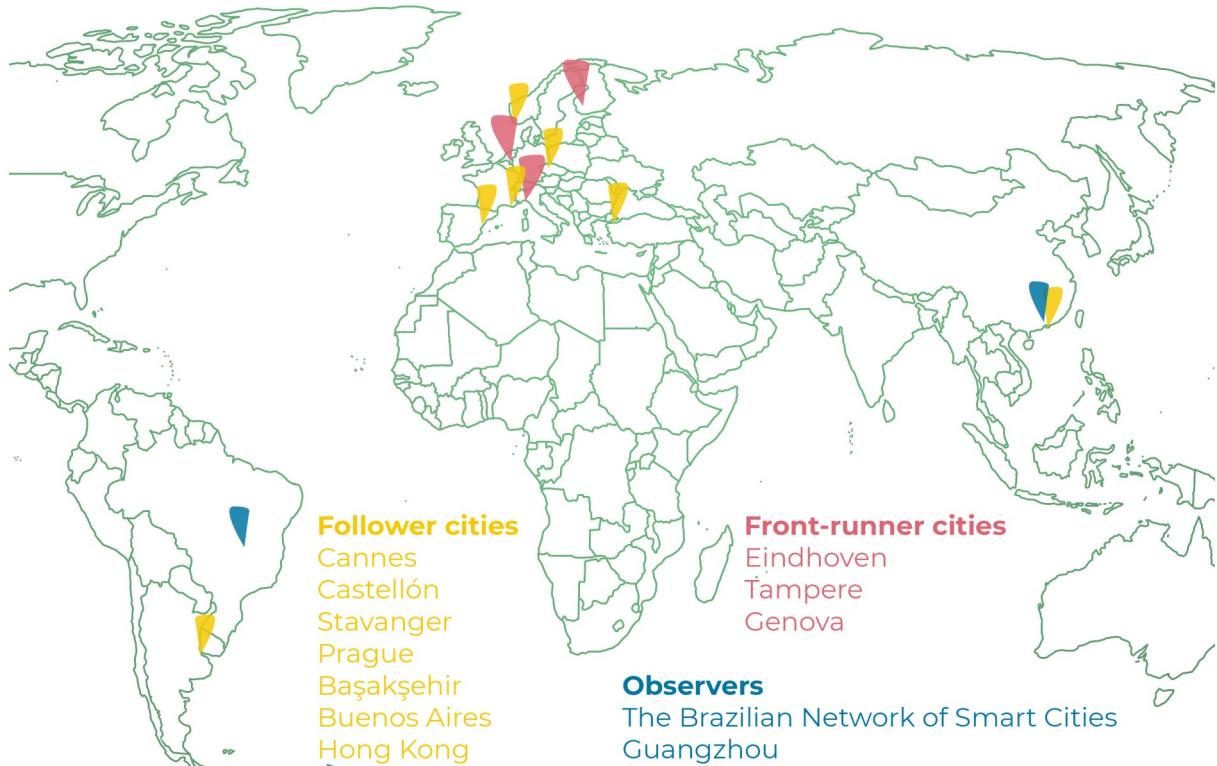


## WHAT IS UNALAB?

The EU-funded UNALab project aims to develop smarter, more inclusive, more resilient and increasingly sustainable societies through the implementation of innovative nature-based solutions (NBS), which are co-created with and for local stakeholders and citizens.

Three front-runner cities - Eindhoven, Tampere and Genova - are, through the establishment of Urban Living Lab demonstration areas, experimenting, demonstrating and evaluating a range of different nature-based solutions that address climate- and water-related urban challenges. The front-runner cities actively collaborate and share their experiences with seven follower cities - Stavanger, Prague, Castellón, Cannes, Başakşehir, Hong Kong and Buenos Aires - as well as observers Guangzhou and the Brazilian Network of Smart Cities.

UNALab project outcomes will contribute to the development of a European NBS Reference Framework on the co-benefits, cost-effectiveness, economic viability and replicability of nature-based solutions, which will guide cities across Europe and beyond in developing and implementing their own co-creative nature-based solutions.



# BRINGING BACK NATURE TO OUR CITIES

## What are nature-based solutions?

Nature-based solutions (NBS) are solutions that are inspired by or supported by nature. They represent natural 'green' solutions to societal challenges such as flooding, environmental pollution, biodiversity decline, and compromised human well-being. NBS are co-created systems that utilise natural features and ecosystem-based processes. In other words, NBS are able to protect, manage or restore ecosystems and their services, thereby addressing a multitude of urban challenges posed by the world's changing climate and rapid urbanisation. These innovative solutions bring more diverse nature and natural features and processes into cities, landscapes and seascapes, thereby creating more sustainable and resilient societies.



Nature-based solutions are cost-effective and simultaneously provide environmental, social and economic benefits to the local community. NBS can be employed across a wide range of environments and at different scales, such as plot, neighbourhood, district or city scale. These solutions are locally adapted and provide a multitude of co-benefits to the local environment.

**Interested in learning more about nature-based solutions?**

**Watch this video!**



## THREE CITIES LEADING THE WAY

The cities of Tampere (Finland), Eindhoven (The Netherlands) and Genova (Italy) are all facing a number of climate- and water-related challenges linked to the impacts of climate change and rapid urbanisation. Identified challenges range from flooding and heat stress to pollution, lack of accessible green spaces and biodiversity loss. Tampere, Eindhoven and Genova have established urban living lab demonstration areas for experimentation, demonstration and evaluation of a variety of different nature-based solutions (NBS) that address local urban challenges, and providing evidence for their environmental, social and economic benefits.

The nature-based solutions implemented in Tampere, Eindhoven and Genova were co-created with local stakeholders and citizens. Each city organised a series of co-creation workshops in spring 2018. During the workshops, stakeholders collaboratively identified key challenges and explored nature-based solutions as a starting point for the living labs that were subsequently developed in the demonstration areas of each respective city.

The co-creation workshops were followed by a period of detailed planning and designing by local city administrators and UNaLab project technical partners prior to starting construction of the planned nature-based solutions. Tampere, Eindhoven and Genova have each implemented different nature-based solutions in one or more demonstration areas within the city. These NBS will be monitored until the end of the UNaLab project in order to evaluate NBS performance and quantify impacts on the identified challenges, along with their many co-benefits.

**Want to learn more about different types of nature-based solutions?**

**Take a look at our NBS Technical Handbook!**



# LEARNING AND DESIGNING TOGETHER

## Co-creating NBS with local stakeholders

### What is co-creation?

Co-creation is the act of working together. It means that a product, whatever it may be, is developed by multiple people from different backgrounds. The concept of co-creation is applied to many different settings. It can be used to design a product or improve a service, or even to write a song. Co-creation is also a great approach when re-designing a living area or a public space.

To demonstrate an example of how co-creation can be used in re-designing a public space, such as a street, the following scenario can be imagined: to use a co-creative approach to re-design and transform the street, the owner of the street, which in our example is the municipality, should invite shop owners, shoppers, apartment owners, and renters as well as researchers and scientists to brainstorm how the street effectively could be re-designed and come up with a solution together. By bringing different groups of people together, each with their own needs and concerns, a solution that takes into account and serve all those needs can be created. If a solution is good and useful, it is more likely to be adopted.



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### TIPS FOR A SUCCESSFUL CO-CREATION SESSION

- It is important not to over-prepare for a co-creation session in order to remain open-minded towards other ideas
- Be prepared to build on other people's ideas
- Do not stick to an idea if it is not working

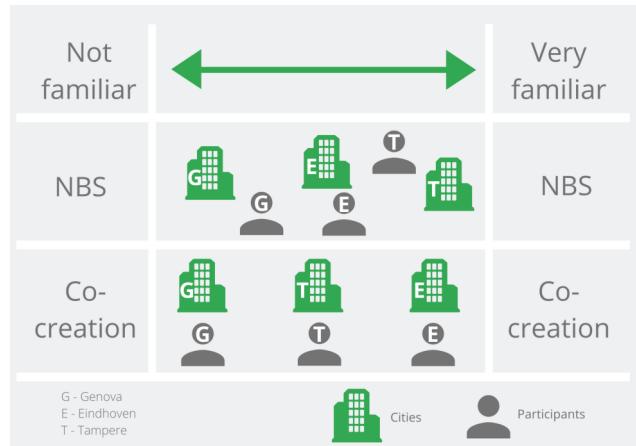
Discover different co-creation  
tools and methods in the  
UNaLab co-creation toolkit!



## How did the UNaLab front-runner cities do it?

Through a series of co-creation workshops, the front-runner cities and the local stakeholders worked together to explore different nature-based solutions (NBS) concepts and to implement NBS demonstration areas in response to local challenges. The cities adopted different methods for their co-creation workshops - Genova used the European Awareness Scenario Workshop (EASW) method, whereas Tampere and Eindhoven used the Design Thinking method.

The cities' respective approaches to the co-creation workshops resulted in a blend of chosen techniques, participants and results. The differences in approaches were mostly due to the various scale and nature of the UNaLab demonstration areas. Cultural and organisational differences also impacted the choices. The city administrators' and the workshop participants' previous experiences and understanding of the concepts of co-creation and nature-based solutions also varied between the three cities, as illustrated in the right-side figure.



Both methods allow to involve the same type of stakeholders in the workshops, although having different aims, focus and methodology. The overall goals and set-up of the workshops were similar: the aim of the first workshop was for the participants to familiarise themselves with the subject and to share views. In the second workshop, the participants mostly worked on creating solutions which were then tested in the third and final workshop.

## TAMPERE, FINLAND

### Selected method

In Tampere, many stakeholders have already embraced the concept of nature-based solutions (NBS), leading the city to select the Design Thinking method for use in their co-creation workshops. By starting with the premise that NBS can effectively address water- and climate-related issues and can contribute numerous co-benefits, a relatively greater amount of time could be dedicated to exploring the possibilities of NBS and finding concrete applications. Although the city was fairly familiar with the concept of co-creation, a trained facilitator was hired for the workshops.

### Set-up of the workshops

Tampere organised three co-creation workshops in each NBS pilot demonstration area – Vuores and Hiedanranta. The main goal of the co-creation process was two-fold: to increase awareness of NBS and how they can solve urban problems, and to hear the citizens' views on how their neighbourhood and city could develop with NBS. The city used a blend of techniques adapted to the different stakeholders that participated in the workshops.

The City of Tampere organised a series of Design Thinking Visioning - Ideating - Testing workshops in both Vuores and Hiedanranta. Altogether, there were six workshops with a total of 258 participants. Some of the co-creation methods and tools used in the workshops were: a participatory design game directed mainly towards residents, a LEGO® workshop for school and kindergarten children, an open idea co-creation workshop for various groups of stakeholders, an idea developing seminar and workshop for experts, and a guided walking tour for the public.



## Selection of participants

Tampere did not have a standard approach for the selection of stakeholders for the co-creation processes. Relevant stakeholder groups were identified, and targeted stakeholder groups were approached through the existing communication channels used by the City of Tampere and by the Hiedanranta and Vuores districts, including websites, Facebook, regular mail, the local magazine, stand activities at events, as well as through a questionnaire which also featured an invitation to one of the workshops.

Depending on the workshop, the participants included residents, school children, teachers, representatives of NGOs, students, researchers, private professionals (architects, landscape architects, urban planners, various technical consultants, building companies), public professionals (university staff) and city professionals (green area and stormwater planners, a constructor of public areas, a green field maintenance foreman, and gardeners).



UNaLab stand at Vuores Day

### LESSONS LEARNT

- NBS are about infrastructure, and it is therefore important to reflect on how different stakeholders are engaged in this rather technical topic.
- Make sure to have a team with expertise in NBS and the chosen co-creation method present both in the planning and execution of the workshop.
- Bring experts and local residents together and provide time for mutual learning. If the progression towards detailed planning and actual implementation is too rapid, experts' voices may overrule citizens' voices. Residents are normally experts on local conditions and how NBS can support well-being.
- If possible, organise the workshop in the area where the NBS will be implemented, e.g. as a guided walking tour, in order to receive more concrete ideas from stakeholders.
- It can be useful to integrate the workshops into other events or planning processes of the city to save resources and to ensure the impact of short-term projects in long-term urban planning.
- Prepare high-quality educational material for the workshop. Maps, pictures and plans of the relevant area are useful as a base for discussion.
- Plan beforehand how the workshop results will be communicated to the different stakeholders. What is the expected impact of their participation?

## EINDHOVEN, THE NETHERLANDS

### Selected method

In Eindhoven, many of the employees working for the municipality as well as the participants of the co-creation workshops were familiar with the concept of nature-based solutions (NBS) and co-creation. The city chose the Design Thinking method for their co-creation workshops, as the focus was on implementing NBS and not exploring the concept. A trained facilitator was hired for the workshops.

### Set-up of the workshops

The city of Eindhoven organised three workshops in a co-creation process with professional experts in fields related to NBS, to explore NBS in Eindhoven and to find ways to improve the process of implementation. The objective of the workshops was to create a community of practice for the application of NBS and to find out how NBS can more often become the 'standard' for projects in public spaces. During the co-creation sessions, the challenge was reframed several times and the group worked towards concrete solutions and plans for a Community of Practice. Between the workshops, additional activities were undertaken to involve more stakeholders and build upon existing initiatives and solutions.

All UNALab projects in Eindhoven follow their own 'standard' process for stakeholder involvement and co-creation. This means that stakeholders are involved early in the process, using techniques and methodologies that fit the project. Key stakeholders are involved in the implementation of NBS throughout these processes.



## Selection of participants

The Municipality of Eindhoven has a standard method for identifying stakeholders, which is part of the co-creation methodology, and can when needed be supported by colleagues from the communication department.

The participants of the workshops were a focused group of professional experts in fields related to NBS. The group consisted of officials from the municipality (communication, area coordination, project leader, water policy, green policy, maintenance); representatives of the health board, water board, and province; an energy company; the professional association of gardeners; and an association of environmental and green organisations (NGOs). The list of participants was compiled by first identifying the main stakeholders in general terms, and after that adding names using formal and informal city networks.



Co-creation workshop in Eindhoven

### LESSONS LEARNT

- Make sure that the information on the invitation to the workshop is clear - state the subject of the workshop and the reason you are inviting people, and make sure that the invitation has the right tone for your audience.
- Use your existing networks to find workshop participants.
- Keep the discussions focused on the objective of the workshop and keep track of time.
- Ensure that you work on two parallel tracks in the workshop: explore ideas and content and explore ways to cooperate during the implementation phase to ensure that the ideas generated are followed up.
- To redefine the challenges and collect as many ideas as possible for solutions, make sure that there is no hesitation among the participants to voice an opinion.

## GENOVA, ITALY

### Selected method

Genova chose the European Awareness Scenario Workshop (EASW) method for the co-creation workshops, as the local community is at the beginning of the process of understanding the concept of nature-based solutions (NBS) and involving stakeholders in the implementation of NBS. Genova municipality employees were generally not familiar with NBS and the knowledge of NBS among the workshop participants varied. Co-creation is not a standard procedure in Genova. Prior to the UNaLab project, the Municipality of Genova experimented with various forms of participatory processes. The co-creation workshops implemented as part of the UNaLab project represented an advancement in co-creation mainstreaming for the city.

### Set-up of the workshops

In Genova, the co-creation workshops were dedicated to the re-development of the plan for the Gavoglio barracks located in the centre of the Lagaccio district. The focus of the workshops was to explain NBS as a concept and for the participants to apply NBS for the re-design of the Gavoglio area. The aim was to present the available data and the analyses carried out on the ground, and to acknowledge the observations and problems of the citizens, their needs and expectations, and to illustrate the possible project scenarios.



Map of the NBS demonstration site



**Interested in learning more about  
the front-runner cities' co-creation  
workshops?**

**Read this report!**



## Selection of participants

The selection of participants was made by the workshop organisers together with the city's participation office. The standard approach for the selection of stakeholders is normally determined by the nature of the project. The city uses databases that can be adapted according to the type of the project. Sometimes, a more random selection method is used such as distribution of flyers or participation to local events.

The workshop participants consisted of local residents and people involved in designing and developing the Gavoglio barracks into an urban park.



Co-creation workshop in Genova

### LESSONS LEARNT

- It is important that both technical experts and decision makers from the public administration take part in the workshop.
- Follow up electronic invitations with phone calls to ensure that the stakeholders representing key areas of expertise participate.
- Send out some information and material before the workshop.
- Choose the methodology for participant involvement in accordance with the goal of the workshop - consider mixing different techniques and tools. Make sure to prepare and train the technical personnel involved in the stakeholder discussions.
- The facilitator of the workshop should be impartial to the discussions.
- Calculate the time carefully beforehand in order to allow everybody to express their opinion and to generate a constructive discussion.
- Involve the participants in site activities, which are managed and supported by city planners and technical experts.

# CO-CREATING ROADMAPS FOR NBS

## How did the UNaLab follower cities do it?

The five European follower cities - Stavanger, Prague, Castellón, Cannes and Başakşehir - developed individual roadmaps for climate change adaptation through nature-based solutions (NBS) within the UNaLab project. Through a series of workshops and on-site assessments, the cities moved from establishing their ambitions and creating a vision for NBS and climate change adaptation for 2050 to establishing the status quo and finally creating a roadmap with goals and potential projects to realise the vision by using the replication framework.

Workshops were organised in the follower cities to support each step of the process. The workshops relied heavily on the involvement of local stakeholders. The stakeholders did not only include those who benefit from nature-based solutions, such as citizens themselves, but also relevant research and industry partners. At the end of the roadmapping activities, each city had a sustainable urban strategy.

This approach is characterised by four main elements:

- Backwards planning – the project starts with the development of a shared vision, as a starting point for the creation of a well-developed path to achieve the vision.
- Inclusive workshops in the cities – a cooperative process to engage key stakeholders within the region in co-creating a clear and well-designed implementation plan, which also will create a stronger commitment to the realisation phase.
- Expert knowledge is sought in a practical and actionable format during the vision development and roadmapping processes.
- A visual language is used to easily connect people and share insights.

### UNALAB'S 5-STEP APPROACH

1. Systems Analysis
2. Ambition Setting
3. Vision Development
4. Replication Framework
5. Roadmapping

Learn more about the follower cities' ambition and vision development processes here!



# 1

## SYSTEMS ANALYSIS

To understand the status quo as a point of departure towards achieving the cities' desired future vision, a systems assessment was conducted to assess the cities' sustainability performance and to support the development of projects to strengthen sustainability and resilience in the city. The analysis also mapped potential stakeholders to help support the roadmapping development process, as well as identified potential sites for NBS implementation.

# 3

## VISION DEVELOPMENT

The vision workshop included several sessions with internal and external stakeholders to define and visualise the desired future for each city. Building on the strategic ambitions, a vision of the desired future scenario for the cities in 2050 was developed.

# 5

## ROADMAPPING

The roadmapping workshop was a two-day workshop with internal and external stakeholders to identify NBS for the specific challenges in the cities and to explore the governance interventions needed for their successful implementation. At the end of the workshop, potential NBS projects had been developed for each challenge, and intermediate goals on the short and long term had also been identified.



# 2

## AMBITION SETTING

An ambition workshop, which included several sessions with policy makers, strategy departments and internal and external stakeholders, was held to obtain a thorough understanding of the cities' ambitions and specific contexts. The result of the ambition workshop was a set of strategic ambitions for each city.

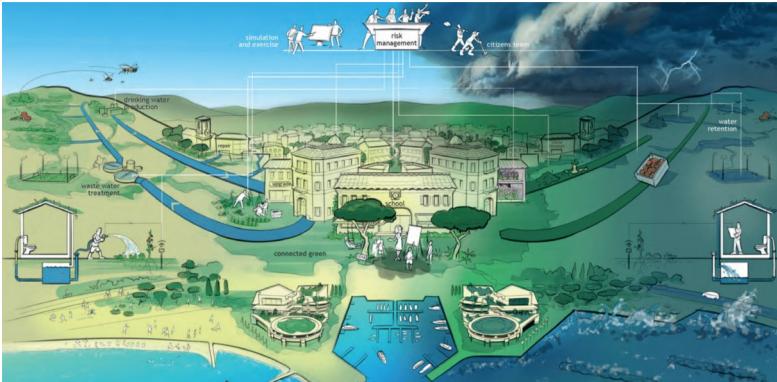
# 4

## REPLICATION FRAMEWORK

To ensure that the knowledge and experiences from the project's research and implementation activities could be replicated and taken up by the follower cities, a replication framework was set up to support the roadmapping process. It consisted of inspiration cards around the topics of NBS, value creation, financing options, co-creation tools and governance actions to inform and inspire local stakeholders during the roadmap development.



# WORKSHOP SNAPSHOTS



# THE GOVERNANCE OF NBS

## How to overcome governance-related barriers to the uptake 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. Until recently, these 'silos' established on different levels of government were relatively effective in delivering public management. Yet the effectiveness of dealing with complex cross-sectoral issues such as climate change has been limited. At the same time, many cities are experiencing a transformation from 'Government' to 'Governance', with a shift in the role of local administrations from top-down regulators towards providers of a certain governance 'context' to organise activities. In this context, non-state actors such as research institutions, companies, local community groups and other urban actors are playing an increasingly important role in the way cities are planned, built and managed. The effective mobilisation of these actors requires the creation of the right structures and 'rules of the game' to steer towards a sustainable and resilient future.

The successful implementation of nature-based solutions (NBS) in urban spaces builds on a combined effort of different actors both inside and outside the municipal organisations, emphasising the importance of understanding the factors that will support or inhibit the effective coordination of these actors. The UNaLab project has explored a range of governance-related barriers inhibiting the effective integration of NBS in cities, and has highlighted a range of actions that can be taken to help overcome these barriers. These *Municipal Governance Guidelines* build on knowledge developed around NBS governance through the work in the UNaLab front-runner cities and other good practices related to supportive governance structures and processes for NBS in cities.

**Interested in learning more about governance-related barriers and actions to overcome these challenges?**

**Read our *Municipal Governance Guidelines*!**



# SETTING UP AND RUNNING AN URBAN LIVING LAB

## What is an Urban Living Lab?

There is a growing trend to involve citizens in city development, in order to make urban areas more adapted to citizens' needs. When addressing the consequences of climate change and urbanisation in cities, such as air pollution, flooding, and heat stress, it is important to think ahead, and at the same time, to consider the social implications of the solutions that are introduced in our urban areas. Addressing complex problems, such as climate change and the social implications linked to it, entails a wide range of aspects to consider. It should be addressed by involving a range of stakeholders, including citizens, companies, research, academia and the public sector, to ensure the successful collaboration towards shared solutions.

Urban Living Labs (ULLs) are the orchestrators of this collaboration, bringing together the different stakeholders - companies, research institutions, the public sector and citizens - through co-creation. Co-creation involves different phases of development to reach the final solution:

- The first phase consists of a joint exploration to identify the challenges and the different needs from the perspectives of all stakeholders.
- The second phase is the experimentation phase, which includes building a prototype of the proposed solution, testing it, and building it again - each time improving the solution based on the feedback gathered from the previous stages. In the case of the UNaLab project, the solution that is proposed is a nature-based solution that is built in a city to reduce the effects of the climate-related challenge that it is designed to address, while also providing a range of benefits and co-benefits. In living labs, the place for experimentation is always a real-life setting: the solution is tested in the real-life environment, right where it is planned to be implemented.
- The third phase of the co-creation process is evaluation and implementation. In this final phase, the solution is evaluated and the final version of it can be built.

## How to set up an Urban Living Lab

The living lab is often - but not always - connected to the public sector organisation, such as the city municipality. The organisation behind the ULL is called the 'host organisation'. In the UNaLab project, the ULLs in the front-runner cities Tampere, Genova and Eindhoven are all run by the local municipalities as the host organisation.

There are many aspects to consider in terms of organisation, operations, resources, business models, users/citizens, openness and value when setting up a ULL. An abundance of trainings were organised in the front-runner cities to identify those aspects that should be considered for a successful ULL implementation.

In one of the trainings, the following elements were presented as important considerations in the process of setting up a ULL: 1) building trust, 2) starting with people - not technology or data, 3) defining a governance model, 4) stakeholder expectation management, 5) aligning stakeholders and focus, 6) working across disciplines, 7) consider the complexity of the context, do not focus only on the solution but everything around it, 8) involve citizens from the very beginning.

## How to run an Urban Living Lab

Specific sets of skills are needed from those running the activities of a ULL. In the ULL framework, developed within the UNaLab project, the roles of the ULL staff are identified as follows:

**ULL Manager:** Manages the everyday practices of the ULL and develops ULL projects.

**Project Manager:** Responsible for specific projects that are run in the ULL.

**Panel Manager:** Recruits and interacts with the different stakeholders involved.

**Human Interaction Specialist:** Plans and designs activities, interacts with the citizens, evaluates and integrates feedback.

**Pilot Manager:** Responsible for the real-life experimentation and prototyping activities.

Learn more about Urban Living Labs in this report!

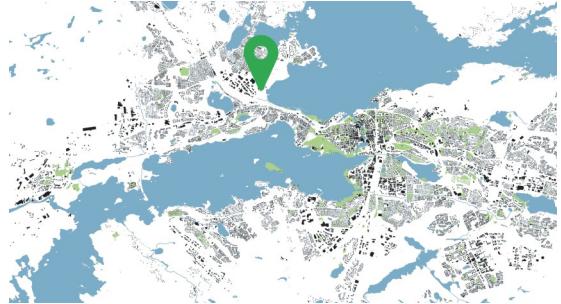


Hiedanranta, Tampere

# IMPROVING WATER QUALITY AND ENHANCING BIODIVERSITY

## Biofilter in Tampere

Hiedanranta is an old pulp mill area owned by the City of Tampere and is located four kilometres from the city centre by the shore of Lake Näsijärvi. Currently, there are no residents living in Hiedanranta, but the plan is to construct housing for 25,000 people in the next 30 years. In 2016, the area became an urban living lab when the city opened it up for activities that promote sustainable urban development.



The biofilter in Hiedanranta is one of the UNaLab project's demonstrations of nature-based solutions (NBS). The biofilter was constructed in this site to clean leachate from the old pulp mill landfill. Previously, the city has used sand filters to purify urban run-off in specific sites, such as snow collection areas. The Hiedanranta NBS demonstration is a first attempt to purify leachate from a contaminated site in situ with more advanced filtering materials. This demonstration has favourable up-scaling possibilities for many sites with water pollution issues in Europe and beyond.

### Process

The reasons behind the initiative include the city's intent to develop the qualitative management of storm water, the reports of disturbing odours from users of the area, and the interest of a biochar factory in Hiedanranta to promote the use of biochar in storm water management. The biofilter was co-created with several stakeholders. As a first step, large stakeholder workshops were organised in spring 2018 to create a vision, to ideate and to test nature-based solutions in Hiedanranta. Simultaneously, a cross-sectoral group of experts started to plan the implementation of the biofilter. The biofilter was constructed in the following autumn and has been operational since December 2018. The construction site posed a challenge due to the old industrial landfill.



Biofilter in Hiedanranta

### Quick facts

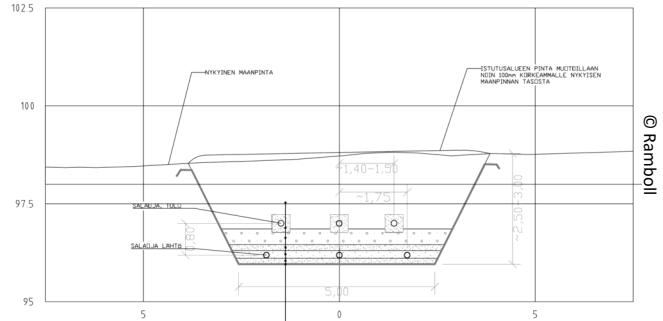
**Cost:** €68 000

**Benefits:** Improved water quality

**Co-benefits:** Enhanced biodiversity and recreational use

## Technical specifications

The landfill leachate, which contains nitrogen and phosphorus, is led through a filtration area which is about 100 m<sup>2</sup> and 3 metres deep. The biofilter consists of different filtering layers. The novel filtering materials used are biochar, peat and Leca-gravel. Deep-rooted bushes and perennials native to the area were planted on top of the filter to retain water and nutrients. At first, the biofilter seemed to function effectively in cleaning the water (reduction N 80% and P 90 %), but its insufficient capacity soon became evident. The inflow volume (over 80 m<sup>3</sup>/day) is higher than expected and the quantitative treatment capacity (about 40 m<sup>3</sup>/day) of the filter is lower than expected. The qualitative treatment results have also decreased. Works are underway to analyse and solve these problems. An initial theory is that the high nutrient content of the leachate has caused biofilm growth, which has blocked the filter. Fine fraction of the biochar might also have caused problems.



## Monitoring - how will the performance of the biofilter be monitored?

Online water monitoring stations are measuring the quantity and quality of the water before it enters and after it leaves the biofilter. The carbon emissions of the NBS are also calculated. Regular biodiversity surveys will be conducted to measure any impacts on the biodiversity, and surveys/interviews will be conducted with people who use the area for recreational activities.

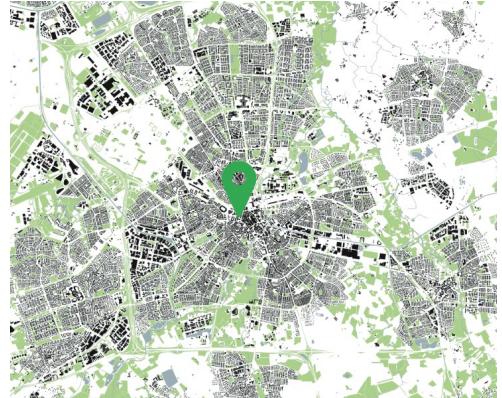
### KEY LEARNINGS

- Biofilters utilising novel filtering materials to purify landfill leachate is a good example of a complex nature-based solution where the implementation requires the use of multidisciplinary expertise.
- Nature-based solutions offer an integrative direction for multidisciplinary cooperation, but the cooperation must be facilitated carefully.
- In a real-life context, water flow analyses contain uncertainty.
- Biochar has potential to remove nutrients.
- Nutrient rich waters can cause biofilm growth and subsequent filter blocking.
- When biochar is used as filtering material, fine fraction needs to be removed.
- Frequent monitoring detects problems and supports in solving them.

# REDUCING FLOODING AND MITIGATING HEAT STRESS

## Green square in Eindhoven

The Clausplein square, located in the city centre of Eindhoven, is refurbished as part of the UNaLab project. The stone-covered square is located in a dense urban area and is greatly affected by extreme weather events. During a heat wave, the square turns into an unpleasant hot place that citizens avoid. At night, the heat is released into the surrounding environment, making it difficult for the residents in that area to sleep. During rain showers, the excess water is discharged directly into the sewer, causing an overload for the system. This results in flooding of the nearby Emmasingel street. To reduce the risk of floods, an underground water retention system is installed. Trees and other plants were planted on the square to address the heat stress problem.



### Process

The new square has been designed together with the surrounding inhabitants and entrepreneurs as well as the local NGO 'Trefpunt Groen Eindhoven'. The presence of a private parking under the square also required a close coordination with the owner. The first construction plans were rejected due to their high costs. A new design was put together, requiring a smaller budget but with higher demands for the greening and water management. The Clausplein square will represent an example of the ways the city wants to address the greening of public spaces and water management issues in the future. The owner of the 'Witte Dame' building, located next to the square, co-financed the works. The Ministry of Infrastructure and Water Management also made a contribution to the project.



Clausplein square in Eindhoven

### Quick facts

**Cost:** €837 000

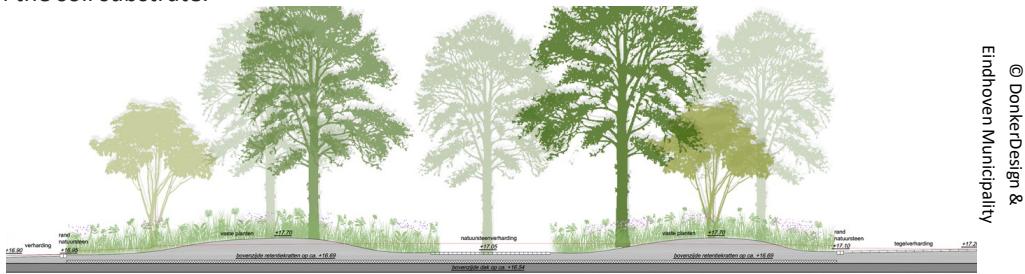
**Benefits:** Increase in robust greening for higher level structures, reduced heat stress, improved water storage capacity, improved water quality and improved air quality

**Co-benefits:** Enhanced biodiversity and enhanced liveability

## Technical aspects

Rain- and stormwater draining from the square and from parts of the 'Witte Dame' building is collected into 2 000 m<sup>2</sup> and 15 cm high boxes on top of the parking. Capillary action makes the water available for the trees and plants on the square. Excess stormwater is later collected by the sewer, which by that time is empty again. This results in a decreased load for the sewers.

Trees, shrubs, perennials and grasses were planted to enhance evapotranspiration, which will aid in regulating the peak temperatures and flood peaks on the square. The pavement on the square was replaced with plant sections. The existing natural stone pebbles and lighting were partially reused, and a walking route was built across the square as well as a terrace space. To ensure the success of the capillary action, extra moisture-regulating clay granulate was mixed through the soil substrate.



## Monitoring - how will the performance of the nature-based solutions be monitored?

The following will be monitored: carbon emissions, temperature, water level in the retention system, soil moisture, and biodiversity. The Municipality is considering to measure health and well-being as well as economic activity with the help of cameras, if the measure is approved.

### KEY LEARNINGS

- Involve residents and entrepreneurs early on and continuously in the design process and the financing.
- Use sumps to prevent contamination in the water retention boxes. Also use inspection shafts to check the system and place sensors for monitoring. If needed, the plant boxes can be refilled through these inlets.
- Make sure that the capillary capacity of the soil substrate fits the water need of the plants.
- Extra capillary cones were added to the water retention boxes near the light poles to ensure enough water supply to the perennials next to the poles.
- Additional watering is not expected to be necessary, but in case of prolonged droughts it is possible to supply water manually.

# REDUCING FLOODING AND IMPROVING AIR QUALITY

## Rain garden in Genova

During the UNaLab project, Genova will transform the Gavoglio military barracks, located in the centre of the Lagaccio district, into an urban park. The Gavoglio urban park will contain 12 types of nature-based solutions (NBS), closely connected to each other. They have been conceived to work in synergy to provide multiple benefits to the new public park and its neighbourhood. One of these solutions is the rain garden, which is located in a very important area of the park at the intersection of two valleys - here rainwater flows naturally thanks to the local topography. Additionally, there is a continuous leak from the valley's retaining walls due to the former lake that once existed uphill. During heavy rain events, excess runoff becomes a significant issue in the area.



### Process

The idea of the urban park originated from the urban planning sector of the city following requests from the citizens: this part of the city suffers from a lack of public green spaces and leisure and sports services, whilst it is characterised by a very high building density and social challenges. The idea of deploying NBS to build this park is the outcome of a longer process involving local stakeholders and public administration. This approach has enabled to combine essential urban functions with new sustainable construction methodologies. Stakeholders were involved through subsequent workshops in which the NBS was presented and consequently, with the contribution of citizens, designed to carry out desired functions. In three successive co-creation sessions the final design was refined and the final project was born.



### Quick facts

**Cost:** €9 740 (€33/m<sup>2</sup>), including material supply and execution costs

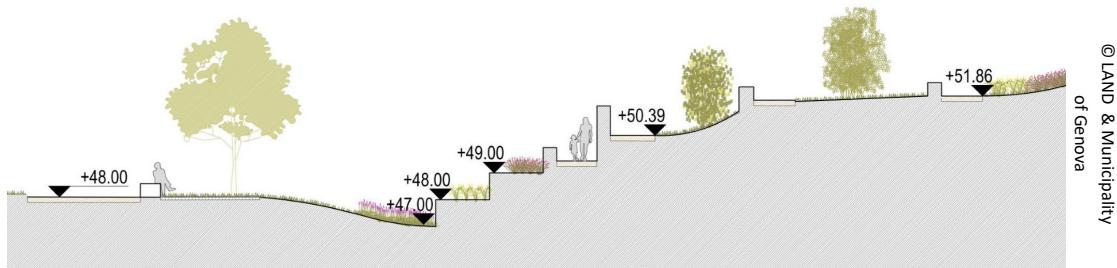
**Benefits:** Temporary retention of stormwater, decrease in runoff, infiltration of water into the soil, improved water quality

**Co-benefits:** Enhanced biodiversity, improved air quality and reduced heat stress

## Technical aspects

The rain garden has been planned in a spot where there is a continuous water flow from natural slopes uphill. This spot also forms the lower point of the steeper part of the park, thus constituting a natural catchment point for rainwater runoff. Grasses have been selected to resist both flooding and protracted drought periods. Ideally, they will recreate a natural-like hygrophilous ecosystem with local species. Two willow trees were placed at the sides to provide shade and foster a moist environment. The most visited part was reinforced with a vegetated pave in order to allow grass to survive and to keep the ground plane and stable.

The layout of the rain garden is set out in three main zones according to a gradient of accessibility and attendance: a vegetated grid pave closer to the path, which is separated by a row of benches; a meadow with trees; and a temporary pond with water-prone grasses.



## Monitoring - how will the performance of the rain garden be monitored?

The following will be monitored: temperature and UHI effect, air quality, biodiversity, number of pollinators, rainwater retention and runoff, water infiltration capacity, water quality, increase in green and blue spaces, distribution of and access to public green spaces.

### KEY LEARNINGS

- On-site surveys and discussions with different municipal sectors allowed to identify the presence of a water source and to address the hazard of significant stormwater runoff in the area.
- A SWOT analysis supported the selection of this NBS when considering the topography, possibilities for recreational activities, rainwater management and biodiversity potential.
- Citizens were involved to verify the acceptance of a such a natural-like spot in the park.
- The location of the NBS was discussed with a multidisciplinary group consisting of engineers, planners and landscape architects. In the design process it was, however, moved to a different location in the same area.

# FINANCING NBS

## Business models and financing strategies for NBS

The development of the concept of nature-based solutions (NBS) in cities demands new insights into how to address its financial dimension. This demand reflects the acknowledgement that smart and innovative financing strategies need to take into consideration the specific institutional, technical, economic and normative contexts where they are applied, and that these contexts need to be adequately understood by the parties involved, be those financial institutions, municipal governments, private companies or civil society.

The UNaLab *Business Models & Financing Strategies* report provides city planners with examples of business models for selected NBS, as well as potential financing strategies that could support NBS implementation and operation efforts. It provides policy makers with the key components of the NBS business models, following a business model canvas approach.

### The Nature-based Solutions Business Model Canvas

The Nature-based Solutions Business Model Canvas was used within the UNaLab project to study some of the planned NBS in the front-runner cities. It is an easy-to-use tool that helps to capture the business model of NBS in a visual format. In particular, the NBS Business Model Canvas helps:

- **To communicate.** The NBS Business Model Canvas provides a simple way of telling others what you want to do and why, who needs to be involved, and how you are going to make it happen.
- **To plan the start of an NBS project.** It helps to consider all the basic building blocks for building a successful long-term sustainable project.
- **To identify new partners.** By considering the value that NBS may offer to different groups of people, the NBS Business Model Canvas helps to identify potential new partners or beneficiaries that may be interested in getting involved in the planning, implementation or maintenance of NBS.
- **To explore new sources of finance.** Combining reflections on the value of NBS with the identification of new partners may help to identify potential sources of initial NBS financing or partners who could help with financing ongoing costs or contributing to cost reductions.
- **To broaden the value proposition.** The NBS Business Model Canvas considers environmental, social and economic values, leading to the identification of new stakeholders and alternative ways of capturing value. This may also lead to the identification of new sources of financing.

## UNaLab solutions and best practices

The UNaLab front-runner cities' business models offered interesting solutions with high replication and up-scaling potential in other cities or contexts.

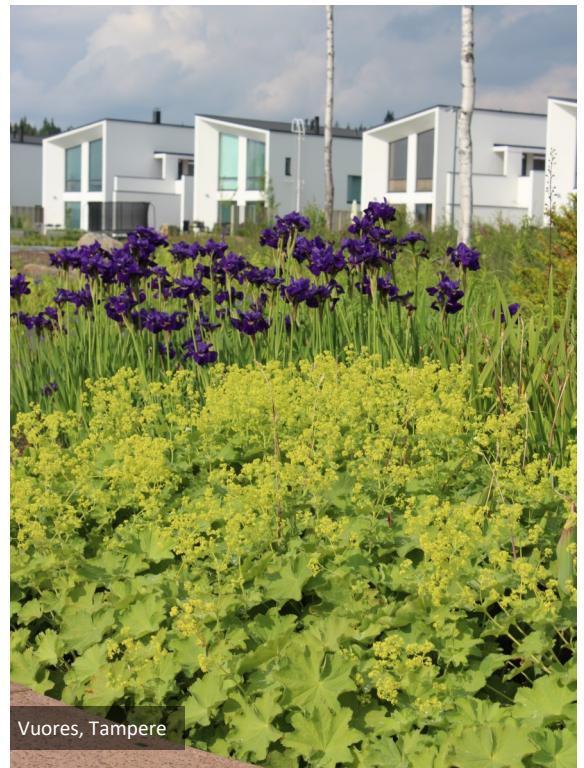
In Tampere, **'innovation vouchers'** were awarded to citizens to enable housing companies and other communities to co-design and co-implement small-scale NBS projects. This solution can be replicated in other cities or contexts, when small- or medium-scale NBS are implemented, such as green walls and green roofs.

In Genova, the Municipality will **engage voluntary citizen associations in the maintenance** of the planned green urban areas. This solution could be replicated in contexts where NBS contribute to the requalification of derelict areas, which might be the focus of charities or volunteer associations working on socially deprived areas.

The NBS Business Model Canvas proved to be an easy and effective tool to engage the municipalities in the business model analysis of their NBS. However, the tool also presented some limitations. The methodology is highly dependent on the type of stakeholders and experts involved in the analysis. Municipality representatives might be the optimal stakeholders to highlight the social and environmental value of the NBS, but sometimes they may fail to identify the direct and indirect benefits for the private sector. It is therefore essential to involve both public and private stakeholders beyond the municipalities in such analysis, through, for example, co-creation sessions.

In some cases, it can be very difficult to capture the direct value of NBS for the private sector, especially when the social and the environmental benefits are difficult to quantify. Other methodologies and approaches could be applied in addition to the NBS Business Model Canvas in these cases.

**Learn more about business models and financing strategies for NBS in this report!**



Vuores, Tampere

## Financing strategies for NBS

Based on the UNaLab business models, the *Business Models & Financing Strategies* report introduces a mapping of financing mechanism alternatives for cities interested in working with NBS. It analyses how and within which contexts the reviewed financing strategies are expected to work best with NBS technologies.

The adoption of alternative financial strategies that encourage the participation of the private sector in sharing costs and gains, risks and benefits, encompasses additional uncertainties for cities. Many cities might have limited experience in dealing with such uncertainties and risks. Therefore, they need to be thoroughly investigated before a certain financing strategy is put into practice. Furthermore, the design of an alternative financial strategy is also highly dependent on the local context. Factors such as the technical characteristics of the NBS; the regulatory frameworks; the availability, capability and interest of the private sector to participate in NBS projects; the financial and technical capacity of the city; as well as the political and social support are likely to determine the choice between different financing alternatives for NBS. In addition, the public and intangible nature of many of the NBS benefits contributes to the uncertainty that cities have to deal with when trying to design the financing strategies for these interventions. Often NBS projects lack a well-defined revenue stream and can differ substantially in the scale of implementation, which means that their upscaling might be difficult in terms of size and/or potential to generate revenues.

## Alternative financing strategies

The UNaLab project has mapped out and created a comprehensive list of the financing strategies suitable for most NBS categories. The project identified around 30 tools that could be used for financing NBS, which served as a basis for the categorisation of the financial mechanisms into five groups:

- **Innovative municipal financing approaches**
- **Public-Private Partnerships**
- **Mandatory requirements and tax initiatives**
- **Incentive programmes**
- **Municipal funds**

The basic definitions, associated risks and potential advantages and disadvantages for these five identified groups are available in the *Business Models & Financing Strategies* report.

## Financing recommendations

The majority of NBS funding is normally provided by the municipal budgets. The municipalities often seem to experience a path-dependency in applying the same sources of finance paired with a lack of knowledge, which might discourage the efforts to find innovative financing approaches for NBS. In addition, the communication issues between planning and budget departments are common in municipalities. This situation is hindered by the lack of experts on NBS financing.

To guarantee the full potential and sustainability of NBS, cities need to ensure the continuity of funding for new NBS interventions as well as proper maintenance of the already established NBS. In this context, private sector involvement is deemed crucial. For example, city governments could make the capital expenditure investment and the private sector could cover the maintenance and operational expenditure, and thus share the responsibilities of implementing NBS. Yet, experts from two other Horizon 2020 NBS projects believe that the engagement of the private sector largely depends on the type of NBS. According to them, NBS that deliver public goods are not very likely to attract private investors.

Overall, it is recommended to avoid clustering all NBS into one single element, but rather work towards understanding the different types of NBS and their scale and scope of implementation. Consequently, different business cases may apply for NBS categories and some of them might draw more attention from the private sector than others. It is deemed important that the private sector can clearly visualise the return of investment for each NBS case.



Vuores, Tampere

### MAIN RECOMMENDATIONS

- Have a wide overview of all the financing options and find and select the most suitable depending on the NBS intervention and the local context.
- Do not place all the expectations on private sector financing, since there are other sources that might be just as useful.
- Engage with real estate developers.
- Document NBS benefits and success stories and communicate these to the private sector.
- Consider means for NBS cost reduction (e.g. involve volunteers with diverse backgrounds for the different operational tasks).

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