VALUE CHAIN ANALYSIS OF SELECTED NBS

D6.1 Deliverable

31/08/2018 (Resubmitted 31/05/2019)

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No & name	**D6.1 Value Chain Analysis of selected NBS**				
Status		**Due**	M15	**Date**	2018-08-31
Author(s)	Rina Consulting S.p.A. (RINA-C)				
Description of the related task and the deliverable. Extract from DoA	**T6.2 Value Chain Analysis & Evaluation of Replication & Upscaling Potential (DAPP) M1 – 60** The value chain of NBS implemented in front-runner cities will be analysed and their potential for replication/upscaling evaluated. During the co-creation process, front-runner cities' proposed solutions will be analysed both from a commercial and industrial perspective and from a geopolitical and strategic point of view. These NBS will be studied from a value chain perspective considering all possible actors involved and the needs expressed by front-runner and follower cities in the first Exploitation Workshop (T6.6). During UNaLab, thorough analysis, evaluation and monitoring of NBS demonstration activities and their results (WP3) will facilitate detailed analysis of NBS suitability for replication from front-runner cities to follower cities, optimising the lessons learned within the UNaLab project. T6.2 links with business model development in T6.3. This task outputs D6.1 and contributes to D6.8. In addition this task will cooperate with other SCC02 projects in exchanging the information about replication and upscaling potential. Moreover it will provide regular information of the progress, outputs and potential alignment of activities to task T1.7 DAPP leads this task with input from EIN, GEN and TRE.				
Participants	Gemeente Eindhoven (EIN), Comune di Genova (GEN), Tampereen Kaupunki (TRE)				
Comments	This deliverable has not yet been approved by the funding agency				

V	Date	Authors	Description
1	16.07.18	RINA-C	First Draft
2	25.07.18	Tom, Ernesta and Petr	WP Leader Check
3	03.08.18	RINA-C	Revised Draft
4	09.08.2018	Tom Hawxwell	WP Leader Check
5	20.05.2019	RINA-C	Revised version

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, Basaksehir, 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

HISTORY OF CHANGES

Version	Date	Changes
V5	20.05.2018	Addition of a new section 3 "Value Chain Analysis & contribution to the replication framework" and relative Appendices (14.1 "Value Chain Analysis: questionnaire for Follower Cities" and 14.2 "Value Chain & Replicability Analysis workshop"). The section is focused on addressing the following issues of the EC letter "Request for revision of deliverable submission for the project "UNALAB (730052)": • *issue i)* with reference to paragraph 3.1 and figure 3.1 • *issue ii)* with reference to paragraph 3.2 and appendices 14.1 and 14.2 • *issue iii) (ref: how will the business model findings will feed into the value chain analysis?)* with reference to paragraph 3.1 and figure 3.1
V5	20.05.2018	The terminology has been revised. "Draining flooring" has been replaced with "permeable pavements" throughout the entire document. This will address the *issue iii)* together with the addition of D6.3 cross-reference within paragraph 8.6 regarding the implementation costs for the Gavoglio Area. The costs are not given within D6.1 as not available at M15. They have been included within D6.3 due to the later submission of the deliverable.
V5	20.05.2018	The use of English has been checked throughout the whole document. There have been several changes in particular regarding the Genoa related sections. This will address the *issue iv).*
V5	20.05.2018	Addition of a new paragraph 11.2 "Common lesson learned" implementing some more reflection. This will address the *issue v).*
V5	20.05.2018	Correction of the section 13 "References". The references have been arranged alphabetically and revised in order to be consistent in their format. This will address the *issue vi).*

Table of Contents

1. EXECUTIVE SUMMARY

The deliverable D6.1 analyses the value chain, the replicability and the upscaling potential of one selected NBS for each Frontrunner city (Eindhoven, Genova and Tampere).

The purpose of the analyses is to provide useful information to support the implementation of the NBSs not only in the follower cities but also in other cities interested in the implementation of NBSs in urban contexts. In particular, within the UNaLab project, the follower cities can use all the evaluations reported in this deliverable to select the most appropriate NBS and to exploit the lessons learned by the front-runner cities in order to replicate the NBS implementation in the most successful way.

Due to the initial phase of the project, the availability of only preliminary information on costs, applied technologies and the lack of monitoring data following the NBS implementation, the selected NBS are analysed only in a qualitative way.

Further WP6 activities and deliverables (e.g. deliverable D6.8 "Handbook to support NBS implementation") will detail and report more in depth evaluations useful to achieve a complete value chain and replication analysis of the selected NBSs, shared and validated by the follower cities.

The present deliverable reports a general description of the NBS location with preliminary information about climate, meteorological events, soil and urban characteristics in order to identify the issues of each front-runner city and contextualize the selection of the NBSs to be implemented.

Following a general description, the central part of the document is focused on the analysis of the value chain of the NBSs, with the characterization of the needs and the specific issues of the cities and with the description of all the actors and resources involved in the co-creation and co-implementation processes. Besides, for each NBS all the expected benefits and advantages at social, economic and environmental as well as the expected costs of the interventions level have been considered.

The replicability and the upscaling potential of each NBS has been evaluated in the final part of the document, focusing on the previous experience of similar NBS and the analysis of both drivers, that could support the NBS implementation, and barriers, that could instead limit their implementation in urban context.

The conclusion summarizes all the achievements and provides possible solutions to the identified barriers to the replicability of the analysed NBS.

2. INTRODUCTION

2.1 Purpose and target group

The aim of this deliverable is to analyse the proposed NBS of the three front-runner cities from a value chain perspective in order to evaluate their replicability and upscaling potential.

The main goal is to support further development and continuous innovation through the assessment and discussion of the potential environmental, social and economic impact exploited in the three front-runner cities.

The approach used includes the evaluation of the specific needs and issues of the frontrunner and the follower cities with a focus both on resources and technologies used and on all actors and activities involved during the implementation of the NBS.

The NBS have been also analysed from the point of view of the relevant benefits and advantages at social, economic and environmental levels and of the potential technical and non-technical barriers to their replicability.

The target group of the deliverable is the seven follower cities. In particular, it refers to the municipalities, the planners and the designers, in order to help them in the choice of the most appropriate NBS for their cities. The follower cities might use this deliverable as a high-level guideline useful to drive the initial decisions, starting from the evaluation of common needs and issues. Based on the VCA performed for the selected NBS, the follower cities will be able to evaluate the most convenient NBS, the expected benefits and actions needed to solve and mitigate possible barriers that could incur before, during and after the implementation of the NBS analysed within the deliverable. Given the initial phase of the project in which the deliverable is settled (in particular before the monitoring and impact assessments and the biophysical NBS simulation results included into the WP3 activities), the NBS implemented in the front-runner cities are analysed in a qualitative way, in order to complement first evaluations. In the present deliverable, the value chain assessment will be performed for one relevant NBS selected by each Frontrunner city.

Further WP6 activities and deliverables will carry out and report more in-depth evaluations. In particular the deliverable D6.8 “Handbook to support NBS implementation” will integrate WP5 and WP6 activities into a comprehensive Handbook of Business, Finance and Governance Models, Value Chain Analysis and Replication Framework to support NBS implementation.

2.2 Contributions of partners

RINA-C, as task leader, is responsible for the deliverable submission and has provided the structure of the whole document, as well as the key principles and contents of the analysis and the final evaluations carried out from the gathered information. In additions, RINA-C has made the revision of all the inputs from EIN, GEN and TRE to give uniformity to the document.

EIN, GEN and TRE provided all the information needed through their active participation to workshops (co-creation workshops, general assemblies and meetings) and the compilation of relevant questionnaires, as well as direct revision of the deliverable contents.

2.3 Relations to other activities

This deliverable is linked to other activities within WP5 (T5.2 “Demonstration of NBS in the City of Eindhoven”, T5.3 “Demonstration of NBS in the City of Genova”, T5.4 “Demonstration of NBS in the City of Tampere") and WP6. Regarding WP6 activities, the deliverable is mainly related to the business model development (T6.3), the road-mapping (T6.5) and the Buddy System (T6.6) in which frontrunner and follower cities expressed their needs. In addition, D6.1 will play an important role in the development of the deliverable D6.8 "Handbook to support NBS implementation" where a complete value chain and replication analysis of the selected NBSs, shared and validated by the follower cities, will be provided.

3. VALUE CHAIN ANALYSIS & CONTRIBUTION TO THE REPLICATION FRAMEWORK

3.1 Overview of the adopted strategy

The strategy proposed to carry out a complete value chain analysis adding value to the NBS Replication Framework includes a series of sub-sequential actions starting from the preparatory activities reported in this deliverable and ending with the D6.8 “Handbook to support NBS implementation”. The main purpose behind this approach is to contribute consistently to the Replication Framework considering all the inputs and interactions coming from other tasks (relevant to support replication and upscaling evaluations) and ensuring that the project achieves its innovation potential. The general overview of all relevant activities planned is depicted in *Figure 3.1.*

The following key actions have been identified:

- **Action 0:** preliminary value chain analysis and replication/upscaling evaluations are carried out for one selected NBS for each front-runner city, based on direct inputs from the cities and reported within the D6.1 due at M15. The analysis will inform and support D6.3 “Business models & financing strategies” which, due the later submission, will include more detailed information (e.g. implementation cost of the permeable pavements implemented in Genoa).
- **Action 1:** analysis of the follower cities needs and categorization of the NBS implemented by the front-runner cities. This activity allows to connect the value chain with T6.5 Roadmapping, implementing also qualitative geopolitical analysis of the frontrunner and follower cities.
- **Action 2:** completion of the qualitative analysis for all the NBS that are going to be implemented in the front-runner cities. All relevant information will be collected both from previous workshops and deliverables (e.g. D6.3 “Business models & financing strategies”) and from ad hoc questionnaires/interviews submitted to each front-runner city.
- **Action 3:** review and interpretation of the information previously collected. The results of the analysis will be summarised and organised within proper matrices/tables and will provide data for the digital website.
- **Action 4:** linking front-runner cities experience with follower cities’ needs. This will provide inputs mainly to T6.5 “Roadmapping” and D6.7 “Replication Roadmaps”.
- **Action 5:** more-in-depth considerations for the replicability including the analysis from both a commercial and industrial perspective and from a geopolitical and strategic point of view. This activity will be possible only after the NBS implementation with solid inputs coming from WP3 regarding monitoring data and impact assessment, (in particular from the draft version of D3.4 “Impacts of NBS Demonstrations”), from WP5 regarding NBS implementation (i.e. from D5.4 “ULL NBS demonstration site start-up report”) and from WP6 regarding business model findings and roadmapping (i.e. from D6.7 on “Replication Roadmaps”, M38).
- **Action 6:** inputs for the D6.8 “Handbook to support NBS implementation” will be provided in the form of cards/tables summarising all the analysis carried out for the Final Replication Framework.

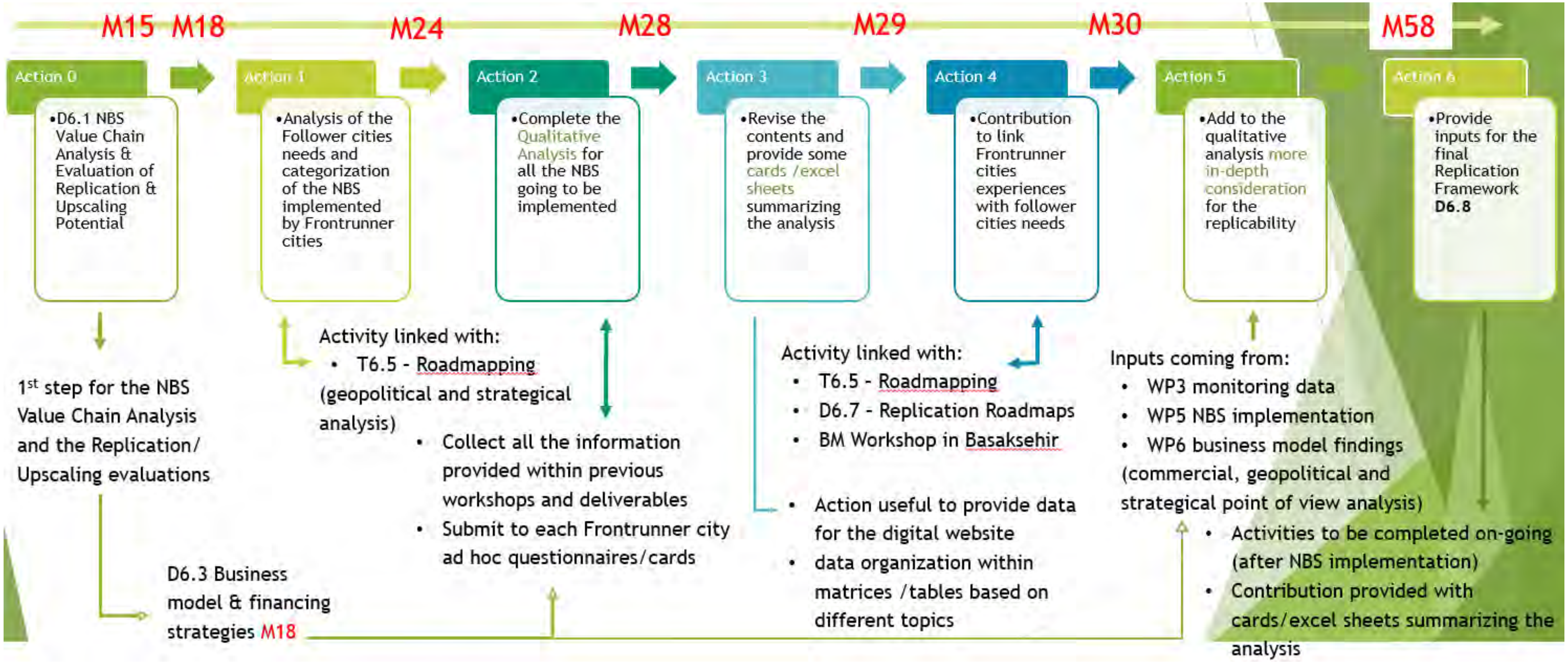


Figure 3.1: Value Chain Analysis & Replication Framework planning

3.2 Approach used to collect and analyse the information

The information reported and analysed in this document has been derived from questionnaires and a dedicated workshop with specific interviews addressed to the three front-runner cities. The information collected have been subsequently structured and interpreted for further analysis and have been subject to a final check by the technical responsible appointed by each front-runner city.

Questionnaire

A structured questionnaire was sent by email to each front-runner city in order to collect all the relevant information to perform a preliminary value chain analysis and define first replicability evaluations for one selected NBS. The questionnaires have been developed to be as simple and clear as possible, with instructions including which aspects to emphasize. There has been profitable multiple correspondence with the front-runner cities responsible in order to get as much information as possible, considering also the preliminary phase of the project. The questionnaire template is included in Appendix 14.1.

Workshop

A dedicated workshop has been conducted during the GA in Eindhoven (May, 31th) to gather relevant information useful to evaluate the replicability and the upscaling potential of selected NBS. The focal points investigated by this workshop were:

- benefits and advantages at environmental, economic and social levels
- possible drivers that can support the implementation of the NBS
- possible barriers that can limit the implementation of the NBS
- expected costs of the NBS at economic, environmental and social level

Three focus groups, one for each front-runner city, composed by the front-runner cities responsible, interested follower cities and relevant partners involved within the discussions, have been invited to discuss upon the previous focal points combining different perspectives and opinions. The answers of the interviews have been collected within specific thematic cards. The information gathered in this workshop have been analysed, linked with those collected with previous questionnaires and elaborated in order to give consistency in the deliverable.
Workshop organisation and results are included in Appendix 14.2.

4. DESCRIPTION OF THE SELECTED NBS OF EIN

4.1 General description

The city of Eindhoven (EIN) has selected several locations within its city centre, with different urban configurations, in which various NBSs will be implemented. The focus of the NBS demonstration in Eindhoven will be the integration of blue (water), green (flora) and grey (built environment) areas, to provide a safe and pleasant living environment for the citizens.

The following image shows the location of the NBSs implemented in the city centre. Due to the ongoing co-creation process and planning activities, the preliminary selected projects may change during the project duration.

Figure 4.1: Location of Eindhoven NBSs [Supplied by the Municipality of Eindhoven]

All the NBSs to be implemented during the UNaLab project are identified in the following table, with a general description and the definition of the relevant objectives and impacts.

Table 4.1: EINDHOVEN Natural Based Solutions

EINDHOVEN Natural Based Solutions			
#	**NBS**	**General description**	**Scope/impact**
1	Green areas	Impermeable pavements are replaced with green spaces or pavements with more permeable materials.	Water flows management
			Increase biodiversity
			Heat stress reduction
			Improve air quality

2	Re-establishment of watercourses (daylighting)	Section of covered watercourses are uncovered and the courses re-established	Water flows management
3	Linking of blue-green urban areas	Connecting existing blue-green areas to improve the robustness of the water system as well as the ecological structure	Water flows management
			Increase biodiversity
4	Preparation of water storage areas	Part of the daylighting of the river Gender will be in the Victoria park. Retention will be facilitated in the park as part of Gender profile	Water flows management (storage)
5	Implementation of green roofs / green building façades	Implementation of green surfaces (roofs and façades) in existing buildings	Water flows management
			Increase biodiversity
			Heat stress reduction

Eindhoven wants to become a more climate resilient city. To achieve this the municipality of Eindhoven intends to create 40-50 mm additional aboveground water storage for peak showers (in total 60 mm storage). One of the ways to ensure this is by **increasing permeability and greening of urban surfaces**. This can be achieved by replacing pavement and impermeable surfacing with vegetation, pavement with more permeable materials and/or water areas. Limiting of surface sealing and greening public areas creates space to store water and infiltrate it into the ground.

To accomplish this, the municipality has the policy to add as much green space as possible in the design of urban spaces (e.g. in streets, squares and riversides).

Increasing greening of urban surfaces also contributes to enhancing biodiversity, to reducing heat stress and to improving the general quality of life. In some areas, filtering plants, such as reeds, can be used to improve water quality.

4.2 Climatic, environmental and urban conditions of the NBS site

In this section, the main relevant climatic, environmental and urban conditions of Eindhoven city centre are analysed in order to provide useful information for the flooding management (peak showers) and for the replicability and upscaling of the NBSs tested.

Climatic conditions

Eindhoven has an oceanic climate with slightly warm summers and cold winters.
Although frosts are frequent in winter, there is no lasting snow cover in a normal winter due to the mild daytime temperatures.

The following tables summarises the average monthly temperature, the average rainfalls and relative humidity.

Table 4.2: Monthly average temperatures [https://www.knmi.nl]

Temperatures [°C]	Months												Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Av. Max Temp	5,7	6,6	10,5	14,5	18,6	21,1	23,4	23,1	19,5	14,9	9,6	6,1	14.5
Av. Min Temp	0,0	-0,1	2,2	4,1	7,8	10,5	12,8	12,2	9,8	6,7	3,3	0,8	5,8
Abs. Max Temp	16,3	18,9	24,6	29,1	33,4	35,0	36,4	36,6	33,1	27,0	20,6	16,4	36,6
Abs. Min Temp	-21,7	-21,6	-14,7	-5,9	-2,6	0,3	2,9	3,6	-0,4	-6,4	-9,6	-17,4	-21,7

Rainfalls in Eindhoven does not exceed 1,000 millimetres per year. The driest months are from February to June while in winter and in summer there is quite abundant rainfall.

Table 4.3: Monthly average rainfalls and humidity [Source: https://it.climate-data.org]

Rainfalls Humidity	Months												Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Rainfall [mm]	64	57	58	44	55	62	77	71	63	63	79	70	750
Rainy days	16	14	16	13	13	14	14	13	14	15	17	17	176
Average Relative humidity [%]	87	84	80	74	73	75	75	77	83	85	89	90	81

Environmental characteristics

Water and soil quality and characteristics

Eindhoven is located in the basin of the river Dommel at the junction of the Dommel and the Tongelreep rivers. The Dommel and the Tongelreep are small rivers with an average discharge of a few cubic meters per second. Rainwater in Eindhoven is collected in a storm water system or combined sewage system and/or in ditches and streams and transported towards the Dommel.

The larger part of Eindhoven has a combined sewage system although two separate systems are being slowly introduced in the city infrastructure. The complete introduction of two separate sewage systems, one for white waters and another one for grey waters, will take decades to be completed.

The soil consists of fine loamy sand with scattered layers of loam and clay. The permeability of the top layer is low (1 to 5 m/day). At a depth of 25 m below surface level, the soil consists of sand with a permeability of 20 to 50 m/day.

The following figure 3.2 shows the Ground level of Eindhoven and its surrounding.

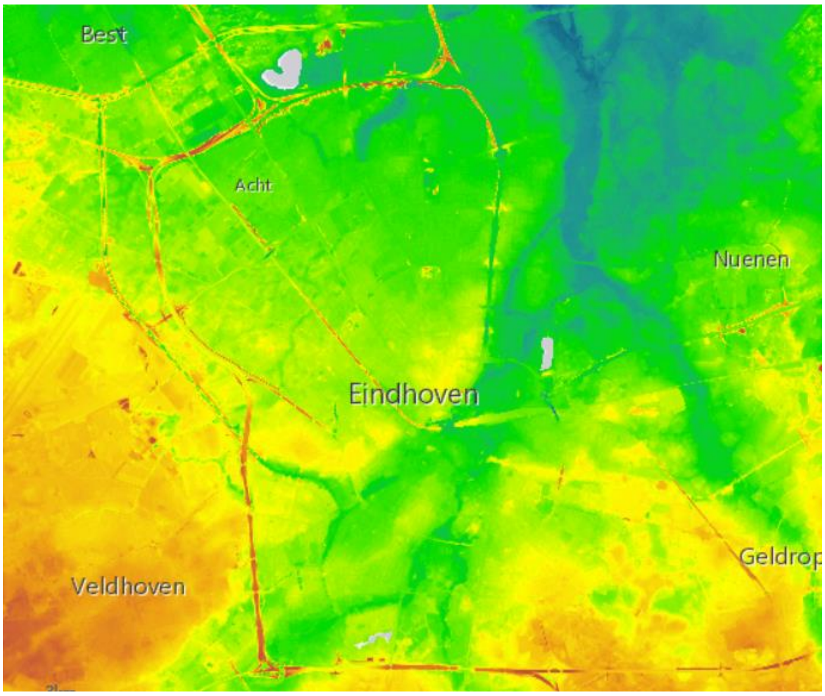


Figure 4.2: Ground level [Supplied by the Municipality of Eindhoven]

Hydrological network

As shown in the following *Figure 4.3*, the groundwater table varies during the year. The fluctuation is between 1 to 1,5 m. The depth of the groundwater table also varies around Eindhoven city area. At some places the level almost reaches the surface, in other it is always several meters below the surface.

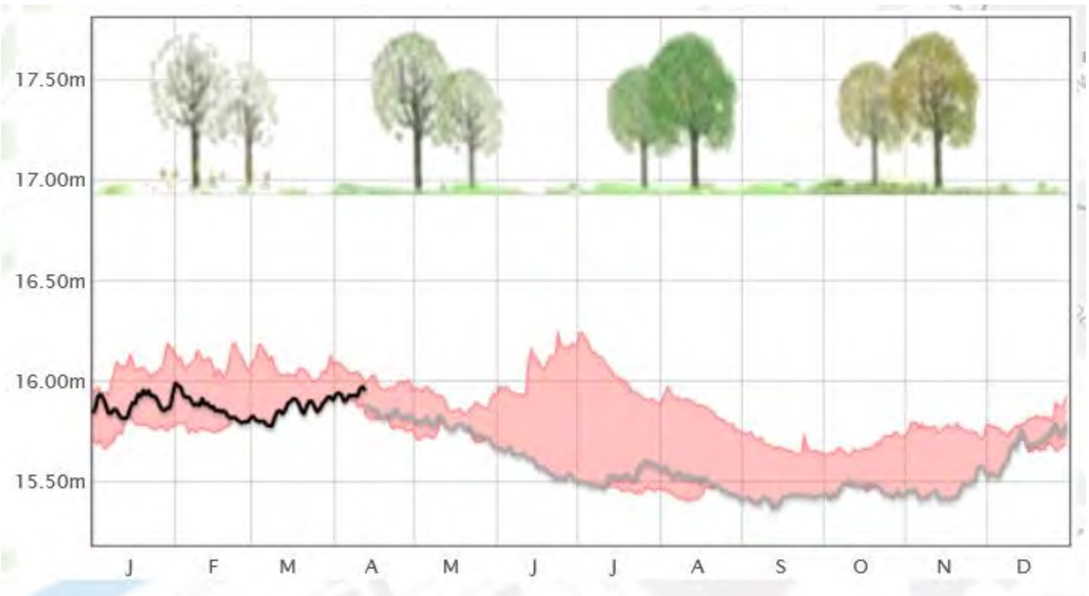


Figure 4.3: Groundwater fluctuation [Supplied by the Municipality of Eindhoven]

Local biodiversity

Eindhoven is developing a map of the city with a description to support designers in making the correct choices of plants and conditions to facilitate the biodiversity.

The choice of plants should be influenced by local conditions like soil and groundwater, but also by the desired biodiversity.

General urban features

Eindhoven can be considered as a green city with a lot of trees and green areas (e.g. flowerbeds, green roofs, gardens and parks). Since the quality of life is an important driver to improve public (and private) areas, there is a trend of creating and facilitating more natural green.

In general, the roads are well maintained. City transportation trends are shifting from cars to public transport, bicycles and pedestrians. However, the streets are still dominated by cars, either parked or driving vehicles.

All the cables and pipes are located underground: the cables are mostly under the sidewalks and the sewage under the road.

4.3 Current destination of the area

In Eindhoven, the NBS locations are situated in or near to the city centre. The current destinations of the several locations are mostly roads and parking places.

Most of these areas are (almost) completely paved. The purpose of the municipality is to convert these areas into greener areas.

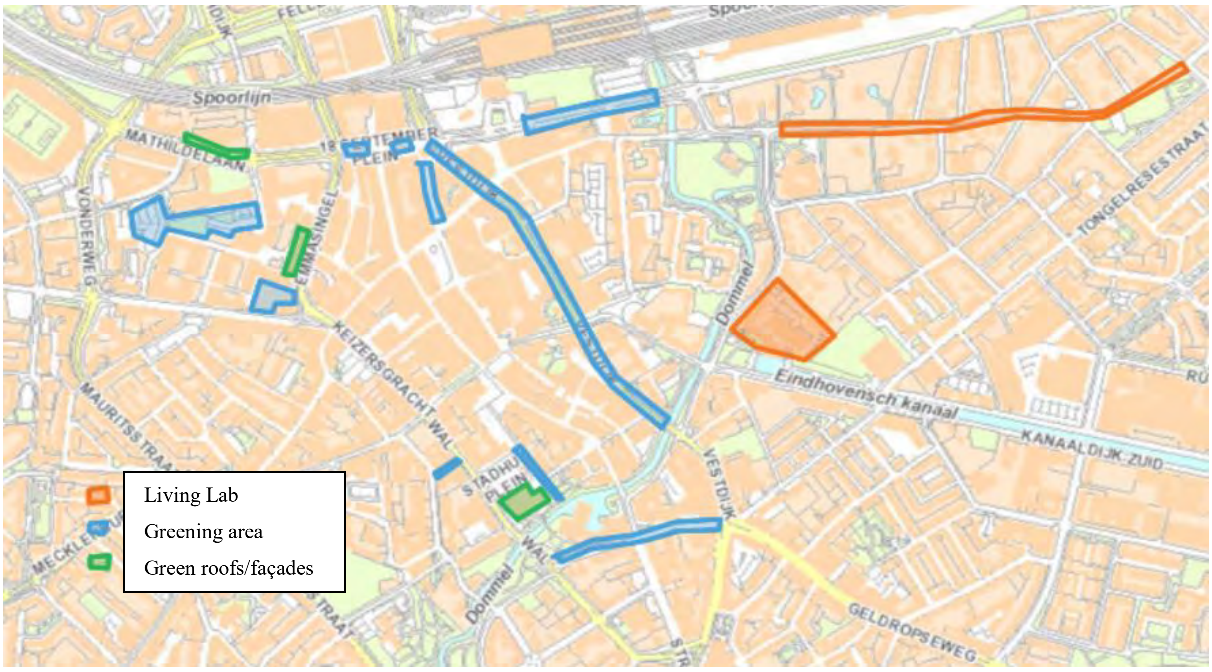


Figure 4.4: NBS projects in Eindhoven [Supplied by the Municipality of Eindhoven]

The implementation of permeable surfaces and green urban areas, evaluated for the Value Chain Analysis, is planned in the project 'Bilderdijklaan' (one of the several NBS locations). This road, owned by the municipality, used to be an ordinary, car-oriented road with a narrow cycle lane and sidewalk. Next to the road, there are some houses, businesses and the Van Abbemuseum.

One of the goals of the project is the redevelopment of the street to create a two-sided bike path that is part of the Slowlane. The project is mostly focused on traffic, but many additional focus points are related to nature and climate-proofing aspects. As an important starting point, paved surfaces are reduced as much as possible.

Regarding water, extra pavement is compensated by extra water storage. The green surface will be increased and it will be connected to surrounding vegetated areas: the Bilderdijklaan can function as an ecological connection zone.

In the following *Figure 4.5*, the location of the 'Bilderdijklaan' project and some photos showing the current state of the area are reported.

Figure 4.5: 'Bilderdijklaan' project [Supplied by the Municipality of Eindhoven]

Figure 4.6: 'Bilderdijklaan' current view [Supplied by the Municipality of Eindhoven]

In the project situation, a high-quality bicycle route allows less space for cars and more space for green surfaces mostly located between the lanes for cars, cyclists and pedestrians.

Clausplein, a square with little green situated on top of a parking garage, represents another example for the implementation of permeable surfaces and green urban areas in the city of Eindhoven. In the following *Figure 4.7* the current situation is shown.

Figure 4.7: 'Clausplein' current view [Supplied by the Municipality of Eindhoven]

The following *Figure 4.8* shows the new design of the square, with increased biodiversity and liveability.

Figure 4.8: 'Clausplein' requalification project view [Supplied by the Municipality of Eindhoven]

5. Description of the selected NBS of GEN

5.1 General description

The city of Genoa has recently approved a Refurbishment Plan for the former Gavoglio Barracks located in the centre of Lagaccio district. The city is going to test a number of NBSs by deploying urban water drainage systems and increasing green spaces, aimed at improving water management and the resilience of the whole area to flooding risk.

The masterplan for the refurbishment of former Gavoglio Barracks is shown in the following

Figure 5.1. The drawing illustrate the current stage of the project. A more detailed design will be developed during further steps of the project.

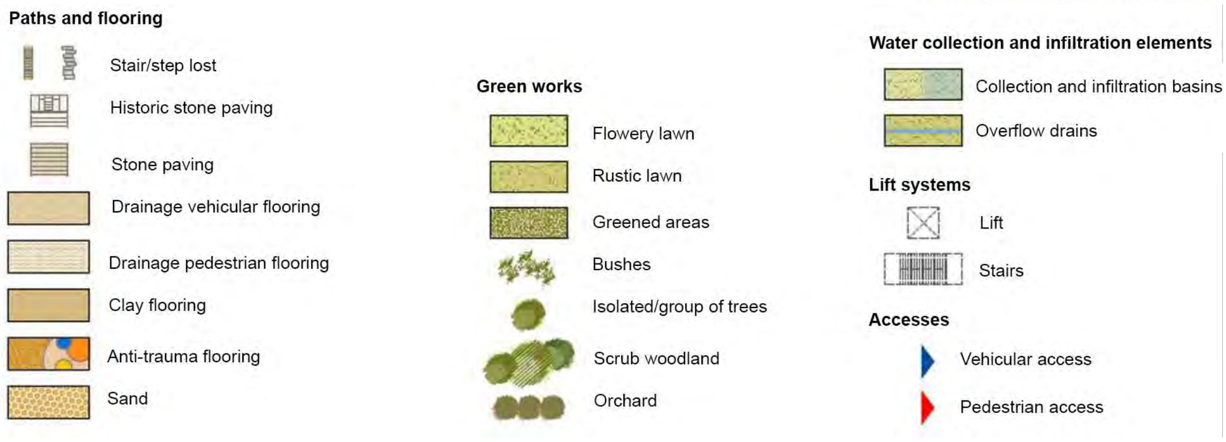


Figure 5.1: Gavoglio Barracks Project Plan [Supplied by the Municipality of Genoa]

As shown in the above masterplan, the Frontrunner city of Genoa is going to implement the following NBS during UNaLab project:

Table 5.1: GENOA Nature Based solutions

GENOA Natural Based Solutions			
#	**NBS**	**General description**	**Scope/impact**
1	Permeable pavements	Vehicle accessible surfaces covered in resin gravel or draining concrete and pedestrian surfaces made of eco-compatible binder	Water flows management
2	Playground draining surfaces	Green playground areas with sand, draining surfaces and play areas connected to natural elements (slides on slopes, on gabions, wooden games, etc.)	Water flows management
			Social connectivity enhancement
3	Retention systems	Underground systems composed by modular elements to retain meteoric waters for irrigation	Water flows management (storage)
4	Infiltration basins	Embedded vegetated soil for the temporary retention of surface meteoric waters, with filter bottom and herbaceous vegetation	Water flows management
			Increase biodiversity
5	Gabions stone	Box filled with rocks, concrete or sometimes sand and soil, for erosion control and land reshaping	Water flows management
6	Vegetated gabions stone	Terraced system of gabions in wire mesh filled with shattered debris from demolitions and shrubs planted in the interstitial space at various levels	Water flows management
7	*Xerophilous* flowered meadows	Lawns with perennial *xerophilous* grasses characterized by high tolerance to drought periods	Water flows management
			Water saving

8	Groups of trees	Groups of trees planted into the new green areas in order to increase the biodiversity and urban quality.	Water flows management
			Increase biodiversity
			Heat stress reduction
			Improve air quality

The most relevant NBS for Genoa, according to the current development of the project, is the implementation of permeable pavements. In order to increase the permeable surfaces of the site, the following actions are planned:

- demolition of over 43˙000 cubic meters of old industrial buildings, land reclamation and debris recovery are expected;
- site preparation for sporting and recreational functions within green areas;
- pedestrian and driveway paths and public spaces made of permeable materials to promote the absorption of meteoric water in the ground;
- several types of permeable materials will be used depending on the functions that will take place on the surfaces: grassy areas, tree-lined spaces, walkways and pause areas in resin gravel or concrete draining, etc.

5.2 Climatic, environmental and urban conditions of the NBS site

In this section, the main relevant climatic, environmental and urban conditions of the Genoa city, and specifically of the Lagaccio district, are analysed in order to provide useful information for the replicability and the upscaling of the NBSs tested.

Climatic conditions

The climate of Genoa is Mediterranean, with mild and rainy winters, and hot and sunny summers. The wind is quite frequent, since in periods of bad weather a depression often forms right on the Gulf of Genoa, which draws to the city a moderate or strong wind from the northeast, able to lower the temperature.

Winter, from December to February, is generally mild. In colder periods, it may even snow but usually night frosts are rare and light. Spring, from March to May, is mild and until the first half of April, unstable periods with rain may take place. Summer, from June to August, is hot and sunny. Generally, the heat is moderate with only few hot and dry periods. Autumn, from September to November, is mild and humid, with sunny days and frequent rainy periods.

The following tables summarised the average monthly temperature, rainfalls and humidity.

Table 5.2: Monthly average temperatures [Source: https://it.climate-data.org]

Temperatures [°C]	Months												Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Av. Max Temp	10,7	12,1	14,4	17,0	20,8	24,2	27,2	27,5	24,3	20,3	15,3	12,3	18,8
Av. Min Temp	4,7	6,0	8,2	10,7	14,5	18,0	20,8	20,9	17,9	14,2	9,6	6,4	12,7
Abs. Max Temp	20,3	22,5	23,5	28,2	32,3	34,0	35,4	38,5	32,9	27,5	22,9	20,8	38,5
Abs. Min Temp	-8,5	-5,0	-3,6	3,4	6,6	7,3	13,9	10,7	9,0	5,1	1,1	-3,6	-8,5

Rainfalls in Genoa are very significant, exceeding 1,000 millimetres (40 inches) per year. In particular, during autumn the rainfalls can lead to flooding of the streams passing through the city. February, March and July are the driest months.

Table 5.3: Monthly average rainfalls and humidity

Rainfall Humidity	Months												Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Rainfalls [mm]	106	66	86	105	95	90	56	121	151	214	162	105	1357
Rainy days	11	10	11	13	12	9	7	9	11	13	12	12	130
Average relative humidity [%]	62	62	62	71	71	72	69	69	69	68	65	64	67

Environmental characteristics

Water and soil quality and characteristics

The hydrographic basin of the Lagaccio district is characterised by narrow, steep valleys converging towards the sea, a common situation in Liguria and across Italy that causes waterways to be flood-prone.

The Cinque Santi and Granarolo rivers both flow into the Lagaccio River, all of which are mostly underground, covered by extensive urban infrastructure.

This has led to the critical situation the district experiences today, with the rivers frequently overflowing and causing floods. In the middle of the valley, there is a former military compound, the former Gavoglio Barracks, built over the Lagaccio River and subject of a substantial planned redevelopment project.

The soil characteristics of the district of Lagaccio includes calcareo-marly turbidities, sometimes siltose, calcarenites, marl and calcareous marl, alternating with pelagic shales, belonging to the formation of limestones of mount Antola. The valley floor of the Lagaccio river and the ancient basin of the homonymous artificial lake are today filled with artificial filling of various eras that have levelled the original river course.

The geomorphological of the area is characterized by the widespread presence of outcropping rocks in good conservation conditions and with favourable disposition of its structures in relation to the slope.

The whole area of the Lagaccio has large areas of rocky clusters characterized by low permeability for cracking, lowered by the buildings and paved areas. In correspondence of the artificial filling where the Gavoglio barracks' complex is located permeable terrains have been founded.

Further analysis (currently ongoing), required by environmental requirements will verify the possible presence of contaminants resulting from past industrial activities. Only after these analysis it will be possible to define the actions needed to reclaim the land in order to accommodate the new functions of the urban park.

Presence of hydrological network

The hydrological network including the main waterways at the regional level is mapped and updated by the Liguria Region. The hydrographic basin of the Lagaccio district is characterised by narrow, steep valleys converging towards the sea increasing the flood risk.

The following figure shows the underground rivers in the area (Rio Cinque Santi, Rio Granarolo and Rio Lagaccio) and the most critical intersection points.

Figure 5.2: Underground Rivers [Supplied by the Municipality of Genoa]

Generally, all the streams that run underground the Lagaccio area present a mixture of rainwater and sewage. This situation cannot be improved in a short and medium period. The Cinque Santi river, in particular, from the latest analysis no longer receives rain water, being completely covered, and become a sewer pipeline.

Furthermore, based on preliminary hydraulic site analysis, the underground sections of the rivers are actually inadequate to discharge the flow rates foreseen by the basin plan. The presence of an extensive urban infrastructure causes a critical situation for which the rivers frequently overflow and cause floods.

Local biodiversity

The Gavoglio Barracks are located in an urban context densely built. However the Lagaccio district is located near an important naturalistic Park (Peralto Park) characterized by high biodiversity with many varieties of flora and fauna.

Therefore, the environmental requalification of the Gavoglio Barracks area will easily allow to extend the local biodiversity of the Peralto Park also into the city and will provide a natural space for many local species.

General urban features

The area of the Gavoglio Barracks is located in the middle of Lagaccio district, in a central area near the main tourist attractions (forts, ancient port, cruise ports, via Balbi, Old Town...) and public services (sports fields, universities, public offices, high schools, etc.).

The Lagaccio district is a densely populated area with a spontaneous post-war era urbanisation and is mainly made up by residential multi-storey buildings. The streets are generally winding and not narrow, except for those in the upstream frame and the parking areas are quite limited. The orography of the site is defined by steep hill slopes, which influence the mobility in the area.

Figure 5.3: Aerial view of the Lagaccio neighbourhood *[Source:* https://www.google.com/maps*]*

As shown in the previous *Figure 5.3*, the soil is largely sealed as it is saturated with large residential buildings and paved streets.

The buildings are mostly of low quality from an architectural point of view as well as from that of energy efficiency.

The urban quality of the district is low because of a lack of adequate public services and amenities. One of the goals of the municipality and of the citizens is to take an active part in improving the quality of life of the whole neighbourhood.

5.3 Current destination of the area

The area involved in UNaLAB project involves the whole Lagaccio District. In particular, the construction site is located in the middle of the valley, within the former Gavoglio Barraks, a military compound currently closed to the public and not used.

The area of the Gavoglio Barracks is largely occupied by old industrial buildings (some of which will be demolished) and includes spontaneous green areas with grassland and some valuable trees that will be maintained.

Figure 5.4: Aerial view of the Lagaccio neighbourhood [Source: *https://www.google.com/maps*]

The following image shows the destination of the whole area at the actual status of the project.

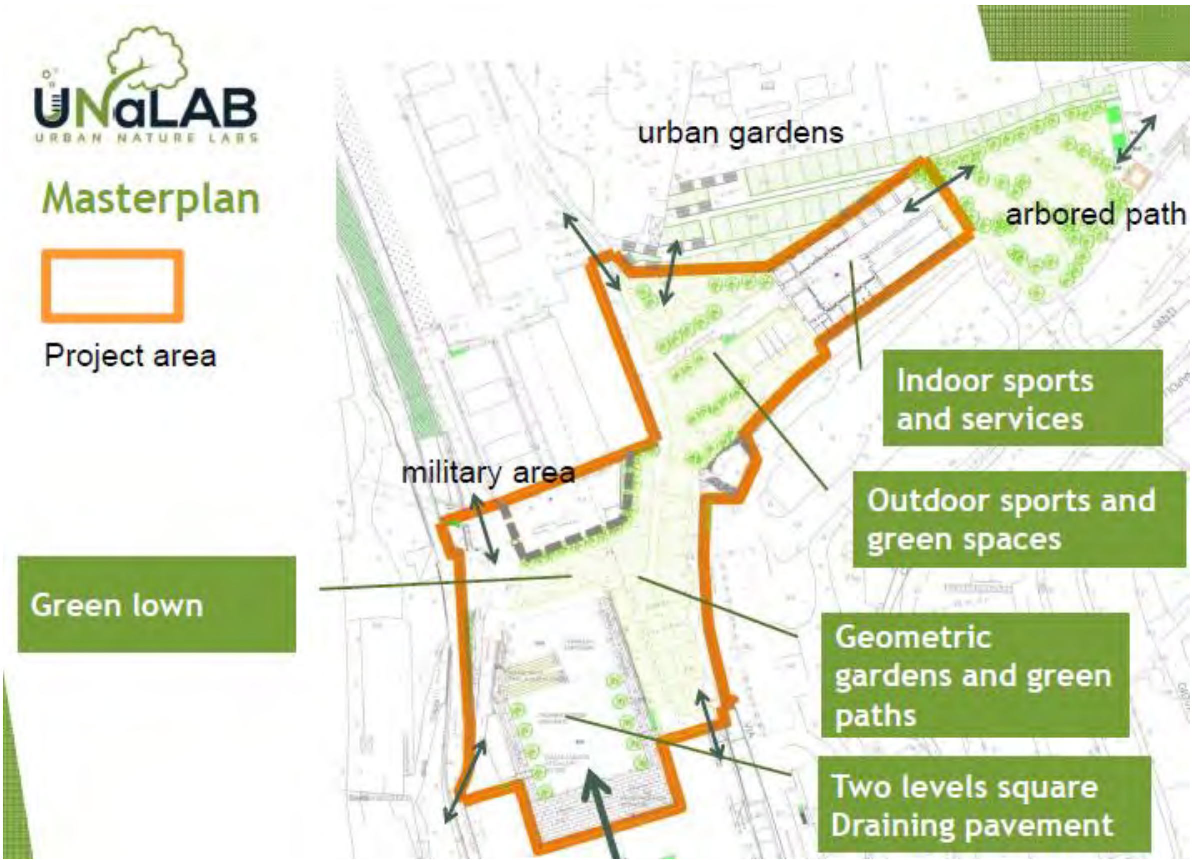


Figure 5.5: Project area [Supplied by the Municipality of Genoa]

6. Description of the selected NBS of TRE

6.1 General description

The main NBS demonstration site in Tampere is located in Vuores, a green district under construction located in the centre of a green area and natural waterbodies. The smart district, to be completed by 2030, offers innovative construction and uses cutting-edge technologies and innovative co-created NBS systems that will be scaled up and developed in Hiedanranta, a former industrial area slated into a housing district that represents the second demonstration site in Tampere. The NBSs installed will be complementary to the existing ones.

All the NBSs implemented in the city of Tampere are identified in the following Table 6.1 with a general description and the relevant scopes and impacts.

Table 6.1: TAMPERE Natural Based Solutions

TAMPERE Natural Based Solutions			
#	**NBS**	**General description**	**Scope/impact**
1	Retention basins and alluvial meadows	Vuores: co-created retention/infiltration basin with alluvial meadows for urban runoff in Tervaslammen Park (area of retention basin and alluvial meadows ca. 700 m2)	Storm water management
			Increase recreation areas
			Increase biodiversity
2	Floating wetland	Floating wetland to Vuores area to e.g. increase biodiversity and recreational values, provide nesting space for birds and improve water quality. Testing of mycorrhizas as a part of the wetland structure.	Storm water management
			Increase recreation areas
			Increase biodiversity
3	Green roof	Implementation of ca. 800 m2 green roof in Hiedanranta to manage water flows (storage) and quality, with particular focus on their performance during cold seasons, suitable growth media, plants (biodiversity) and maintenance needs. Aim is to develop replicable solutions for construction companies.	Water flows management
			Increase recreation and heath
			Increase biodiversity
			Management of rapid growth/densification
4	Biofilters to manage waters from residential area	Vuores: Virolaisten Park co-created biofilter (area of bio filter ca. 650 m2). Biochar and Leca® gravel will be tested as a part of filtration structures.	Storm water management
5		Innovation vouchers to enable existing housing companies and other communities	Social connectivity enhancement

	Urban gardens with small-scale NBS	(ca. 3 sites) in Vuores to co-design and co-implement small-scale NBS and complementary infrastructure (e.g. green roofs or walls, rain gardens, rainwater collection systems for non-potable irrigation, etc.) and/or urban garden areas. Aim is to enhance social connectivity, biodiversity and storm water management.	Management of rapid growth/densification Storm water management Increase biodiversity
6	Bio filter to manage storm waters from contaminated site Hiedanranta	Co-created bio filter for leakage from contaminated site (area of bio filter 50-100 m2) in Hiedanranta.	Water flows management (quality)
7	Microalgae-based system	Pilot-scale microalgae-based system (400 L + 2000 L ponds) in Hiedanranta for integrated urban water management, urine treatment and nutrient recovery. So far biomass growth (g VSS/L) and nutrients have been measured.	Water flows management (quality)
8	Ruderal park	Collection of topsoil and/or plant seeds from valuable biodiversity locations in Hiedanranta and nearby before construction phase (bank for later use in the area) and maybe already planting them to suitable locations that are not going to be built. The action will support local industrial history highlighted in co-creation.	Increase biodiversity Increase recreation areas Restoration
9	NBS education	Awareness raising and education of citizens including schoolchildren about NBS, water quality and biodiversity of NBS. Ca. 25 information signs will be installed to Vuores' NBS. Educating schoolchildren to monitor water quality and water insects.	Education
10	NBS accessibility	Improvement of accessibility: Duckboards ca. 600 m to improve citizens' accessibility to conservation area in Vuores.	Improvement of accessibility

The implementation of green roofs aims to manage water flows (storage) and quality, with particular focus on their performance during cold seasons. Suitable species of vegetation will be planted in order to resist in the sub-arctic climate with changing freezing-melting cycle and snow load as well as to support native species and enhance biodiversity.

The location for testing the selected NBS is the "Old water treatment plant", one of the city protected and owned building in Hiedanranta brownfield site. The building is located next to "edible garden" that is planned in another R&D project (Hierakka, government key projects in Finland), green houses project (Active refugees in the community, EU and Interreg) and old garden of Lielahti mansion that is going to be regenerated. These green areas represent therefore valuable entity for NBS, biodiversity and recreation. Preliminary timetable: start planning spring 2018 and building spring 2019.

6.2 Climatic, environmental and urban condition of the NBS site

In this paragraph, the main relevant climatic, environmental and urban conditions of the city of Tampere, and in particular of Hiedanranta district, are analysed in order to provide useful information for the replicability and upscaling of the NBSs tested.

Climatic conditions

The city of Tampere has a borderline humid continental/subarctic climate with cold winters and mild summers. Winters, from November to March, have an average temperature below 0 °C with frequent snow. The following tables summarised the average monthly temperature, rainfalls and humidity.

Table 6.2: Monthly average temperatures [Source FMI climatological normal for Finland 1981-2010 – Retrieved the 26th April 2016]

Temperatures [°C]	Months												Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Av. Max Temp	-3,4	-3,5	-1,2	8,2	15,4	19,5	22,2	19,9	14,0	7,5	1,5	-1,9	8,4
Av. Min Temp	-9,7	-10,6	-6,6	-1,3	3,8	8,6	11,7	10,4	5,9	1,9	-3,0	-7,6	0,3
Abs. Max Temp	8,0	9,4	14,9	24,2	28,4	31,7	33,1	32,1	24,8	18,4	11,1	9,6	33,1
Abs. Min Temp	-37,0	-36.8	-29.6	-19.6	-7,3	-2,8	1,8	-0,4	-6,7	-14,8	-22,5	-34,2	-37,0

Rainfalls in Tampere are not above average, given that they do not exceed 1,000 millimetres per year. June, July and August are the wettest months.

Table 6.3: Monthly average rainfalls and humidity [Source FMI climatological normal for Finland 1981-2010 – Retrieved the 26th April 2016]

Rainfall and humidity	Months												Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Rainfalls [mm]	41	29	31	32	41	66	75	72	58	60	51	42	598
Rainy days	22	18	16	12	12	13	15	15	14	17	21	22	197
Average Relative humidity [%]	90	87	82	70	63	66	69	76	82	87	91	92	80

As seen above, weather in Finland is usually cool or freezing, and very seldom hot. On the other hand, it is often raining. This type of climate is demanding for NBS and plants: in the winter time soil is frozen and therefore not permeable, and most plants are not green/growing during the winter. Due to the Nordic climate, the most important issues related to green roofs are the storm water retention and their overall functionality (plants, soil, ice and building structure). However, depending on the type and the use of the buildings, green roofs could also have benefits regarding heating and cooling consumptions.

6.3 Current destination of the area

The area involved in the implementation of green roof is located in Hiedanranta brownfield area. In particular, a green roof will be implemented and tested above the "Old water treatment plant", one of the city owned and protected buildings. The future use of the building is not yet defined, but the current flat roof needs to be renovated.

Figure 6.1: Location of Hiedanranta brownfield area (4 km from city centre of Tampere) [Source: https://www.google.com/maps]

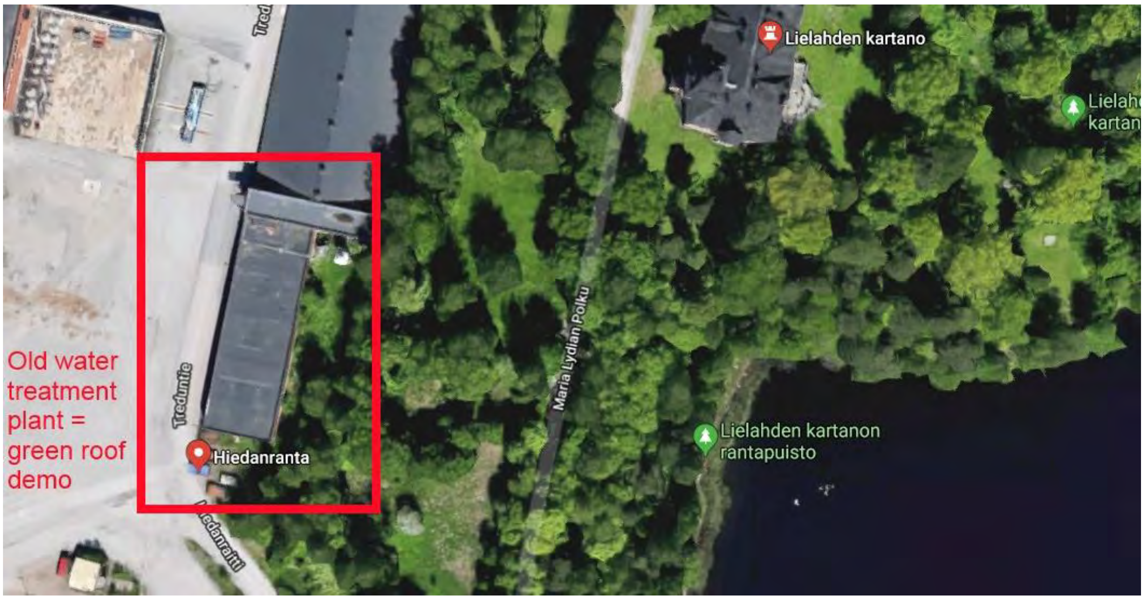


Figure 6.2: Aerial view of Hiedanranta pilot [Source: https://www.google.com/maps]

7. ANALYSIS OF VALUE CHAIN FOR THE NBS OF EIN

The Eindhoven NBS selected for the Value Chain Analysis is the implementation of **permeable surfaces and green urban areas**.

7.1 Needs and specific issues of the city

The city of Eindhoven is facing serious challenges due to rapid population growth. Critical issues for the city include flooding, urban heat stress, air pollution, lower quality of life and the disappearance (in the past) of streams and ditches. One of the goals of the municipality of Eindhoven is to have 40-50 mm additional storage **to build up resistance to peak showers** (in total 60 mm storage). One of the ways to ensure this is by increasing permeability and greening of urban surfaces. This can consist of replacing impermeable surfacing with vegetation or water. Limiting of surface sealing and greening public areas creates space for water to infiltrate into the ground. Another goal is to create new water systems to optimise the use of water storage capacity as well as to create extra capacity in the sewage system of Eindhoven. A general objective of the city it is also to improve the quality of life.

7.2 Management and actors involved in the NBS

An active stakeholder's involvement has been essential to perform a good implementation of the selected NBS. The main actors involved in the implementation and maintenance of the Eindhoven selected NBS are illustrated in the following tables.

Table 7.1: Actors involved in the implementation of the Eindhoven selected NBS

Permeable surfaces and green urban areas implementation	
Phases	**Actors involved**
Implementation (during the project)	Project leader (internal actor)
	Policy advisor (internal actor)
	Designers, civil engineers, maintenance experts, area coordinators (internal actors)
	Contractors for construction (external actors)
	External advisor/engineers (possible actors if necessary)

Table 7.2: Actors involved in the maintenance of the Eindhoven selected NBS

Permeable surfaces and green urban areas implementation	
Phases	**Actors involved**
Maintenance (during and after the project)	Project leader (internal actor)
	Policy advisor (internal actor)
	Designers, civil engineers, maintenance experts (internal actors)
	Contractors for maintenance (external actors)

Public tenders will be used to find contractors for construction and maintenance. In larger projects in area development, tenders contain also the design of public space.

Regarding the project financing, the main stakeholder involved is the municipality.

7.3 Infrastructure: resources/activities involved

In order to implement increasing permeability and greening of urban spaces solutions in a successful way, a series of resources and activities are needed. The following Table 7.3 identifies the key resources needed in Eindhoven to fulfil the proposition of the selected NBS.

Table 7.3: Eindhoven NBS Key resources

Key resources	
Key resources	**Needed to…**
Project leader, designers, civil engineer, maintenance expert,	Planning, specific knowledge
Construction/maintenance contractors	Implement and maintain the project
Organizational structure	Responsibilities
Money and funds (Municipality budget, subsides/grants regional, national, European)	Design, implement and maintain the NBS
Municipality	Involve, inform, inspire residents/businesses through a communication plan

The following Table 7.4 identifies the key activities needed in Eindhoven to deliver the proposition of the selected NBS.

Table 7.4: Eindhoven NBS Key activities

Key activities	
Key activities	**Description of activities**
Inform, inspire and involve stakeholders	Dissemination of the purpose, advantages and benefits of the selected NBS
R&D activities	Research in the choice of plants, paving materials, ways of construction and, if necessary, develop/produce new materials
Hydrologic/soil survey	Specific analysis on ground water table, ground water fluctuations, permeability analysis of the soil
Biodiversity survey	Specific analysis on current state and chances for improvement, plant choice according to outcome
Determine identify of the place	Requalification of the areas, re-definition of the functions, re-creation of new imagine of the spaces
Demolition	Remove street cover and sewer system, if necessary
Construction of new design	Implement the project with new material laying

Frequent maintenance	Depending on new design, materials chosen. The goal is to have less maintenance in green spaces.

7.4 Applied technologies

In order to increase permeability of the urban surfaces and replace pavement with green space, only generic and common technologies will be applied. The works carried out are limited to ordinary replacements of the actual pavements with more permeable materials.

The plant species are chosen according to the particular characteristics of the biodiversity, water management, soil composition, city structure and function of the area.

7.5 Benefits/advantages at environmental, economic and social level

The integration of permeable surfaces and green areas in the urban context creates a series of advantages from an environmental, economic and social point of view as shown in the following Figure 7.1.

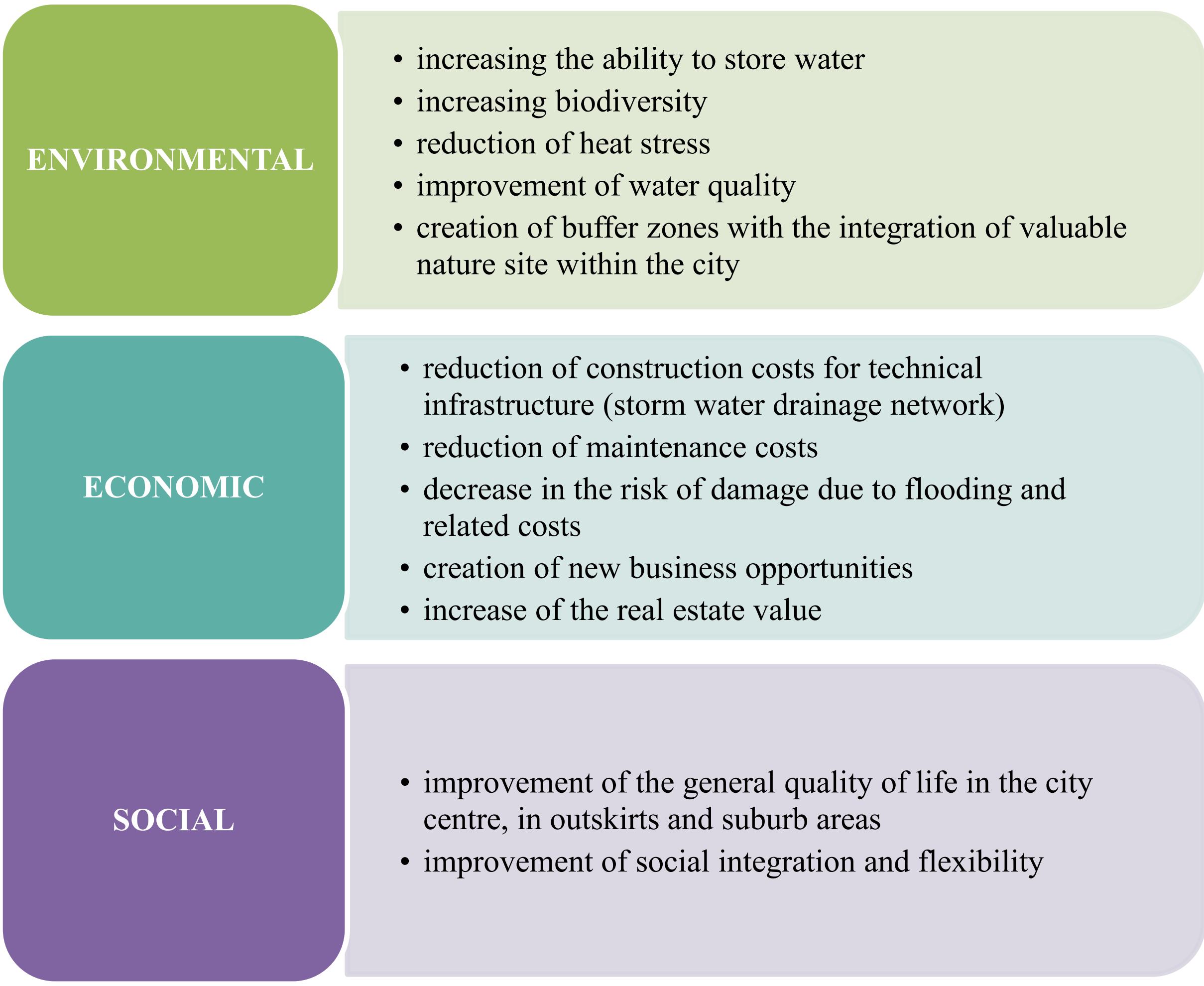
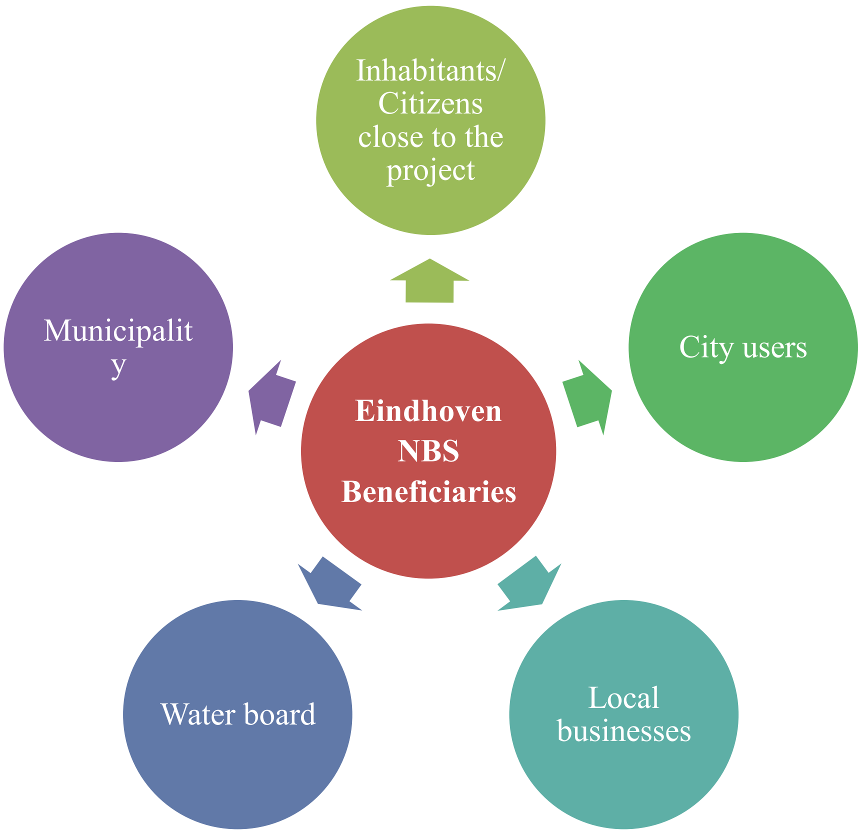


Figure 7.1: Eindhoven NBS expected benefits and advantages

As stated within the document "Eindhoven goes greener", green can, as an example, create advantages for citizens of Eindhoven in the following ways:

- healthcare costs are considerably higher in a paved environment. Costs for medicine and medical treatments may be lower in a green working and living environment, due to the reduced occurrence of diseases in medium term (e.g. respiratory diseases) and the general increase of the urban quality.
- real estate has an increased value in a green environment.
- the rise of temperature in a city during warmer periods increases cooling energy costs. A green city typically uses less energy for cooling since the heat island effect is generally reduced. A green city has lower fluctuations between extreme temperatures throughout the day and different seasons. This reduces heating energy costs compared to those in a paved environment. Especially robust green in direct proximity to buildings reduces the difference in indoor and outdoor temperatures and decreases energy expenses.
- water retaining facilities need to be installed due to the increased speed of water drainage from paved areas. The cost for these facilities is a lot lower for green areas, because they contain and evaporate water. Furthermore, the costs of sewage and treatment are clearly related to the size of the paved area connected to the sewage system. Greening paved area reduces these costs.

The main groups of beneficiaries are summarised in the following **Error! Reference source not found.**.



Definitions:
***Inhabitants/citizens**: people that live in the city*
***City users**: people that don't live in the city but come regularly in the city for work or to use other services or amenities*

Figure 7.2: Eindhoven NBS main beneficiaries

7.6 Costs of intervention

This section collects the preliminary information about main economic, social and environmental costs during the implementation of the selected NBS (permeable surfaces and green urban areas) in Eindhoven.

Economic costs

The construction costs for the implementation of permeable surfaces and green areas in the city of Eindhoven have been collected from the official document of the Eindhoven Municipality "Eindhoven goes greener".

Every type of pavement has its own price tag, as well as every type of green. The direct expenses are comprised of the installation, maintenance, and management as well as the replacement at the end of its lifespan.

Excluding inevitable shifts in environment maintenance techniques, the Table 7.5 below provides an up-to-date overview of direct costs. The investment required for each type of design (a constant value) increases from top to bottom. Looking at the direct costs, the most desirable types are in the top of the table.

In particular, the following Table 7.5 shows the costs for a basic design. The cost for both installation and maintenance increases when exclusive material and/or planting are used.

Table 7.5: Direct costs for the implementation of permeable surfaces [Source: Eindhoven goes greener]

Type	Installation € per m²	Maintenance € per m²	Lifespan	Replacement € per m²	Investment value € per m² *
Dry grassland	2,15	0,12	100	2,15	6
Tall grass	2,15	0,22	60	2,15	14
Lawn	2,15	0,77	30	2,15	43
Forest park [1]	6,5	1,61	70	8,5	90
Convenient shrubbery	14,85	1,1	20	16,85	104
Pavement (no drivelane)	38	1,35	60	40,5	123
Ornamental planting	14,85	2,04	20	16,85	151
Paved driving lane	59	1,46	40	61,5	183
Closed paved driving lane [2]	75	1,16	50	90	186

1 could become a forest with infinite lifespan
2 assuming non-tarred asphalt is used
* *calculated using an inflation of 1.8% and a 3.8% interest, based on data from the CPB, 2002-2012*

Currently is not possible to define if the implementation of the selected NBS will led to extra or maybe less costs but generally, as indicated into the official document "Eindhoven goes greener" of the Eindhoven Municipality, costs of installing and maintaining manageable green spaces are considerably lower than the price of paving those areas.

Regarding the maintenance costs, the municipality of Eindhoven has the goal to decrease these costs by the optimisation of the choice of material and plant species. The maintenance costs have not yet evaluated.

Social costs

The main social cost related to the implementation of permeable surfaces and green areas in the city of Eindhoven is linked to the direct accessibility with private cars to houses and services and the initial resistance of the citizens to change their behaviour.

Environmental costs

The implementation of permeable surfaces and green areas have no relevant environmental costs in addition to those related to temporary increasing of air pollution during the construction works and limited to close proximity of the construction sites. Potential ecosystem disservices like higher amount of pollen and tree litter are reduced thanks to the careful selection of small shrubs.

8. ANALYSIS OF VALUE CHAIN FOR THE NBS OF GEN

The Genoa NBS selected for the Value Chain Analysis is the implementation of **permeable pavements** within the Gavoglio area.

8.1 Needs and specific issues of the city

Starting from the Municipality preliminary considerations and taking into account citizens' wishes coming from the co-creation workshops, local meetings and other public events carried out with small groups of stakeholders (Municipality's technicians, citizens, local associations, etc.), it has been possible to clearly identify all the needs and specific issues of the city and, in particular, of the Lagaccio district.

The city of Genoa is hit by frequent flooding which resulted in significant damages in the past, primarily due to intense rainfall on a high urbanised landscape. The city faces numerous environmental challenges relating to extreme weather conditions, water management issues, heat stress and water and air pollution.

The Nature-Based Solutions implemented in the front-runner city of Genoa have been firstly selected to increase the **environmental protection** of the area by reducing the hydrological risk and by increasing the geological consolidation of the slopes.

Secondly, the needs of the city have been focused to **improve the local mobility** and to **increase the landscape perception** and **social inclusiveness** by the creation of an urban park with outdoor sport facilities and green areas.

Furthermore, the implementation of the selected NBSs will also allow fulfilling other specific needs of the neighbourhood such as the reduction of local pollution and urban heat island effect.

The permeable pavements are able to increase the natural permeability of the soil, to mitigate the hydraulic risk and to create a new perception of the district and of the relationship between the valley slopes and the sea horizon. In addition, the new permeable surfaces will be designed in order to improve the local mobility by the creation of new connections between the two sides of the area.

8.2 Management and actors involved in the NBS

The success of the NBS implementation and integration in the development policy of the city of Genoa has been possible by active stakeholders' involvement.

The following tables summarize the main actors involved in the implementation (during the project) and in the maintenance (during and after the project) of the selected NBS for the Value Chain Analysis.

Table 8.1: Actors involved in the implementation of the Genoa selected NBS

Permaeble pavements implementation	
Phases	**Actors involved**
Implementation (during the project)	Genoa Municipality
	Liguria Region
	LAND (designer)
	IRE Liguria
	Urban ecologists and planners
	Representatives of local communities

Table 8.2: Actors involved in the maintenance of the Genoa selected NBS

Permeable pavements implementation	
Phases	**Actors involved**
Maintenance (during and after the project)	Genoa Municipality
	Representatives of local communities

8.3 Infrastructure: resources/activities involved

In order to implement permeable pavements in a successful way in the front-runner city of Genoa, a series of resources and activities are needed.

The following Table 8.3 identify the key resources needed to fulfil the proposition of the permeable pavements.

Table 8.3: Genoa NBS Key resources

Key resources	
Key resources	**Needed to…**
Planners	Design of the area surfaces
Building installers/Construction company	Realise the designed works
Government/Municipality	Realise the masterplan and the surveys
Money and funds (EU, Municipality)	Design, implement and maintain the NBS
Marketing and advertising materials	UNALAB, communication office

The following Table 8.4 identifies the key activities needed to deliver the proposition of the permeable pavements.

Table 8.4: Genoa NBS Key activities

Key activities	
Key activities	**Description**
R&D activities	Research in the NBS design
Demolition	Demolition of buildings, street cover and other
Hydraulic survey	Specific analysis on ground water table, ground water fluctuations, permeability analysis of the soil
Frequent maintenance	Reduction on the maintenance costs

8.4 Applied technologies

The planned works for the implementation of the selected NBS in the Gavoglio Barracks area do not include any particular technology. The implementation of permeable surfaces are limited to ordinary replacements of the actual pavements with more permeable materials and green areas. Only generic and common technologies will be applied.

8.5 Benefits/advantages at social, economic and environmental level

The main benefits expected from the implementation of permeable pavements within the wider requalification plan for Gavoglio Barracks, are reported at environmental, economic and social level in the following Figure 8.1.

ENVIRONMENTAL

- reduction and management of surface runoff by direct infiltration into the ground
- increasing biodiversity
- preliminary drainage of meteoric water
- reduction of the heat island effect with the creation of an evapo-breathable surface
- ground water recharging

ECONOMIC

- creation of a new attractive pole for investments, real state and commercial activities
- decrease in the risk of damage due to flooding and related costs
- reduction of the water treatment costs

SOCIAL

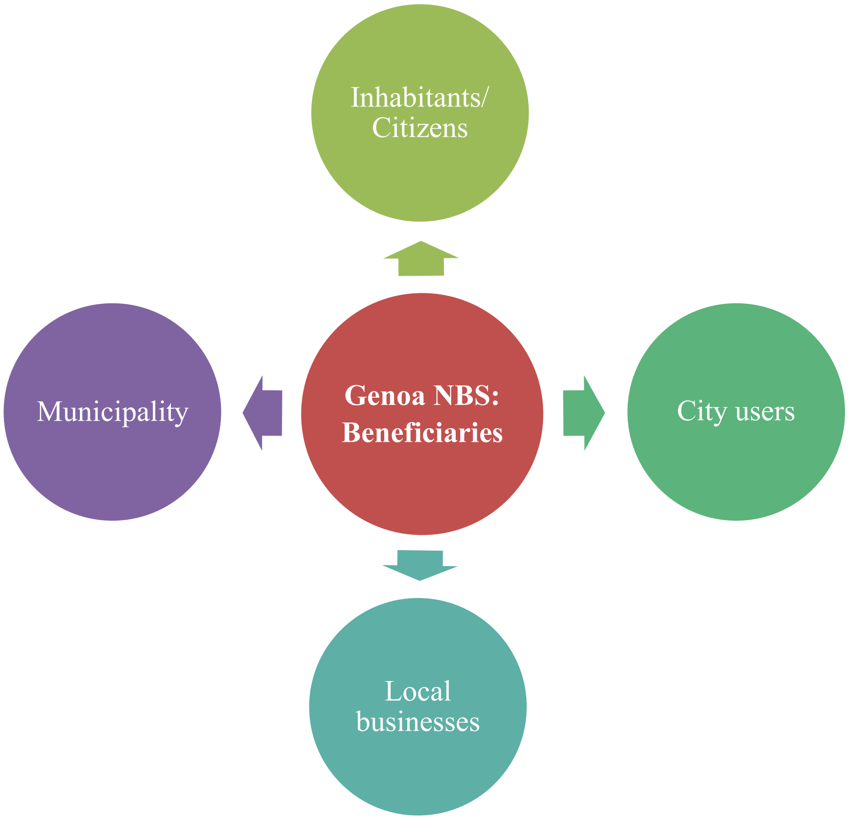
- improvement of the district perception (relationship between the valley slopes and the sea)
- improvement of the local mobility (the area is actually closed to public, the requalification give the possibility to create new paths and connections)
- increase of social inclusiveness (children game areas, sport facilities)
- improvement of the communication with citizens

Figure 8.1: Genoa NBS expected benefits and advantages

Considering the permeable pavements together with the other NBSs implemented within the whole requalification plan (e.g. retention systems, infiltration basins and groups of trees), other additional benefits are expected:

- retaining of runoff waters and rain water recovery for irrigation
- water saving, drainage of meteoric water, local biodiversity and pollination increasing
- increase of shading area, absorption of CO_2, increase of urban quality
- increase of the urban quality and of the citizens' health
- creation of an attractive pole within the city and the district that may attract investments, commercial activities and other general businesses

The main groups of beneficiaries are reported in the following Figure 8.2.



Definitions:
Inhabitants/citizens*: people that live in the city*
City users*: people that don't live in the city but come regularly in the city for work or to use other services or amenities*

Figure 8.2: Genoa NBS benefits and advantages

8.6 Costs of intervention

This section collects the preliminary information about the main economic, social and environmental costs during the implementation of permeable pavements in the renovation works of the area.

Economic cost

The construction and the maintenance costs for the implementation of permeable pavements in the city of Genoa are currently under evaluation (the project is ongoing). The costs will be reported in the following D6.3 and will contribute to the replication framework analysis.

Generally, the drainage surfaces planning has taken into account the needs to minimize these costs (e.g. by choosing plants that do not need much water). Besides, citizen associations (volunteers) will be involved to take care of the park.

Social cost

There are no expected costs regarding social aspects. Currently, the area is closed to the public and the permeable pavements will increase the urban quality after their implementation.

Environmental cost

There are no expected costs regarding environmental aspects. The permeable pavements will mitigate the hydro-geological risk and increase materials and resources savings.

9. ANALYSIS OF VALUE CHAIN FOR THE NBS OF TRE

The Tampere NBS selected for the Value Chain Analysis is the implementation of **green roofs**.

9.1 Needs and specific issues of the city

The main objective of green roofs/walls in Tampere is to **retain storm water** in dense areas. In addition, green roofs/walls can **improve biodiversity** providing **attractive green areas** for citizens (recreation and health). Furthermore, carbon storage capacity obtained by installing green roofs is considered an interesting solution for Tampere, as its aim is to become a carbon neutral city by 2030.

The main goals of the city related to storm water management are:

- novel solutions for storm water management in growing and densifying city;
- management of water quantity and quality;
- the measurement of water quantity and quality and other relevant parameters (knowledge creation to support replication);
- avoid nutrient leakage from green roofs, which has been identified as a challenge in earlier research;
- looking for optimal solution (feasible), testing different solutions;
- changing Nordic winter conditions.

Green roofs/walls could be a solution to solve these specific issues.

Regarding biodiversity and plants, the main objectives of the city are:

- create a high (rooftop level) green network (flora & fauna);
- novel city green to support recreation and health of people;
- encourage diversity in green roofs (native species, bushes, shrubs, pollinators, etc.);
- test the adaptation to heavy climate conditions;
- knowledge of maintenance practices.

Besides, the implementation of green roofs/walls will be useful for construction companies to test the replication and upscaling potential of the selected NBS. In addition to the above listed goals, important viewpoints for investors (replication) are maintenance needs and costs, and risk (moisture, leakage) to the building.

9.2 Management and actors involved in the NBS

In order to achieve a good implementation of the NBS in Tampere, public and private stakeholders have been widely involved. The following tables summarize the main actors involved in the implementation (during the project) and maintenance (during and after the project) of the selected NBS.

Table 9.1: Actors involved in the implementation of the Tampere selected NBS

Green roofs Implementation		
Phases	**Actors involved**	**Description of roles**
Implementation (during the project)	Tampere Municipality	Public body involved in the project with the role of co-definition of demonstration aims, supervision according to the aims and stakeholder engagement. Owner of the renovated/demonstration building and leader of Hiedanranta area development project, which includes "innovation platform" activities. Funding of the project (besides EU). The main activities performed are chair of the green roof project steering group, responsibility of the building renovation, mobilising results.
	Ramboll	Actor involved in the project with the role of green roof expert, stakeholder engagement and project management duties. The main activities performed are related to the planning stage.
	Construction companies (large companies/investors of apartment houses)	Actor involved in the project with the role of guiding the demonstration and bringing in future investor viewpoints (important for replication), mobilisation of results. The main activities performed are member of green roof project steering group, participation in interview/survey of drivers/barriers of green roofs.
	UNaLab project coordinator VTT	Partner involved in the steering group. The main activities performed are communications between other UNaLab activities, especially indicator and monitoring development.
	Research institutions	Partner (University of Helsinki) involved in the steering group. In addition, other research institutions involved in related and nearby located NBS/city green projects are being contacted. The main activities performed are bringing in the earlier research knowledge on green roofs. In addition, synergies are sought from other projects.
	Associations (Green infra building, VYRA)	Actors involved in the steering group. The main activities performed are bringing in green infra building expertise and mobilising results.

	SMEs	Partner involved in the selling new products and services needed. The main activities performed are e.g. growth media, plants, building materials, monitoring devices.
	Builders (building and green)	Partner involved in the construction the demonstration. The main activities performed are construction.
	Citizen society (co-creation participants, residents, Hiedanranta visitors, students, NGOs)	Actors involved in the co-creation and testing. The main activities performed are participation in UNaLab and other co-creation activities, site visits to green roof demo, changing knowledge and iterating plans.

Table 9.2: Actors involved in the maintenance of the Tampere selected NBS

Green roofs maintenance		
Phases	**Actors involved**	**Detailed description of roles**
Maintenance (during and after the project)	Kitia (City property office)	Public body involved in the project with the role of building owner. The main activities performed are maintaining the building (in change of green roof maintenance after the UNaLab project).
	SMEs	Partner involved in the selling new products and services needed. The main activities performed are e.g. maintenance and monitoring services. It is also possible that City of Tampere takes care of the maintenance.
	Citizen society (co-creation participants, residents, Hiedanranta visitors, students, NGOs)	Actors involved in the mobilising results, and possibly maintenance and monitoring. The main activities performed are participating Hiedanranta site (innovation platform) visits. For maintenance and monitoring, practices are not yet in place, but aim is to run ULL activities, where citizens have active role. Hiedanranta is a satellite campus for Tampere University and vocational education, and an association (Sopimusvuori) running social work projects. These actors can participate into the project during implementation and maintenance.

Regarding the project financing, the main stakeholder involved is the municipality that owns the building and finances the renovation.

9.3 Infrastructure: resources/activities involved

In order to implement green roofs in a successful way in the front-runner city of Tampere, a series of resources and activities are needed. The following Table 9.3 identifies the key resources needed to fulfil the proposition of the permeable pavements.

Table 9.3: Tampere NBS Key resources

Key resources	
Key resources	**Needed to…**
Planners Ramboll + steering group	Plan the demonstration according to the aims
Building installers/Construction company	Implement the demonstration + mobilise results
Government/Municipality	Co-create common understanding of the demonstration aims, responsibility, funding
Money and funds	EU + municipality, in replication phase construction companies/investors
Marketing and advertising materials	Involve stakeholders and mobilise results
Knowledge	Green roofs have already been studied a lot. Previous knowledge must be acquired in order to achieve optimal solution and useful results

The following Table 9.4 identifies the key activities needed to implement green roof and reach aims of the demonstration.

Table 9.4: Tampere NBS Key activities

Key activities	
Key activities	**Description**
R&D activities	Consulting from previous R&D projects, setting monitoring program according to the aims, analysing results, mobilising results (e.g. temperature, water quantity and quality, biodiversity, effects to building structures, moistures)
Renovating/constructing the roof	Construction according to the aims requires new actors, products and services
Frequent maintenance	Learning new maintenance practices that again meet the aims, new actors are needed, and heavy maintenance may not be feasible
Stakeholder engagement	To build novel green roof that meets aims and is replicable, requires interaction with many internal (city units) and external stakeholders.

9.4 Applied technologies

Due to the preliminary stage of the project, the planning of the green roof is not yet in detailed stage. Preliminary ideas for technologies that could be applied in the NBS are:

- testing three types of green roof. Whole roof is ca.800 m^2, and current idea is to test 3 types of green roof, ca. 270 m^2 each
- presence of a structure that can store storm water (soil or other storage system)
- laying of growing medium suitable for selected plants, minimizing nutrient leakage (e.g. biochar can be used). To find right growing medium, the results from previous R&D projects (e.g. Fifth Dimension – Green Roofs And Walls In Urban Areas) will be used
- planting of local species that do not need intensive maintenance and promote biodiversity
- measurement of relevant indicators (e.g. temperature, water quantity and quality, biodiversity, effects to building structures, moistures) and possibly operating the NBS according to the measured data (e.g. need to irrigate or fertilize)

9.5 Benefits/advantages at social, economic and environmental level

The main **environmental benefits** expected from the implementation of green roofs are linked to the storm water management. In particular, in Tampere, the main purpose of green roof is to **retain storm water** in dense areas. Nature based storm water management system in Tampere and especially in Vuores and Hiedanranta, is based on decentralization principle: green roofs serve as a first step of the system. Waters are retained in building plots, before they are led to nature-based system in public green areas. Besides, green roofs can improve biodiversity especially in dense areas and the carbon storage capacity of green roofs/walls can help the aim of the city to be a carbon neutral city by 2030.

In addition to the environmental benefits, the implementation of green roofs can bring also social and economic advantages to the city. Under the point of view of **social benefits**, green roofs can provide attractive green areas for citizens (recreation and health). This is important, as the city is growing and especially becoming very dense. The Tampere demo case is going to be open for visitors and later for users (not defined yet) of the renovated building. In some cases, it maybe also possible to open green roofs as public parks.

Regarding **economic aspects**, building green roofs/walls is going to be more expensive than building grey roofs and their maintenance is expected to cost more. The need to repair roof structures is not yet defined. Green roofs can make neighbourhood and buildings attractive (good for investors). It is important to consider social justice = find business models for green roof building/maintenance that keep housing costs of building with green roofs affordable. New business models can bring new business opportunities for various SMEs (providers of growth media, plants, maintenance, measurements etc.) and therefore contribute to economic benefits.

The main benefits at environmental, economic and social level are summarised in the following Figure 9.1.

ENVIRONMENTAL

- improvement of the storm water management
- increasing biodiversity (flora & fauna)
- improving air quality
- CO_2 storage (climate change prevention)
- opportunities for testing new urban green solutions
- possibility to recycle water and nutrients in urban (rooftop) gardening

ECONOMIC

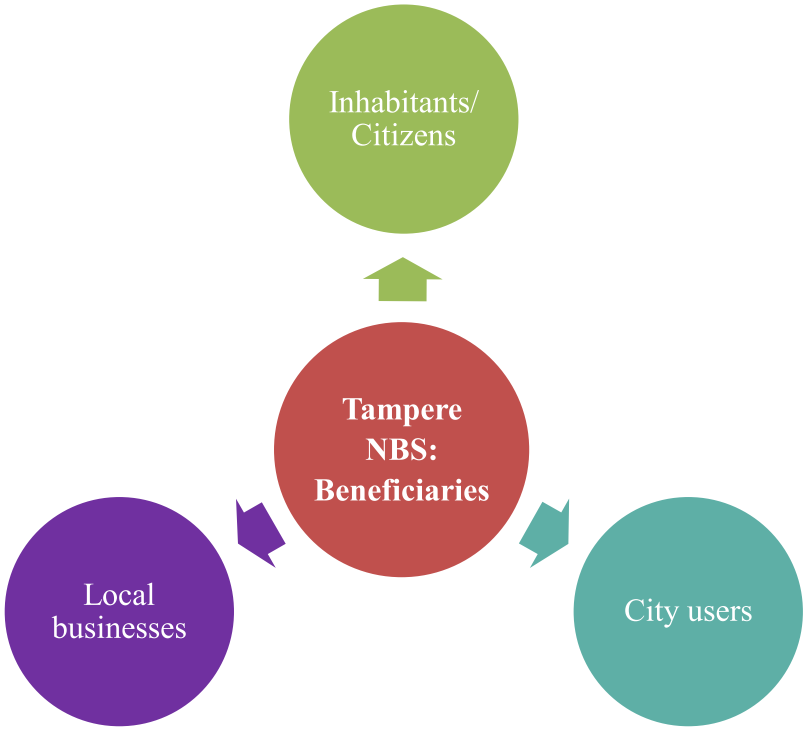
- creation of new attractive areas (good for investors)
- creation of new business opportunities
- more green roofs would decrease their costs
- potential decrease in energy usage (cooling and even heating due to insulation effect) in Nordic conditions is studied
- resource (water & nutrient) recycling

SOCIAL

- new attractive areas (recreation and health)
- more visibility
- city green has positive impact on mental health
- new meeting point
- awarness raising/educational opportunities
- rooftop gardening builds sense of community and ownership

Figure 9.1: Tampere NBS expected benefits and advantages

The main groups of beneficiaries are reported in the following Figure 9.2.



Definitions:
Inhabitants/citizens*: people that live in the city*
City users*: people that don't live in the city but come regularly in the city for work or to use other services or amenities*

Figure 9.2: Tampere NBS benefits and advantages

9.6 Costs of intervention

This section collects the preliminary information about the main economic, social and environmental costs expected during and after the implementation of green roof in the city of Tampere.

Economic cost

Material and installation costs for the implementation of green roofs able to manage water flows (storage) and improve water/air quality, with particular focus on their performance during cold seasons have been estimated:

- 100 €/m^2 for standard solutions
- 250 €/m^2 for "smart" solutions

Besides, an increase of capital expenditure for polder-style and load bearing green roofs due to extensive structures modification (e.g. for people to walk on, water storage) has to be considered.

For a green roof, maintenance costs are also relevant and the risk of moisture and leakage into the building has to be considered.

Social cost

The implementation of green roofs could create social injustice due to the increase of costs to live in the building and neighbourhood (increase of the real estate value).

Environmental cost

Regarding the environmental costs related to the implementation of green roofs following aspects that have to be considered:

- nutrient leakage risk
- unwanted biodiversity: risk of the establishment of infesting plant species and attraction of undesirable species (e.g. bugs, mosquitos).

10. NBS REPLICABILITY: LESSON LEARNED, EXPECTED DRIVERS AND BARRIERS

The following sections collect the information about the lesson learned by each front-runner city on similar NBSs to those that will be implemented during UNaLab project. All the previous experiences provide some information, which can aid the front-runners and follower cities in overcoming the critical aspects and the weak points already experienced during the implementation of similar NBS.

10.1 Previous experience of similar NBS in the frontrunner cities

10.1.1 Previous experience of similar NBS applied in the Eindhoven city

The Eindhoven municipality has the policy, in projects of refurbishing of public places, to add green space in the design wherever this is possible.

The municipality applied the implementation of green areas and permeable surfaces in several projects that brought to an increase of green areas. Unfortunately, in some projects, the total green area still decreases but through monitoring, the municipality aims to make sure that the total green area does not decrease by having a positive balance in the end.

Whether adding green space has led to less problems with water on neighbourhood or city scale, it has not been clearly monitored yet. The previous experiences showed that the actual construction and maintenance has to be monitored to make sure that it works as it is supposed to work, especially when applying new methods or materials.

The public opinion shows that the increase of green space has a positive effect on how people feel about the city or their neighbourhood.

10.1.2 Previous experience of similar NBS applied in the Genoa city

Regarding the city of Genoa, several NBSs have been applied but in most cases not in urban context. The UNaLab project offers an important opportunity to evaluate the implementation of NBS also in a densely urban context.

The following figures show some examples of NBSs previously applied in several areas located near Genoa. Similar NBSs will be applied in the Gavoglio area, in particular as regards the solution of vegetated gabion stones. The implementation of these NBS allowed to solve efficiently the problems related to the slope stability and the meteoric water management.

Figure 10.1: NBS solution applied for geological slope consolidation [Provided and owned by the Municipality of Genoa]

Figure 10.2: NBS solutions applied for meteoric water management [Provided and owned by the Municipality of Genoa]

Figure 10.3: Example of vegetated gabion stones [Provided and owned by the Municipality of Genoa]

10.1.3 Previous experience of similar NBS applied in the Tampere city

Current situation in Tampere is that only few green roofs have been built, mainly by the private sector (apartment houses) and less by the public sector (schools, hospitals).

Few years back, one barrier to implementation was lack of guidelines, but now that is solved and there are guidelines (how to build green roofs) in place. Subsequently, green roofs began to be built over garages, etc., but the step to build green roof to apartment houses has not completely been taken yet.

Now in Tampere, there are some areas (e.g. Santalahti and Hiedanranta) developing, where it is possible that green roofs will become more common in near future. In these areas the pressure to take green roofs into use is high because of the density of the neighbourhood with the consequent lack of green areas, the proximity of the city centre and the need to improve the storm water retention system.

There are some barriers in both, private and public sector. First, NBS advantages are not valued high enough to overcome barriers and green roof is seen as expensive and risky structure.

Possibly also natural environment that is nearby the city, also decrease conceived value and importance of such novel urban NBS. City has land use planning power and other tools (e.g. storm water retention requirements) to effect private construction companies, but so far, green roofs have not been strict requirement. In addition, the municipality has started a process of internal interactions to create common skills and knowledge between the municipality departments about role of green roofs.

In Tampere, a few green roofs have been built mainly to private buildings and to Tampere University of Technology.

10.2 Drivers to NBS replicability

10.2.1 Possible drivers to replicability of the selected NBS of EIN

Regarding the implementation of permeable surfaces and green areas in an urban context, as tested in the city of Eindhoven, there could be some drivers able to facilitate the replicability and upscaling potential of the selected NBS. The following considerations summarise the possible drivers considering both technical/organisational aspects and non-technical (social and economic) guides.

- **Technical/Organizational drivers**

  Several technical and organisational issues can support the implementation of permeable surfaces and green urban areas:

  - technology and know-how transfer between universities, research centres and businesses;
  - proven reduction of the storm-water within the system and improving of the rainwater management;
  - living lab experience;
  - other examples of implementation that can help to prioritise the interventions with the lessons learned.

- **Stakeholder-related constellation that supports implementation**

  Generally, "Trefpunt Groen Eindhoven" supports the implementation of more green spaces. They are spokesperson for several green organizations (NGOs), inform their network about projects, show their support and answer questions on social media. They also provide advice for projects in green space and some projects need their permission to be implemented.

- **Social drivers**

  - educational program and increase citizens' interest about the NBS implemented;
  - creation of a new identity and image of the urban spaces;
  - improvement of citizens' health with new places for moving and recreating;
  - new meeting points for social interaction.

- **Regulations and incentives/funds**

  Several regulations and incentives can support the implementation of permeable surfaces and green urban areas:

  - new regulations for climate adaptation that contain quite strict demands for adding green space and storing water (local policy, national commitment);
  - local policy with new vision for the inner city that add 10% of green space;
  - "*groenfonds*"/green fund, referred in particular to a provincial fund called ""Groen Ontwikkelfonds Brabant" (Green Development Fund Brabant). This incentive was founded in 2014 and is aimed at the realisation of the Natuur Netwerk Brabant (Nature Netwerk Brabant): nature areas, ecological structures and connections. When a project is included in this 'NNB', it can get some specific funding for the addition of green spaces. It contains subsidies for buying land, depreciation, and construction. Since March 2018 Eindhoven has also a municipal green fund: the "Groenfonds" for the compensation of green space. Citizens have to make a deposit into the Groenfonds to compensate financially for building or paving in green space. The municipality can spend this money on certain projects concerning adding green.

- discounts and subsidies for the disconnection from the public sewage network;
- agreements, private or public co-funding and promotion of start-ups and entrepreneurship.

10.2.2 Possible drivers to replicability of the selected NBS of GEN

Based on the Genoa experience and considering the initial phase of the project, some possible drivers that can support the implementation, replicability and upscaling potential of the selected NBS have been identified. All the drivers are mainly related to technical, organisational and economic aspects.

- **Technical/Organizational drivers**

  Some technical and organisational aspects can support the implementation of drainage flooring within an urban context:

  - climate conditions and the possibility of use open spaces according to seasons;
  - design experience in similar urban context about materials and technologies already used, management of the construction site and of the urban traffic and mobility.

- **Economic drivers**

  In addition, some economic drivers have been identify from the Genoa experience in order to support the implementation of permeable pavements also in other urban contexts:

  - the possibility of use money savings (e.g. savings coming from maintenance costs) for other citizens' benefits and services;
  - the use of NBS is generally less expensive than the use of traditional engineering works;
  - come to an agreement with citizens' association for the maintenance of green areas
  - increase of the real estate value of the neighbourhood.

10.2.3 Possible drivers to replicability of the selected NBS of TRE

Several useful drivers could facilitate the implementation, replicability and upscaling potential of green roofs. The following considerations summarises the drivers analysed when planning the implementation of a green roof in the city of Tampere.

- **Technical/Organizational drivers**
  - presence of structures that need to be requalified;
  - reference sites so that actors can take green roofs into use without too high risks;
  - cool buildings in summer – possible reduction for air conditioning;
  - increase of roofs insulation and reduction of heating consumptions;
  - functionality in Nordic conditions;
  - improvement of storm water retention;
  - growing and densifying city: need for novel city green and storm water solutions;
  - regulations and city plans that can help the NBSs implementation;
  - need of cities to reduce overall CO_2 emissions to comply with the Paris Agreement.

- **Social drivers**

  Generally, the following social drivers can support the implementation of the green roofs/walls:

- facilitating of gardening community (environmental NGOs/associations, engaged individuals);
- wellbeing increase: green roofs provide attractive recreation areas and improve living conditions;
- desire to "be green" and develop sustainable lifestyles.

- **Economic drivers**

  The following economic aspects can support the implementation of the green roofs/walls:

  - green roof might last longer than a grey structure because of the more frequent maintenance;
  - new owner's opportunities: possibility to use new green space to attract residents, businesses and organise events;
  - new business opportunities: services, materials, maintenance, etc.

10.3 Barriers to NBS replicability

10.3.1 Possible barriers to replicability of the selected NBS of EIN

Some barriers could hamper the implementation and replicability of permeable surfaces and green areas in an urban context, as tested in the city of Eindhoven. The following considerations summarises the possible barriers considering both technical/organisational and non-technical (social and economic) aspects.

- **Too many ambitions**

  Designers of public spaces have to pay attention to all the ambitions and regulations that a design has to respect. Often, green spaces are not implemented to leave space, for example, to the construction of new parking or accessibility.

  Prioritizing all these ambitions is very difficult for a designer. The city is working on a better way to do this on a different level of the organization, on the level of program management.

  In some cases, priorities are set for political reasons.

- **Pre-conditions at site**

  - soil has to be clean enough – contamination can bring a lot of extra costs;
  - soil can be densified by use (less permeable);
  - soil can be densified during construction (less permeable).

- **Technical/Organizational barriers**

  Several technical or organisational aspects can limit the implementation of permeable surfaces and green urban areas:

  - non appropriate or little flexible rules and regulations;
  - problem in identifying juridical ownership of the areas;
  - presence of underground pipelines and cables (currently it is better to separate trees from cables and pipelines) – Competition for underground space between NBS and pipes, cables and other human-made infrastructure;
  - problems related to the change from an old water management system to a new one.

- **Not in my back yard/I need my space**

Most inhabitants are happy when green space is added, but they generally do not want to lose parking space in their own environment or at their most used amenities like shops and hospitals. There have also been complaints about losing space to drive, about the accessibility of amenities by car, when paved space was turned into green space.

The accessibility is of course also very important for business owners.

- **Social barriers**
  - lack of learning process, educational program and citizens' sensitization about the NBS implemented;
  - need for a change of the citizens' mind-set;
  - reduced perception of safety around the NBS because of the presence of shrubs that could create areas not completely visible.

- **Economic barriers**

  In addition, several economic aspects can limit the implementation of permeable surfaces and green urban areas:

  - increase of the maintenance costs;
  - extra costs due to the possibly presence of contaminated soil;
  - reduction/loss of the direct accessibility with cars for the business owner;
  - difference between economic investments and political impacts: who invests now in the implementation of permeable surfaces and green areas makes costs but the benefits will come later;
  - low flexibility for future use of the areas.

10.3.2 Possible barriers to replicability of the selected NBS of GEN

Few possible barriers could limit the implementation, replicability and upscaling potential of the selected NBS. All the barriers are mainly related to technical, organisational and economic aspects. The implementation of the permeable pavements in the Gavoglio area does not involve any social barriers, for example inhabitants' opposition due to possible disturbances of the construction site. The area is currently closed to public.

- **Technical/Organizational barriers**

  Several technical/organisational aspects can limit the implementation of the permeable pavements in urban areas:

  - lack of technical operators competence;
  - problems related to the habit of use traditional methods;
  - stringent hydraulic regulation and building permit procedure;
  - lack of communication between the municipality departments in making decisions (e.g. water management department with road department).

- **Economic barriers**
  - high cost related to expected benefits: it is important to compare what exist now in the area and the solution adopted;
  - low level of economic cooperation between municipality and private citizens;
  - not clearly identification of the foreseen use of the area.

10.3.3 Possible barriers to replicability of the selected NBS of TRE

Several technical, social and economic barriers could limit the implementation, replicability and upscaling potential of green roofs/walls in urban contexts. The following considerations summarise the possible barriers analysed with the contribution of the city of Tampere.

- **Technical/Organizational barriers**

  The following technical/organisational aspects can limit the implementation of green roofs/walls:

  - possible potential damages to the buildings (e.g. presence of moisture, mould growth, leakages);
  - problems related to climatic conditions: presence of ice/snow during winter and lack of water during the dry season;
  - investors make decisions and they favour feasible and not risky solutions (e.g. concerning the risk of the establishment of infesting plant species and attraction of undesirable species as bugs and mosquitos).

- **Economic barriers**

  Generally, green roofs/walls are more expensive than grey and traditional structures and have higher maintenance costs, hence the possible buildings owners' opposition. These NBSs both require a major initial investment by investors/building companies and do not provide always a short-term return of the investment.

  At any rate, the buildings need to have conventional storm-water management systems and the presence of green roofs/walls do not involve construction cost savings.

- **Social barriers**

  Regarding possible social barriers against the implementation of green roofs/walls, they are limited to the building owners' worries about the perception of more risks and damages (e.g. presence of moisture, mould growth, leakages) and the related restoration costs, resale values and times.

11. CONCLUSIONS

11.1 Summary of achievements

All the information collected and analysed in the present deliverable represent the first step for the NBS Value Chain Analysis and the replication and upscaling potential evaluations of the NBS implemented in the three front-runner cities. As described within the section 3.1, the preliminary results of this report will be completed throughout the project with a series of further actions and will contribute to the Final Replication Framework informing the Deliverable D6.8 “Handbook to support NBS implementation”. The results will help not only the follower cities but also other cities interested in the implementation of NBS in urban contexts, in order to identify the most valuable NBS and to optimize their implementation.

11.2 Common lessons learned

For each front-runner city and for each NBS, considering the initial phase of the project, a few drivers to the replicability but also a few barriers have been identified. To speed up the replicability and the upscaling of the NBS it is fundamental to maximize and incentive all the available drivers and to reduce and solve as many barriers as possible. A summary of the lessons learned and possible solutions to overcome the identified barriers are set out further in this paragraph.

Every city is characterised by own urban features. However, some common lesson learned emerged from the information gathered among the three front-runner cities. These lessons can be framed into four main key areas that include:

- similar experiences and political strategies
- economic aspects
- use of co-design approach
- citizens’ support

The importance of similar experiences and of long-term political strategies

The NBS projects need different approaches and technical skills, both for design and implementation, compared with ones related to conventional urban developments. Other examples of similar NBS implementation can help to prioritise the interventions and to optimise their design. For this purpose, it is fundamental to analyse similar projects, to encourage new expertise and skills and to transfer technologies and know-how among universities, research centres, municipalities and business. Various type of knowledge ranging from scientific expertise to local information based on more traditional experiences may lead to a greater range of options that can be explored and challenges can be addressed and unintended consequences identified and mitigated.

Moreover, a clear long-term political strategy for the implementation of NBS, re-connecting urban contexts and nature, is highly needed in order to speed up the upscaling potential of the interventions that otherwise would remain isolated pilot cases. National commitments, local policies with regulations for adding green spaces and water management requirements, city plans implementing NBS and practical guidelines are key steps to boost the replicability of the NBS and to address a range of interconnected challenges.

The importance of economic aspects

The success of a NBS is often linked to the possibility of money savings for citizens' and municipalities and the development of new business opportunities. The design of the NBS should consider how to reduce both implementation and maintenance costs. Several incentives and public funds can support the NBS implementation. These incentives are at the moment not sufficient for the private citizens. Examples of incentives for the private citizens can be the release of tax discounts and subsides for the replacement of impermeable surfaces with green areas and/or other permeable surfaces or for the disconnection from the sewage network through the implementation of alternative systems. In addition, a clear dissemination on the economic benefits that the NBS are presumable to provide to the neighbourhoods where will be implemented as the increase of the real estate value and the attraction of new residents and business is highly recommended.

The useful support of co-design approaches

Consider different perspectives and knowledge and include expertise and key actors from various sectors during the NBS design process allows to response in a successful way to several urban challenges. The co-design approach is essential to identify problems, actors and resources and develop potential solutions implementing ideas coming from citizens' and other key actors. Furthermore, the use of a co-design approach will allow to include human needs and behavioural patterns ensuring a greater public acceptability and responsiveness to actual real needs. The process requires the engagement of appropriate stakeholders improving the benefits, the efficient use of resources and the cost-effectiveness of the NBS.

The need of citizens' support

To ensure a wider replicability of NBS solution it is essential a political and a social support with a common nature-oriented vision for urban developments. Educational programs to increase citizens' interest about the NBS that are going to be implemented, meeting points, seminars, workshops and preferential communication channels for social interactions about the NBS topics may be useful. The organisation of these activities could be managed by the municipal workers supported by suitable training and evaluation tools. Moreover, the stipulation of agreements with citizens' associations (local environmental NGOs/associations, gardening communities, engaged individuals, etc.) for the maintenance of the green areas can both increase the social acceptance inspiring sustainable lifestyles and reduce the maintenance costs. To ensure a good social acceptance of the NBS solutions, it is essential to support a clear and extensive communication of the environmental, social and economic benefits, including the health and local liveability improvements, provided by the NBS implementation.

Other more technical lessons learned will be possible only after the NBS detailed design and implementation and will be added into the complete value chain analysis during the further steps, as described within section 3.1.

Most of the barriers previously analysed could be common to several NBSs. The following Table 11.1 shows the actions needed to solve and mitigate some of the barriers that may incur before, during and after the implementation of the NBSs analysed in the present VCA.

Table 11.1: Possible solutions to overcome barriers to the implementation of NBSs

Cat.	Barriers	Solution
Regulation / Project Management and Organisation	• Too many ambitions and regulations for the public space design • Non-appropriate or little flexible rules and regulations • Stringent hydraulic regulations and building permit procedures • Possible difficulties in getting a construction permits due the non-standard technical solutions and the different looking of the buildings • Lack of communication between the municipality departments in making decisions	• Efficient design organization and program management • Constant interaction with the municipality • Creation of a "program table" for the management of interdepartmental projects
Technical aspects	• Presence of underground pipelines and cables • Changing from an old water management system to a new one • Lack of technical operators' competence/knowledge • Problems related to the habit of use traditional methods	• Careful planning and management of the construction site • Encouraging new expertise and skills • Develop booklets (e.g. Eindhoven Goes Greener, Inspiration Booklet) and map of biodiversity to inform technicians
Parking & Accessibility	• Loss of parking spaces • Less space for private transportation • Reduction of the direct accessibility for resident and business	• Promote alternative ways of transport • Show the environmental benefits effects • Promote green and social values through citizens' awareness and education
Citizens 'education & sensitization	• Lack of educational programs and citizens' awareness • Difficulties in changing citizens' mind-set • Low level of cooperation between municipality and private citizens • Owners' worries about the perception of more risks and damages and the related restoration costs, resale values and times	• Inspire with examples from other cities • Develop booklets and map of biodiversity to inform citizens in order to share their mind-set • Promote green and social values through recruiting and education • Show the effects and focus on the liveability

Potential damages and risks	• Reduced perception of safety around the NBS • Contaminated soil • Possible potential damages to the buildings (e.g. presence of moisture, mould growth, leakages) • Risk of the establishment of infesting plant species and attraction of undesirable species (e.g. bugs, mosquitos)	• Careful planning and management of the NBS also related to the citizens' safety perception • Develop booklets to inform technicians (identify which species in which areas) • Select plants minimizing damages to buildings and attraction of undesirable species
Costs	• Increase of the maintenance costs • Extra costs due to contaminated soil • High cost related to expected benefits • Green roofs/walls are more expensive than grey and traditional structures • Difficulties in getting a loan for non-standard construction solutions • Difference between economic investments and political impacts	• Adopt a suitable business model • Consider also long-term effects and social benefits and not just immediate economic impact
Climatic condition & climate change	• Problems related to climatic conditions: presence of ice/snow during winter and lack of water during the dry season • Long terms goals (e.g. climate change adaptation) are not priorities because the timeframe is not aligned with politicians own targets	• Careful planning and management of the NBS • Careful selection of suitable species • Promote a new mind-set • Inform the citizens about the effects of climate change, the actual risks and the benefits of the NBSs implementation

11.3 Impacts

Regarding the evaluations carried out and given the initial phase of the project, the main outcome of this deliverable is to provide useful information for a preliminary identification of the replication and upscaling potential of the following NBS:

- permeable surfaces and green areas: evaluated in Eindhoven urban context
- permeable pavements: evaluated in Genoa urban context
- green roofs: evaluated in Tampere urban contest

All the evaluations previously reported are productive to start further analysis within the WP6 activities and deliverables. In particular, with reference to the development of the deliverable D6.8 "Handbook to support NBS implementation".

11.4 Other conclusions

Several problems related to the rainwater management and the improvement of the urban quality could be easily solved by the implementation of adequate NBS.

To increase the implementation of NBS in urban contexts, after the first steps taken forward by the municipalities, an important role is given by the promotion of private actions.

The main problems related to the implementation of the NBS concerns the social distrust about new solutions and the increase in the construction and maintenance costs. Hence, to promote the use of more "green" it is important to plan an efficient communication strategy, make available adequate tax incentives and promote external funding (e.g. Eindhoven promote private gardens through "operatie steenbreek" in order to remove the impermeable surfaces and pavements and to replace it with plants).

12. ACRONYMS AND TERMS

Acronyms and terms	
GEMEENTE EINDHOVEN	EIN
COMUNE DI GENOVA	GEN
TAMPEREEN KAUPUNKI	TRE
Follower City	FC
Frontrunner City	FrC
Key Performance Indicators	KPI
Natural Based Solutions	NBS
Research and Development	R&D
Urban Living Lab	ULL
Value Chain Analysis	VCA
Work Package	WP

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14. APPENDIX

14.1 Value Chain Analysis: questionnaire for Follower Cities

UNaLab
URBAN NATURE LABS

Template for Frontrunner Cities

Collecting information for Deliverable D6.1
"Value Chain Analysis on selected NBS"
26/03/2018

RINA Consulting SpA

Please return the form to margherita.cioffi@rina.org - elenia.duce@rina.org - francesca.zappia@rina.org

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Dissemination level		
PU	Public	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

Table of Contents

European Commission

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 730052

Topic: SCC-2-2016-2017: Smart Cities and Communities Nature based solutions

1. DESCRIPTION OF THE SELECTED NBS

1.1 General description

- Please list the NBSs which the frontrunner city is going to implement during UNaLab project;
- Please select only ONE of them and describe it in detail. As a provisional choice during the Workshop in Genova at M6 Genova selected the "draining pavement" and Tampere "green roofs" but please feel free to select the most relevant one for your city according to the latest development of the project. It is important that such NBS will be implemented during the project.

1.2 Climatic condition of the NBS site

Please describe the main climatic conditions that characterize the NBS.

Please describe the main climatic conditions that characterize the NBS.

For example, for the NBS in Tampere related to the storm water management could be useful to know information about:

- Soil characteristics
- Humidity and temperature
- Rainfall
- Presence of hydrological network
- Sewage network characteristics
- Structural building characteristics, especially for green roofs

For the NBS in Genoa:

- Water and soil quality and characteristics
- Structural building characteristics
- Presence of hydrological network
- Rainfall
- Temperature and humidity values
- Local biodiversity
- Urban quality

For the NBS in Eindhoven:

- Soil characteristics
- Structural building characteristics especially for green roofs and façades
- Presence of hydrological network
- Temperature values
- Local biodiversity
- Urban quality

1.3 Current destination of the area

Please state the current destination/site of the area where the NBS will be implemented (building, green area, existing utilities, etc.)

2. Analysis of Value Chain for the NBS

2.1 Needs and specific issues of the city

Please describe the needs and specific issues of the city to be addressed by the NBS: e.g. reduction of hydrologic risk, pollution reduction, reduction of heat islands, reduction of heat dispersion, increased indoor/outdoor comfort, improved mobility and social inclusiveness.

2.2 Management and actors involved in the NBS

Please list the main actors (public and private bodies, industries, and service providers) to be involved in the implementation (during the project) and in the maintenance (during and after the project) of the selected NBS. Please be as specific as possible. In case public tenders are needed to involve the actors, please state it and describe the type of needed actors.

Please describe the main financial stakeholders involved in financing the selected NBS

2.3 Infrastructure: resources/activities involved

Please describe the type of activities/resources needed to implement the NBS.

We refer to the identification of resources and activities required for operating successfully.

- What key resources do you need to fulfil your value proposition?
  - Planners and building installers?
  - Government/Municipality?
  - Money and funds?
  - Marketing and advertising materials?
- Which key activities must you perform to deliver your value proposition?
  - R&D activities?
  - Demolition?
  - Hydrologic survey?
  - Frequent maintenance?

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Topic: SCC-2-2016-2017: Smart Cities and Communities Nature based solutions

2.4 Applied technologies

Please described the technologies applied in the NBS (if any - in fact we recognize that sometimes NBS do not include any particular technology).

2.5 Benefits/advantages at social, economic and environmental level

Please describe the main benefits/advantages to be brought by NBS social, economic and environmental level.

Please describe the main groups of beneficiaries and the corresponding benefits captured by the respective groups.

2.6 Costs of intervention

Please describe the main economic, social and environmental costs that would be incurred when implementing the intervention (financial and non-financial). Please describe who would incur those costs and how they could be compensated (e.g. in case of any negative externalities brought by the intervention).

Economic costs:

Social costs:

Environmental costs:

3. NBS Replicability: Lesson Learned and Barriers

3.1 Previous experience of similar NBS applied in the city

Please describe some previous experience of similar NBS applied in the city, focusing on main lessons learned for their replicability.

3.2 Possible drivers and barriers to replicability of the selected NBS

Please describe possible barriers to the replicability of the selected NBS in yours or in other cities considering both technical aspects (e.g. lack of compatibility with existing construction, soil characteristic not suitable for draining pavements) and critical organisational and other non-technical challenges (e.g. cooperation of external stakeholders, high costs related to expected benefits, inhabitants' opposition, stringent water regulation and building permit procedure, climatic conditions).

Suggestion :

Please describe possible drivers and barriers to the replicability of the selected NBS in yours or in other cities considering both technical and organisational aspects (if there are any)

a. Are there any pre-conditions at the construction site that support or limit the implementation (e.g. previous infrastructure, climatic and geographical aspects, etc)?
b. Are there any stakeholder-related constellations that support or limit the implementation (e.g. existing working groups, cooperation, citizen engagement, agreements)?
c. Are there any regulations and incentives that support or limit the implementation (e.g. subsidies, building permits, rules to be considered, etc.)? If applicable, please also indicate at which level (European, national, local).
d. Are there any alternative financing options available to push implementation (e.g. green bonds, sustainability funds, ppps, etc.)?

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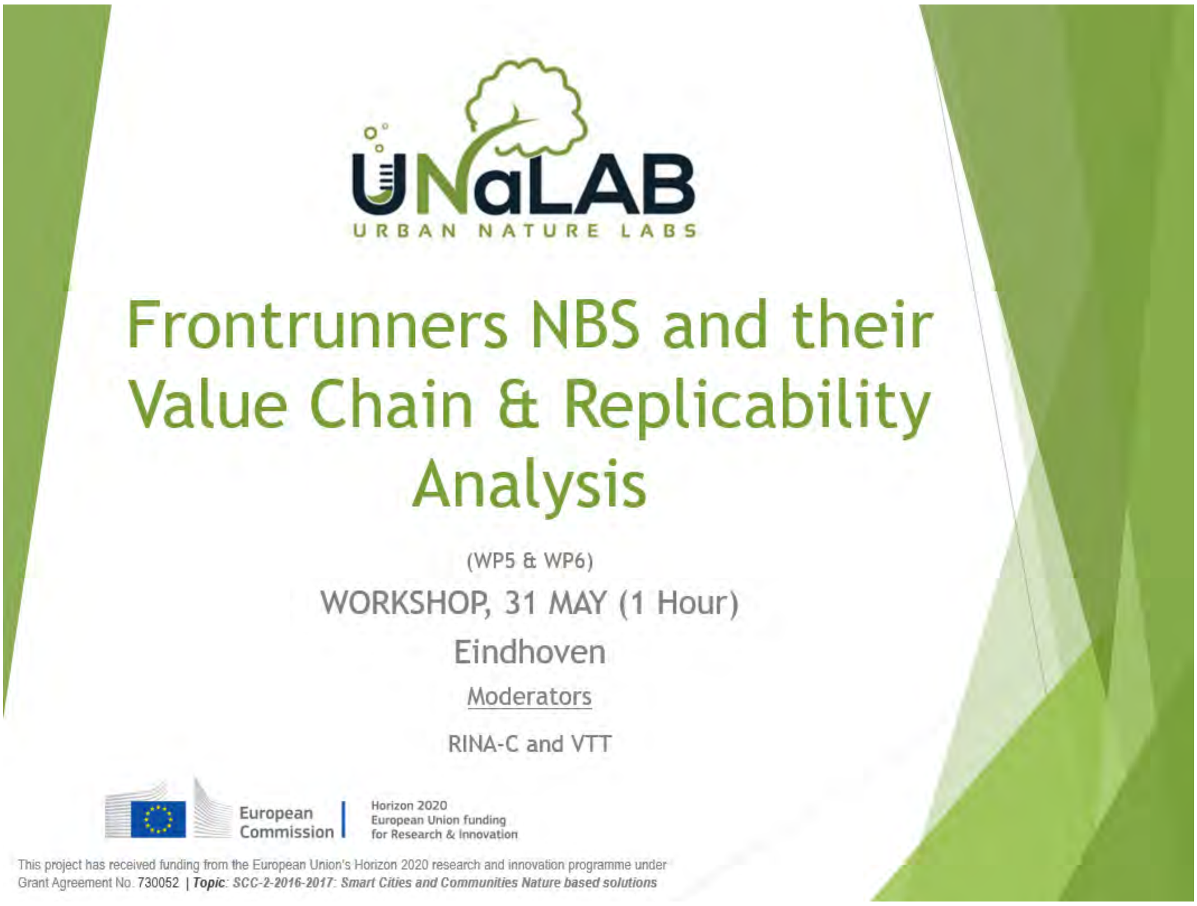
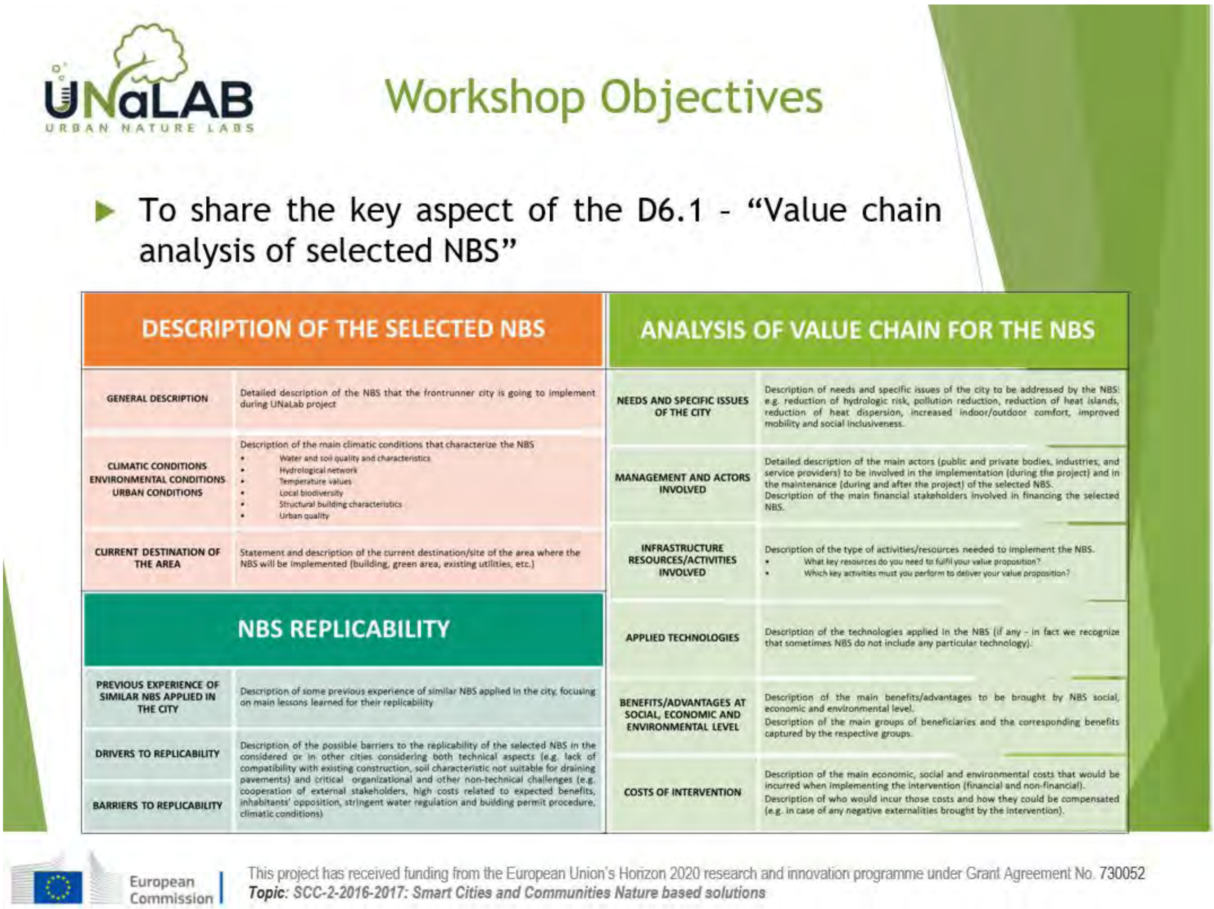
Topic: SCC-2-2016-2017: Smart Cities and Communities Nature based solutions

14.2 Value Chain & Replicability Analysis workshop





Workshop Objectives

- Discussion with the front-runners cities and collection of the relevant information useful to evaluate the replicability and the upscaling potential of the selected NBS.

The focal points investigated by this workshop will be:

- Benefits/advantages at environmental, economic and social levels
- Possible drivers that can support the implementation of the NBS
- Possible barriers that can limit the implementation of the NBS
- Expected costs of the NBS (economic, environmental and social)

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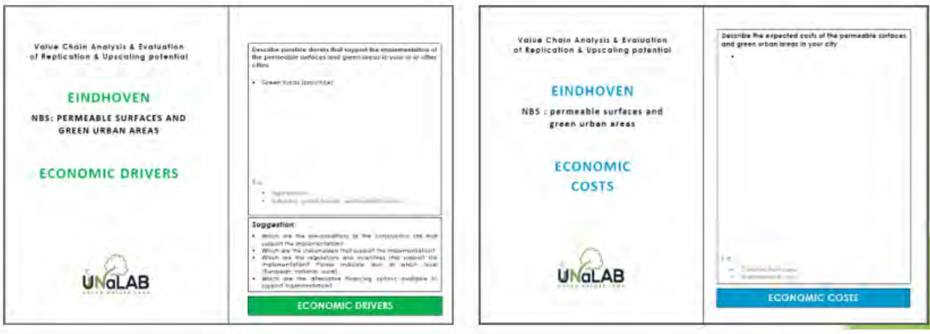
Methodology

- There will be 3 groups, one for each frontrunner cities, moderated by RINA-C and VTT
- The moderator will provide each group with a set of 12 info cards of different colors:
  - Green → Drivers
  - Red → Barriers
  - Blue → Costs
  - Orange → Benefits



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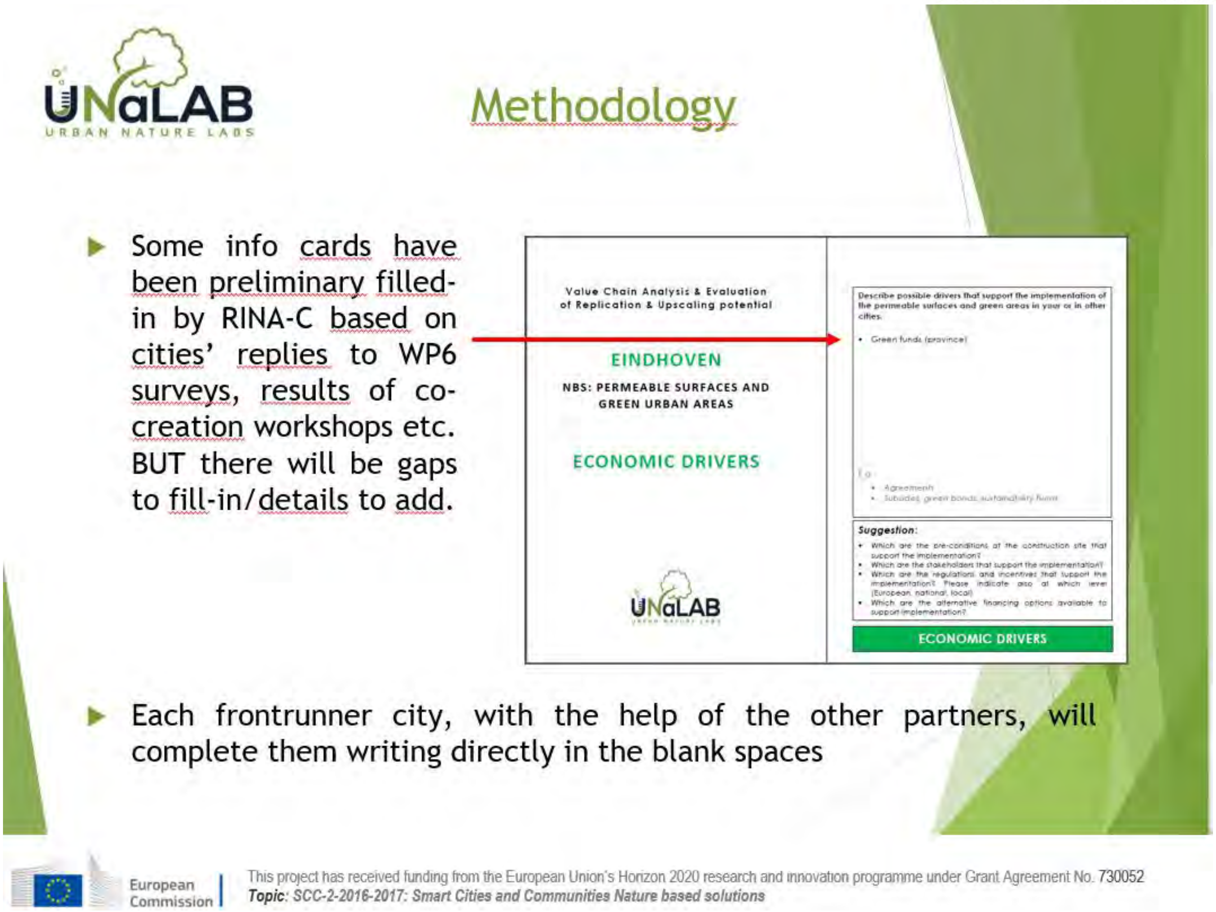


Eindhoven: info cards results

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

ECONOMIC BENEFITS

Describe the benefits of the permeable surfaces and green urban areas in your or in other cities

- Reduction of maintenance costs

E.g.:

- *Storm water drainage network saving (construction costs)*

ECONOMIC BENEFITS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

ENIVIRONMENTAL BENEFITS

Describe the benefits of the permeable surfaces and green urban areas in your or in other cities

- Increase of the ability of storm water
- Increase of biodiversity
- Heat stress reduction
- Improvement of water quality

ENVIRONMENTAL BENEFITS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND
GREEN URBAN AREAS

SOCIAL BENEFITS

Describe the benefits of the permeable surfaces and green urban areas in your or in other cities

- Improvement of general quality of life

E.g.:

- *Increase inclusiveness*

SOCIAL BENEFITS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND
GREEN URBAN AREAS

ECONOMIC COSTS

Describe the expected costs of the permeable surfaces and green urban areas in your city

-

E.g.:

- *Construction costs*
- *Maintenance costs*

ECONOMIC COSTS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

ENVIRONMENTAL COSTS

Describe the expected costs of the permeable surfaces and green urban areas in your city

-

ENVIRONMENTAL COSTS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

SOCIAL COSTS

Describe the expected costs of the permeable surfaces and green urban areas in your city

-

SOCIAL COSTS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

ECONOMIC DRIVERS

Describe possible drivers that support the implementation of the permeable surfaces and green areas in your or in other cities.

- Green funds (province)

E.g.:

- *Agreements*
- *Subsides, green bonds, sustainability funds*

Suggestion:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

ECONOMIC DRIVERS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

SOCIAL DRIVERS

Describe possible drivers that support the implementation of the permeable surfaces and green areas in your or in other cities.

- Green organizations that support the implementation of green spaces (Trefpunt Groen Eindhoven)

E.g.:

- *Existing working groups cooperation*
- *Citizen engagement*

Suggestion:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

SOCIAL DRIVERS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

TECHNICAL ORGANIZATIONAL DRIVERS

Describe possible drivers that support the implementation of the permeable surfaces and green areas in your or in other cities.

- Local policy (add 10% more green spaces)
- New regulations for climate adaptation (national and local commitment)

E.g.:

- *previous infrastructure*
- *climatic and geographical conditions*
- *Agreements, building permits, rules to be considered*
- *costs)*

Suggestion:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

TECHNICAL/ORGANIZATIONAL DRIVERS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

ECONOMIC BARRIERS

Describe possible barriers to the implementation of the permeable surfaces and green urban areas in your or in other cities

- Extra costs due to contaminated soil
- Decrease of accessibility for business owners

E.g.:

- *Soil characteristics*

Suggestion:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

ECONOMIC BARRIERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

SOCIAL BARRIERS

Describe possible barriers to the implementation of the permeable surfaces and green urban areas in your or in other cities

- Inhabitants' opposition due the reduction of parking areas

E.g.:

- *Inhabitants' opposition*

Suggestion:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

SOCIAL BARRIERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

EINDHOVEN

NBS: PERMEABLE SURFACES AND GREEN URBAN AREAS

TECHNICAL ORGANIZATIONAL BARRIERS

Describe possible barriers to the implementation of the permeable surfaces and green urban areas in your or in other cities

- Too many ambitions
- Contaminated soil
- Densification of soil by use or during construction (less permeable)

E.g.:

- *Soil characteristics*

Suggestion:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

TECHNICAL/ORGANIZATIONAL BARRIERS

Genoa: info cards results

Value Chain Analysis & Evaluation of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

ECONOMIC BENEFITS

UNaLAB URBAN NATURE LABS

Describe the benefits of the permeable surfaces in your or in other cities

- Creation of an attractive pole (new investments for commercial activities)

E.g.

- *Storm water drainage network saving (construction costs)*

ECONOMIC BENEFITS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

ENIVIRONMENTAL BENEFITS

UNaLAB URBAN NATURE LABS

Describe the benefits of the permeable surfaces in your or in other cities

- Reduction and management of surface runoff
- Increase of re-creative areas
- Increase of biodiversity
- Preliminary drainage meteoric water
- Creation of evapo-breathable surface

ENVIRONMENTAL BENEFITS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

SOCIAL BENEFITS

Describe the benefits of the permeable surfaces in your or in other cities

- Better perception of the district
- Improvement of local mobility
- Increase of social inclusiveness (children game areas, sport facilities)

SOCIAL BENEFITS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

ECONOMIC COSTS

Describe the expected costs of the permeable surfaces in your city

-

E.g.:

- *Construction costs*
- *Maintenance costs*

ECONOMIC COSTS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

SOCIAL COSTS

Describe the expected costs of the permeable pavements in your city

•

SOCIAL COSTS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

ENVIRONMENTAL COSTS

Describe the expected costs of the permeable surfaces in your city

•

ENVIRONMENTAL COSTS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

ECONOMIC DRIVERS

Describe possible drivers that support the implementation of the drainage pavements in your or in other cities

•

E.g.:

- *Agreements*
- *Subsidies, green bonds, sustainability funds*

Suggestion:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

ECONOMIC DRIVERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

SOCIAL DRIVERS

Describe possible drivers that support the implementation of the permeable pavements in your or in other cities

•

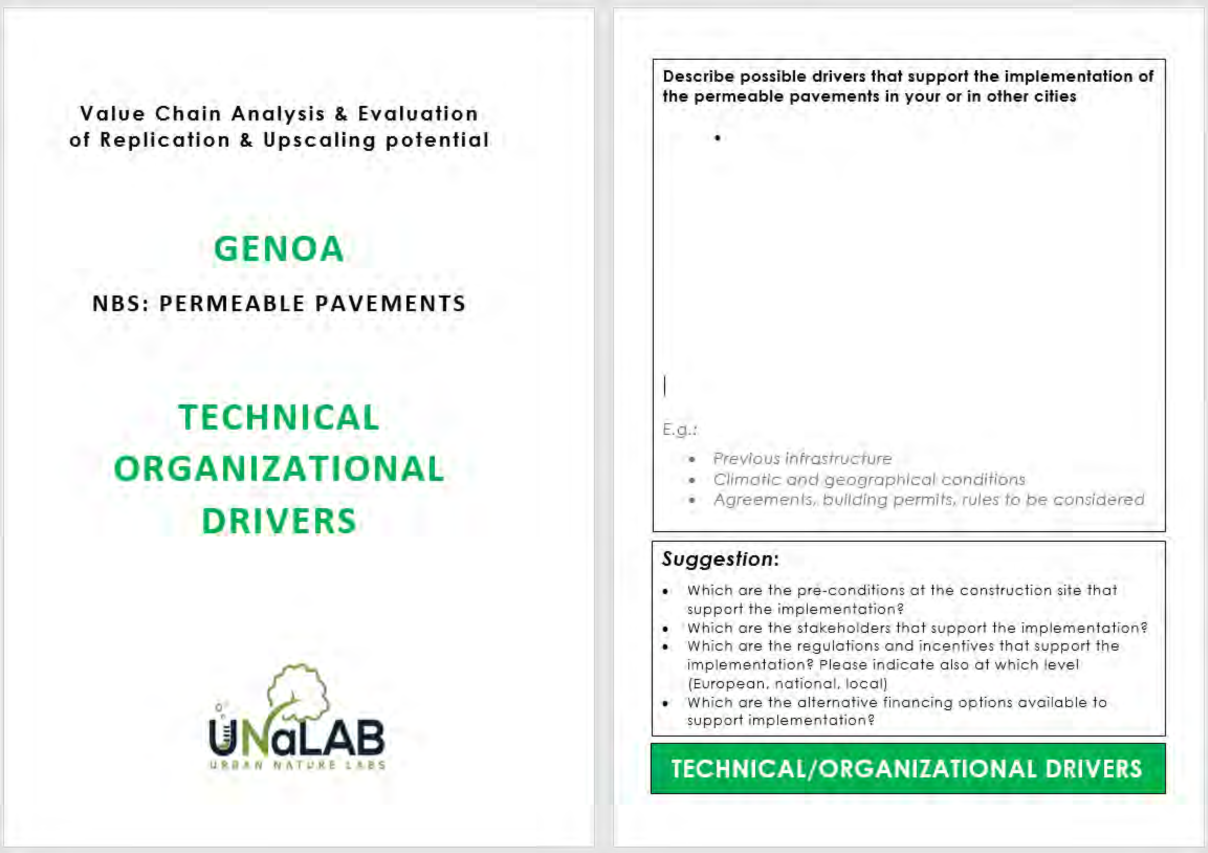
E.g.:

- *Existing working group cooperation*
- *Citizen engagement*

Suggestion:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

SOCIAL DRIVERS



Value Chain Analysis & Evaluation
of Replication & Upscaling potential
GENOA
NBS: PERMEABLE PAVEMENTS
TECHNICAL
ORGANIZATIONAL
DRIVERS
UNaLAB
URBAN NATURE LABS
Describe possible drivers that support the implementation of the permeable pavements in your or in other cities
E.g.:
Previous infrastructure
Climatic and geographical conditions
Agreements, building permits, rules to be considered
Suggestion:
Which are the pre-conditions at the construction site that support the implementation?
Which are the stakeholders that support the implementation?
Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
Which are the alternative financing options available to support implementation?
TECHNICAL/ORGANIZATIONAL DRIVERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential
GENOA
NBS: PERMEABLE PAVEMENTS
ECONOMIC BARRIERS
UNaLAB
URBAN NATURE LABS
Describe possible barriers to the implementation of the permeable pavements in your or in other cities
High costs related to expected benefits
E.g.:
High management and maintenance costs
Suggestions:
Which are the pre-conditions at the construction site that limit the implementation?
Which are the stakeholders that limit the implementation?
Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
Which are the alternative financing options available to limit implementation?
ECONOMIC BARRIERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

SOCIAL BARRIERS

UNaLAB
URBAN NATURE LABS

Describe possible barriers to the implementation of the permeable pavements in your or in other cities

- ……………………………………………

E.g.:

- *Inhabitants' opposition*

Suggestions:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

SOCIAL BARRIERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

GENOA

NBS: PERMEABLE PAVEMENTS

TECHNICAL ORGANIZATIONAL BARRIERS

UNaLAB
URBAN NATURE LABS

Describe possible barriers to the implementation of the permeable pavements in your or in other cities

- Lack of technical operators competence
- Habit of using traditional methods
- Stringent hydraulic regulation
- Building permit procedure

E.g.:

- *Climatic conditions*
- *Contaminated soil*

Suggestions:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

TECHNICAL/ORGANIZATIONAL BARRIERS

Tampere: info cards results

Value Chain Analysis & Evaluation of Replication & Upscaling potential

TAMPERE

NBS: GREEN ROOF

ECONOMIC BENEFITS

Describe the benefits of the green roof in your or in other cities

- New attractive areas (good for investors)

ECONOMIC BENEFITS

Value Chain Analysis & Evaluation of Replication & Upscaling potential

TAMPERE

NBS: GREEN ROOF

ENIVIRONMENTAL BENEFITS

Describe the benefits of the green roof in your or in other cities

- Water management improvement
- Increase of biodiversity
- Pollution reduction/Increase of air quality

ENVIRONMENTAL BENEFITS

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SOCIAL
BENEFITS

UNaLAB
URBAN NATURE LABS

Describe the benefits of the green roof in your or in other cities

- New attractive areas (recreation and health)

SOCIAL BENEFITS

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ECONOMIC
COSTS

UNaLAB
URBAN NATURE LABS

Describe the expected costs of the green roof in your city

- Material and installation costs: 100 €/m2

E.g.:

- *Construction costs*
- *Maintenance costs*

ECONOMIC COSTS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

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ENVIRONMENTAL
COSTS

Describe the expected costs of the green roof in your city

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ENVIRONMENTAL COSTS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

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SOCIAL
COSTS

Describe the expected costs of the green roof in your city

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SOCIAL COSTS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

NBS: GREEN ROOF

ECONOMIC DRIVERS

Describe possible drivers that support the implementation of the green roof in your or in other cities

•

E.g.:

- *Agreements*
- *Subsidies, green bonds, sustainability funds*

Suggestions:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

ECONOMIC DRIVERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

NBS: GREEN ROOF

SOCIAL DRIVERS

Describe possible drivers that support the implementation of the green roof in your or in other cities

•

E.g.:

- *Existing working groups cooperation*
- *Citizen engagement*

Suggestions:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

SOCIAL DRIVERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

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TECHNICAL
ORGANIZATIONAL
DRIVERS

Describe possible drivers that support the implementation of the green roof in your or in other cities

- Presence of structured that need to be requalified

E.g.:

- *Previous infrastructure*
- *Climatic and geographical conditions*
- *Agreements, building permits, rules to be considered*

Suggestions:

- Which are the pre-conditions at the construction site that support the implementation?
- Which are the stakeholders that support the implementation?
- Which are the regulations and incentives that support the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to support implementation?

TECHNICAL/ORGANIZATIONAL DRIVERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

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ECONOMIC BARRIERS

Describe possible barriers to the implementation of the green roof in your or in other cities

- Green roofs are more expensive than grey structures
- High maintenance costs

E.g.:

- *High management and maintenance costs*

Suggestions:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

ECONOMIC BARRIERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

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SOCIAL BARRIERS

UNaLAB
URBAN NATURE LABS

Describe possible barriers to the implementation of the green roof in your or in other cities

- ……………………………………………

E.g.:

- *Inhabitants' opposition*

Suggestions:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

SOCIAL BARRIERS

Value Chain Analysis & Evaluation
of Replication & Upscaling potential

TAMPERE

NBS: GREEN ROOF

TECHNICAL ORGANIZATIONAL BARRIERS

UNaLAB
URBAN NATURE LABS

Describe possible barriers to the implementation of the green roof in your or in other cities

- ……………………………………………………

E.g.:

- *Climatic conditions*
- *Contaminated soil*

Suggestions:

- Which are the pre-conditions at the construction site that limit the implementation?
- Which are the stakeholders that limit the implementation?
- Which are the regulations and incentives that limit the implementation? Please indicate also at which level (European, national, local)
- Which are the alternative financing options available to limit implementation?

TECHNICAL/ORGANIZATIONAL BARRIERS