URBREATH [101139711]

Systemic Integration of Transformative Technical and Nature-based Solutions to Improve Climate Neutrality of European Cities and Regions and tackle Climate Change: the URBreath Approach

URBREATH

[D2.4 Use case scenarios and baselines]

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Document description	This document has three aims. First, it provides a description of each pilot city's experience with Nature-Based Solutions (NBS), co-creation, and digital twin. Second, it outlines the baselines of the specific sites selected by the cities, including physical and social characteristics, needs, and visions/desired changes following the implementation of NBSs. Finally, it explains the cities' use case scenarios in relation to the URBREATH Toolbox.

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Disclaimer

The URBREATH project is co-funded by the European Union under grant agreement ID 101139711. The information and views set out in this document are those of the URBREATH Consortium only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

Executive Summary

The main objective of this deliverable is to provide a comprehensive threefold overview of:

1. The URBREATH pilot cities' experience with Nature-Based Solutions (NBS), co-creation, and digital twin.
2. The baselines of the specific pilot sites selected by the cities, including physical and social characteristics, needs, and visions/desired changes following the implementation of NBS.
3. The use case scenarios for the pilot site associated with the URBREATH Toolbox.

The document also provides a brief insight into the methodology used to collect data, although a full and thorough description will be provided in the deliverable D2.1 "URBREATH methodological framework for urban greening Living Labs and hybrid/NBS interventions and adaptive pathways - V1", due at M15 (March 2025).

This deliverable D2.4 will also serve as a reference document and data source for the consortium partners involved in the following activities along the URBREATH workplan:

i) The development of task T2.5 "Platform requirements" and the related deliverable D2.5.
ii) The development of the tools related to data management, modelling, and simulation within the WP3 activities.
iii) The implementation of the decision-making framework within the WP4 domain.
iv) The co-creation process of the NBS intervention (WP5) and its lifecycle management (WP6).

This document has been produced jointly with the team of The Lisbon Council, which is the leader of task T2.4, whose outcomes have informed the production of this deliverable. It will be shared with the consortium and establish the reference document about cities pilot sites' baselines and use case scenarios.

No updates are planned for this deliverable, however, changes in minor aspects considered by the management team as improvements for the project will be considered and implemented as regular practices over the course of the project.

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List of Terms and Abbreviations

Abbreviation	Definition
ATL	Atlantic
BOR	Boreal
CONT	Continental
CZ	Climatic zone
DT	Digital Twin
FLC	Follower City
FRC	Frontrunner City
IoT	Internet of Things
LDT	Local Digital Twin
LEU	Leuven
LL	Living Lab
M	Month
MAD	Madrid
MED	Mediterranean
NBS	Nature-Based Solution
T	Task
WP	Work Package

1 Introduction

1.1 The Challenge

The URBREATH project aims to address two main challenges within the fields of urban regeneration, resilience, and climate neutrality:

- Gaps in the prevailing/conventional approach to revitalisation, regeneration, and greening planning about advanced integrated methods and concepts. The prevailing/conventional approach is frequently simplified to cost/profit criteria which do not often provide the necessary return on investment by failing to attract sustained funding, people, and businesses to regeneration areas.
- A lack of consideration of local communities' needs and hence often ending up with Nature-Based Solutions (NBSs) that are imposed on the community, i.e. that are not socially acceptable.

1.2 Project and Deliverable Objectives

Considering the challenges that URBREATH aims to address, the main project objective is to develop, implement, demonstrate, validate, and replicate a comprehensive urban revitalisation methodology, based on community and stakeholders' participation in greening and renaturing, supported by digital technologies that the project will further develop and test.

To achieve this objective, this deliverable, which reflects the activities carried out and the results achieved under task T2.4[1], outlines the cities' experience with NBSs, co-creation, and digital twin, the baselines of the pilot sites, and the use case scenarios for the URBREATH Toolbox.

First, each of the nine cities involved in the project is framed with a description from the triple perspective of the URBREATH's key objectives: climate neutrality, co-creation, and digital technologies. Specifically, the URBREATH cities, grouped by climatic zone[2], are described by providing the reader with the following information:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Further, the specific pilot site chosen by each city is briefly presented, together with the expected implementation of the NBS (if already planned) and the potential key stakeholders to be involved in the regeneration of the selected area.

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[1] T2.4 "Use case scenarios and baselines" (M1-M12) [Lead: LC - Participants: POLIMI, VLO, MUN, DEDA, URB, TRA, BAS, DML, all cities].

[2] Atlantic, Boreal, Continental, and Mediterranean climatic zones.

Secondly, in terms of baselines, this document provides an understanding of the systems and state of play for each of the pilot sites selected by the cities from four perspectives:

1. Physical characteristics.
2. Social and liveability conditions.
3. Needs and potential barriers.
4. Goals, visions, and expected benefits.

Finally, the deliverable describes the use case scenarios identified by the cities, i.e. how they plan to use the URBREATH toolbox, e.g. for urban heat island analysis and/or for engaging local communities in a co-design process.

The URBREATH Methodology[3] was used to collect the data needed to understand the experiences of the cities, to outline the baselines of the pilot sites, and to identify the use case scenarios for the Toolbox. This methodology involves different methods and tools for data collection and further processing. On the one hand, primary and secondary available data provided by the cities were collected. On the other hand, the given data has been coupled with other information gathered by involving key stakeholders of the nine URBREATH cities in numerous co-creation sessions using the methodology published by task T2.1.

The outcomes of task T2.4, and thus of this related deliverable D2.4, contribute to:

v) Inform the parallel development of task T2.5 "Platform requirements" and the related deliverable D2.5.
vi) Inform the development of the tools related to data management, modelling, and simulation within WP3 activities.
vii) Support the implementation of the decision-making framework within the WP4 domain.
viii) Operationalize both the co-creation process of the NBS intervention (WP5) and its lifecycle management (WP6).

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[3] Ref. D2.1 "URBREATH methodological framework for urban greening Living Labs and hybrid/NBS interventions and adaptive pathways - V1", due by March 2025.

2 Methodological framework

The purpose of this chapter is to describe the methodological framework used to collect data on:

a) The experiences of the URBREATH cities with NBS, co-creation, and digital twin.
b) The baselines of the pilot sites that the cities are planning to regenerate with a Nature-Based-Solution. These baselines include a description of the physical characteristics of the sites, social and liveability conditions, needs and potential barriers, as well as visions and expected benefits, following the implementation of the NBS.
c) The use case scenarios for the URBREATH Toolbox, i.e. how each city intends to use the URBREATH Toolbox, for example, to analyse heat islands and/or air pollution.

To meet the objectives of T2.4 "Use case scenarios and baselines", whose processes and outputs shape this deliverable D2.4, the URBREATH Methodology was adopted (ref. D2.1[4]). On the one hand, each city provided information about its experience with NBS, co-creation, and digital twin by preparing an initial PowerPoint presentation. On the other hand, all the nine cities were involved in numerous co-creation sessions to outline their pilot sites and to identify the related use case scenarios for the URBREATH Toolbox.

The URBREATH Methodology is structured to organise different activities and use different methods and tools that could enhance both the co-creation process, and the internal organisation of the URBREATH project. Broadly speaking, the methodology is based on three key principles which serve the whole process of the URBREATH knowledge creation. These three principles are:

1. Learning by doing, as the internal process of interacting and the organisation among URBREATH partner organizations.
2. Learning by interacting, which means that all partners benefit from the activities that are processed and organised, contributing to the enrichment of knowledge and methods for carrying out relevant activities.
3. Reflexive learning, as the process that the whole consortium adopts to review and organise activities and operations to better integrate communication and joint activities.

According to the project rationale, the nine URBREATH cities are organised by four climatic zones (CZ) (Figure 1):

- Atlantic (ATL): Leuven and Aarhus.
- Boreal (BOR): Tallinn and Kajaani.
- Continental (CONT): Cluj-Napoca and Pilsen.
- Mediterranean (MED): Madrid, Athens, and Parma.

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[4] Ref. D2.1 "URBREATH methodological framework for urban greening Living Labs and hybrid/NBS interventions and adaptive pathways - V1", due by March 2025.

For each of the CZ, there is a Frontrunner City (FRC) coupled with a Follower City (FLC). Cities have been organised by climatic zones because they may face similar climate challenges and hazards, while most probably being characterized by different maturity levels for what concern Nature-Based Solutions and smart city technologies development, thus promoting peer-to-peer learning.

In any case, disregarding such organisation of the cities, the living lab activities carried out within the framework of WP5 will ensure that the contamination (and relative mediation) of both requirements, processes, and tools is ensured among all the cities and not just by climatic zone.

Figure 1: URBREATH Cities organised by Climatic Zones: Atlantic, Boreal, Continental, Mediterranean
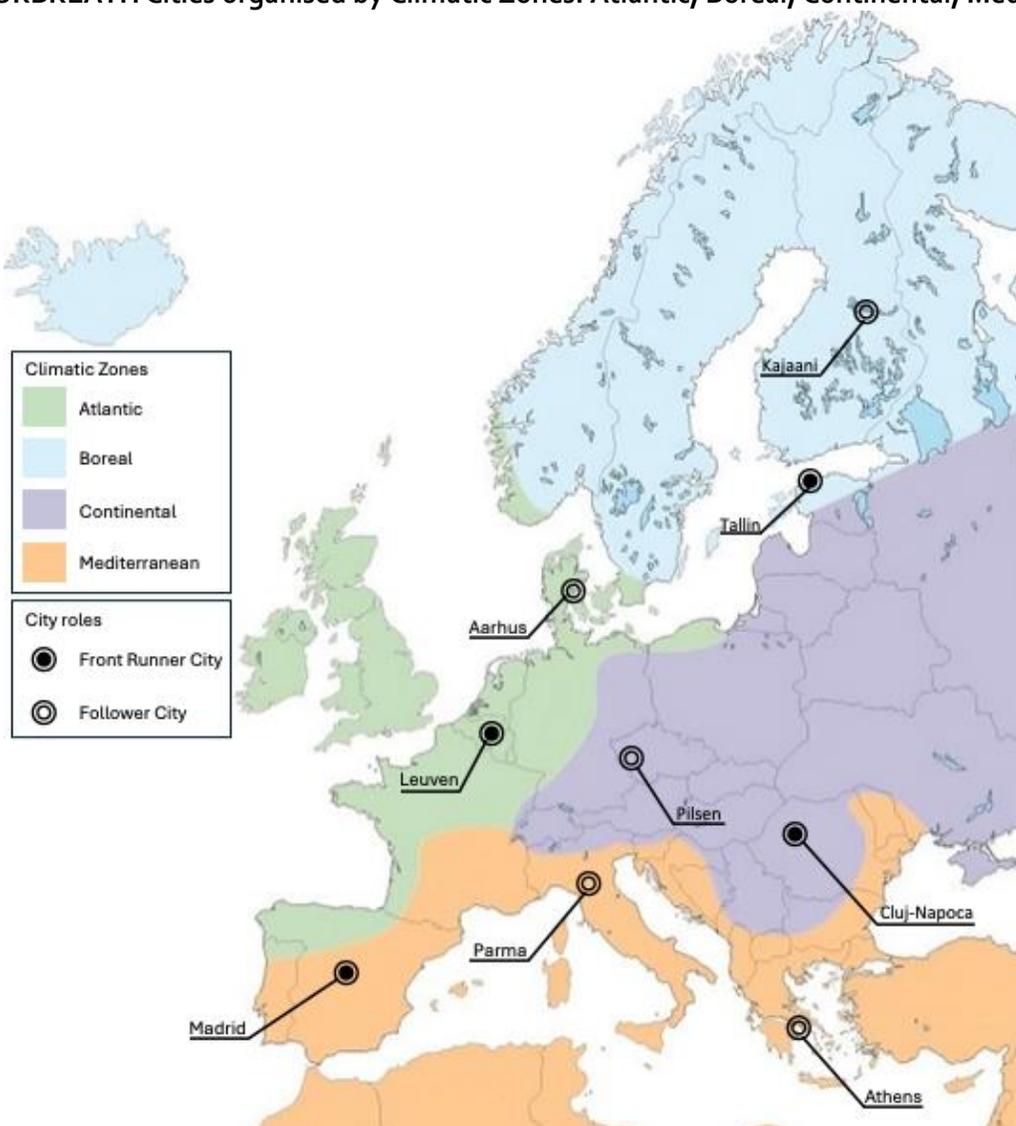
(Credits: URBREATH Team)

2.1 Data Collection

Data collection on baselines and use case scenarios was carried out both online, by engaging cities' stakeholders in seven co-creation sessions organised and led collaboratively by WP 2-3-4-5, and offline, by developing presentations and reports, which are stored as data sources in the URBREATH project repository.

2.1.1 Online: co-creation sessions

Cities' baselines

In total, three co-creation sessions were organised to collect data about the baselines of the pilot sites selected by each of the nine URBREATH cities.

The first one, in February 2024, was held at the project kick-off in Leuven on the 7th and 8th, during which all the cities presented their baselines, introducing an overall city's context, but also focusing on the selected pilot sites' characteristics.

After that, in March 2024, two other co-creation sessions with the cities were organised:

- On March 6th, the session was dedicated to the Atlantic and Mediterranean cities, namely Leuven, Aarhus, Madrid, Athens, and Parma.
- On March 7th, to the Boreal and Continental ones, Tallinn, Kajaani, Cluj-Napoca, and Pilsen.

The main purpose was to start collecting data on the pilot sites' baselines and to give the cities themselves the opportunity to outline and present some more detailed information about:

1. Needs and expectations for the next four years of project development.
2. Expected NBS to be implemented.
   - Financial aspects of the NBS.
3. Previous experience with digital twin (if any).
4. Other experiences related to co-creation and citizens' participation.
5. Urban planning regulation(s) to be considered.
6. Potential stakeholders to be involved.
7. Data sources that could be used for the URBREATH Toolbox.
8. Any other relevant experience.

In addition to the PowerPoint presentations prepared by the cities, the two sessions (on 6 and 7 March) were supported by Miro boards, which were organised with the following objectives in mind:

- Designing further steps for data collection (D2.4) and production (D2.5).
- Understanding the similarities and differences between the cities to enable the design and drafting of a possible first list of 'basic requirements' for the URBREATH Toolbox.
- Allowing all partners to take notes on the same tool, facilitating the collection of information.

These two sessions gave the whole consortium a first general overview of the pilot sites selected by each city to start the urban regeneration process and implement the NBS.

As a follow-up to these sessions, four reports were drafted, one for each climatic zone, considering both the micro level of the specific cities with their particularities, and the meso-level of the climatic commonalities between the four CZs. These reports were drafted by WP2 with further integration by the URBREATH cities. They can be seen as a first milestone in the validation of some elements of the pilot sites by both the cities and the whole consortium.

Cities' use case scenarios

Regarding the definition of the use case scenarios, a total of four co-creation sessions were organised with the active participation and involvement of all the nine cities. From a chronological point of view, all of these sessions took place after the baselines-focused ones mentioned above, as the use case scenarios are strictly related to and consequently come from the characteristics, conditions, needs, and visions of the pilot sites, alias the baselines.

On May 30th, 2024, the first co-creation session, a four-hour workshop focused on identifying use case scenarios, was organised and held online with the active participation and engagement of all the nine URBREATH cities. The main purpose of this workshop was to brainstorm on the needs of the stakeholders who will use the URBREATH Toolbox, i.e. to detail the use case scenarios and the associated user actions. To this end, after a presentation of the structure, objectives, and expected outcomes of the workshop, the cities were divided into four groups, based on their climatic zone, to discuss use case scenarios and associated users' actions in four dedicated breakout rooms, with the support of two facilitators and of a Miro board. The breakout room exercise lasted an hour and a half. This activity is closely related to task T2.5 "URBREATH platform requirements", as the identification of use case scenarios was also crucial to define - from a technical and digital point of view - the requirements that could be met by all cities and different 'personas', i.e. the users of the Toolbox (ref. D2.5 "Platform requirements").

A second round of use cases-focused workshops was scheduled in September 2024. Specifically, two sessions of two-hour workshops with the URBREATH cities were organised:
- On September 6th, the workshop was dedicated to the Atlantic and Mediterranean cities, namely Leuven, Aarhus, Madrid, Athens, and Parma.
- On September 20th, to the Boreal and Continental cities, respectively Tallinn and Kajaani, Cluj-Napoca and Pilsen.

On these occasions, cities were asked to prepare a 15-minute presentation (followed by 5-10 minutes for Q&A) to validate the baselines of the selected pilot sites and to propose use case scenarios based on the identified challenges and needs, as well as visions and expected benefits derived from the implementation of the NBS.

Based on the three co-creation sessions described above, the challenges faced by each city within the selected pilot site and the associated use case scenarios for the URBREATH Toolbox were identified. For example, one of the challenges faced by the city of Kajaani in its pilot site is the presence of invasive plant species, therefore the associated use case is "Kajaani wants to assess habitat and biodiversity

restoration (after the NBS implementation)". All pilot site challenges, and associated use case scenarios, were presented to the cities during 1-1 meetings organised in September 2024, whose main purpose was to identify the URBREATH Toolbox requirements and assess data availability.

Finally, the fourth and last workshop was organised at the General Assembly of the project, which took place in Madrid from 2 to 4 October 2024. The main purpose of this workshop was to validate and prioritise the cities' use case scenarios and requirements identified so far. This prioritisation exercise with the cities had a twofold objective:

1. Understanding the key challenges of the pilot sites and associated use case scenarios for the URBREATH Toolbox.
2. Accordingly, as a next step, having the URBREATH technical teams initiate the technical feasibility assessment of these 'desired' requirements to develop a technical proposal for each of the pilot cities, starting with the FRCs (for more details, ref. D2.5 "URBREATH Platform requirements").

Cities baselines and use case scenarios were synchronised and enriched with the outcome of various workshops led collaboratively by WP3-4-5 on pilot-specific micro-level requirements, local living lab setups, KPI determinations, the elaboration of technical solutions, and stakeholder mappings.

2.1.2 Offline: documents and reports
Four reports, one for each climate zone, have been produced based on the two kick-off meetings held in March 2024 to outline cities' baselines. Each report follows this structure:

1. Introduction
2. Description of the climatic zone
3. NBS: what, why, how
4. Digital twin and co-creation
5. Expectations.

In addition to these four reports produced, the URBREATH cities also prepared a PowerPoint presentation for both the two baseline-focused workshops (held in March 2024) and the two use-case focused workshops held three months later in September 2024.

As a general remark, all the seven co-creation sessions were supported by either PowerPoint presentations and/or Miro boards to make sure that data collected could be well-documented and stored after the sessions themselves.

Please note that a detailed and comprehensive description of the methodological framework will be published as part of task T2.1 and the associated deliverable D2.1 "URBREATH framework: integrating urban planning, citizen engagement and living labs", whose due date is M15 (March 2025).

3 Atlantic Cities: Sites' Baselines and Use Case Scenarios

The Atlantic climatic zone (light green area in Figure 2) covers the countries and regions which are influenced by the Atlantic Ocean, North Sea, and Baltic Sea. The climate usually has mild, wet winters and cool, humid summers. Long, harsh frost periods are rare, just like hot summers.

This chapter is dedicated to producing an understanding of the systems and state of play of the two URBREATH cities representing indeed the Atlantic climatic zone, namely:
- Leuven, the Frontrunner City, located in Belgium.
- Aarhus, the Follower City, located in Denmark.

Figure 2: URBREATH Cities by Climatic Zones: Leuven and Aarhus, the Atlantic cities
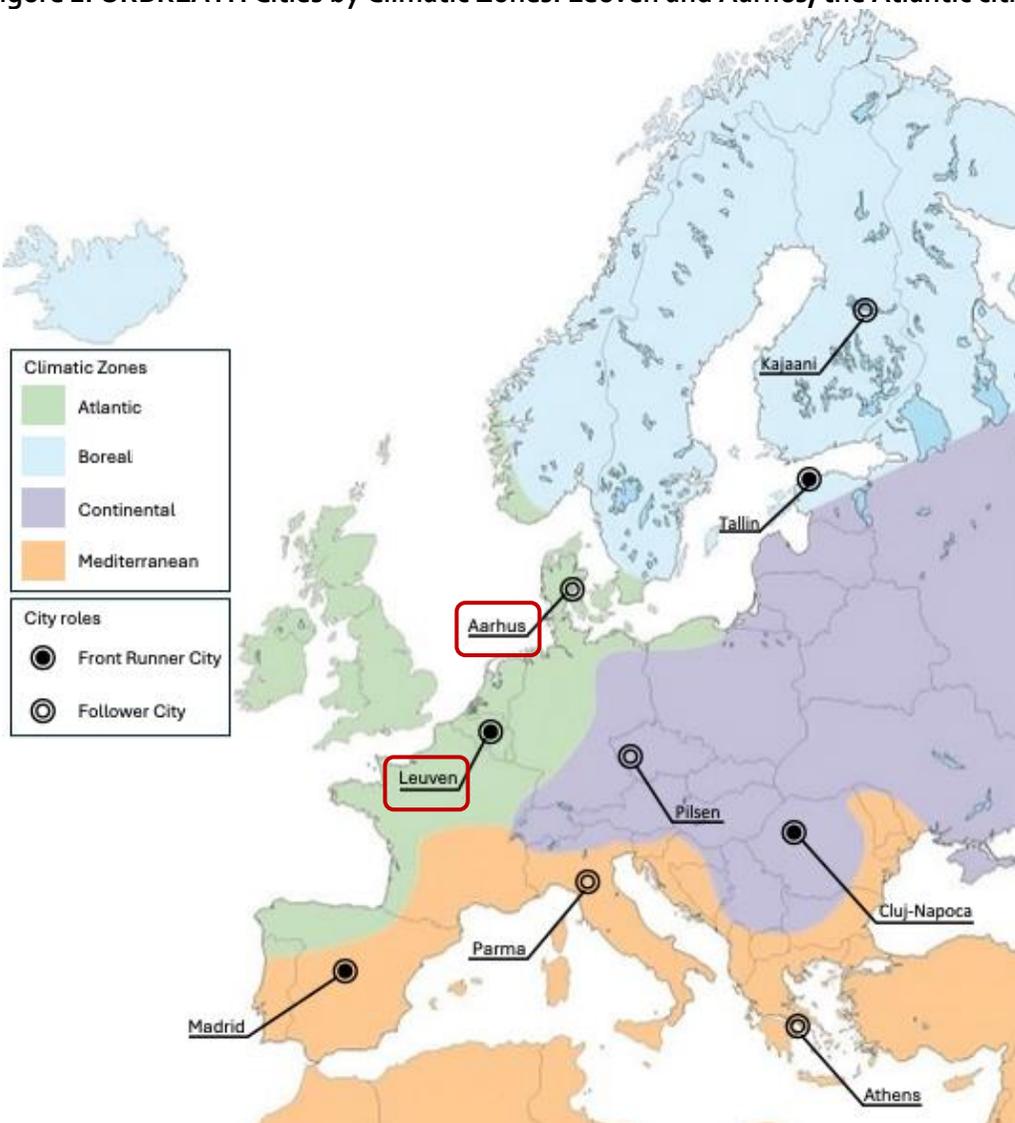
(Credits: URBREATH Team)

First, Leuven and Aarhus are framed with a _background description_ from the threefold perspective of the URBREATH key objectives, namely 1) climate neutrality, 2) co-creation, and 3) digital technologies. Accordingly, both the two Atlantic cities are described by providing the reader with the following information:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Lastly, the specific areas chosen as pilot sites by both the two cities are briefly presented, together with the expected NBS to be implemented (if already planned) and the potential key stakeholders to be involved.

Secondly, in addition to the background of the Atlantic cities, the _baselines_ of the two pilot sites chosen by Leuven and Aarhus, are described by outlining:

- ➢ Physical characteristics.
- ➢ Social and liveability conditions.
- ➢ Needs and potential barriers.
- ➢ Goals, visions and expected benefits.

Finally, the challenges and associated _use case scenarios_ for both the Atlantic Frontrunner and Follower Cities are outlined. By use case scenarios we mean how Leuven and Aarhus plan to use the URBREATH Toolbox components developed by the technical partners. In other words, what functionalities the two Atlantic cities would like to have implemented and available to support their activities and decision-making. To give an example of a use case identified: "Aarhus wants to understand the reduction of noise pollution in the area (after NBS implementation)".

3.1 Leuven and its Pilot Site: The Krakau Square

As mentioned above, the specific objective of this section is to present Leuven, the Atlantic FRC, from the perspective of:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs.
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Focusing on Leuven strategic framework to tackle climate change, the first key milestone refers back to 2013, when the Atlantic FRC, alongside 60 other stakeholders, co-founded "Leuven 2030", a platform for structural cooperation among citizens, companies, and local authorities to accelerate the transition towards climate-neutrality. In 2019, the platform produced a roadmap to climate neutrality, laying out across ten thematic programs (including buildings, mobility, and energy) and three cross-cutting programs (including governance, finance, and monitoring) of what is needed to reach the net-zero-city goal.

In 2022, coherently to this climate-neutrality path started almost ten years before, Leuven was chosen by the European Commission as one of the 100 cities to be a member of the mission "100 Climate-Neutral and Smart Cities by 2030". To achieve and enable this mission, Leuven has also developed its own "Climate City Contract" (2024) which outlines both the path to accelerate climate neutrality by 2030 and the associated financial plan to support the city's transition.

Shifting the focus to Leuven's experience with co-creation, the Atlantic FRC has established a unique symbiosis of empathy in leadership and structural collaboration among citizens, knowledge institutions, and local organizations. This constant and durable awareness of the value of cooperation has been recognized and awarded by the European Commission with the iCapital 2020 award.

In terms of specific projects through which the city of Leuven has gained experience especially with co-creation and Living Labs, there are several ones, the most relevant are briefly described in Table 1 below.

Table 1: Selection of projects in which the city of Leuven has gained experience in co-creation

Name of the project	Brief description	Website (if available)
JUSTNature	Participatory neighbourhood budgeting.	https://justnatureproject.eu/labs/leuven
Life Pact	Participation platform.	https://leuven.be/en/life-pact
Kom op voor je wijk	Citizen panel via sortition focused on reshaping the public space of Kessel-Lo with residents.	https://leuven.be/komopvoorjewijk
Martelarenplein square re-design		https://participatie.leuven.be/nl-BE/projects/voorontwerp-martelarenplein
Vorm3010 (Climate-Kic)	Focused on reshaping public spaces of the Kessel-Lo neighbourhood with the residents' involvement and engagement.	https://www.vorm3010.be/en
Ontharding Redingenhof – Volmolenlaan	A participatory process for the reconstruction of the Volmolenlaan, as one of the sub-projects within the "Redingenhof Ontharding" project, experiments with how open spaces can be designed and controlled by residents and users.	https://www.onthardingredingenhof.org/
Leuven maak het mee	The future of the city project through the collection of ideas on an online participation platform.	https://participatie.leuven.be/nl-BE/projects/betrokken-en-participatieve-stad

Regarding, instead, the city's level of digital twin expertise, Leuven was involved in various projects. The most relevant ones are:

- JUSTNature: The project aims to create more sustainable and resilient cities by implementing NBSs and focuses on ensuring a just transition to low-carbon cities, prioritizing the rights of all citizens to clean air, healthy environments, and thriving biodiversity. By co-designing and implementing NBS solutions in six European city practice labs, JUSTNature seeks to address climate change, improve air quality, and enhance urban living conditions.
- VARcities: The VARcities project puts the citizens and the 'human communities' at the centre of future cities' vision by focusing on the implementation of a series of innovative NBS interventions in seven European pilot cities. At the heart of the project, VARcities H&WB Platform acts as a bridge connecting the tangible reality of the pilot with their digital twins, offering the users a seamless and user-friendly experience.
- URBANAGE: As older populations pose multiple challenges for cities, URBANAGE looks for digital solutions to increase the comfort of older adults and to make cities more age friendly. To this end, the project develops a global platform for dialogue and research on urban issues, which provides a range of data-based visualisation tools and analytical services to understand the complex interrelation between urban factors and expected impacts of potential changes on the population, especially older residents.

Furthermore, in cooperation with the university KU Leuven, the city is working on a project for the development of a GIS tool for multi-parameter and multi-layer prioritisation for the implementation of NBS, following to the 3-30-300 rule. This rule provides criteria for the minimum provision of trees in urban communities by setting the following three minimum requirements: 3 mature trees from every home, 30 percent tree canopy cover in every neighbourhood, and 300 metres from the nearest high-quality public park or other green space.

However, despite the aforementioned projects and the 'under construction' GIS tool, the city of Leuven has limited experience in the integration and design of urban digital twins.

Given and considering the abovementioned city's background, Leuven has chosen as pilot site the Krakau Square, located in the north-west area of the city, in the Casablanca neighbourhood outside the city centre (Figure 3). An extension to "Tarweschoof", another smaller square in the neighbourhood is possible. The extension could also touch the neighbouring streets if deemed useful.

To date, there is no specific NBS design available. However, potential key stakeholders that Leuven is planning to involve in the regeneration of the pilot site are:

- Government
  - City's departments (Public Works, Participation and Liveability, ICT and Data, Mobility, Sustainability)
  - Smart City Leuven
- University
  - KU Leuven
  - Tallinn University of Technology - TalTech
  - UrbanLab

- Community
  - Citizens
  - Lower socio-economic status groups
  - Students
  - Community watchers
  - Youth workers
  - Neighbourhood police
  - Neighbourhood centre
- Industry
  - Leuven 2030
  - UrbanSense (data platform)
  - Soccer club
  - Social housing company
  - Local shops.

Figure 3: Location of the Leuven pilot site. Krakau Square in green and Tarweschoof Square in yellow

(Credits: Google Maps)

3.1.1 Baselines of Krakau Square

Given the choice and location of the Leuven pilot site (Figure 3), this subsection aims to provide the following additional information about the Krakau Square and its surroundings:

- ➢ Physical characteristics.
- ➢ Social and liveability conditions.
- ➢ Needs and potential barriers.
- ➢ Goals, visions, and expected benefits.

Physical Characteristics

The Krakau Square and its surroundings can be described as (Figure 4):

- Surrounded by four low-rise residential buildings positioned at the corners of the central square.
- Mainly paved with stone creating a grey hardscape environment with low environmental quality and limited comfort.
- Planted with some deciduous trees (specifically, Gleditsia Triacanthos 'Shademaster'), which struggle to thrive due to the harsh surrounding conditions (e.g. lack of space for the roots).
- Equipped with some metal infrastructures for movement and play, as well as benches, yet outdated and in need of improvement.
- Easily accessible by all road transport types (driving through the square is possible, as it is a local mobility axis for slow traffic).
- With the availability of parking lots on one side of the square and in the side streets.

Figure 4: Krakau Square and its surroundings

(Credits: Google Maps)

Social and Liveability Conditions

From a socio-economic perspective, the Casablanca neighbourhood in which both the Krakau and the Tarweschoof Squares are located can be described as a social-housing area, with prevailing low-income population. Additionally, to better understood the social conditions, and particularly the local community living in the area, some key percentages are provided below:

- 81,9% have a Belgian nationality.
- 55% inhabitants are male.
- 47% are single-family households.
- 13% are younger than eighteen.
- 6% are refugees.

Key figures from the above list show that there are few young people living in the neighbourhood and that about half of the households are single-person ones.

In terms of the quality of the built environment, the square appears neglected. The buildings facing the square were built in the late 1990s and are owned by Dijledal, a Belgian social housing organisation. In the surrounding streets, most of the houses are now privately owned, but Dijledal also owns other buildings in the area. The buildings have an occupancy rate of 70-75% and are characterised by rapid tenants' turnover.

It is worth noting that in 2023 there was a launch moment for the area's regeneration process, and the local community has shown support for the project and trust in the local authorities to create a beautiful square. However, the local community is not yet aware of the URBREATH project.

Needs and Potential Barriers

The Krakau Square and its surroundings have numerous needs to be fulfilled for improving the urban area's climate resilience. Out of them, the priority and focus should first go on:

1. 'More and better' greenery.
2. Water infiltration enhancement.
3. De-paving, unsealing.
4. Biodiversity improvement.
5. Increased green space accessibility.

Unpacking these bullet points, the city of Leuven is willing to slow down, or even eliminate entirely the traffic in certain areas, to create a greener urban environment. This would not only improve air quality but also create more space for Nature-Based Solutions. One of the key strategies is enhancing water infiltration, which can be achieved by incorporating permeable surfaces, such as green spaces and permeable paving, that allow rainwater to soak into the ground, rather than running off into storm drains. This approach helps to manage urban flooding and supports the health of local ecosystems. In addition, the city of Leuven is planning to improve social and recreational spaces and the overall aesthetic feeling and appearance of the Krakau Square and its surroundings.

Possible other needs to be considered, but not strictly related to urban greening, are:

6. Integrated and collaborative design of the NBS to be implemented. The design team is planning to provide a limited number of scenarios to engage the local community in the co-creation of the NBS.
7. Specific attention to vulnerable social groups living in the area. There are a lot of older and single-person households in the area – making the implementation of digital tools for engaging the residents more difficult.

Focusing, instead, on the barriers that could potentially hinder and slow down these needs' fulfilment, the city of Leuven has identified the following ones:

- Land use change and mobility constraints. Traffic and parking lots could be reduced to leave space to more greenery, yet the city has already cut down mobility in the neighbourhood. This could be an unpopular choice leading to residents and local community's resistance.
- Political resistance against the NBS implementation, which might be an unpopular decision, considering also the next political elections.

- Maintenance challenges related to the need for more labour to take care of the Nature-Based Solution implemented.
- Financial constraints due to a predefined budget for the NBS implementation.
- Municipal limited experience in the integration of urban digital twin and design.
- Regulatory hurdles (although limited).

Aims, Opportunities, and Expected Benefits

Based on the needs outlined above, the city of Leuven would like to turn the Krakau Square into a greener and climate-adaptive space, giving a more pleasant and appealing feeling to the citizens, such as having a big front-yard, as well as combating heat-islands, capturing and storing carbon, increasing resilience to heavy rainfall and droughts, and enhancing biodiversity in the built environment.

General principles/ideas include:

- Permeable paving systems and adding some flower beds and fruit trees.
- Inclusive design/design for all (e.g. for benches that should be adapted with a support for older people).
- Usage of wooden materials.
- Introduction of water elements/structures.
- Safe and natural play yard (e.g. small hills, treehouse, climbing wall, etc.).
- Picnic tables to be used as a meeting-place for inhabitants and local community.
- Instalment of more bike parking lots and reduction of parking lots for cars (which will be re-designed and paved with infiltration materials).
- Cut the traffic in the local streets and possibly adding shared mobility (cars and bikes).
- Green walls/tiles on the buildings.

The redesign will be done involving key-stakeholders and in collaboration with and participation of the local community, creating a shared space for the citizens. The design should serve the local community – representing a 'pleasant front yard' for those who lack one.

Concerning digital tools, and the creation of an urban DT especially, they should serve the city in the sense that they adapt to its needs, are easy to use, and well documented, thus resulting in tools that are and can be effectively used. With this regard, Leuven's expectations are also connected to the definition/availability for the city of a simple set of KPIs for monitoring the impact of the NBS (e.g. focusing on water infiltration/run-off/flooding, biodiversity, heat/drought and wellbeing) and related meaningful visualisations.

3.1.2 Leuven Use Case Scenarios

The understanding of the Leuven pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Atlantic Frontrunner City to identify and build up its own use case scenarios. Table 2 below outlines the seven use case scenarios of Leuven concerning the URBREATH Toolbox components.

As explained in Chapter 2, these use case scenarios were identified through multiple rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the two Atlantic cities (Leuven and Aarhus), on 6 September 2024.
- A 1-1 workshop entirely dedicated to Leuven, scheduled for 26 September 2024.

Table 2: Use case scenarios identified by the city of Leuven

ATL-LEU - Use case scenarios
Leuven wants to…
1. Get input and interaction with stakeholders to shape their case (using LL and DT).
2. Monitor environmental effects and ecosystem services resulting from the redesign of the square.
3. Monitor social justice and well-being.
4. Monitor if the planned NBS implementation impacts traffic.
5. Monitor if there is a modal shift (after the NBS implementation).
6. Get input-interaction from/with stakeholders to evaluate the NBS implementation (using LL and DT).
7. Monitor environmental effects and ecosystem services resulting from the redesign of the square.

Following the identification process based on the needs and challenges of the Leuven pilot site, these seven use cases were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Atlantic Frontrunner City selected the following three use cases as priorities:
- ATL-LEU-1: Leuven wants to get input and interaction with stakeholders to shape their case (using LL and LDT).
- ATL-LEU-2: Leuven wants to monitor environmental effects and ecosystem services resulting from the redesign of the square.
- ATL-LEU-3: Leuven wants to monitor social justice & wellbeing.

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Atlantic FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Leuven and Aarhus during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

3.2 Aarhus and its Pilot Site: The Vesterbro Torv Square

As in the case of Leuven, the specific objective of this section is to present Aarhus, the Atlantic FLC, from the perspective of:

❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
❖ The city's experience with co-creation and Living Labs.
❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

As the Belgian Frontrunner City, Aarhus is also part of the EU mission for 100 climate-neutral and smart cities by 2030 and signatory to the Mission Charter under the EU Mission on Adaptation to Climate Change.

Aarhus is Denmark's second-largest city with 350000 inhabitants. The city anticipates a densification with an additional 75000 inhabitants by 2030. On this background, Aarhus's measures to keep regreening through NBS is pivotal. Aarhus has indeed decided to double the total natural area in the municipality by 2030 and to increase the forested area to 8000 hectares to ensure clean drinking water provision and improve green recreational areas for all citizens.

Accordingly, Aarhus is currently part of the LIFE project "UrbanLIFEcircles" with the aim of creating green corridors. The city is also part of many international networks and have a substantial experience within both Horizon and Interreg EU projects. In this context, Aarhus is partner in Horizon 2020 projects like "RECONNECT" and "REGREEN" and Horizon Europe, "RESIST" and "Invest4nature", which seek to promote investments in NBSs and to accelerate the related market uptake.

When it deals with urban planning, such as NBSs, the city must consider different aspects, involving cooperation among municipal departments, even if they are not always accustomed.

From this perspective, the city of Aarhus adopted a specific framework, labelled "The Aarhus Compass", which implies that the city is obligated to work with co-creation across all the municipal departments, by involving multiple stakeholders, internal (i.e. within the municipality itself) and external (e.g. local businesses, residents, civic associations, etc.). NBSs offer a good opportunity for the municipality to cooperate and co-create with the society. NBSs in this case are considered as a mean to establish cooperation with stakeholders, build liaisons with them, and strengthen the local ecosystem.

In this regard, the city is already experimenting with co-creation projects related to climate change adaptation. Table 3 below outlines a selection of these projects.

Table 3: Selection of projects in which the city of Aarhus has gained experience in co-creation

Project Name	Brief Description	Website
Aarhuskompasset "The Aarhus Compass"	Co-creation framework adopted by the municipality to work increasingly with multi-level governance and to involve citizens earlier and more deeply.	https://aarhus.dk/demokrati/planer-og-politikker/medborgerskab-frivillighed-og-samskabelse/aarhuskompasset

NBS in Åbyhø	The neighbourhood of Åbyhøj is undergoing urban transformation to create a more climate-resilient area. The local community is involved in giving input to NBSs and other solutions.	https://www.regreen-project.eu/news/nature-based-solutions-in-the-field-a-journey-to-the-aarhus-ull/
Active Citizenship Policy	In 2014-15, over 700 participants were involved in defining the city of Aarhus' policy for Active Citizenship.	https://aarhus.dk/media/gc1armqi/policy-for-active-citizenship.pdf
DivAirCity (EU-project)	The Living Lab in this project is focused on NBS, health, and air quality (AQ) impact tracked by Internet of Things (IoT), with a focus on using a crowdsensing approach that raises awareness and translates it into concrete action to improve AQ and decarbonise the city.	https://divaircity.eu/
CO-SHAPE (EU Project)	A new EU project starting in April 2024 that will support the comprehensive planning of a new energy park in the urban area of Spørring. Citizens and various energy operators will help plan the transformation of their neighbourhood, ensuring that value is transferred back.	https://aarch.dk/en/co-shape-co-shaping-areas-in-peri-urban-environments/

Regarding, instead, the city's digital maturity, Aarhus has developed a 3D- OpenCityPlanner, which works well for the needs of visualization and calculation. However, it is a corresponding premise that the existing model does not work quite as effectively with broader communication and involvement in urban development processes. It needs further data layers to evolve into a digital twin. On this background, there is a wish for the model to evolve to cover both the professional and the political-communicative needs and in time evolve into a digital twin - Aarhus CityVerse.

Given and considering the abovementioned city's background, Aarhus has chosen as pilot site the Vesterbro Torv Square, a former farmer's market square located in the western part of the city, very close to the centre, in the district of Vesterbro. (Figure 5).

Figure 5: Location of the pilot site in the city of Aarhus
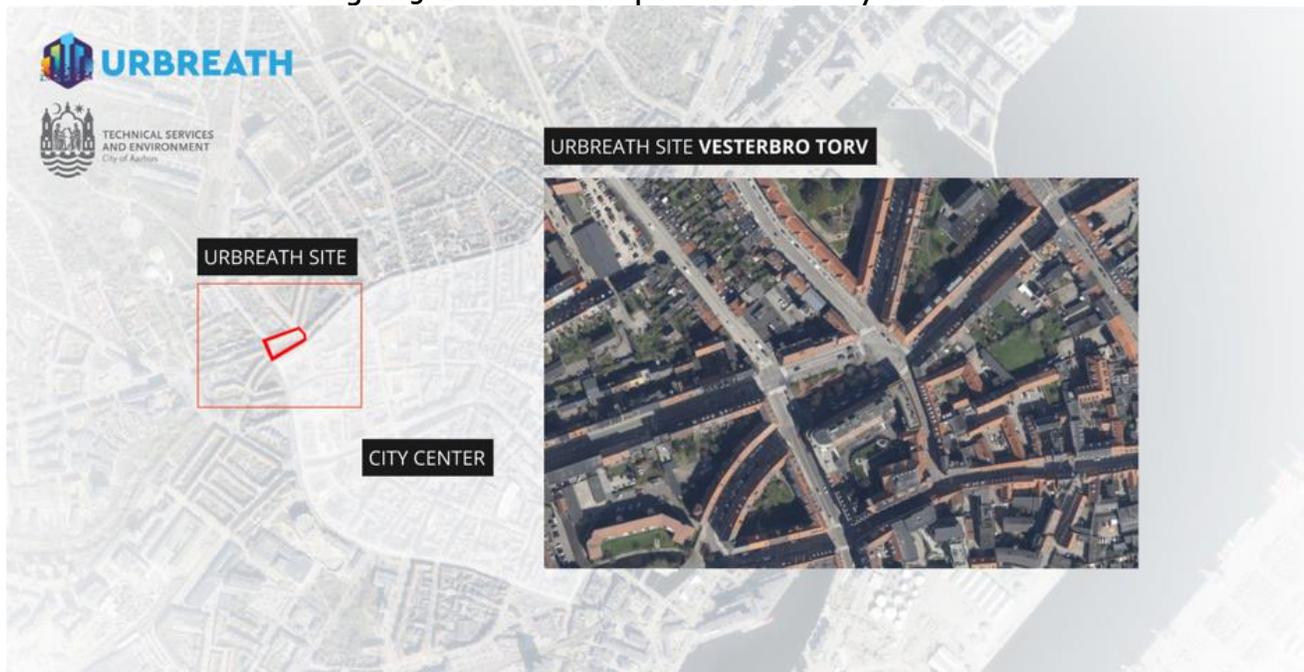
(Credits: Aarhus Team)

A project for the transformation of the square has already been defined. Some changes are currently underway, such as the modification of traffic mobility. In fact, it is no longer possible to cross the square by car, as the northern side has become a pedestrian zone, and the southern side is now reserved for buses and bicycles. The intervention is also expected to create an underground channel for rainwater. Potential key stakeholders that Aarhus is planning to involve in the regeneration of the square are:

- Government
  o Municipal offices for digitalization, water management, urban spaces, green areas, planning
  o Aarhus Futures lab
- University
  o Tallinn University of Technology -TalTech
  o Aarhus University
  o Aalborg University
- Community
  o Commuters
  o Local community council
  o Citizens
  o Students
- Industry
  o Restaurants and pubs owner
  o Shops owners
  o Consultants.

3.2.1 Baselines of Vesterbro Torv Square

Given the location and the transformation project of the Aarhus pilot site (Figure 5), this subsection aims to provide the following additional information about the Vesterbro Torv Square:

➢ Physical characteristics.
➢ Social and liveability conditions.
➢ Needs and barriers.
➢ Goals, visions, and expected benefits.

Physical Characteristics

The main features of the Vesterbro Torv Square (Figure 6) include:

- Originally designed as a 'central island' in the middle of four main streets, it is now surrounded by streets along three sides only, as the northern side was closed to all traffic last spring 2024 and turning into a pedestrian zone.
- Medium-rise buildings (five/six stores) facing the square and along the north side, shops, bars, and commercial activities are located.
- Originally paved with a grey stone, like cobblestones, the site is currently covered with gravel paving as a temporary measure until construction begins.
- Some red benches have also been temporarily installed.
- The trees that previously stood on the square have been replanted to create a cosy and inviting atmosphere. Some greenery is present on site, mainly trees and bushes.

Figure 6: Vesterbro Torv Square and its surroundings

(Credits: Google Maps)

Social and Liveability Conditions

Due to its location, the Vesterbro Torv Square is characterized by high levels of traffic congestion and noise, which downgrades the liveability of residents and the local community.

Needs and Potential Barriers

Therefore, one of the main needs is a significant reduction in motorised mobility and noise pollution, both day and night. The city of Aarhus has also identified another important need that is cross-cutting and could be at the heart of the city's objective: communication. According to the Aarhus team, communication is indeed crucial for this pilot site, both from a political perspective (to make the goals and expectations more tangible) and from a community perspective (to make citizens more aware of the positive effects of the site transformation and development within the city).

Aims, Opportunities, and Expected Benefits

The overall aim is to help the city achieve its objectives of regreening and climate neutrality by 2030. Additionally, other specific key goals and expected benefits are:

- Enhanced communication with the local community.
- Square liveability improvement.
- Noise pollution reduction.
- Better flooding management.
- Motorized mobility reduction.

All the above will ultimately lead to an increase in the quality of life in the square.

Additionally, the city of Aarhus aims to establish a close collaboration with the Atlantic FRC, Leuven. Furthermore, the city wants to continue working and increasing its expertise on NBSs that it is not only strictly related to climate change and adaptation, but also to biodiversity, air pollution, etc. Additionally, Aarhus would experiment how and what digital solutions and models can support the design and planning of such NBSs.

3.2.2 Aarhus Use Case Scenarios

The understanding of the Aarhus pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Atlantic Follower City to identify and build up its own use case scenarios. Table 4 below outlines the six use case scenarios of Aarhus concerning the URBREATH Toolbox components.

As explained in Chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the two Atlantic cities (Leuven and Aarhus), on 6 September 2024.
- A 1-1 workshop entirely dedicated to Leuven, scheduled for 18 September 2024.

Table 4: Use case scenarios identified by the city of Aarhus

ATL-AA - Use case scenarios
Aarhus wants to…
1. Understand the reduction of motorized mobility in the area after the increased number of pedestrians sqm.
2. Understand the evolution of residents' liveability in the area (after the NBS implementation).
3. Simulate the reorganization of the main square in the local digital twin (LDT) to support communication with residents and the local community.
4. Understand the reduction of water flooding in the area after the intervention of a subterranean path for the rainwater.
5. Understand the reduction of noise pollution in the area (after the NBS implementation).
6. Measure the above parameters (mobility and liveability) in different scenarios, using LDT.

After the identification process based on the needs and challenges of the Aarhus pilot site, these six use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly, which took place in Madrid (2-4 October 2024). On that day, the Atlantic Follower City has selected the following three use case scenarios as priorities:
- ATL-AA-1: Aarhus wants to understand the reduction of motorized mobility in the area after the increased number of pedestrians sqm.
- ATL-AA-2: Aarhus wants to understand the evolution of residents' liveability in the area (after the NBS implementation).
- ATL-AA-3: Aarhus wants to simulate the reorganization of the main square in the LDT to support communication with residents and the local community.

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Atlantic FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Leuven and Aarhus during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

4 Boreal Cities: Sites' Baselines and Use Case Scenarios

The Boreal climatic zone (light blue area in Figure 7) extends over Scandinavia (including Iceland). It is characterised by cold, wet winters and mild, wet summers. There is usually snow in winter.

This chapter is dedicated to producing an understanding of the systems and state of play of the two URBREATH cities representing indeed the Boreal climatic zone, namely:
 − Tallinn, the Frontrunner City, located in Estonia.
 − Kajaani, the Follower City, located in Finland.

Figure 7: URBREATH Cities by Climatic Zones: Tallinn and Kajaani, the Boreal cities
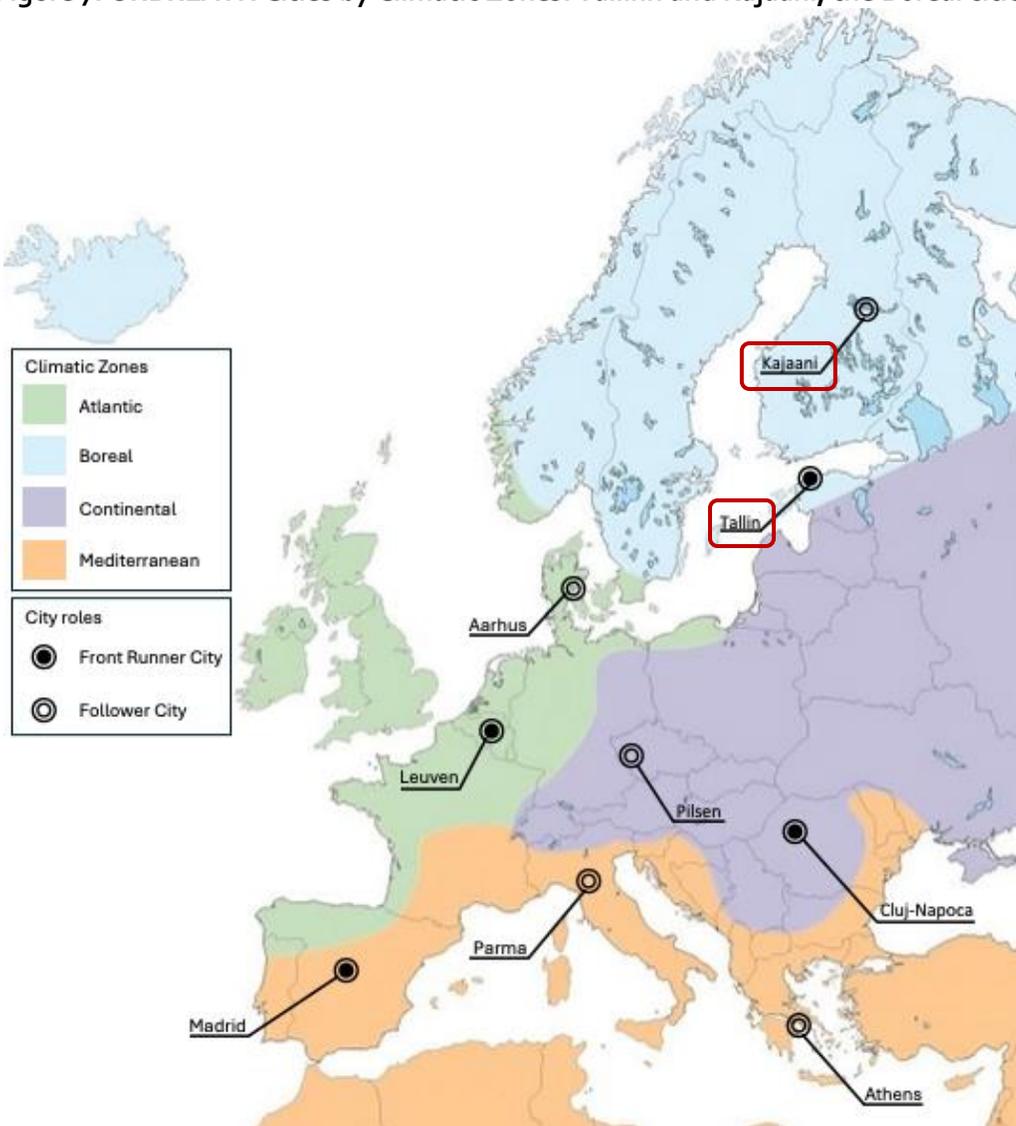
(Credits: URBREATH Team)

First, Tallinn and Kajaani are framed with a _background description_ from the threefold perspective of the URBREATH key objectives, namely 1) climate neutrality, 2) co-creation, and 3) digital technologies. Accordingly, both the two Boreal cities are described by providing the reader with the following information:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Lastly, the specific areas chosen as pilot sites by both the two cities are briefly presented, together with the expected NBS to be implemented (if already planned) and the potential key stakeholders to be involved.

Secondly, in addition to the background of the Boreal cities, the '_baselines_ 'of the two pilot sites chosen by Tallinn and Kajaani, are described by outlining:

- ➢ Physical characteristics.
- ➢ Social and liveability conditions.
- ➢ Needs and potential barriers.
- ➢ Goals, visions and expected benefits.

Finally, the challenges and associated _use case scenarios_ for both the Boreal Frontrunner and Follower Cities are outlined. By use case scenarios, we mean how Tallinn and Kajaani plan to use the URBREATH Toolbox components developed by the technical partners. In other words, what functionalities the two Boreal cities would like to have implemented and available to support their activities and decision-making. To give an example of a use case scenario identified: "Tallinn wants to assess residents' satisfaction with the area (after the implementation of the NBS).".

4.1 Tallinn and its Pilot Site: The Linnahall Area

As mentioned above, the specific objective of this section is to present Tallinn, the Boreal FRC, from the perspective of:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

To understand Tallinn framework to tackle climate neutrality, the plan "Tallinn 2035" aims is a key development strategy. It is implemented through six strategic goals which will be carried out through the cooperation of the entire city organization and the citizens, communities, entrepreneurs, local authorities in the urban region and state and international partners. One of these six goals is the city's green transformation, whose main objective is to adapt to climate change and reduce greenhouse gas emissions towards climate neutrality.

"Climate-neutral Tallinn. Tallinn Sustainable Energy and Climate Action Plan 2030" is a cross-sectoral development document that specifies the strategic goal of the development strategy and creates a specific action plan to fulfil the commitment set out in the Covenant of Mayors to reduce greenhouse gas emissions of cities by 40% by the year 2030.

For what concerns co-creation, Tallin has already gained experience in previous projects, also about combining co-participation processes with urban digital twins. To make an example, in a previous project, the city has created a "physical space" equipped with visualization technology, facilitating digitally aided participation and collaboration in urban planning. On this line, the city has also an ongoing project aimed at setting up a real-life urban living lab.

Table 5 below outlines a selection of projects in which the city of Tallinn has been involved and gained experience with co-creation.

Table 5: Selection of projects in which the city of Tallinn has gained experience in co-creation

Project Name	Brief Description	Website
SOFTacademy	Aimed at developing a community inclusion model to accelerate neighbourhood-level circular deep renovation. The intervention logic, as well as digital tools developed as a part of the solution, are transferable to any mass-produced mono-functional apartment building district that needs a change that goes beyond just renovation.	https://www.softacademy.ee/en/home/
PRECINCT	It exploits the Digital Twin concept in Smart Cities to model the current and future behaviour of territory-based interdependent critical infrastructures in a variety of conditions and configurations, to anticipate threats, detect anomalies, and incentivize optimized command structure and coordinated responses between CIs and first responders.	https://www.precinct.info/en/about/
GREEN TWINS – BRINGING TOGETHER PUBLIC SPACE, GREENERY AND PEOPLE THROUGH A DIGITAL TWIN	It deals with the issue of urban greening and how to better take the urban natural environment into account in urban planning processes. The focus was on digital twins of the city: they can be used to enable comprehensive data exchange and can contain models, simulations and algorithms that describe the actual urban environment, its characteristics and behaviour in the real world.	https://finestcentre.eu/project-pilot/greentwins/

Regarding, instead, the city's availability and expertise in digital twin, Tallin has a Tallinn City Model, which is a 3D representation of the city developed for different applications and user types. It is a data source for urban planning processes and architectural design. Construction and engineering specialists use it to simulate real-life scenarios before any concrete is poured. It unlocks spatial analyses like daylight and shadow simulations, noise and air pollution calculations etc. Moreover, a digital twin has been used in the past to manage critical infrastructure (water pipes).

In addition, Tallinn has a rich Open Data Portal in which there are 48 open datasets freely accessible that might be integrated in the project.

Given and considering the above-mentioned city's background, Tallinn has chosen as pilot site the Linnahall area, located in the city centre, close to the harbour (Figure 8). To date, there is no specific NBS design available.

Figure 8: Location of the pilot site in the city of Tallinn (red pin) and focused aerial view
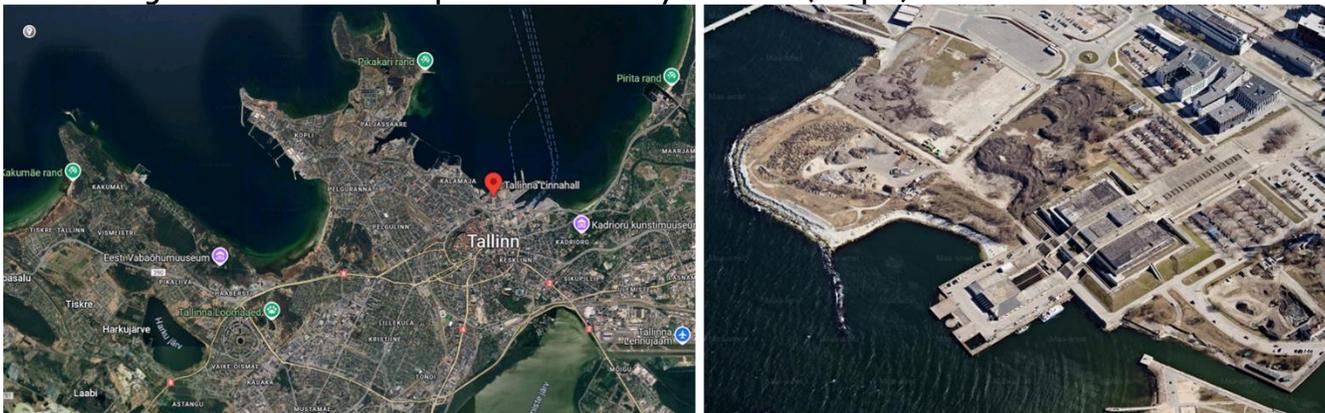
(Credits: Google Maps)

However, potential key stakeholders that Tallinn is planning to involve in the regeneration of the pilot site are:

- Government
  - City's departments (Spatial Planning and Design, Urban Environment and Public Works, Urban Planning)
- University
  - Tallinn University of Technology - TalTech
- Community
  - Sauna users
  - Winter swimmers
  - Pedestrians/visitors with a focus on children/older adults
  - Car picnickers
  - Tourists

- Industry
  - Close by restaurant's owner
  - Harbour
  - Developers
  - Parking lot owner
  - Street cleaning company
  - Small businesses (arts and crafts).

4.1.1 Baselines of Linnahall Area

Given the choice and location of the Tallinn pilot site (Figure 8), this subsection aims to provide the following additional information about the Linnahall area:

➢ Physical characteristics.
➢ Social and liveability conditions.
➢ Needs and potential barriers.
➢ Goals, visions, and expected benefits.

Physical Characteristics

Key features of Linnahall (Figure 9) include:

- Located in the centre of Tallinn, close to the harbour.
- City owned land (approximately 40300 sqm) surrounded by privately owned land, with underway development activities nearby.
- The existence of a promenade and a national monument, which has been abandoned for more than two decades with no plans for restoration.
- There is an unofficial beach, a community sauna built as a citizens' initiative, and a snow storage area (288000 cubic metres of snow collected last winter).
- A new tram line is planned.

Social and Liveability Conditions

From a social and liveability perspective, Linnahall is a dysfunctional and neglected urban site, and a former brownfield area characterised by a high level of underuse relative to its potential.

The reasons for this are well explained in two studies: on the one hand, a baseline assessment for the Tallinn Central City General Planning (2020) shows that the area is completely disconnected from the city centre and not easily accessible; on the other hand, a study (2024) by the Stockholm Environment Institute shows that the perception of citizens, tourists, and nearby business owners is of an area that is "abandoned, confusing, unfriendly".

Figure 9: Features of Linnahall (left) and pictures of the beach and sauna (right)
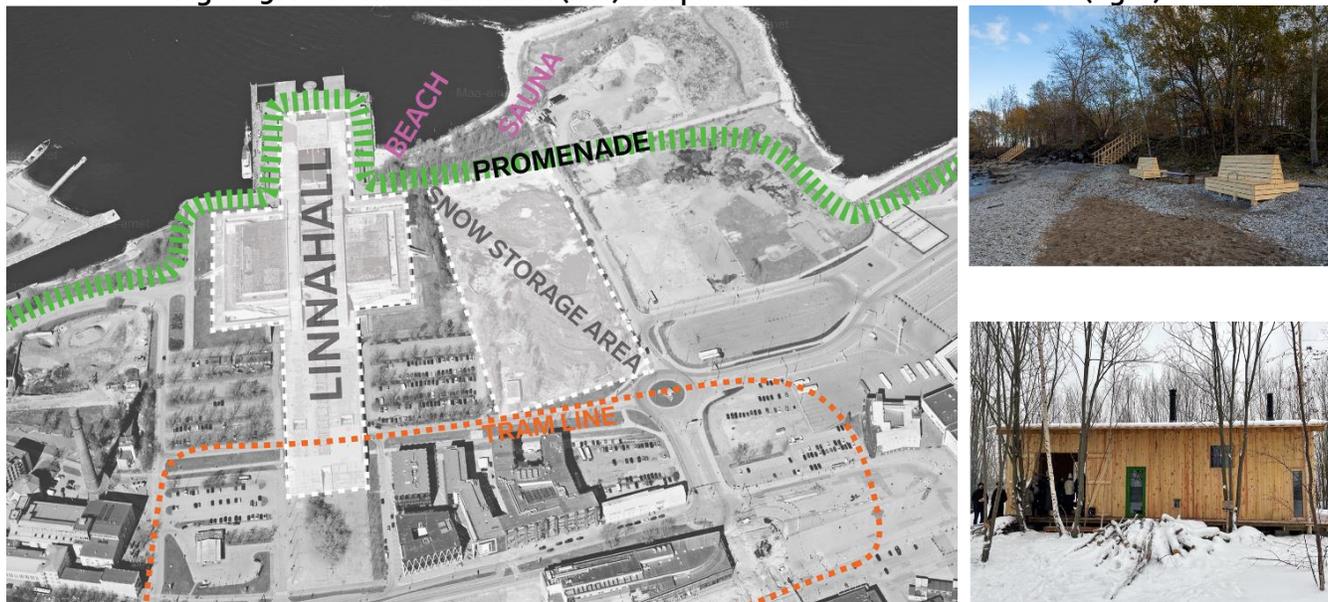
(Credits: Tallinn Team)

Needs and Potential Barriers

Linnahall has many needs that need to be met to improve the status quo of the urban area. Of these, priority and focus should be given to the following:

1. Increased accessibility.
2. Biodiversity enhancement.
3. Snow meltwater management
4. Pollution reduction (i.e. the snow is polluted and full of trash: cobblestones, car tyres, bottles, plastic bags, shoes, socks, e-cigarettes and much more).
5. Social and recreational spaces.
6. Aesthetic improvements.

Other needs to be considered, more related to the management of the regeneration process, are:

7. Baseline assessment and continuous monitoring of progress.
8. Establishing appropriate KPIs for a given solution.
9. Scalability of the solution.
10. Comparability of data across the project.

Focusing, instead, on the barriers that could potentially hinder and slow down the fulfilment of these needs, the city of Tallinn has identified the following ones:

- Maintenance challenges.
- Regulatory hurdles.
- Lack of technical expertise.
- Poor coordination due to the complexity of the municipal organization. Tensions and problems arise from organisational silos that make it difficult for the different departments involved in

the decision-making process to work together effectively. The tension between 'nature for nature' and 'nature for people' is significant, as different departments may be working in the same area with different expertise and objectives.

Aims, Opportunities, and Expected Benefits

In terms of expectations, Tallinn aims to revitalise the Linnahall seaside area by socially and environmentally upgrading and re-naturalising a dysfunctional and neglected urban site, formerly a brownfield in the central harbour zone of the city.

The main objective is to make the seafront accessible to residents and to transform it into an attractive public space. This includes creating a well-functioning demonstration area for urban coastal Nature-Based Solutions, while actively involving residents and the community in the co-planning process. By promoting the value of the coastal ecosystem, the project aims to raise awareness among citizens and city officials of the importance of adapting to climate change. In addition, the initiative plans to expand existing short-term interventions in the area to create multi-purpose urban spaces that connect the waterfront. A key aspect of the project is to reduce the polluting effects of snowmelt on the coastal zone by exploring site-specific NBS solutions for snowmelt management, particularly by adapting these solutions to urban streets.

The area has already been the subject of short-term experiments, but the idea of involving a NBS in its development and further implementation is linked to the expansion of interventions in the area, making it more sustainable in the long term. The NBS envisages the inclusion of:

- Saltwater ecosystems on the waterfront, with the aim of increasing biodiversity in the coastal area.
- Snow-melt water storage, treatment and/or bio-filtration system to reduce the polluting effects of snow-melt water on the coastal area.
- NBS demo park / adventure playground combined with green infrastructure to link the NBS with recreational activities.

One of the elements emphasised by the city of Tallin is also the possibility to share experiences and best practices with the other FRCs and FLCs to improve specific projects and processes and to learn from peers. In this way, Tallin would learn how to design Living Labs and to contextualise them within a specific area and context. Furthermore, the implementation of the NBS is crucial to be more sustainable: for this reason, Tallin is willing to have tools and techniques to monitor the progress of the NBS (both baseline monitoring and continuous monitoring).

4.1.2 Tallinn Use Case Scenarios

The understanding of the Tallinn pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Boreal Frontrunner City to identify and build up its own use case scenarios. Table 6 below outlines the six use case scenarios of Tallinn concerning the URBREATH Toolbox components.

As previously explained in Chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the two Boreal cities (Tallinn and Kajaani), on 6 September 2024.
- A 1-1 workshop entirely dedicated to Tallinn, scheduled for 23 September 2024.

Table 6: Use case scenarios identified by the city of Tallinn

BOR-TAL - Use case scenarios
Tallinn wants to…
1. Explore possibilities of location of specific NBSs for snow meltwater solutions on site and to understand the effectiveness of the selected NBS for snow meltwater infiltration.
2. Assess residents' satisfaction with the re-designed area (after the NBS implementation).
3. Understand the changes in accessibility in the area (after the NBS implementation), i.e. visitors' number/more vulnerable users (e.g. children).
4. Assess the habitat and biodiversity restoration (after the NBS implementation).
5. Estimate the potential change of cars driving in the area (after the NBS implementation).
6. Engage residents and the local community in the co-planning process.

Following the identification process based on the needs and challenges of the Tallinn pilot site, these six use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Boreal Frontrunner City selected the following three use case scenarios as priorities:

- BOR-TAL-1: Tallinn wants to explore possibilities of location of specific NBSs for snow meltwater solutions on site and to understand the effectiveness of the selected NBS for snow meltwater infiltration.
- BOR-TAL-2: Tallinn wants to assess residents' satisfaction with the area (after the implementation of the NBS).
- BOR-TAL-3: Tallinn wants to understand the changes in accessibility in the area (after the NBS implementation), i.e. visitors' number / more users from the vulnerable groups (for example children).

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Boreal FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Tallinn and Kajaani during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

4.2 Kajaani and its Pilot Site: The Maasto Area

As in the case of Tallinn, the specific objective of this section is to present Kajaani, the Boreal FLC, from the perspective of:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Kajaani has a population of over 36000 and is the capital of the Kainuu region. The city is known for its forests and its location on Lake Oulujärvi. As part of the city's climate change strategies and plans, Kajaani is actively seeking new ways of sustainable development. One of the three strategic themes of the boreal municipality is indeed "Sustainable Development. A resource-wise city of nature". In this regard, the city has participated or is participating in many projects related to sustainability, biodiversity and runoff/stormwater control. The most relevant projects in recent times have been "PEATSTOP" on controlling runoff water in the urban environment and a recently launched project "HUDA", which aims to develop technological solutions and methodological know-how for sustainable development of waste logistics and wastewater flow.

Kajaani also has some experience in co-creation activities (with previous projects related to water management, ecological support, modelling for CO_2-efficient city maintenance, and social and environmental sustainability). Table 7 below outlines a selection of projects in which the city of Kajaani has been involved and gained experience with co-creation.

Table 7: Selection of projects in which the city of Kajaani has gained experience in co-creation

Project Name	Brief Description	Website
PeatStop - Sustainable runoff water management in Karelia and Kainuu	Developing transboundary solutions to improve the condition of urban water bodies through the introduction of effective monitoring and the use of new environmentally friendly solutions for filtering run-off water. A mobile citizen science application is used.	https://kareliacbc.fi/en/projects/ka10020-peatstop-sustainable-runoff-water-management-karelia-and-kainuu#home
KIRKU – Lake Iso-Ruuhijärvi ecological support project	Restoration project for lake Ruuhijärvi.	
Lake Kaupunginlampi recovery actions	Restoration project for lake Kaupunginlampi.	
PiHi – CO_2 effective city maintenance	Management for city heavy machinery to mitigate CO_2.	

Regarding the city's digital twin availability and expertise, Kajaani has a digital twin (developed during 2022-2023) that the city would like to develop further, including new features (e.g. green factor or water modelling). Kajaani has also already experimented a mobile app for participatory observations (citizen science) related to water quality and other environmental issues. Kajaani would like to develop these tools further and possibly integrate them with the digital twin.

Given and considering the above-mentioned city's background, Kajaani has chosen as pilot site the Maasto area, on the west side of the city (Figure 10). To date, there is no specific NBS design available. However, potential key stakeholders that Kajaani is planning to involve in the regeneration of the pilot site are:

- Government
  - City of Kajaani
  - ELY-centre - Regional authority for environmental issues
- University
  - Kajaani University of Applied Sciences - KAMK
  - Oulu University
  - Tallinn University of Technology - TalTech
  - Environmental research institute of Finland
- Community
  - Residents
  - School children and students
  - Nature conservation association
  - Associations in old and new snow melt sites
- Industry
  - NBS consultant(s)
  - Development companies.

Figure 10: Location of the pilot site in the city of Kajaani (red pin)
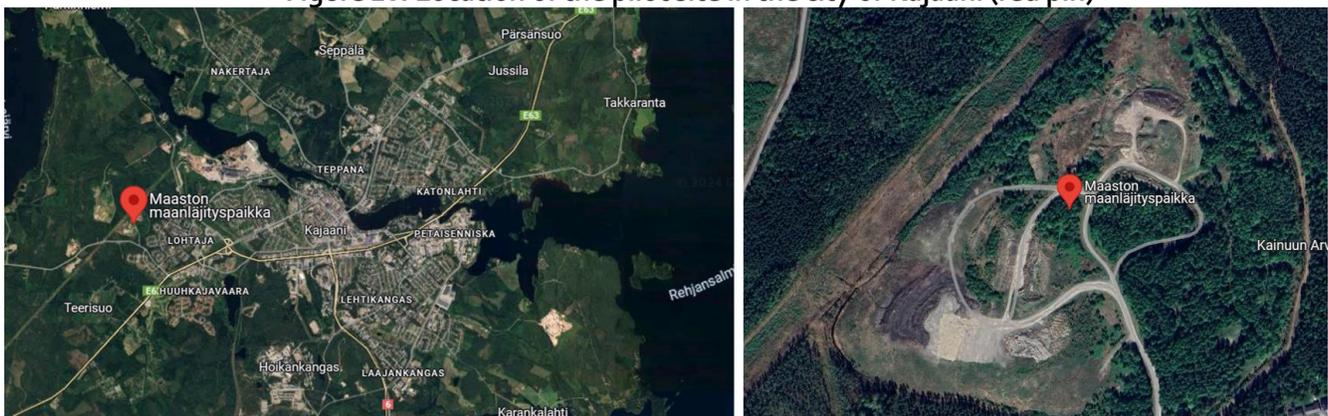
(Credits: Google Maps)

4.2.1 Baselines of Maasto Area

Given the choice and location of the Kajaani pilot site (Figure 10), this subsection aims to provide the following additional information about the Maasto area:

➢ Physical characteristics.
➢ Social and liveability conditions.
➢ Needs and potential barriers.
➢ Goals, visions, and expected benefits.

Physical Characteristics

The main features of the Maasto area are as follows:

- Located on the west side of Kajaani, far from the city centre.
- City-owned land surrounded by forest, but on the east side, very close to residential areas.
- Currently used as a site for snow placement and mass storage.
- The site should replace current smaller sites with better opportunities for water management structures and geological features.

Social and Liveability Conditions

No information available.

Needs and Potential Barriers

In terms of needs, the city of Kajaani is looking to achieve better resilience and prevention of environmental impacts from floods, droughts and snowmelt. There is also a need for ideas on mechanisms to support biodiversity in combination with carbon sequestration and water management. The problems faced by Kajaani are mainly related to finding a balance between biodiversity and regulation, and specific NBS to achieve this goal. Kajaani also faces water pollution, which is a problem, and wants to be able to find NBSs that can cope with and avoid this problem. There is also a need to further develop and use the existing digital twin, as well as to evaluate citizen science tools and explore opportunities for citizen and youth engagement.

For the pilot site in particular, the main challenge is the difficulty of building new structures due to its geological characteristics and geographical location. Soon, there will be a need for smaller snowmaking sites in different parts of the city to minimize the logistics required. The presence of invasive species is also a relevant issue for the area as it affects natural biodiversity.

Goals, Visions, and Expected Benefits

The main objective of the Finnish city is to increase collaboration and expertise in combining Nature-Based Solutions, citizen science, and data management. In particular, the city is willing to explore NBSs for better systemic management of water flows (e.g. creating a "sponge structure" to better balance water flows), as well as identifying NBSs to improve resilience to floods and droughts and generally experimenting with new design ideas for a flood resilient city.

Overall, Kajaani's expectation from the URBREATH project is related to the possibility of designing new ideas for new NBSs, including peer-to-peer learning from other cities, both FRCs and FLCs. At the same

time, Kajaani would like to add new features to its already existing digital twin, especially related to green index and water modelling and simulation, and to receive support for IT integration.

The vision for the Maasto area is to replace current smaller sites with better possibilities for water management structures. 'What-if' scenarios could be

- Permeable pavements to absorb stormwater, thereby minimizing and delaying surface water runoff, while reducing the amount of some pollutants.
- Constructed wetlands to harvest, treat and store stormwater runoff, as well as to help support urban biodiversity by including, for example, diverse vegetation and barrier-free shores.
- Biofilters to collect and purify storm- and wastewater and represent a promising system for stormwater treatment.

4.2.2 Kajaani Use Case Scenarios

The understanding of the Kajaani pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Boreal Follower City to identify and build up its own use case scenarios. Table 8 below outlines the five use case scenarios of Kajaani concerning the URBREATH Toolbox components.

As previously explained in Chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the two Boreal cities (Tallinn and Kajaani), on 6 September 2024.
- A 1-1 workshop entirely dedicated to Kajaani, scheduled for 23 September 2024.

Table 8: Use case scenarios identified by the city of Kajaani

BOR-KA - Use case scenarios
Kajaani wants to…
1. Design potential ideas for NBSs for better water management to achieve a flood-proof city.
2. Estimate potential costs-benefits of such NBSs.
3. Understand biodiversity support mechanisms related to NBSs.
4. Engage citizens/youth in the co-planning process.
5. Assess habitat and biodiversity restoration (after the NBS implementation).

Following the identification process based on the needs and challenges of the Kajaani pilot site, these five use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Boreal Follower City selected the following three use case scenarios as priorities:

- BOR-KA-1: Kajaani wants to design potential ideas for NBSs for better water management to achieve a flood-proof city.
- BOR-KA-2: Kajaani wants to estimate potential costs-benefits of such NBSs.

- BOR-KA-3: Kajaani wants to understand biodiversity support mechanisms related to NBSs.
- BOR-KA-4: Kajaani wants to engage citizens/youth in the co-planning process.

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Boreal FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Tallinn and Kajaani during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

5 Continental Cities: Sites' Baselines and Use Case Scenarios

The Continental climatic zone (light purple area in Figure 11) covers the central and eastern part of Europe. The main characteristics of the climate type are cold, long-lasting winters and predominantly hot summers.

This chapter is dedicated to producing an understanding of the systems and state of play of the two URBREATH cities representing indeed the Continental climatic zone, namely:
- Cluj-Napoca, located in Romania, which is the Continental Frontrunner City.
- Pilsen, located in the Czech Republic, which is the Continental Follower City.

Figure 11: URBREATH Cities by Climatic Zones: Cluj-Napoca and Pilsen, the Continental cities
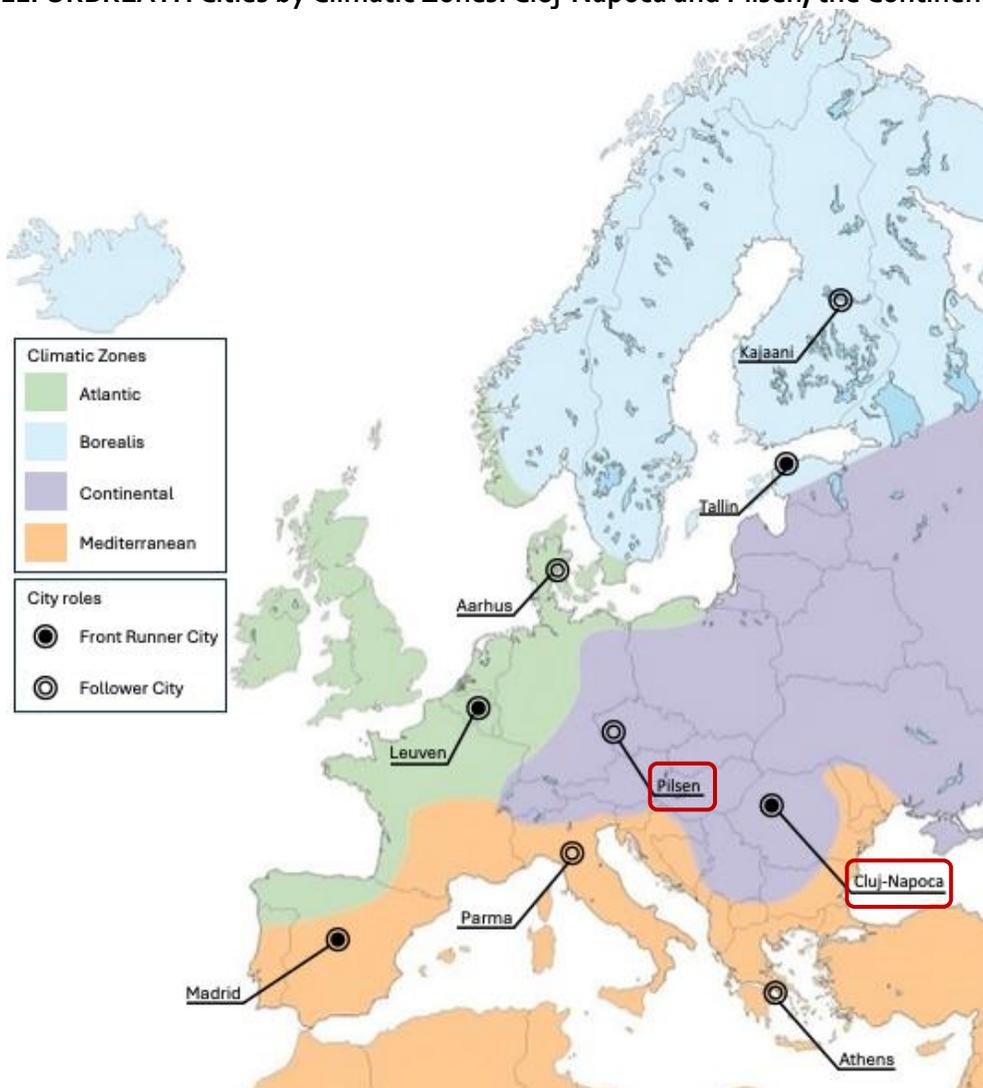
(Credits: URBREATH Team)

First, Cluj-Napoca and Pilsen are framed with a _background description_ from the threefold perspective of the URBREATH key objectives, namely 1) climate neutrality, 2) co-creation, and 3) digital technologies. Accordingly, both the two Continental cities are described by providing the reader with the following information:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Lastly, the specific areas chosen as pilot sites by both the two cities are briefly presented, together with the expected NBS to be implemented (if already planned) and the potential key stakeholders to be involved.

Secondly, in addition to the background of the Continental cities, the '_baselines_ 'of the two pilot sites chosen by Cluj-Napoca and Pilsen, are described by outlining:

- ➢ Physical characteristics.
- ➢ Social and liveability conditions.
- ➢ Needs and potential barriers.
- ➢ Goals, visions and expected benefits.

Finally, the challenges and associated _use case scenarios_ for both the Continental Frontrunner and Follower Cities are outlined. By use case scenarios, we mean how Cluj-Napoca and Pilsen plan to use the URBREATH Toolbox components developed by the technical partners. In other words, what functionalities the two Continental cities would like to have implemented and available to support their activities and decision-making. To give an example of a use case scenario identified: "Cluj-Napoca wants to understand the reduction of CO_2 emissions (after the NBS implementation)".

5.1 Cluj-Napoca and its Pilot Site: The Iris Neighbourhood

As mentioned above, the specific objective of this section is to present Cluj-Napoca, the Continental FRC, from the perspective of:

- ❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
- ❖ The city's experience with co-creation and Living Labs (LLs).
- ❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Cluj-Napoca is one of the 100 cities selected by the European Commission to be part of the EU mission "100 Climate Neutral and Smart Cities by 2030" in 2022, placing it among the first ten cities in the European Union. From this perspective, the municipality is consolidating its goal of achieving a green transition by 2030 and reducing greenhouse gas emissions by at least 80% compared to 2011. The "Integrated Urban Development Strategy 2030-2050" includes a major investment programme for green spaces (Green Cluj), which aims to invest in more than 100 ha of new green spaces, 100000 new

trees, the installation of sensors and stations for measuring air quality, water and soil, as well as blue-green corridors for boosting sustainable mobility along riverbanks in the Cluj metropolitan area. Focusing specifically on the city's approach to Nature-Based Solutions, Cluj-Napoca currently promotes community gardens as a first approach to increasing greenery and nature in the city, as well as boosting civic participation. The municipality's objective is to create more solid social relationships through co-design and implementation of community gardens, as well as blue-green corridors.

Focusing on the Romanian municipality's experience of co-creation, Cluj-Napoca has been involved in previous projects, namely "H2020 – proGIreg" and "Agora" (Table 9), which developed strategies for the recovery and reuse of green corridors and adjacent vacant land, as well as co-management solutions for urban open spaces. Some of the co-creation activities and processes are directly related to the implementation of NBSs, and landscape settings. On the other hand, Cluj-Napoca emphasises the importance of combining ongoing participatory activities (e.g. community gardens) with the implementation of NBSs.

Table 9: Projects in which the city of Cluj-Napoca has gained experience in co-creation

Project Name	Brief Description	Website
H2020 proGIreg	Co-creation of an urban plan for the implementation of NBSs in post-industrial neighbourhoods (in the form of a strategy), including the Iris neighbourhood (selected pilot site for URBREATH).	https://progireg.eu/cluj-napoca/
AGORA	Developing and adopting new governance tools for public authorities, building capacity to involve and empower a wide range of stakeholders in the reintegration of vacant buildings and land, public and private, into the productive urban value system.	https://www.interreg-danube.eu/approved-projects/agora

Moving from the co-creation experience to the availability of a digital twin, the Continental Frontrunner City does not have a digital twin (yet). However, the Romanian municipality uses a relatively comprehensive Geographical Information System (GIS) with multiple data layers from different domains such as cadastre data, transport data, demographic data, infrastructure data (https://beta.getlayer.xyz/cluj/) and a regulatory GIS (https://gis.primariaclujnapoca.ro/Public/).

Given and considering the above-mentioned city's background, Cluj-Napoca has chosen as pilot site the Iris district, a post-industrial neighbourhood located in the northern part of the city. Within the Iris district, four different intervention sites were selected (Figure 12).

Figure 12: Location of the pilot site in Cluj-Napoca: the Iris district (left) and the four selected areas (right)
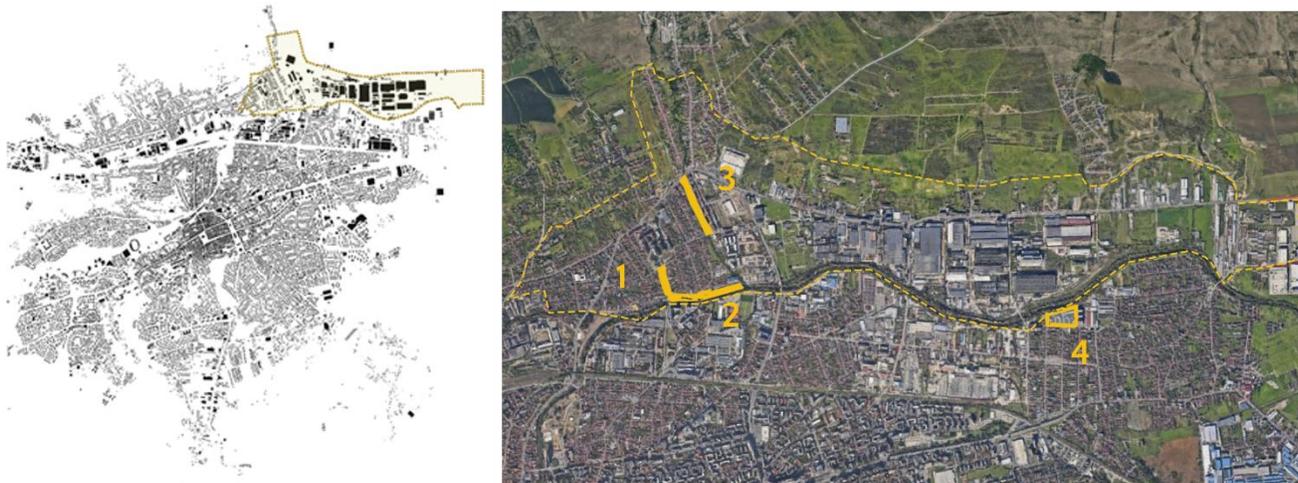
(Credits: Cluj-Napoca Team)

Overall, the main objectives to be met by NBSs in the Iris district are related to green and blue infrastructures. Specifically, the Municipality of Cluj-Napoca is willing to implement different NBSs in the selected four locations. In particular

- Site 1 | *Str. Alexandra Sahia*: experimental plantings for the creation of a new "local standard" for green corridors related to traffic routes (Figure 13).
- Site 2 | *Str. Nădăşel–Someşul Mic*: blue-green corridor (replicable for other sections of the corridor) with temporary activities and promotion of soft mobility, for example through shaded areas (Figure 14).
- Site 3 | *Access Road Str. Sobar*: new pedestrian connection / promotion of walking / integration of a vegetation corridor into the structure of the public space.
- Site 4 | *Str Timișului - Str Blajului*: multi-functional ecological development based on the needs of the community and "owned" by the community to demonstrate the value of green pockets for multi-family housing areas.

Potential key stakeholders that Cluj-Napoca is planning to involve in the regeneration of the four pilot sites are:
- Government
  - City's departments: European funds, Urban Strategies, Urban Ecology and Green Spaces, Public Events and Citizen Information
  - Civic Imagination and Innovation Center
  - Cluj Metropolitan Area (CMA)
- University
  - Technical University of Cluj-Napoca (Faculties of Architecture and Urban Planning)
  - The Babeș-Bolyai University- UBB
  - The University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca - USAMV
  - Tallinn University of Technology – TalTech

- Community
  - Residents
  - Cultural centre
  - Youth federation
  - Architect groups
  - Scena Urbana (initiative of the Order of Architects of Romania)
  - Cycling tourism club
- Industry
  - Delivery NGO
  - Transylvania IT-cluster
  - Industrial zone owners
  - Water company Somes SA
  - Electric Energy Distribution Romania.

5.1.1 Baselines of Iris Neighbourhood

Given the choice and location of the Cluj-Napoca pilot site (Figure 12), this subsection aims to provide the following additional information about the Iris district:

- ➢ Physical characteristics.
- ➢ Social and liveability conditions.
- ➢ Needs and potential barriers.
- ➢ Goals, visions, and expected benefits.

Physical Characteristics

The main characteristics of the Iris district are as follows:

- It covers an area of 5.2 square kilometres with a population of approximately 15000-20000 inhabitants.
- Although a former industrial area (a legacy of industrialisation under the post-war communist government), the district is now characterised by a mixed land use consisting of residential, industrial and developing commercial areas. There are also primary and secondary schools.
- In terms of accessibility, the neighbourhood is well connected to the city centre and other parts of Cluj-Napoca by major roads and railways.
- Public transport (buses and trams) is also available, as well as a network of cycle paths.

Social and Liveability Conditions

Given the post-industrial identity of the district, Iris is characterised by a heterogeneous fabric - newer individual and collective housing, privately owned industrial areas, brownfield sites and big box stores. The quality of public and green spaces is currently quite low, as shown in Figure 13 and Figure 14. Consequently, the demand for socially inclusive open green spaces is very high.

To better understand the neighbourhood's living conditions, it should also be noted that the level of air and noise pollution is quite high, especially near the railway and the former industrial areas.

Figure 13: Intervention site 1 within the Iris neighbourhood

Site 1 – Str. Alexander Sahia
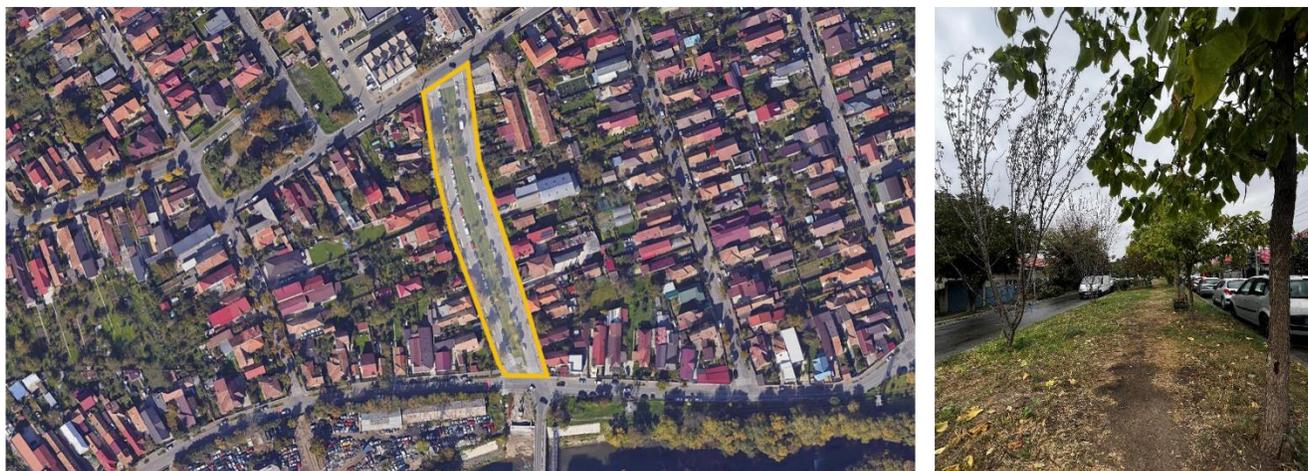
(Credits: Cluj-Napoca Team)

Figure 14: Intervention site 2 within the Iris neighbourhood

Site 2 – Str. Nădăşel–Someşul Mic

(Credits: Cluj-Napoca Team)

Needs and Potential Barriers

The short-term needs identified by the municipality are, on the one hand, to address the requests of the local community and to design and implement an NBS specific to the local climate and biodiversity context. On the other hand, medium-term needs are to facilitate linkages and possible collaboration with private owners of the Iris Industrial Estate (located to the east of the neighbourhood) and to influence real estate projects for a synergistic effect towards a green and climate-neutral Iris.

Cluj-Napoca also has some basic needs related to technical and organizational tasks. On the one hand, Cluj-Napoca will need specific technical support for NBS deployment and implementation; on the other

hand, it will need tools and devices for detailed monitoring activities that are easy to use, and that can be qualitatively beneficial to citizens as well.

Cluj-Napoca could also face some barriers in developing NBSs. In fact, the Romanian city highlights some pressing problems, such as the infrastructural and regulatory constraints of the city (especially in relation to one of the four identified sites where there are Overhead Power Lines - LEA). Therefore, the chosen NBS will have to comply with the protection requirements for overhead power lines. The City also emphasises property rights and their influence, particularly in relation to private land. Another problem that could arise, and which is shared with the other cities, is the municipal organisation, which could influence the outcome. In fact, the sectoral knowledge required to implement NBSs is organised in different municipal silos, which creates difficulties for knowledge sharing and communication between municipal departments. Short-term barriers also include:

- Lack of state-of-the-art data for impact monitoring.
- Limited resources by design for a dense monitoring network.
- Temporary "negative" perception due to construction sites.

Goals, Visions, and Expected Benefits

Concerning the objectives focused on the expected benefits derived from the NBS, Cluj-Napoca aims to achieve the following:

- Implement a multifunctional NBS towards community needs that allows for replication flexibility.
- Investigate the greening transformation opportunities with privately owned areas: new mixed usage developments and industrial areas.
- Build new community facilities and temporary uses in cooperation with local actors and community members, based on the paradigm from "closed streets" to community markets, cultural events, etc.
- Tackle pollution caused by construction sites/car traffic.
- Improve the local landscape and the comfort of the district's urban environment.

The desired changes are to institutionalise a 'new practice' for (i) multifunctional NBS owned/managed by the community and (ii) green corridors along mobility infrastructures, as well as to improve the policy framework supporting NBS and to update local legislation (prohibition of community gardening).

Looking, instead, at aims and objectives related to the functionalities of the URBREATH Toolbox (e.g. monitoring, participation, simulation, etc), Cluj-Napoca wishes to work on the following:

- Participatory-driven identification of replication areas.
- Green-blue corridor.
- Vegetation strips related to traffic routes.
- Green pockets.
- Integrate results of heat island analyses / environmental data / new citizen data? (on a voluntary basis).

The desired changes are related to the transfer of the digital platform for co-creation processes to future participatory budgeting and other regeneration initiatives, as well as the transfer of the digital twin for the monitoring of other sites.

5.1.2 Cluj-Napoca Use Case Scenarios

The understanding of the Cluj-Napoca pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Continental Frontrunner City to identify and build up its own use case scenarios. Table 10 below outlines the eight use case scenarios of Cluj-Napoca concerning the URBREATH Toolbox components.

As previously explained in chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:
- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the two Continental cities (Cluj-Napoca and Pilsen), on 20 September 2024.
- A 1-1 workshop entirely dedicated to Cluj-Napoca, scheduled for 25 September 2024.

Table 10: Use case scenarios identified by the city of Cluj-Napoca

CONT-CLUJ - Use case scenarios
Cluj-Napoca wants to…
1. Demonstrate the value of green pockets for multi-family housing areas.
2. Involve the community in co-creation (i.e. tree selection and planting).
3. Integrate greening simulations in the Local Digital Twin.
4. Understand the changes (increase?) in shaded areas (after the NBS implementation).
5. Understand CO_2 emissions reduction (after the NBS implementation).
6. Understand the reduction in traffic (after the NBS implementation).
7. Raise awareness.
8. Understand the sense of well-being (after the NBS implementation).

Following the identification process based on the needs and challenges of the Cluj-Napoca pilot site, these eight use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Continental Frontrunner City selected the following three use case scenarios as priorities:
- CONT-CLUJ-1: Cluj-Napoca wants to demonstrate the value of green pockets for multi-family housing areas and to involve community in co-creation (i.e. trees selection and planting).
- CONT-CLUJ-2: Cluj-Napoca wants to integrate greening simulations in the local digital twin.
- CONT-CLUJ-3: Cluj-Napoca wants to understand the changes (increase?) in shaded areas (after the NBSs implementation) and to understand the reduction in CO_2 emissions (after the NBS).

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Continental FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Cluj-Napoca and Pilsen during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

5.2 Pilsen and its Pilot Site: The Náměstí Republiky Square

As in the case of Cluj-Napoca, the specific objective of this section is to present Pilsen, the Continental FLC, from the perspective of:

❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
❖ The city's experience with co-creation and Living Labs (LLs).
❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Pilsen is the fourth largest city in the Czech Republic and well-known for being an important industrial pole. It is a full member of Eurocities since 1996, the network of over 200 major European cities that helps local administrations to improve local quality of life by innovating and sharing best practices while putting into place low-carbon and smart solutions for cleaner air and better public services.

The city, which is at the forefront of the fight against climate change, was recently one of the locations in which round table discussions over the adaptation of climate change took place (the others being Prague and Brno). In addition, the city is a signatory of Living-In.eu, an EU initiative for local and regional leaders to share smart city strategies and a member of the European Digital Infrastructure Consortium, a legal framework aiding Member States to set up and implement multi-country projects, as well as a Follower City in the Horizon project Climaborough on climate adaptation and resilience in urban areas.

As regards the experience with co-creation and participatory processes, the city has already made use of a digital platform to enable citizens submitting a proposal to revive the public space in specific neighbourhoods and improve the overall living conditions of the city. This is the case for the Decide for Yourself project, a public initiative based on the participatory budgeting which empowers participants to exert control over the allocation of municipal funds they wish to be spent and make them decide what is to be paid for with public money, prioritizing the implementation of the most popular proposals. Other similar activities and initiatives involving co-creation processes are summarized in the Table 11 below:

Table 11: Projects in which the city of Pilsen has gained experience in co-creation

Project Name	Brief Description	Website
Pěstuj Prostor	It is an umbrella platform encompassing a slew of projects, united by a common goal: to enhance public spaces by making them more democratic, cleaner and responsive to final user needs.	https://pestujprostor.plzne.cz/
Rozhodněte sami	The project gathers different ideas for revitalising public spaces and improving living conditions in the district by using participative budgeting tools.	https://rozhodnetesami.cz/plzen3/
Jiráskovo náměstí	This joint project, which involves the monastery, non-profit organizations, local	https://jiraskovonamesti.plzen.eu/

	schools and residents, aims to restore Jirásek Square to its architectural value and turn it into an open cultural and social centre civic participation.	

When it comes to the use of digital twin in urban planning, the city has gained some experience. Similarly to Athens (see chapter 6.2 of this document), Pilsen has developed a digital model within the context of the DUET project, incorporating simulations of traffic, air pollution, and noise levels along with 3D data. The city's Open Data Portal offers a wealth of additional data sources, such as traffic and environmental data, which could be valuable for enriching the existing digital twin.

RoadTwin traffic modelling constitutes another digital twin, primarily dedicated to offering web-based traffic measurement solutions by simulating future traffic flows and analysing different potential scenarios. In the same vein, Pilsen utilizes the Traffic Analytical Map that incorporates information deriving from an Interactive Mobility Dashboard, including data on bike sharing flows, floating car, and road crash data and more than 1000 street traffic sensors in congested spots. Additionally, the city has announced that a Geographic Information System (GIS), which encompasses various data sources (such as Open Transport Maps, Points of Interest, cadastral and hydrographical data) may be incorporated into URBREATH in a later stage.

Lastly, an Interactive 3D Application is available and freely accessible by the citizens to showcase the city's planned developments and modifications to public spaces as of 2021.

Given and considering the above-mentioned city's background, Pilsen has chosen as pilot site the Náměstí Republiky Square, located in the historical city centre (Figure 15).

A transformation project has been already defined after an architectural competition. The winning design was selected from a pool of twelve entries, and an expert jury praised its comprehensive approach and ability to balance historic preservation with modern urban design. Key features of the winning design are:
- Increased pedestrian and cycle-friendly areas: The winning design prioritises walking and cycling, reducing car traffic and creating more inviting public spaces.
- Greenery and urban forest: The plan includes the planting of many trees to create a more natural and shaded environment.
- Cultural and social activities: The square will be designed to accommodate a variety of cultural events, markets and social gatherings.
- Improved public transport: The design will improve access to public transport and integrate it seamlessly into the layout of the square.
- Phased implementation: The project will be implemented in phases to minimise disruption and allow for public input.
- The city plans to start construction in 2026.

Figure 15: Location of the pilot site in Pilsen: Historical map and 3D focus on the square (bottom-right)

(Credits: Pilsen Team)

Potential key stakeholders that Pilsen is planning to involve in the regeneration of the pilot site are:

- Government
  - City of Pilsen
  - Urban Planning and Development Institute (UKRMP)
  - Public Property Administration (SVSMP) - Department of Heritage Protection.
  - Information Technology Administration (SITMP)
- University
  - Tallinn University of Technology - TalTech
  - University of West Bohemia
- Community
  - Residents
  - Expert NGOs / citizen organisations in public space design
  - Environmental groups
- Industry
  - Pilsen-based companies/startups
  - Local businesses (cafes, restaurants, shops).
  - Investors.

5.2.1 Baselines of Náměstí Republiky Square

Given the choice and location of the Pilsen pilot site (Figure 15), this subsection aims to provide the following additional information about the Náměstí Republiky Square:

➢ Physical characteristics.
➢ Social and liveability conditions.
➢ Needs and potential barriers.
➢ Goals, visions, and expected benefits.

Physical Characteristics

The main characteristics of the Náměstí Republiky Square (Figure 16) are as follows:

- Located in the historical city centre and one of the largest squares in Europe (139 x 193 meters).
- The Gothic St. Bartholomew's Cathedral stands in the middle, while neighbouring buildings are townhouses, many of which are important cultural monuments.
- Accessible via pedestrian zones from south and west.
- Well-connected by public transport (trams and buses) and pedestrian pathways.
- Encircled by roadways, allowing vehicular access from all four sides.
- Featured with various commercial activities, including retail shops, restaurants, and cafes.
- Hub for cultural events and key site for both local and tourist activities.

Figure 16: Views of the Náměstí Republiky Square
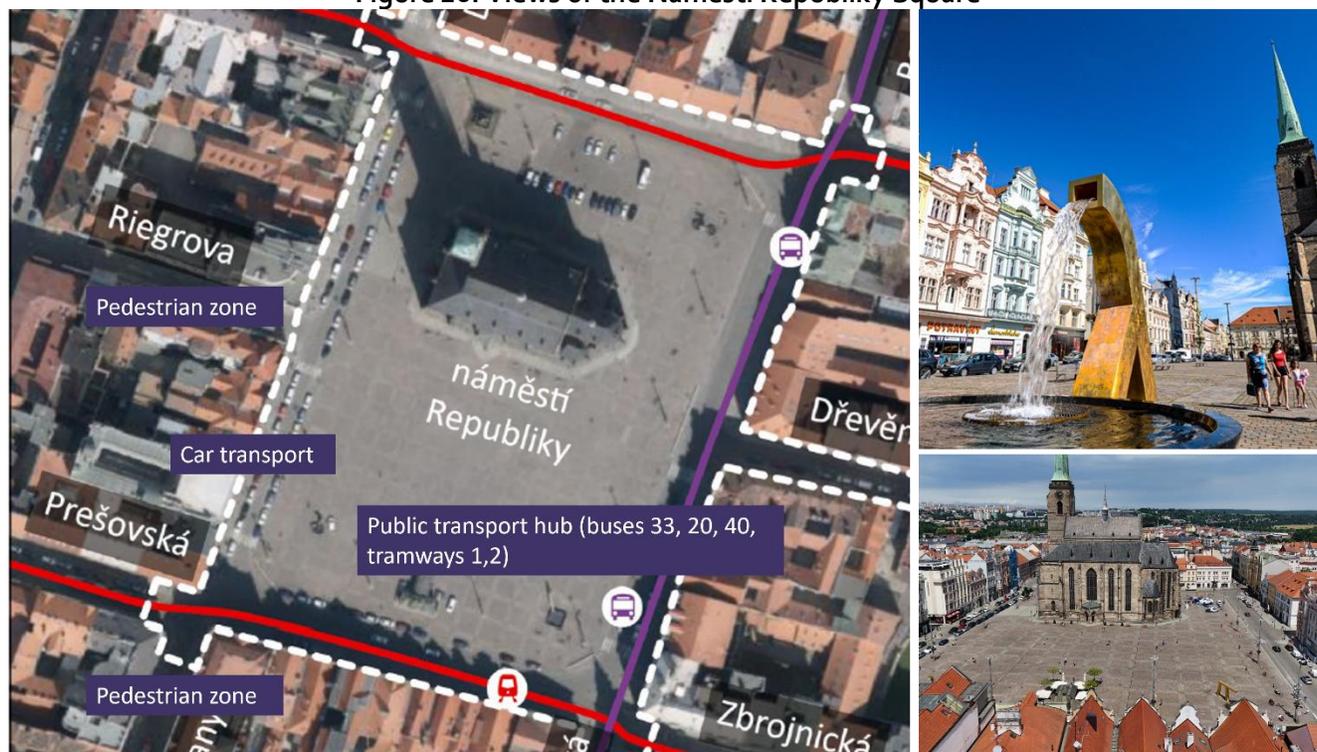
(Credits: Pilsen Team)

Social and Liveability Conditions

Pilsen has a diverse population, including residents and a high number of visitors and tourists due to its historical and cultural landmarks, while at the same time facing a declining population in the central part of the city.

The Náměstí Republiky Square, located in the historic centre of the city, is characterised by heavy traffic and public transport, resulting in air and noise pollution. This public space is frequently perceived as unsafe, due its flow density.

In addition, the historic and modern infrastructure of the square is undergoing environmental degradation due to the challenges of maintaining and upgrading the facilities without affecting the historic fabric of the area. However, there are ongoing efforts to preserve and enhance the historical and cultural value of the square, including the maintenance and restoration of significant landmarks and buildings.

Needs and Potential Barriers

The city of Pilsen has identified the following requirements for the urban greening of the Náměstí Republiky Square:

- To improve stormwater management by designing vegetation and storm water management solutions comprehensively as blue-green infrastructure in coordination with technical infrastructure requirements through landscape design.
- To increase the accessibility of green spaces by integrating more accessible green spaces into the urban framework.
- To increase biodiversity and improve environmental quality, for example through the selection of appropriate taxa.
- To reduce pollution (CO_2, NO_2 monitoring, etc.).
- To improve climate resilience by reducing urban heat islands, run-off conditions and stormwater management in the area.

Instead, in terms of potential barriers to these needs, Pilsen has identified the following:

- Conflicts between existing land uses and the introduction of new green spaces (restrictions on changing existing paving and structural layout, not disturbing heritage values - it is necessary to preserve views of important buildings).
- Financial constraints and limited budgets.
- NBS maintenance challenges.
- Building consensus between different stakeholders.
- Compliance with existing regulations and policies.
- Resistance from local communities or specific groups and potential disruption to daily activities.

Goals, Visions, and Expected Benefits

The objectives associated with the Náměstí Republiky Square regeneration process include the implementation of green infrastructure, integration and enhancement of commercial activities (front gardens of restaurants), creation of inclusive spaces for different groups, improvement of the

pedestrian environment and public spaces, better management of rainwater and integration of resilient infrastructure (urban heat island, sealed ground), involvement of local stakeholders and respect for the historical and cultural values of the area.

From this perspective, the desired changes for the Pilsen pilot site can be grouped and described as it follows:

- Physical transformation: redesigning street profiles for pedestrian and place to stay's quality enhancements.
- Improved technical infrastructure elements: rainwater retention, runoff conditions.
- Social cohesion: inclusive space design (spaces that cater to diverse groups – families, friends, visitors etc.), event and vendor integration
- Economic diversification: support for local businesses (restaurant gardens), enhancement for event spaces (attractivity).
- Environmental health: green infrastructure implementation

5.2.2 Pilsen Use Case Scenarios

The understanding of the Pilsen pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Continental Follower City to identify and build up its own use case scenarios. Table 12 below outlines the six use case scenarios of Pilsen concerning the URBREATH Toolbox components.

As previously explained in chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the two Continental cities (Cluj-Napoca and Pilsen), on 20 September 2024.
- A 1-1 workshop entirely dedicated to Pilsen, scheduled for 26 September 2024.

Table 12: Use case scenarios identified by the city of Pilsen

CONT-PILS - Use case scenarios
Pilsen wants to…
1. Investigate if there is an impact on traffic (size and modal shift) using the local digital twin.
2. See if there is an impact on air quality, noise, heat and shadow impact using the local digital twin.
3. Understand the perception of residential Quality and safety of public space (after the NBS implementation).
4. Visualise designs in the local digital twin.
5. Visualise designs using generative AI-driven tools.
6. Investigate the social impact on well-defined target groups (i.e. pedestrians and cyclists).

Following the identification process based on the needs and challenges of the Pilsen pilot site, these six use case scenarios were first validated and then prioritised by the city's working team during a

workshop organised on the first day of the project's General Assembly. On this day, the Continental Follower City selected the following three use case scenarios as priorities:

- CONT-PILS-1: Pilsen wants to investigate if there is an impact on traffic (size and modal shift) using the local digital twin.
- CONT-PILS-2: Pilsen wants to see if there is an impact on air quality, noise, heat and shadow impact using the local digital twin.
- CONT-PILS-3: Pilsen wants to understand the perception of residential quality and safety of public space (after the NBS implementation).

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Continental FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Cluj-Napoca and Pilsen during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

6 Mediterranean Cities: Sites' Baselines and Use Case Scenarios

The Mediterranean climate can be found around the Mediterranean Sea. Countries such as Spain, Italy and Greece experience hot, dry summers and mild winters with little frost. Drought and heat islands are typical challenges of this climatic zone (light orange area in Figure 17).

This chapter is dedicated to producing an understanding of the systems and state of play of the three URBREATH cities representing indeed the Mediterranean climatic zone, namely:

- Madrid, the Frontrunner City, located in Spain.
- Athens and Parma, the two Follower Cities, located respectively in Greece and Italy.

Figure 17: URBREATH Cities by Climatic Zones: Madrid, Athens and Parma, the Mediterranean cities
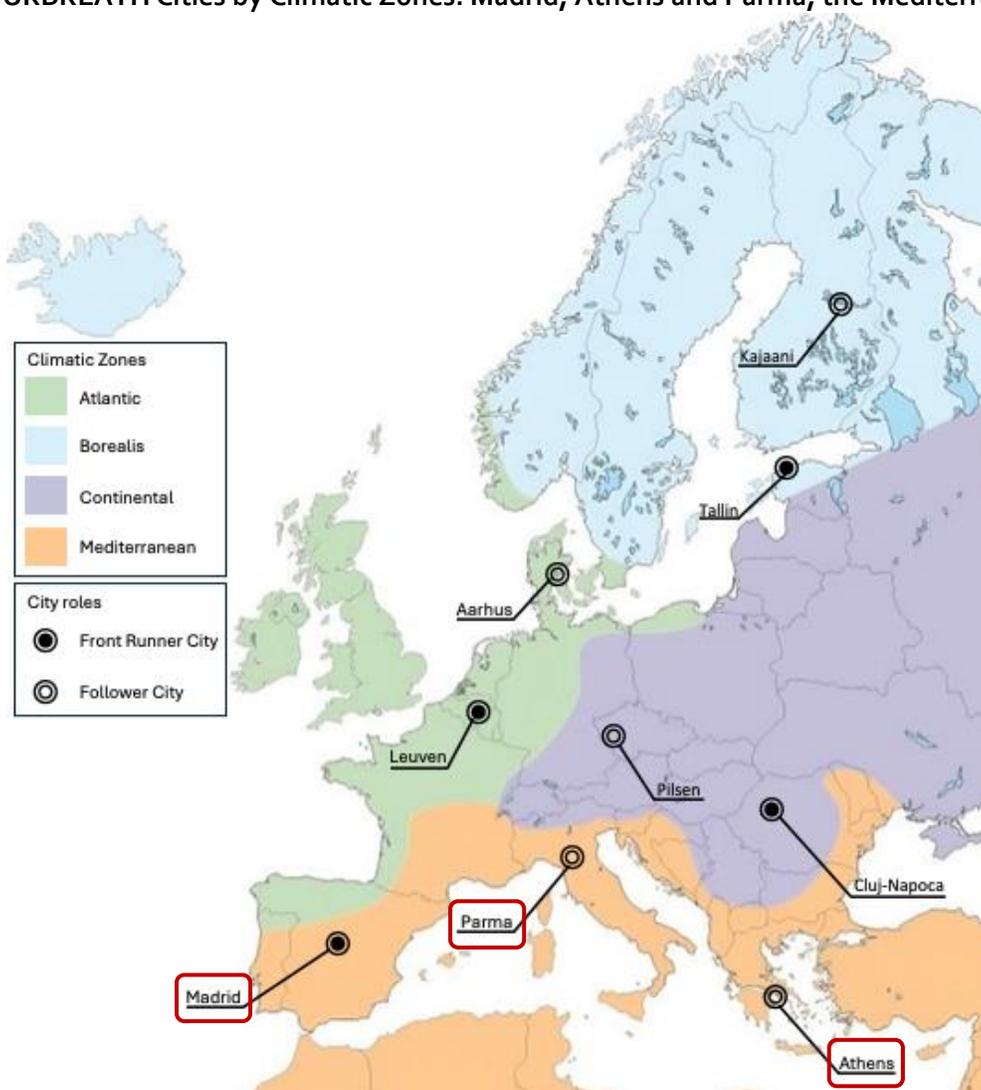
(Credits: URBREATH Team)

First, Madrid, Athens, and Parma are framed with a _background description_ from the threefold perspective of the URBREATH key objectives, namely 1) climate neutrality, 2) co-creation, and 3) digital technologies. Accordingly, all the three Mediterranean cities are described by providing the reader with the following information:

❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
❖ The city's experience with co-creation and Living Labs (LLs).
❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Lastly, the specific areas chosen as pilot sites by all three cities are briefly presented, together with the expected NBS to be implemented (if already planned), and potential key stakeholders to be involved.

Secondly, in addition to the background of the Mediterranean cities, the '_baselines_ 'of the three pilot sites chosen respectively by Madrid, Athens, and Parma, are described by outlining:

➢ Physical characteristics.
➢ Social and liveability conditions.
➢ Needs and potential barriers.
➢ Goals, visions and expected benefits.

Finally, the challenges and associated _use case scenarios_ for the Mediterranean Frontrunner and the two Follower Cities are outlined. By use case scenarios, we mean how Madrid, Athens, and Parma plan to use the URBREATH Toolbox components developed by the technical partners. In other words, what functionalities the three Mediterranean cities would like to have implemented and available to support their activities and decision-making. To give an example of a use case scenario identified: "Parma wants to analyse the changes (reduction) of urban heat islands, after the NBS implementation".

6.1 Madrid and its Pilot Site: The Villaverde District

As mentioned above, the specific objective of this section is to present Madrid, the Mediterranean FRC, from the perspective of:

❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
❖ The city's experience with co-creation and Living Labs (LLs).
❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Regarding the first point, Madrid, the capital and largest city in Spain, has implemented Nature-Based Solutions as a key strategy for climate adaptation since 2016. NBSs have been successfully adopted in integrating nature into the city, improving urban biodiversity, and mitigating the impacts of climate change. Madrid has a strong commitment to climate and air quality actions, evident in its Environmental Policy and Madrid 360 Sustainability Strategy.

The city has already started a transformation of public spaces and facilities, particularly schools, using NBSs and inclusive design to increase the presence of greenery and nature in the city, as well as to generate social benefits.

Madrid is also involved in two major projects, namely the "Bosque Metropolitano" and the "Arco Verde", which are two major green infrastructure initiatives which aim to improve ecological connectivity and provide key benefits related to health, well-being, and climate adaptation.

Within the context of the URBREATH project, the city of Madrid wants to develop and test an approach in which multiple dimensions (climate, social, economic, ecological etc.) can be integrated to create a systemic strategy for co-designing urban spaces that are resilient and adaptable to climate change, while providing socio-economic and ecological benefits. Such an objective will be achieved by integrating the needs and perspectives of different internal and external actors, urban regeneration and climate adaptation initiatives, such as climate shelters, for example, together with urban green strategies to improve the climate adaptation of the city's areas.

Regarding Madrid's experience in co-creation and Living Labs, Madrid has been involved in several projects in which local communities' engagement played a key role in urban area regeneration. Table 13 provides an overview of these projects, correlated with a brief description and the relevant website.

Table 13: Projects in which the city of Madrid has gained experience in co-creation

Project Name	Brief Description	Website (if available)
LIFE-PACT	Focused on community participation in the design of school environments with good air quality and adaptation to climate change.	https://leuven.be/en/life-project-pact
School Environments	Aimed at improving schools and their play areas through climate change adaptation measures, focusing on naturalization and urban solutions.	https://estrategiaurbana.madrid.es/entornos-escolares/
Itinerario Habitable (Clever Cities)	Focused on the adaptation of the urban fabric of "Usera" to the climate crisis.	https://www.madridmashabitable.com/
Study about the Public Health Social Vulnerability in Villaverde	Aimed at understanding public health vulnerability in the Villaverde district by analysing equity and health determinants, as well as carrying out a vulnerability spatial representation.	https://madridsalud.es/estudio-de-vulnerabilidad-social-en-salud-de-villaverde-mapa-de-vulnerabilidad/
Opportunity Areas Planning Proposals - La Latina, Carabanchel, Usera y Villaverde	With the objective to develop a diagnosis and a set of proposals for the opportunity areas, such as focusing of poly-centres, use of natural resources, and close-proximity sustainable mobility.	https://www.trazaconsultoria.com/plan-de-espacios-industriales-de-villaverde/
Autobarrios San Cristóbal	Designed to involve neighbourhood communities to consolidate existing processes and activate new ones through the recovery of abandoned or disused spaces, using art and culture.	https://autobarrios.eu/

Paisaje Sur	Its objective is to improve urban landscape through a series of artistic and cultural interventions in collaboration with agents and associations.	https://www.intermediae.es/proyectos/paisaje-sur-autocontruyendo-usera-y-villaverde

Regarding, instead, the city's level of digital twin expertise, Madrid is already working to develop its digital twin, as the city strategy for digital transformation asked to foresee a digital twin to have an integrated management and control centre. The first version is available online at the following link: https://gemelodigital.madrid.es/.

The city of Madrid aims at using the digital twin to improve climate adaptation, for instance by activating real protocols that require interdepartmental cooperation, both in the provision of data (e.g. heat response and socio-demographic data) and skills (e.g. climate change, health, and culture teams working together to decide when to open public facilities for climate refugees).

In addition to the digital twin, Madrid can rely on three key data sources which are freely accessible and therefore of primary importance for the URBREATH objectives:
- Geoportal https://servpub.madrid.es/CSEBD_WBINTER/arbol.html
- Open Data Portal https://datos.madrid.es/portal/site/egob
- AEMET - Portal for climate data https://www.aemet.es/es/datos_abiertos/AEMET_OpenData.

Given and considering the above-mentioned city's background, Madrid has chosen as pilot site the Villaverde district, located in the south area of the city (Figure 18). The plan is to co-design an urban regeneration strategy and experiment with different types of NBS and then extending them to the whole city. Schools and commercial areas will also be included in the regeneration and greening project.

Figure 18: Madrid pilot site location
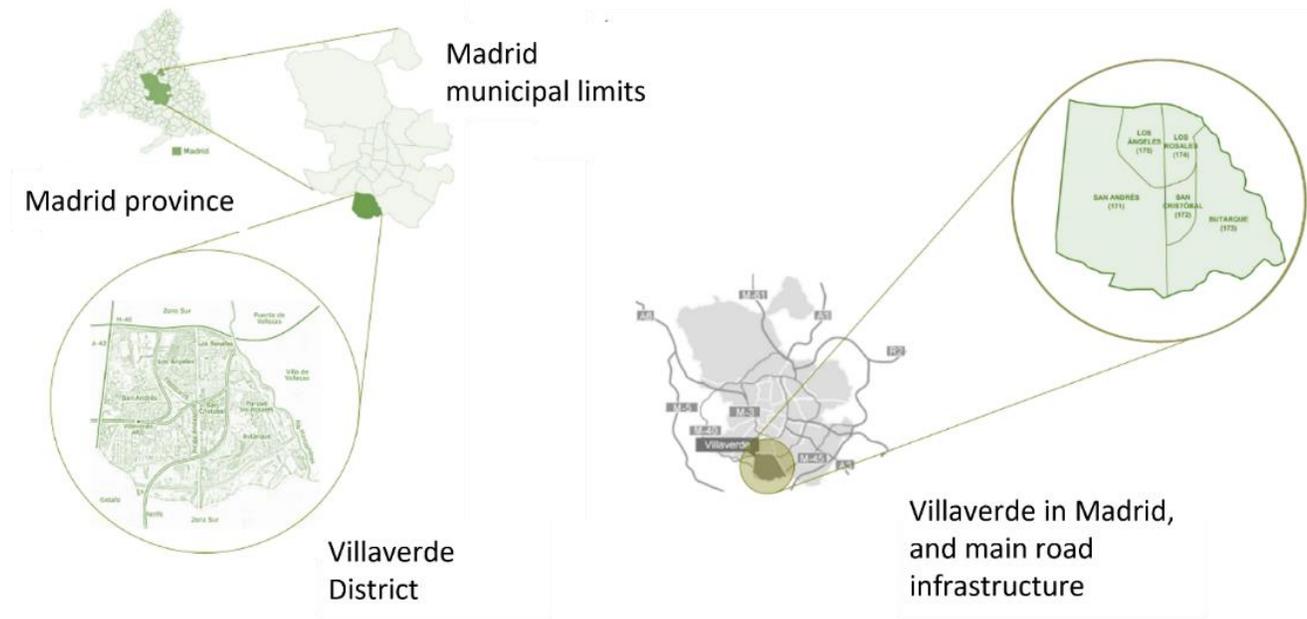
(Credits: Madrid Team)

Potential key stakeholders that Madrid is planning to involve in the regeneration of the pilot site are:
- Government
    - City's office (Sustainability and Environmental Control, Water and Green Areas, Strategic Planning, Mobility and Infrastructure Planning, Urban Regeneration, Innovation, General Urban Development Plan)
- University
    - Universidad Politecnica de Madrid - UPM
    - Tallinn University of Technology - TalTech
- Community
    - Residents
    - San Cristobal Community Board
    - "Navas de Tolosa" and "Sagunto" public schools in Villaverde
    - NGO "Education, Culture and Solidarity"[5]
    - Environmental groups
    - Continuing Care Program (service support in the schools of San Cristóbal)
- Industry
    - NBS implementors
    - Potential investors.

6.1.1 Baselines of Villaverde

Given the choice and location of the Madrid pilot site, this subsection aims to provide the following additional information:
- Physical characteristics.
- Social and liveability conditions.
- Needs and potential barriers.
- Goals, visions, and expected benefits.

Physical Characteristics

The Villaverde district is located in the south of the city of Madrid (Figure 18). It covers an area of around 2000 sqm and is subdivided into five zones: Villaverde Alto, San Cristobal, Butarque, Los Rosales, and Los Angeles.

In terms of land use, it is characterized by a mixed and fragmented reality in which residential and industrial areas co-exist (Figure 19). This land use has a big impact on both space accessibility, given that industrial sites represent a physical barrier, sometimes leading to a condition of urban segregation, and on the district's mobility which is characterized not only by pedestrians and slow mobility traffic, but also by heavy trucks circulating in the area, for example.

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[5] NGO whose objective is that the residents of San Cristóbal have a dignified life, being able to enjoy opportunities to know, participate and collaborate in the construction of our neighbourhood.

Figure 19: Land use of Villaverde: in purple, the industrial areas, in orange, the residential ones
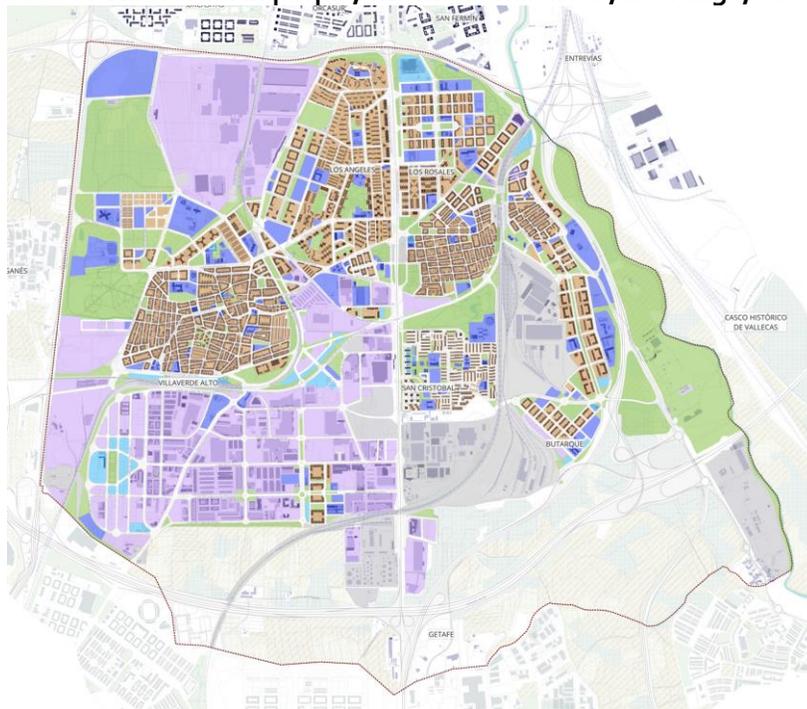
(Credits: Madrid Team)

Social and Liveability Conditions

The Villaverde population counts 159038 inhabitants, among which there is 36,1 % of the foreign-born population. However, to understand the socio-economic context of Villaverde, the average household income of the district is also a key-data. Indeed, it accounts for 29.640 per year, while in Madrid is equal to 43.000 €, thus around 30% less than the city's average household income (Figure 20).

These numbers frame Villaverde as a low-income neighbourhood characterized by economic inequality and segregation, in which social, economic, and environmental challenges persist despite the numerous studies and proposals of the Madrid municipality.

Needs and Potential Barriers

From a greening perspective, the district needs climatically adapted, biodiverse, and socially vibrant spaces for the district's inhabitants. It also needs to find a way to overcome physical barriers, urban fragmentation, and lack of accessibility on daily itineraries (Figure 21).

However, numerous studies and proposals have added layers of municipal work in the district. Nevertheless, social, economic, and environmental challenges persist. One of the most significant potential barriers to the regeneration process is, therefore, the misalignment between policies and interventions of each municipal department, which do not relate well to each other.

Figure 20: Average household income of Villaverde (€/per year)
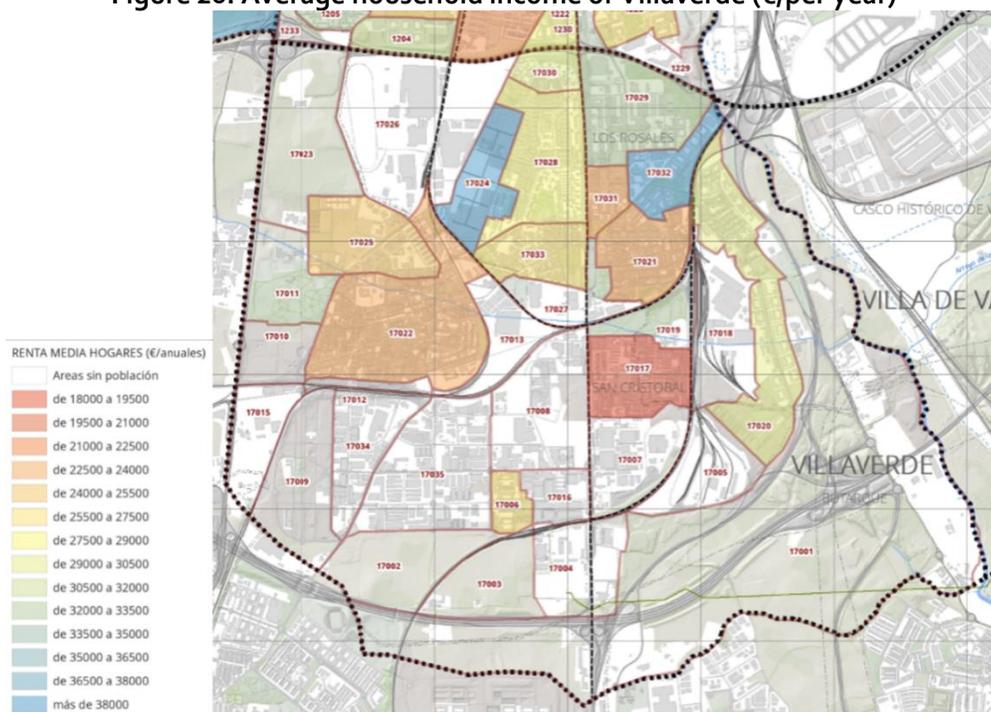
(Credits: Madrid Team)

Goals, Visions, and Expected Benefits

Overall, the main goals and objectives of the city of Madrid regarding the Villaverde district are to promote environmental sustainability, together with economic revitalisation, social inclusion and equity, improved public health, boosted resilience to climate change, and community engagement and empowerment, together with cultural preservation and enhancement.

Expected benefits for the pilot site include physical transformation, improved infrastructure, social cohesion, economic diversification, environmental health, improved regulatory and policy frameworks, education and awareness campaigns.

In addition, the city of Madrid is looking for simple technical tools to analyse data and make informed decisions across municipal teams regarding urban regeneration about climate shelters and new uses for urban spaces based on community needs. This includes the development of a participatory approach for urban regeneration, specifically for the Villaverde district, with the intention of creating a replicable model for the entire city. From this perspective, tools and processes that are being identified as being needed, aim to:

1. Facilitate cross-departmental decision-making:
   a. Visualisation and analysis tools combining diverse information
   b. Impact analysis/ 'what if' simulation
   c. Concrete simulations: species-specific shading, vegetation density, temperature, air quality etc at the intervention scale.

2. Increase citizen participation and mixed public-civic processes, including decision-making and maintenance.
3. Combine qualitative and quantitative data (e.g. economic and demographic information from municipal statistics plus ad-hoc survey responses).

Lastly, in terms of NBS implementation, the city aims to establish resilience corridors that connect public spaces and to provide access to urban and peri-urban natural areas, with the goal of improving biodiversity, local economies, and overall well-being.

Figure 21: Villaverde urban greening needs and barriers

(Credits: Madrid Team)

6.1.2 Madrid Use Case Scenarios

The understanding of the Madrid pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Mediterranean Frontrunner City to identify and build up its own use case scenarios. Table 14 below outlines the six use case scenarios of Madrid concerning the URBREATH Toolbox components.

As previously explained in chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the three Mediterranean cities (Madrid, Parma, and Athens), on 20 September 2024.
- A 1-1 workshop entirely dedicated to Madrid, scheduled for 27 September 2024.

Table 14: Use case scenarios identified by the city of Madrid

MED-MAD - Use case scenarios
Madrid wants to…
1. Centralise past/ongoing studies, plans, and interventions for the Villaverde district.
2. Organise training and co-design sessions.
3. Centralise existing information about potential NBS for the Villaverde district.
4. Offer LDT-visualisations of datasets and simulations for better insights into district officials.
5. Measure the success level of collaboration initiatives.

Following the identification process based on the needs and challenges of the Madrid pilot site, these five use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Mediterranean Frontrunner City selected the following three use cases as priorities:

- MED-MAD-1: Madrid wants to centralise past/ongoing studies, plans, interventions for the Villaverde district.
- MED-MAD-2: Madrid wants to organise training and codesign sessions. AND to centralize existing information about potential NBS for the Villaverde district.
- MED-MAD-3: Madrid wants to offer LDT-visualizations of datasets and simulations for better insights of district officials.

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Mediterranean FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Madrid, Athens, and Parma during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

6.2 Athens and its Pilot Sites: Kypseli and Neos Kosmos

As in the case of Madrid, the specific objective of this section is to present Athens, one of the two Mediterranean FLCs, from the perspective of:

❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
❖ The city's experience with co-creation and Living Labs (LLs).
❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Like the other two cities located in the Mediterranean climatic zone, also Athens is listed among the 100 European cities that are part of the "EU Mission for 100 Climate Neutral and Smart Cities by 2030". In this regard, Athens's efforts to incorporate nature-based ecosystems into grey infrastructure and to achieve climate neutrality are framed around different urban revitalization programmes. These programmes cope with a complex urban landscape, marked by existing urban canyons in densely populated neighbourhoods, a unique topography, low levels of green space coverage, poor natural ventilation, heat islands in the summer season, and microclimate extremes.

Athens is also a member of the Open and Agile Smart Cities (OASC) network, which comprises 168 cities across four continents focused on driving digital transformation with the use of interoperability, data sharing, and open standards.

In the field of co-creation, Athens boasts experience in using co-creation as a tool to address the management of the city. This includes engaging residents and multiple stakeholders in the processes of urban planning, infrastructure development and public space renovation. Of particular interest, there are three initiatives considered as connected to URBREATH and outlined in Table 15 below.

Table 15: Projects in which the city of Athens has gained experience in co-creation

Project Name	Brief Description	Website
Life Athens_Wav	Techno-economic studies for retrofitting (energy upgrade) of nine public schools in Athens.	https://athens-wave.eu/
Pocket Parks and Playground spots	Construction of three pocket parks and three playgrounds to transform vacant lots or derelict spaces into safe and easily accessible areas for citizens.	
Memorandum of Understanding between Anaplassis SA, Municipality of Athens, Ministry of Public Works and Elliniko Metro SA	- seven open competitions for the design of seven public squares to be built at the new Metro Line stations. - 2000 new trees planted as ecological compensation.	

Regarding, instead, the city's level of digital twin expertise, the Mediterranean FLC intends to develop its own digital twin to integrate the various digital sources and facilitate access, exploration, and data-driven experimentation. This way, the digital twin will enable city officials to conduct policy simulations in a controlled and monitored environment. Athens has also gained experience with digital twin through its participation in the DUET project, a Horizon 2020 EU-funded project providing cost-effective virtual city replicas accessible through the DUET Digital Twin platform and enabling the analysis of complex interrelations between traffic, air quality, noise, and other urban factors.

Given and considering the above-mentioned city's background, Athens has chosen as pilot sites Kypseli, located in central area, and Neos Kosmos, located in the south close to the Acropolis (Figure 22).

Figure 22: Athens pilot sites location: Kypseli (left) and Neos Kosmos (right)
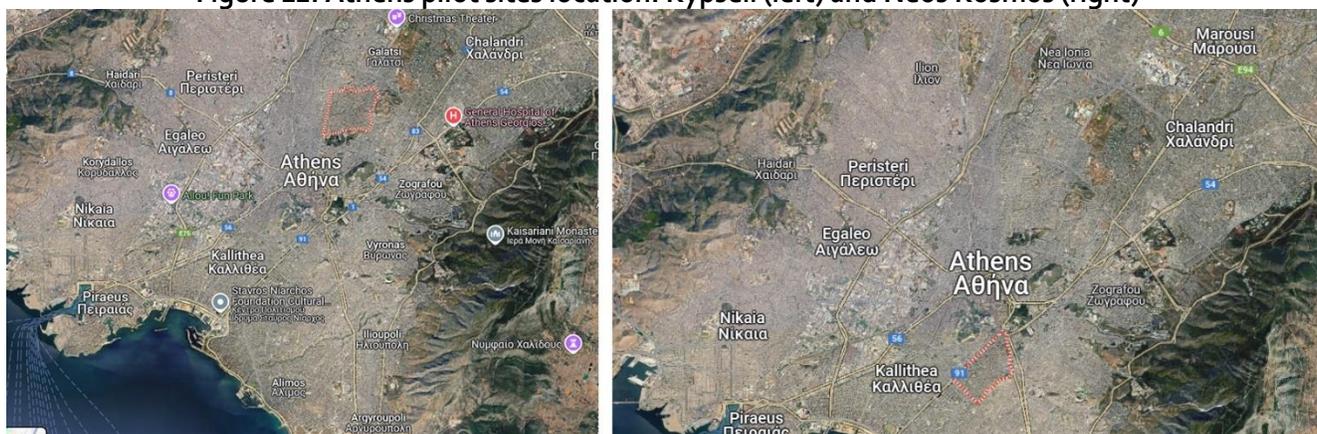
(Credits: Google Maps)

To date, there is no specific NBS design available. However, potential key stakeholders that Athens is planning to involve in the regeneration of the two pilot sites are:
- Government
  - City's departments
  - Local Government IT Company- DAEM
  - Elliniko metro
  - Ministry of Transport and Infrastructure
  - Athens Urban Transport Organisation - OASA
- University
  - University of Aegean
  - Tallinn University of Technology - TalTech
- Community
  - Residents
- Industry
  - Real estate
  - Green technologies.
  - Local businesses.

6.2.1 Baselines of Kypseli and Neos Kosmos

Given the choice and location of the Athens pilot sites, this subsection aims to provide the following additional information about Kypseli and Neos Kosmos:

➢ Physical characteristics.
➢ Social and liveability conditions.
➢ Needs and potential barriers.
➢ Goals, visions, and expected benefits.

Physical Characteristics

The main characteristics of Kypseli are:

- Located in the south of Athens city centre, close to the Acropolis.
- Well served by public transport, including the metro, buses and trams.
- Characterised by a dense urban fabric with narrow streets and older residential buildings.

For Neos Kosmos, specifically the pocket park in Antisthenous & Klada streets (Figure 23):

- Located in the south of central Athens, close to the Acropolis.
- In an area characterised by a mix of older residential buildings and little new construction.
- Rectangular shape with a surface area of 110 m2.
- Well served by public transport.

Social and Liveability Conditions

The socio-economic profile of Kypseli can be described as historically middle class, but now its legacy presents some dissimilarities. Indeed, it is a mix of older residents, younger families and a growing expatriate and immigrant community. The area is also characterised by a vibrant local economy of restaurants, cafes and small retail shops. However, some issues, such as air pollution, limited green space and urban density, negatively affect the liveability of this area.

For what concerns the Neos Kosmos area, it is a traditionally working-class area that is now experiencing gentrification. Like Kypseli, it has a vibrant local economy with many shops, cafes and small businesses. The challenges are the same: air pollution and limited green space. Recent revitalisation efforts through improved pedestrian areas and public spaces are attempting to overcome these typical urban challenges. Focusing only on the pocket park (Figure 23), it is now used as a dumping ground and home for abandoned pets. The existing trees are in good condition.

Figure 23: Aerial view (left) and pictures (right) of the pocket park in Neos Kosmos

(Credits: Athens Team)

Needs and Potential Barriers

Regarding the needs of the two pilot sites, the city of Athens has identified the following ones:
- Increased accessibility to address the issue of limited green spaces.
- Reduction of pollution caused by dense traffic in both areas.
- Improved stormwater management to overcome the significant runoff problems, especially in highly urbanized areas such as Neos Kosmos.
- Improved climate resilience as urban heat islands exacerbate hotter summers in Athens.
- Aesthetic improvements, as densely built neighbourhoods could benefit from beautification.

However, these needs could be hindered by potential barriers which can be categorized as follows:
- Land availability and land use conflicts: dense urban fabric and buildings leave little unused land for green spaces.
- Financial constraints: urban greening requires significant investment.
- Stakeholder engagement: conflicting interests make it difficult to engage stakeholders.
- Inadequate use of public transport turning into a heavy use of private transport.
- Regulatory hurdles: bureaucratic delays, especially in historic or regulated areas.
- Community resistance: residents or businesses may resist change for fear of disruption.

Goals, Visions, and Expected Benefits

Given the above needs and potential barriers, Athens expects to improve the environmental sustainability of the two areas by reducing urban heat islands and canyon effects, improving air quality and temperature with green spaces and Nature-Based Solutions.

Other expected benefits include improving the public health of citizens, engaging and empowering the local community by involving them in the co-design of public spaces and projects and in local decision-making, promoting local ownership by encouraging sustainable practices and behaviours in everyday life.

In terms of the physical transformation and enhanced infrastructure of the two pilot sites, the Mediterranean Follower City aims to improve the urban landscape with green spaces, public areas and

transport and utility upgrades, making the two neighbourhoods more attractive with better accessibility and efficiency for residents and investors. For residents, this will mean an improved quality of life with cleaner air, more recreational space and social cohesion.

From a regulatory and policy framework perspective, Athens aims to streamline regulations for urban renewal and incentivise sustainability, facilitating the implementation of green projects and attracting investment. Finally, the city aims to raise awareness of urban greening and sustainability through the promotion of education and awareness campaigns that could ensure the support of the local community and, thus, long-term success.

Specific scenarios envisaged for NBSs include the creation of pocket parks, green walls and urban trees in high-traffic areas and narrow streets, such as in Neos Kosmos, and the use of air quality and temperature sensors to monitor real-time data to visualise and compare the effectiveness of interventions.

6.2.2 Athens Use Case Scenarios

The understanding of the Athens pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Mediterranean Follower City to identify and build up its own use case scenarios. Table 16 below outlines the six use case scenarios of Athens concerning the URBREATH Toolbox components.

As previously explained in chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the three Mediterranean cities (Madrid, Parma, and Athens), on 20 September 2024.
- A 1-1 workshop entirely dedicated to Athens, scheduled for 30 September 2024.

Table 16: Use case scenarios identified by the city of Athens

MED-AT - Use case scenarios
Athens wants to…
1. Detect potential areas for pocket parks, green walls, and other NBSs.
2. Analyse the changes (reduction) of urban heat islands (after the NBS implementation).
3. Increase awareness, engagement, participation and co-creation with stakeholders (local governments, residents, investors).
4. Monitor the improvement in air quality in the Neos Kosmos area and to investigate the correlation with traffic in particular
5. Investigate the accessibility of NBS.
6. Analyse the changes (improvement) in stormwater management.

Following the identification process based on the needs and challenges of the Athens pilot sites, these six use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Mediterranean Follower City selected the following three use cases as priorities:

- MED-AT-1: Athens wants to detect potential areas for pocket parks, green walls, and other NBSs.
- MED-AT-2: Athens wants to analyse the changes (reduction) of urban heat islands (after the NBS implementation).
- MED-AT-3: Athens wants to increase awareness, engagement, participation and cocreation with stakeholders (local governments, residents, investors).

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Mediterranean FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Madrid, Athens, and Parma during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

6.3 Parma and its Pilot Site: The San Leonardo Neighbourhood

As in the case of Madrid and Athens, the specific objective of this section is to present Parma, one of the two Mediterranean FLCs, from the perspective of:

❖ The city's strategies and plans to move towards climate neutrality, particularly in relation to the implementation of NBSs.
❖ The city's experience with co-creation and Living Labs (LLs).
❖ The city's digital maturity (e.g. availability of a digital twin and/or open data portal).

Parma is one of the nine Italian cities selected to participate in the "EU Mission for 100 Climate Neutral and Smart Cities by 2030," being awarded the EU Mission Label for its efforts towards climate neutrality. Parma's Climate City Contract and Action Plan outlines the overall city vision to become carbon neutral no later than 2030 through an ambitious, bold plan and a public-private investment strategy.

In addition, Parma's efforts to become a green and sustainable city are also sanctioned by several formal commitments made in the last years, including the signing of the "Covenant of Mayors for Climate Change and Energy", the membership to the "Declaration on climate adaptation for the Green Cities" and the adoption of a "Climate and Environmental Emergency Declaration".

In terms of planning regulations, Parma counts with the "General Urban Plan", adopted in 2021, which aims to guide the city towards environmental enhancement, with a strong focus on bottom-up strategies integrating NBS in urban regeneration areas, thus facilitating the ecological, economic and social transition of the city.

Parma has embraced co-creation as an integral component of its urban development strategy over the past years and applied co-creation activities and processes in multiple projects and initiatives by supporting stakeholders in the planning and maintenance of green areas through the involvement of the private sector and local citizens. From this perspective, Parma's experience with co-creation and Living Labs, specifically in the context of smart city ecosystems, citizen-driven energy actions and energy poverty, is rooted in the projects detailed in Table 17 below:

Table 17: Projects in which the city of Parma has gained experience in co-creation

Project Name	Brief Description	Website
RUGGEDISED	Co-creation of the smart city plan.	https://ruggedised.eu/legacy/
EU Mission for 100 Climate-Neutral and Smart Cities	Co-creation of the Climate City Contract (CCC) with local stakeholders.	https://netzerocities.app/knowledge-ccc
Cooperation pacts for the regeneration of green areas	Co-creation with citizens of interventions on public green areas in different neighbourhoods.	
Renewable Energy Communities (RECs)	Co-creation of the REC (in development) in the neighbourhoods of Lubiana and San Lorenzo.	https://www.comune.parma.it/it/novita/notizie/nasce-la-prima-cer-di-parma
Cooltorise	Co-creation of green areas in social housing buildings.	https://cooltorise.eu/

Although Parma does not currently have an urban digital twin, the city has participated in various initiatives as a test city for the implementation of local digital twins in the domains of urban planning, municipal services, and cultural heritage conservation. This experience can be summarized as follows:

- Under the Horizon 2020 RUGGEDISED project, Parma, as a Follower City, developed a Replication Plan of the digital twin realised by the city of Rotterdam and focused on the most crucial aspects of environmental quality, efficiency, and circular use of resources. The project addressed mitigation and adaptation to climate change while enhancing the economic and social implications (better quality of life and well-being) at the urban level generated by a green economy.
- Collaboration with the Emilia-Romagna Region for the development and application of a regional digital twin under the VERA project (Virtualizing Emilia-Romagna Air Quality). By being involved in this regional initiative, Parma has contributed to steering the capacity of the Emilia-Romagna Region in simulating and predicting the responses of the territorial and environmental system as support for regional policies to achieve carbon neutrality, to counteract and mitigate climate changes, and to improve air quality conditions.
- Tools currently under development for integration into the digital twin include: the SaferPlace platform, a simulation tool at both the city and neighbourhood levels, a health waves simulation tool in the San Leonardo District and simulation tools for Positive Energy Districts and Renewable Energy Communities at the city level.

Given and considering the above-mentioned city's background, Parma has chosen as pilot site the San Leonardo district, located in the north of the city (Figure 24). To date, there is no specific NBS design available. However, key stakeholders that Parma is planning to involve in the regeneration of the pilot site are:

- Government
  - City's departments (Maintenance and Green, Urban Planning, Civil protection, Public Works and Infrastructures)
- University
  - University of Parma
  - Tallinn University of Technology - TalTech
- Community
  - Citizens
  - CEA - Environmental Ethics Centre
  - Art Lab
  - KMVerde Parma[6]
- Industry
  - Railway company
  - Companies with parking lots and other NBS plans.

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[6] Consortium aimed to create permanent green areas and woods in Parma and its province.

Figure 24: Location of the pilot site in Parma
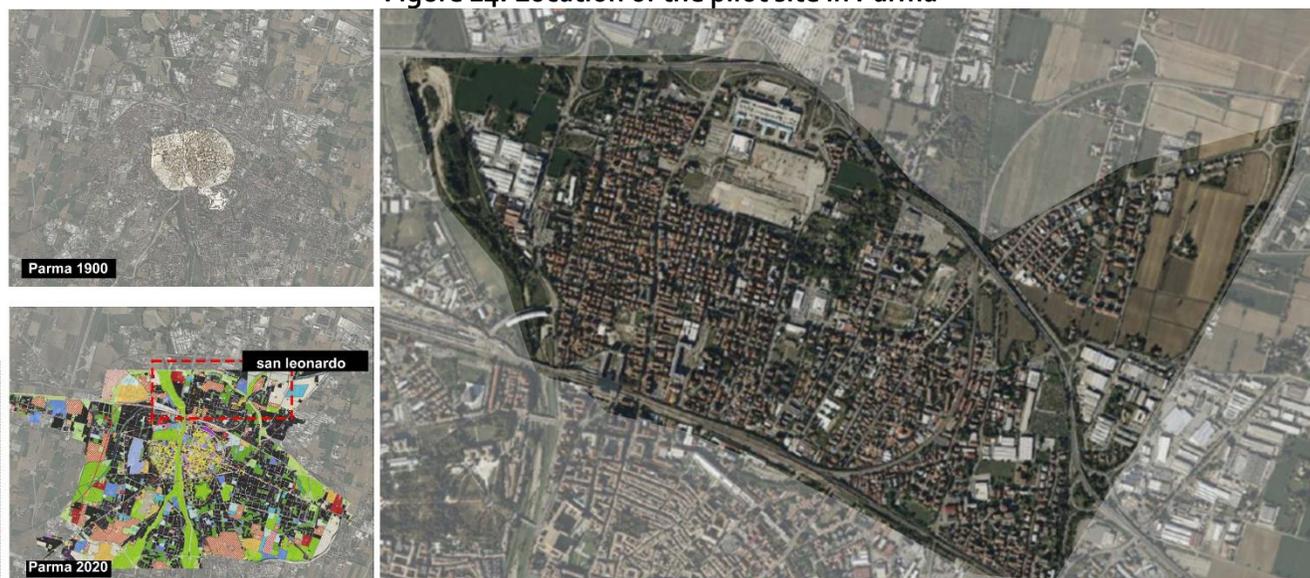
(Credits: Parma Team)

6.3.1 Baselines of San Leonardo

Given the choice and location of the Parma pilot site, this subsection aims to provide the following additional information about the San Leonardo district:

- ➢ Physical characteristics.
- ➢ Social and liveability conditions.
- ➢ Needs and potential barriers.
- ➢ Goals, visions, and expected benefits.

Physical Characteristics

The main characteristics of the San Leonardo neighbourhood (Figure 25) are the following:

- Located in the northern part of Parma.
- It covers an area of approximately 3276 square km with a population of 19458 inhabitants.
- Cut off from the city centre by the existing railway line.
- A non-homogeneous area where residential and industrial uses coexist.

Social and Liveability Conditions

Regarding the social and living conditions of the district, the area is large and inhomogeneous. On the northern side, there is a big industrial site close to the residential areas. Land use is intensive, although there are large urban voids (unbuilt areas). Overall, San Leonardo is a large periphery without identity. From an environmental point of view, the number of trees is lower than the average for Parma and their size is also smaller, which prevents them from providing shade and absorbing large amounts of rainwater. This increases the heat island effect on the streets, leading to a high risk for the elderly population living in the area.

Figure 25: Aerial view and pictures of some green areas in San Leonardo

(Credits: Parma Team)

Needs and Potential Barriers

Based on the characteristics outlined above, the most important needs for San Leonardo include:

- The social and environmental upgrading of the district.
- The renovation of dysfunctional and neglected urban spaces.
- The cooperation with local communities on the environment (co-planning).
- The promotion of the value of biodiversity reservoirs such as public gardens.
- The implementation of existing public spaces in the area to create multi-use urban spaces.
- The reduction of the polluting effects of motorised mobility.

Goals, Visions, and Expected Benefits

Associated expectations for the regeneration of San Leonardo involve the increase of green space accessibility, improved climate resilience, particularly for stormwater management and urban heat islands, as well as the realization of a soft mobility network with new pleasant surroundings. Additionally, key objectives are implementing the NBS in the neighbourhood through local minimum actions (minimum costs), putting in every street green area using public spaces and persuading private businesses to switch to bike-friendly initiatives, fostering civic pride and creating a green identity of San Leonardo.

6.3.2 Parma Use Case Scenarios

The understanding of the Parma pilot site's baselines, in terms of physical characteristics, social and liveability conditions, needs and barriers, as well as aims and expected benefits, has steered the Mediterranean Follower City to identify and build up its own use case scenarios. Table 18 below outlines the five use case scenarios of Parma concerning the URBREATH Toolbox components.

As previously explained in chapter 2, these use case scenarios were identified through three rounds of co-creation sessions with the city, namely:

- A plenary workshop attended by all nine URBREATH cities on 30 May 2024.
- A presentation and co-creation session focused on the three Mediterranean cities (Madrid, Parma, and Athens), on 20 September 2024.
- A 1-1 workshop entirely dedicated to Parma, scheduled for 25 September 2024.

Table 18: Use case scenarios identified by the city of Parma

MED-PA - Use case scenarios
Parma wants to…
1. Engage technicians and administrators in the co-creation of NBSs.
2. Simulate/test green renovation actions in the local digital twin.
3. Collect the information related to the green strategy and show results to local communities.
4. Understand the changes in mobility, i.e. reduction in traffic and modal shift and/or increase in soft mobility (after the NBS).
5. Understand the changes in climate resilience of the area (after the NBS, i.e. unsealing the area).

Following the identification process based on the needs and challenges of the Parma pilot site, these five use case scenarios were first validated and then prioritised by the city's working team during a workshop organised on the first day of the project's General Assembly. On this day, the Mediterranean Follower City selected the following three use case scenarios as priorities:

- MED-PA-1: Parma wants to engage technicians and administrators in co-creation of NBSs.
- MED-PA-2: Parma wants to simulate/test green renovation actions in the local digital twin.
- MED-PA-3: Parma wants to collect-share information on green strategies to local community.

The final step was carried out in collaboration with the project's technical partners (WP3-4) that assessed the technical feasibility of the use case scenarios prioritised by the Mediterranean FRC and translated them into technical solutions. These technical solutions were then presented as proposals to both the teams of Madrid, Athens, and Parma during a workshop (November 2024) for discussion and final approval, so that the technical teams can start developing the associated URBREATH Toolbox components from January 2025.

Technical details on the requirements and associated development of the URBREATH Toolbox components can be found in the dedicated deliverable D2.5 "URBREATH platform requirements".

7 Conclusions

The URBREATH project aims to address two key challenges in urban regeneration, resilience and climate neutrality. Firstly, the gap in the conventional approach to revitalisation, regeneration and greening planning towards advanced integrated methods and approaches. Indeed, the conventional approach is often simplified to cost/benefit criteria that do not deliver the necessary return on investment by failing to attract sustainable funding, people, and businesses to regeneration areas. Secondly, a lack of consideration for the needs of local communities, often resulting in Nature-Based Solutions (NBS) being imposed on the community.

Considering these challenges, the main objective of the project is to develop, implement, demonstrate, validate and replicate a comprehensive urban regeneration methodology based on community and stakeholders' participation in greening and renaturation, supported by digital technologies.

Given this key URBREATH objective at the intersection of NBS, community engagement and digital technologies, this deliverable represents a cornerstone of the project development. Indeed, it provides a comprehensive description of the cities pilot sites' baselines and use case scenarios, paving the way, on one side, to the choice and design of the NBS based on the challenges identified in the pilot sites, on the other side, to the development of the URBREATH Toolbox based on the cities' use case scenarios.

Following the General Assembly held in October 2024, the prioritised use case scenarios and requirements were indeed further refined, and technical solutions were designed, based on the expertise and experience of the technical partners.

The technical solutions and methodologies developed by the technical partners were then presented to, discussed with and validated by the pilot cities in November and December 2024. Based on these validations, on one side, the technical partners (WP3-4) are now prepared to commence the development of the URBREATH Toolbox starting in January 2025, on the other side, partner organizations leading the NBS and Living Lab (LL) activities (WP5-6) can now kick-off the local organization of LLs and design of NBSs.

From a process perspective, this deliverable is in fact the result of extensive cross-work package collaboration, a cornerstone of the URBREATH methodology, including multiple co-creation sessions with the cities, both individually and grouped by climate zone where appropriate.

This process has also highlighted the importance of developing and implementing NBSs in different cities (as per the rationale of the URBREATH project) which, although experiencing different climatic conditions, share similar challenges that transcend the specific climatic zone. This means that climate change exacerbates conditions and poses similar challenges to all cities. These challenges will be 'solved' with similar technical solutions, which creates and highlights the requirements for the URBREATH Toolbox to work not only at the micro (i.e. city) level, but also at the 'macro' level, thus providing a legacy for other cities.

8 Annexes

CLIMATIC ZONE	CITY	USE CASE SCENARIOS
Atlantic	Leuven - LEU *Front Runner City*	1. To monitor environmental effects and ecosystem services resulting from the redesign of the square.
		2. To monitor if the planned NBS implementation impact traffic.
		3. To monitor if there is a modal shift (after the NBS implementation).
		4. To monitor social justice and wellbeing.
		5. To get input and interaction with stakeholders to shape their case (using living lab and LDT).
		6. To get input and interaction with stakeholders to evaluate the NBS implementation (using LL and LDT).
	Aarhus - AA *Follower City*	1. To understand the reduction of motorized mobility in the area after the increased number of pedestrians sqm.
		2. To understand the reduction of water flooding in the area after the intervention of a subterranean path for the rainwater.
		3. To understand the reduction of noise pollution in the area (after the NBS implementation).
		4. To understand the evolution of residents' liveability in the area (after the NBS implementation).
		5. To simulate the reorganization of the main square in the LDT to support the communication with residents and local community.
		6. To measure the above parameters (mobility and livability) in different scenarios, using LDT.
Boreal	Tallinn – TLN *Front Runner City*	1. To explore possibilities of location of specific NBSs for snow meltwater solutions on site.
		2. To understand the effectiveness of the selected NBS for snow meltwater infiltration
		3. To assess habitat, biodiversity restoration (after the NBS implementation).
		4. To understand the changes in accessibility in the area (after the NBS implementation), i.e. visitors' number/more vulnerable users (e.g. children).
		5. To estimate the potential change of cars driving in the area (after the NBS implementation).
		6. To engage residents and local community in co-planning process.

CLIMATIC ZONE	CITY	USE CASE SCENARIOS
		7. To assess residents' satisfaction with the re-designed area (after the NBS implementation).
	Kajaani – KA *Follower City*	1. To design potential ideas for NBSs for better water management to achieve flood-proof city.
		2. To estimate potential costs-benefits of such NBSs.
		3. To assess habitat, biodiversity restoration (after the NBS implementation).
		4. To understand biodiversity support mechanisms related to NBSs.
		5. To engage citizens/youth in the co-planning process.
Continental	Cluj-Napoca – CLUJ	1. To integrate greening simulations in the LDT.
		2. To understand the changes (increase?) in shaded areas (after the NBS implementation).
		3. To demonstrate the value of green pockets for multi-family housing areas.
		4. To understand CO_2 emissions reduction (after the NBS implementation).
		5. To understand the reduction in traffic (after the NBS implementation).
		6. To raise awareness.
		7. To involve community in co-creation (i.e. trees selection and planting).
		8. To understand the sense of wellbeing (after the NBS implementation).
	Pilsen – PILS	1. To investigate if there is an impact on traffic (size and modal shift) using a LDT.
		2. To see if there is an impact on air quality, noise, heat and shadow impact using a LDT.
		3. To understand the perception of residential Quality and safety of public space (after the NBS implementation).
		4. To visualise designs in a LDT.
		5. To visualise designs using generative AI-driven tools.
		6. To investigate the social impact on well-defined target groups (i.e. pedestrians and cyclists?).
Mediterranean	Madrid – MAD *Front Runner City*	1. To organise training and codesign sessions.
		2. To measure the success level of collaboration initiatives.
		3. To offer LDT-visualisation of datasets, simulations to district officials to get a better knowledge and insights.
		4. To centralise past/ongoing studies, plans, interventions for the Villaverde district.

CLIMATIC ZONE	CITY	USE CASE SCENARIOS
		5. To centralise existing information about potential NBS for the Villaverde district.
	Athens – AT *Follower City*	1. To monitor the improvement in air quality in the Neos Kosmos area and to investigate the correlation with traffic in particular
		2. To invest potential candidates for pocket parks, green walls, and other NBS.
		3. To investigate the accessibility of NBS.
		4. To analyse the changes (improvement) in stormwater management.
		5. To analyse the changes (reduction) of urban heat islands.
		6. To increase awareness, engagement, participation and cocreation with stakeholders (local governments, residents, investors).
	Parma – PA *Follower City*	1. To engage technicians and administrators in co-creation of NBSs.
		2. To test green renovations actions in the local digital twin (technicians can model the LDT).
		3. To understand the changes in mobility, i.e. reduction in traffic and modal shift and/or increase in soft mobility (after the NBS).
		4. To understand the changes in climate resilience of the area (after the NBS, i.e. unsealing the area).
		5. To collect the information related to the green strategy and show results to local communities.

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