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

D5.1 – Local baseline state and URBREATH revisited requirements and technical framework – V1

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Editor(s)	Jurgen Silence, VLO Thomas Adolphi, VCS Alisa Krumm, FRAUNHOFER Inna Zhuravlova, FRAUNHOFER Antonella Tozzi, MUN
Contributor(s)	Beatrice Maria Bellè, POLIMI
Reviewer(s)	Luisa Maria Männilaan, TAL Katariina Mustasaar, TAL Manuel Alméstar, UPM

Document description	This document is the first in a series of four reports outlining the joint efforts undertaken within Tasks 5.1, 5.2, 5.4, 5.5, and 5.6 to assess the local baseline state of the URBREATH pilot cities. It covers the identification of functional requirements and their translation into technical specifications, the facilitation of collaboration between pilot cities and technical partners, the development and validation of a Key Performance Indicator (KPI) framework, the design of monitoring tools, a gap analysis of local technical infrastructures (including the availability and suitability of tools, models, and datasets), and the mapping and implementation of city-specific customisation needs.

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		Modification Reason	**Modified by**
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Disclaimer

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Executive summary

This Deliverable presents the structured approach followed by Work Package 5 (WP5) to identify, organise, and translate the functional needs of the URBREATH pilot cities into concrete technical development pathways. The aim was to co-create a robust foundation for the design and implementation of the **URBREATH digital toolbox**, which supports both the **monitoring of Nature-Based Solutions** (NBSs) and the **operation of Local Living Labs** (LLLs). The process was guided by a user-centred design approach and closely aligned with the work carried out in Work Packages 2, 3, 4, and 7.

The process began with an initial review and assessment of existing tools, methodologies, and workflows already in use across the pilot cities. This enabled the identification of gaps in functionality and supported the development of a **general methodological framework**.

A series of structured **interactive co-creation workshops** followed, enabling an iterative and participatory approach that allowed WP5 to:

- Establish a baseline understanding of the current state of tools, processes, and data availability across pilots.
- Elicit and structure needs through **mind mapping** and thematic clustering.
- Translate identified needs into **epics** and **user stories** with associated high-level functional requirements.
- **Integrate** these requirements with the macro-level functional framework developed in Work Packages 2 and 4.
- **Explore the relationships** between functional requirements, Key Performance Indicators (KPIs), and NBS typologies.

A major milestone was reached at the URBREATH **General Assembly** held in Madrid in October 2024, where the consolidated list of use cases, epics and user stories was **validated** and **prioritised** by pilot representatives. This list, accompanied by prioritised use cases, was subsequently presented to the technical consortium partners to inform the design and development of technical components.

Guided by Task 5.2, the technical partners translated the functional requirements into concrete **technical specifications.** These were presented, discussed and fine-tuned with the pilot cities during four co-creation workshops. This also enabled a preliminary **gap analysis** focusing on the availability and quality of required datasets and models.

The prioritised list of technical functionalities developed through this collaborative process formed the basis for designing key components of the URBREATH Toolbox, including models, data layers, and tools that support both NBS monitoring and LLL activities. WP5 continues to play a central role in supporting and facilitating the translation of functional needs into integrated technical solutions.

Moreover, the outcomes of the WP5 process extended beyond tool development. They also provided a critical foundation for:

- Conducting a comprehensive **stakeholder mapping** exercise grounded in the principles of the quadruple helix model. This mapping also provided a foundation for designing and implementing Task 5.3 (Local Living Labs), as further elaborated in Deliverable 5.5.
- Developing a coherent, pilot-specific **KPI framework** and a set of **monitoring dashboards** to follow up on the impacts of NBSs (Tasks 5.5 and 5.6).
- Performing structured **gap analyses** to identify dataset needs for simulation models, scenario planning, and performance evaluation tools and to define local needs for the implementation of toolbox components (Task 5.4). Also, the effective customisation of the initial set of developed and available tools to address the specific needs of the local pilot cities was initiated during the first 18 months of the URBREATH project.
- **Establishes a direct link with WP6** through the monitoring of pilot sites and their NBSs, encompassing both those explicitly represented by KPIs and those monitored through complementary environmental parameters.
- **Interfaces with Task 5.3** by supporting the development of digital tools that facilitate participatory processes and stakeholder engagement within the LLL framework, thereby enhancing co-creation and collaborative decision-making. Deliverable 5.5 adds more details.

This Deliverable thus represents a key step in bridging stakeholder needs, functional planning, and technical implementation within URBREATH's transdisciplinary innovation process.

Over the **next six months**, Task 5.2 will focus on strengthening technical development processes and fostering effective collaboration between pilot cities and technical partners. In parallel, Task 5.4 will continue to support the data-driven implementation and local integration of URBREATH tools and models by identifying critical datasets, addressing data gaps, and advancing localisation strategies tailored to each pilot context. Tasks 5.5 and 5.6 will consolidate the KPI monitoring framework by developing standardised monitoring protocols and translating KPI inputs into operational, city-specific monitoring dashboards.

Table of contents

List of figures

List of tables

List of terms and abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
BAF	Biotope Area Factor
CO_2	Carbon Dioxide
DoA	Description of Action
DT	Digital Twin
GA	General Assembly
GDPR	General Data Protection Regulation
ICT	Information and Communication Technologies
IT	Information Technology
KPI	Key Performance Indicator
LDT	Local Digital Twin
LL	Living Lab
LLL	Local Living Labs
NBS	Nature-Based Solution
NO_x	Nitrogen Oxides
$PM_{2.5}$	Particulate Matter 2.5
T	Task
UI	User Interface
UX	User Experience
VR	Virtual Reality
WP	Work Package

1. Introduction

1.1 Scope of this Deliverable

This first Deliverable in a series of four outlines the methodological process undertaken to identify and structure the functional and technical needs of all URBREATH pilot cities.

This Deliverable presents the methodological foundations and early implementation steps that collectively supported the technical preparation of the **URBREATH digital toolbox**, aimed at enabling data-driven **monitoring of Nature-Based Solutions** (NBSs) and **operationalising Local Living Labs** (LLLs). The Deliverables' scope encompasses both strategic and operational aspects, covering the identification of pilot-specific functional needs, the translation of these needs into actionable technical requirements, and the facilitation of alignment with broader project goals as defined in Work Packages 2, 3, 4, and 7.

Specifically, this Deliverable outlines the process of engaging pilot cities in a structured, iterative co-creation process to elicit and refine functional requirements, prioritise use cases, and validate the relevance of proposed tools and models. It further details the mechanisms through which Work Package 5 (WP5) facilitated collaboration between cities and technical partners, ensuring that user needs remained central to the design and development of toolbox components. The report also introduces the initial framework for Key Performance Indicators (KPIs) and accompanying monitoring dashboards, while offering a first layer of analysis concerning the availability and suitability of local datasets, tools, and models.

Although closely interlinked with Task 5.3, which addresses the development and operation of Local Living Labs, this report does not address the LLL process in depth; those aspects are covered in **Deliverable 5.5**. Similarly, while the Deliverable includes input relevant to WP6, particularly with respect to monitoring strategies, it primarily focuses on preparatory and cross-cutting activities that support WP5's technical development agenda.

Taken together, the findings, processes, and outputs described in this report establish a foundation for the next phase of WP5, during which technical components will be further developed, tested, integrated, and customised to the specific needs and contexts of the pilot cities. The report thus serves both as a status update and a roadmap for continued collaboration and technical refinement within the URBREATH framework.

1.2 A combined effort of five WP5 tasks

This report presents the coordinated efforts undertaken within WP5 of the URBREATH project, focusing on Tasks 5.1, 5.2, 5.4, 5.5, and 5.6. It integrates the outcomes of these tasks to provide a coherent and multidisciplinary overview of the activities related to functional and technical analysis, the definition of a KPI framework, monitoring of NBSs and associated KPIs, analysis of local IT (Information Technology) infrastructure and data gaps, and the development and customisation of digital tools.

The Grant Agreement states:

Task 5.1 - Analysis of the local baseline state

- M1-M18
- Lead: VLO
- Participants: TAL, MUN, DEDA, URB, BLOX, TEL, OASC, CA, SPG, TRA, BAS, all cities.
- For each city, a baseline evaluation and measurement will be made, explicitly the problems as experienced locally and conducting a data-based analysis enriched with collective intelligence information of the current state. In addition to T2.4, this task will include a data gap analysis and enrichment to allow the measurement and monitoring of the local/ regional and project-related KPIs. In addition, specific **local requirements** will be gathered and shared to **ensure the functionalities and technical requirements** are suited to local policy and engagement-focused usage for local pilot implementation.

T5.2 Alignment of requirements and technical solutions (M6-M48)

- Lead: VLO
- Participants: POLIMI, TAL, ICCS, UPM, ENG, MUN, DEDA, ATC, VCS, URB, DBC, TEL, EXUS, OASC, FIC, MAD, LEU, TLN, CLUJ].
- Support and coordination to ensure that user requirements from local living labs are accurately reflected in the technical solutions developed in WP4. It will involve facilitating communication between the technical team and the local living labs and providing guidance on how to translate user requirements into technical solutions.

T5.4 Customisation and deployment of the URBREATH decision-making framework into pilots (M10-M36)

- Lead: VCS
- Participants: TAL, ICCS, VITO, UPM, VLO, MUN, DEDA, ATC, URB, LAT, TEL, EXUS, FIC, TRA, BAS, MAD, LEU, TLN, CLUJ].
- This task gathers information on the current systems and solutions used in the urban planning process within the cities and identifies the potential for integration or replacement. Based on this, tailoring of the overall framework according to the specific pilots' needs is done, integrating selected components into their existing IT systems. Finally, the task performs the continuous data ingestion, collection and harmonisation to feed KPIs calculation. Activities of this task are performed in strict collaboration with local technical partners.

T5.5 Tools for monitoring, co-creating, deciding and steering (M10-M40)

- Lead: MUN
- Participants: TAL, ICCS, VITO, UPM, VLO, VCS, URB, LAT, BLOX, TEL, EXUS, FIC, MAD, LEU, TLN, CLUJ].
- This task will implement the specific KPI calculation and visualise these to allow local monitoring and policy steering to increase the impact of NBS. Interactive dashboards and decision support systems like digital twins

(T5.4) will be used to display the KPI evolutions in a clear and intuitive way. These tools will enable LL participants to view and interpret data related to the selected urban area for a given NBS scenario. It will provide a visual representation of data, allowing LL participants to easily explore and analyse different locally co-created NBS scenarios and identify patterns and trends that may inform the selection or adaptation of the most strategically optimal NBS scenario. KPIs calculation will be done with the impact models developed in WP3. Ex-ante evaluation of the KPIs will be conducted in T5.6 and it will support the co-creation process (T5.2[1]) of NBS scenarios for the FRC. Tools for monitoring, cocreating, deciding, and steering will allow to visualize the simulated impacts on the dashboard developed in T5.3[2].

T5.6 Performance evaluation and impact assessment (M10-M48)

- Lead: IAO
- Participants: LC, USTUTT, TAL, UPM, VLO, DEDA, URB, TEL, CA, FIC, TRA, BAS, all cities].
- This task focuses on evaluating the impact of the implemented solutions.
  This will include the creation of a common simulation, assessment basis and monitoring protocols based on the expected impacts identified through the LLs activities of the FRC and FLC. This will consolidate the simulation, monitoring, and evaluation work of the URBREATH solutions, the impact assessment framework and tools developed in T5.1 [3] and T5.5. During the co-creation process described in the methodology paragraphs 1.2.2 and 1.2.3, this task will conduct an ex-ante impact simulation of the selected NBS scenarios by using the impact models developed in WP3 and made available to LL participants to the dashboard developed in T5.3 [4] for supporting participatory urban policy decisions and NBS scenario co-creation processes. In the final stage of the demonstration, will be conducted an ex-post assessment of the given KPI, so to inform WP7 and WP8 with evidence-based knowledge and data for scaling the NBS initiatives. Inputs and data gathered from all WP5 and WP6 tasks will be used to conduct an evaluation to assess the level of success of the demonstration activities of the project, enabling comparisons between cities and sectors, and underpinning replication (in direct link with WP7) at five levels, using the EU-CITYKeys framework as a reference: planet, people, prosperity, propagation, and governance.

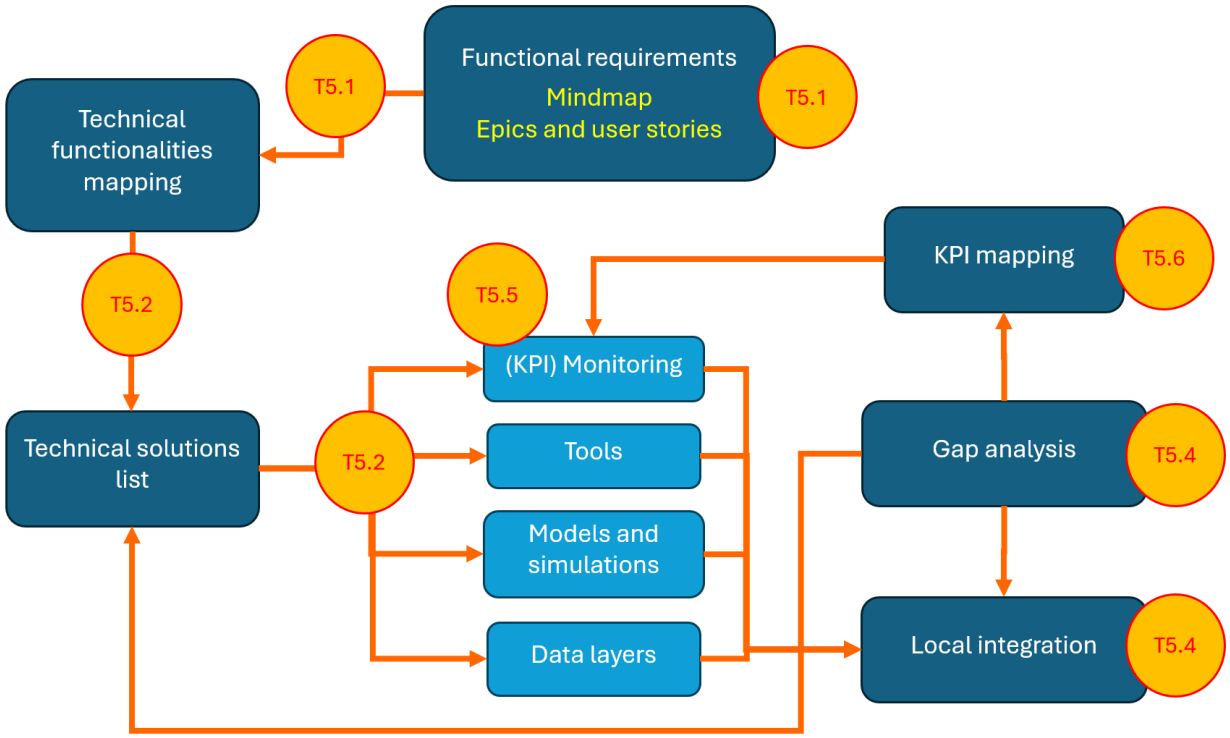
  This task will manage the data gathering and conduct the evaluation assessment to capture the impact and success of the solutions. Each city will be responsible for filling and providing the data requested for conducting the impact assessment activities using quantitative data (based on T5.1) and qualitative impact factors, which would explain the developments and unique elements which contributed or hindered the implementation process of the city. This task will contribute by developing long-term monitoring protocols for the pilots and streamlined monitoring protocols for follower Cities and other cities and regions, in alignment with their proposed roadmap (T7.5). The assessment framework will be developed with the participation of partners who possess complementary expertise in NBS, policymaking, modelling and visualisation, stakeholder/citizen

[1] The reference to “T5.2” in this context is incorrect and should be understood as “T5.3”.
[2] The reference to “T5.3” in this context is incorrect and should be understood as “T5.5”.
[3] The reference to “T5.1” in this context is incorrect and should be understood as “T5.6”.
[4] The reference to “T5.3” in this context is incorrect and should be understood as “T5.5”.

engagement, innovation, and governance, who will work closely with the task leader and city partners in a sustained fashion. Evaluation will be aligned with the project implementation in cities, producing reports in M30 and a final summary in M48.

The interdependencies among the various WP5 tasks and their respective contributions to the overarching processes of functional and technical analysis, tool development, (KPI-based) monitoring, and local implementation are illustrated in the diagram below.

Figure 1: Diagram illustrating the interdependencies between WP5 tasks and their contributions to the core processes of functional and technical analysis, tool development, KPI-based monitoring, and the local implementation of URBREATH solutions.



Within the context of this Deliverable, the specific roles and inputs of the relevant WP5 tasks can be summarised as follows:

- **Task 5.1 - Functional and technical requirements analysis**
    - Leads the identification and consolidation of functional requirements across pilot cities.
    - Provides support for technical requirement analysis to ensure alignment with functional needs.

- **Task 5.2 - Co-creation and Living Lab (LL) facilitation**
    - Supports the technical analysis process by ensuring that the perspectives and priorities of local pilots and LLs are accurately captured.
    - Ensures effective translation of local requirements into technical specifications.
    - Facilitates communication and iterative feedback loops between technical developers and pilot city representatives, including LL coordinators.
- **Task 5.4 - Data and infrastructure assessment**
    - Conducts a comprehensive assessment of available data sources and Information and Communications Technology (ICT) infrastructures within the pilot cities.
    - Evaluates the feasibility of integrating URBREATH tools and simulation models into the local digital frameworks and supports the customisation process.
- **Task 5.5 – Development of monitoring dashboards**
    - Leads the design and development of digital dashboards for KPI monitoring of NBS effects.
    - Coordinates with Task 5.6 to ensure that indicators are technically feasible.
- **Task 5.6 – KPI mapping and specification**
    - Identifies, defines, structures, and validates KPIs monitoring NBS effects, in collaboration with the pilot cities.
    - Provides structured input to support both the technical design of monitoring tools and the NBS evaluation framework.

Together, these tasks contribute to a cohesive and iterative process of co-design, technical validation, and local contextualisation, ensuring that the tools developed under WP5 are fit for purpose, scalable, and responsive to the diverse needs of the URBREATH pilot cities and their stakeholders (through the LLLs).

1.3 Connections with other WP activities

Tasks 5.1, 5.2, 5.4, 5.5, and 5.6, which constitute the focus of this Deliverable, are closely interconnected with various other Work Packages (WPs), the interactions of which will be outlined in the present chapter. In contrast, the activities undertaken within Task 5.3 (Local Living Labs), along with its cross-WP linkages, fall outside the scope of this Deliverable and will be addressed in detail in **Deliverable 5.5**.

The collaboration between WP5 and WP2 has been continuous and firmly integrated. It is structured around a feedback loop that connects the local (micro), Climatic Zone (meso), and European-wide (macro) scales.

While **WP2** has led the definition of the overarching platform requirements (see Deliverable 2.5 - *URBREATH platform requirements*), WP5 plays a central role in enriching, refining, and translating these requirements into locally grounded specifications. This ensures their applicability within the real-world contexts of both front-runner and follower cities.

Through direct and ongoing engagement with pilot cities, WP5 gathers detailed insights into local priorities, infrastructure, and constraints. These insights have proven essential for contextualising and fine-tuning the platform-level requirements developed by **WP2**, anchoring them in diverse urban, administrative, and climatic environments.

WP5 has also supported cities in applying these general requirements to their specific scenarios and use cases (see Deliverable D2.4 - *URBREATH use case scenarios and baselines*). This bridging function has enabled a smooth alignment between strategic platform planning and practical local implementation, paving the way for tailored digital solutions that remain interoperable within the broader URBREATH framework.

In the first 18 months of the project, WP5's core contribution has centred on its close connection with both the pilot cities and the technical partners. The work package serves three key roles:

- WP5 acts as a bridge between the macro scale, where requirements, methods, and activities are defined based on shared cross-city characteristics, and the micro scale, where community needs and stakeholder engagement shape project implementation through LL activities (see Deliverable D2.1 - *URBREATH Methodological framework for urban greening, Living Labs and hybrid/NBS interventions and adaptive pathways*). Within this process, Task 5.1 is critical in identifying context-specific, locally sustainable technical requirements, while **WP2** contributes macro-level requirements. Together, these were synthesised into a single master list of platform requirements through the joint efforts of Tasks 5.1, 5.2, and **WP2**.
- WP5 functions as a facilitating interface between the pilot cities and the URBREATH technical teams (**WP3 and WP4**). Guided by Tasks 5.1 and 5.2, the technical teams translated city-driven requirements into digital functionalities, enabling the design of tools and models that meet both project-wide and local needs. This process also included an iterative refinement phase involving the pilot cities. Additional information needed for the development and calibration of tools, such as input for models, datasets, or technical constraints, was collected through co-creation processes led by Tasks 5.4 (Data and infrastructure assessment), 5.5 (Development of monitoring dashboards), and 5.6 (KPI mapping and specification).

- WP5 plays a central role in designing and coordinating the LLL experimentations, as well as in preparing for the testing of digital tools and the evaluation/monitoring of NBS effects. **WP6** is responsible for the design, implementation, and operation of the co-created NBSs in the four front-runner pilot cities of the URBREATH project. Through this collaboration, WP5 ensures that the digital tools and models are grounded in real-world urban governance contexts and stakeholder engagement processes, making them both actionable and contextually relevant for the pilot cities.

In summary, WP5 ensures that the URBREATH digital platform is not only technically sound but also context-sensitive and co-owned by its end users, providing the vital operational link between high-level platform design and local implementation.

WP7 is specifically aligned with Task 5.3 (Local Living Labs) within WP5. The nature and scope of this interrelation are elaborated in detail in Deliverable 5.5.

2. Finding pilots' functional requirements

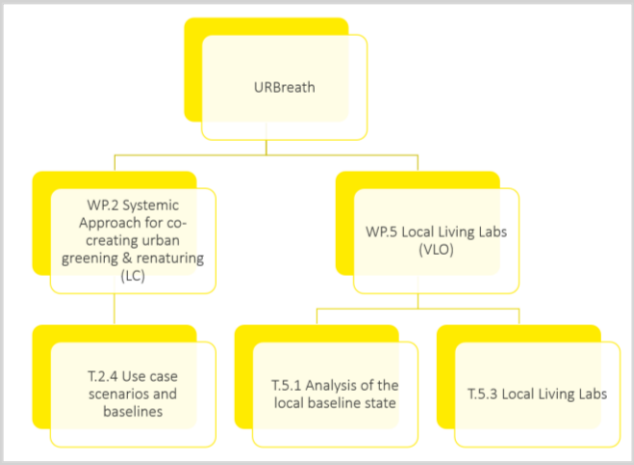
2.1 Alignment with other Work Packages and planning

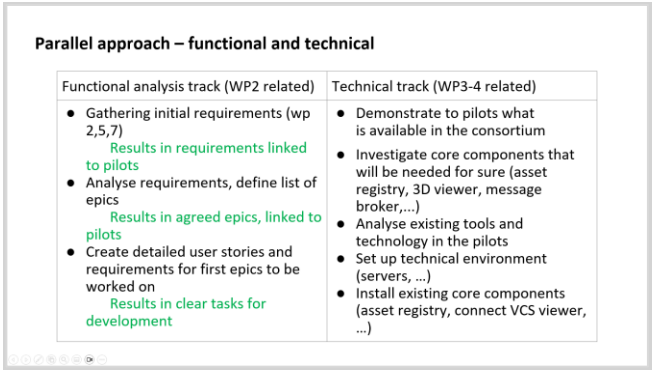
Following the URBREATH project's official kick-off on February 7 and 8, 2024, where WP5 outlined its overarching strategy, targeted efforts were initiated to foster alignment across the involved WPs. WP5 proactively launched a series of cross-WP coordination meetings, specifically bringing together the WP2, WP3, WP4, WP5, and WP7 leads to harmonise methodologies, synchronise milestones, and consolidate shared objectives.

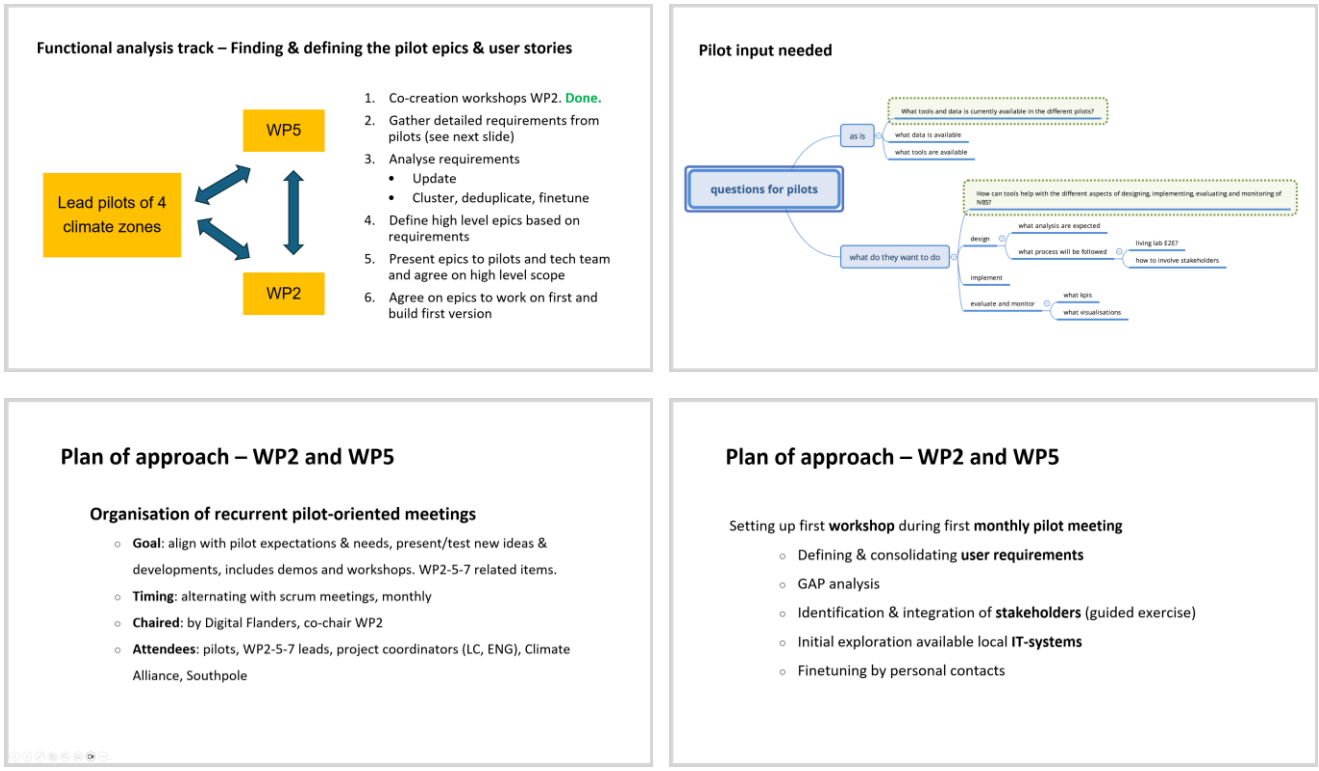
As a result of two co-creation workshops organised by WP2 and supported by WP5 in March and May 2024, additional input was gathered to support the development of an integrated, cross-WP strategy. This iterative process, supported by regular presentations in the bi-weekly project management meetings, led to the formulation of a **preliminary operational framework** in April 2024.

This framework sought to integrate **Living Lab methodologies** and **Design Thinking principles** to ensure alignment with the needs of the pilot cities and the project's overarching ambitions.

Figure 2: Set of six PowerPoint slides illustrating the key steps and methodologies used to establish the preliminary WP5 operational framework, including the mapping of interdependencies and alignment with other WPs. Presented during a bi-weekly management call, May 2024.



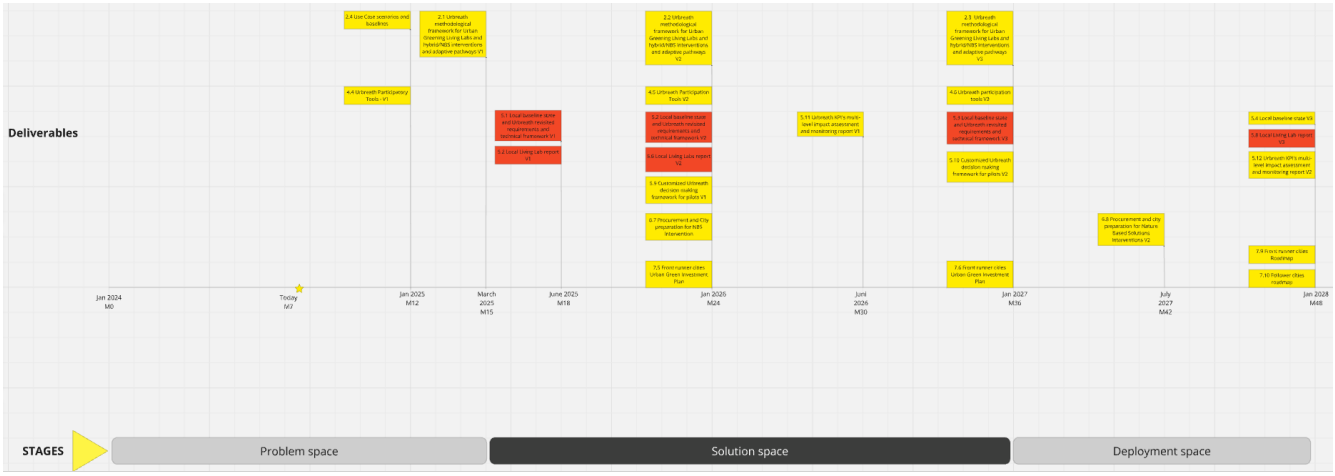




Subsequently, WP5 developed a more refined version of this cross-WP approach and presented the result to the WP2 leads in July 2024.

All URBREATH cross–WP Deliverables were systematically mapped onto a MIRO whiteboard timeline (see figure 3), which also delineates the sequential project phases—problem space, solution space, and deployment space. This integrative visual framework serves as a strategic coordination instrument, offering a shared temporal and conceptual reference point for all project partners and WP leads. It supports alignment of activities, facilitates inter-WP coherence, and enhances the synchronisation of milestones across the URBREATH project lifecycle.

Figure 3: Visual timeline of cross–Work Package Deliverables mapped on a MIRO whiteboard. The timeline illustrates the sequencing of project activities across the URBREATH phases—problem space, solution space, and deployment space—serving as a coordination and alignment tool for all project partners and WP leads.



A second key component (see figure 4) of the preliminary operational frameworks involved the comprehensive mapping of additional key elements onto the MIRO whiteboard timeline. This exercise aimed to support strategic planning and cross-task integration by aligning multiple project dimensions. Specifically, the following components were integrated into the timeline:

1. **LLL objectives aligned with the project phases**, reflecting the stepwise logic of the participatory co-creation process:
    - Preparation of the participatory setting and the supporting toolbox, including tools, methodologies, and guidance materials.
    - Definition and communication of participation opportunities to relevant stakeholder groups.
    - Enrichment of the local baseline with data, expert input, and local collective intelligence to establish a shared understanding of the current and evolving context, including NBS.
    - Generation of ideas, synergies, and representation needs from stakeholder input.
    - Integration and prioritisation of these ideas and functional needs into the design process.
    - Testing, application, and evaluation of ideas through digital tools and monitoring mechanisms.
    - Implementation of the selected NBS configurations.
    - Monitoring, assessment, and iterative adjustment of implemented interventions.
    - Development of a roadmap for scaling and replicating successful approaches.
2. **A sequence of key milestones**, outlining the main stages of progress within the WP5 scope, including the launch of the LLLs, the validation of local baseline conditions, the virtual prototyping of NBS and tool-supported interventions, the development and deployment of digital tools, the implementation of NBS interventions, and the planning for upscaling and replication.
3. **Stakeholder group involvement**, mapping the engagement of various actors across the process phases, including: URBREATH project partners, municipal authorities and decision-makers, technical staff within

municipal administrations, expert stakeholders (e.g., academia, civil society, business actors), and local citizens.

This structured mapping exercise contributed to a unified visual framework that supports alignment across the URBREATH project's participatory, technical, and operational streams, while also serving as a reference for synchronising activities across Work Packages.

Figure 4: Visual representation of the second key component of the WP5 preliminary framework, mapping the alignment of LLL objectives, key project milestones, and stakeholder involvement across the URBREATH project timeline. The diagram supports a structured, phase-based approach to participatory co-creation, tool development, and implementation, enhancing coordination and coherence across Work Packages.

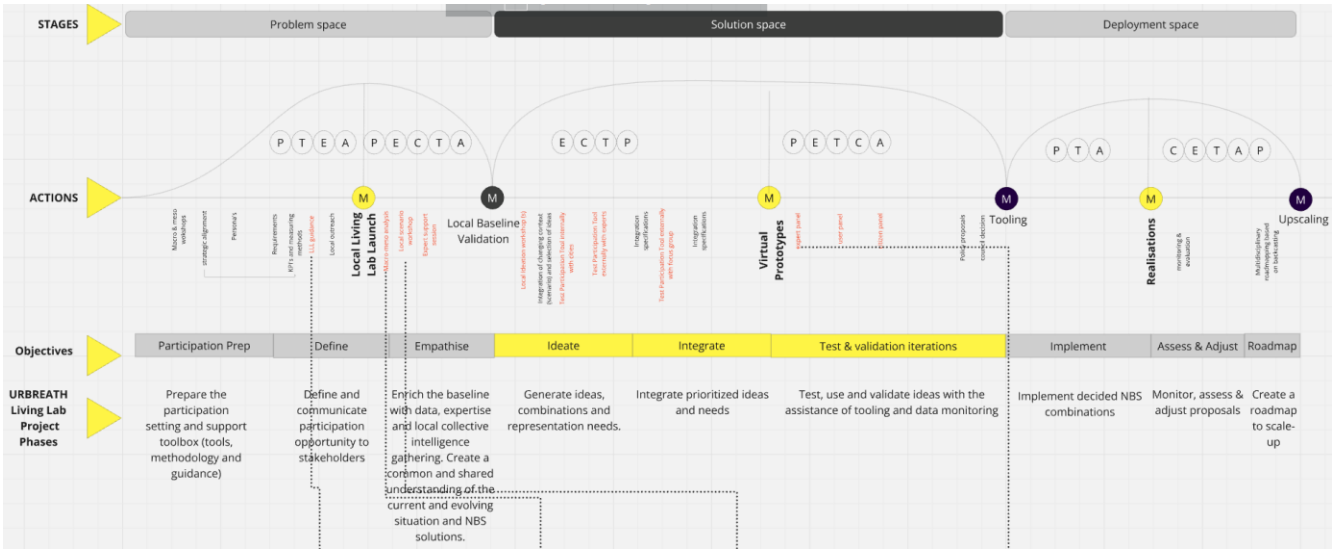
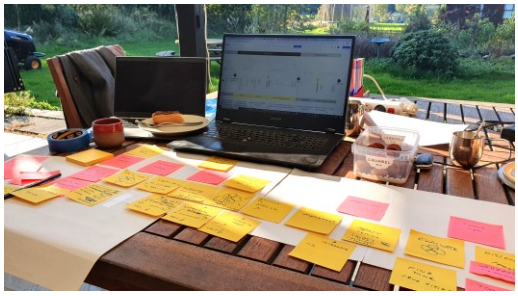


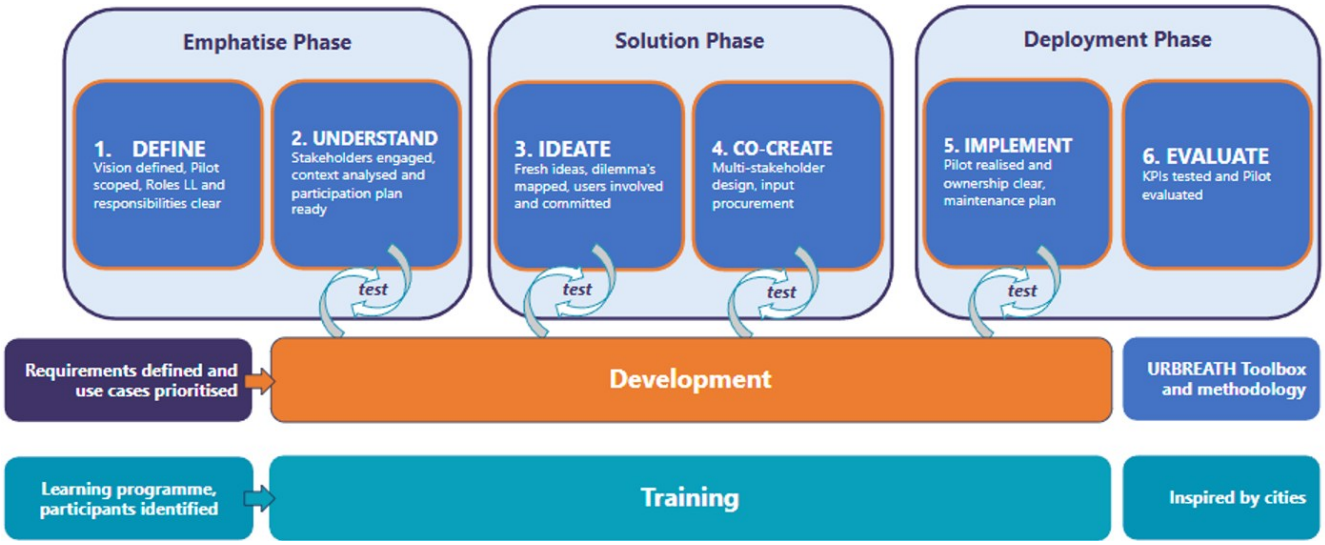
Figure 5: The co-creative process of finalising the operational LLL-framework.



The plan reached its finalised form in October 2024, following a co-creation workshop between Digital Flanders and Climate Alliance. At that point, it had evolved into a comprehensive, operational, and hands-on roadmap that contextualised WP5's Living Lab activities within the broader scope of the project's phases. It explicitly links WP5's participatory design processes to the technical development streams of WP3 and WP4, as well as to the capacity-building and training activities overseen by WP7.

This plan (see figure 6) was presented and explained to the pilot cities and validated during the LLL workshops organised at the end of 2024.

Figure 6: Schematic representation of the WP5 integrated framework, structured in three layers: (1) the process timeline outlining the sequential phases and key LLL actions from 2023 to 2027; (2) the digital tool integration layer depicting the iterative development, testing, and refinement of tools and models; and (3) the capacity building layer illustrating the continuous process of strengthening knowledge and skills among local stakeholders.



The operational framework presented is centred on the LLL approach outlined in Task 5.3 and is elaborated in detail in Deliverable D5.5.

In summary, the top layer of the framework (**process timeline**) delineates the chronological sequence of phases and key LLL actions that pilot cities are expected to undertake throughout the 2023–2027 project timeline. The middle layer (**digital tool integration**) visualises the iterative development, testing, and refinement of digital tools and models, ensuring alignment with pilot needs. The bottom layer (**capacity building**) represents the continuous enhancement of knowledge and competencies among city stakeholders.

Within the scope of this Deliverable, which reports on progress under Tasks 5.1, 5.2, 5.4, 5.5, and 5.6, particular emphasis is placed on the initial stage of the digital tool integration layer. This includes the definition of functional and technical requirements, local IT system needs, KPIs, NBS-monitoring, and the identification of both existing and missing datasets and models, as well as the prioritisation of relevant use cases.

2.2 Finding and mapping pilots' functional needs

2.2.1 Mapping the pilot cities' baseline state of functionalities, processes, tools and living labs

In May and June 2024, four online exploratory co-creative workshops were organised, with a dual focus on pilot cities' requirements and LLs. Each two-hour workshop was dedicated to the pilot cities of one climatic zone.

Objective

Employing a bottom-up and transparent approach, an initial step was taken toward the identification of pilot-specific functional and technical requirements. This process was grounded in the use cases defined for each pilot, as outlined in the Description of Action (DoA) of the Grant Agreement and presented by the pilot cities during the kick-off Meeting held in Leuven in February 2024.

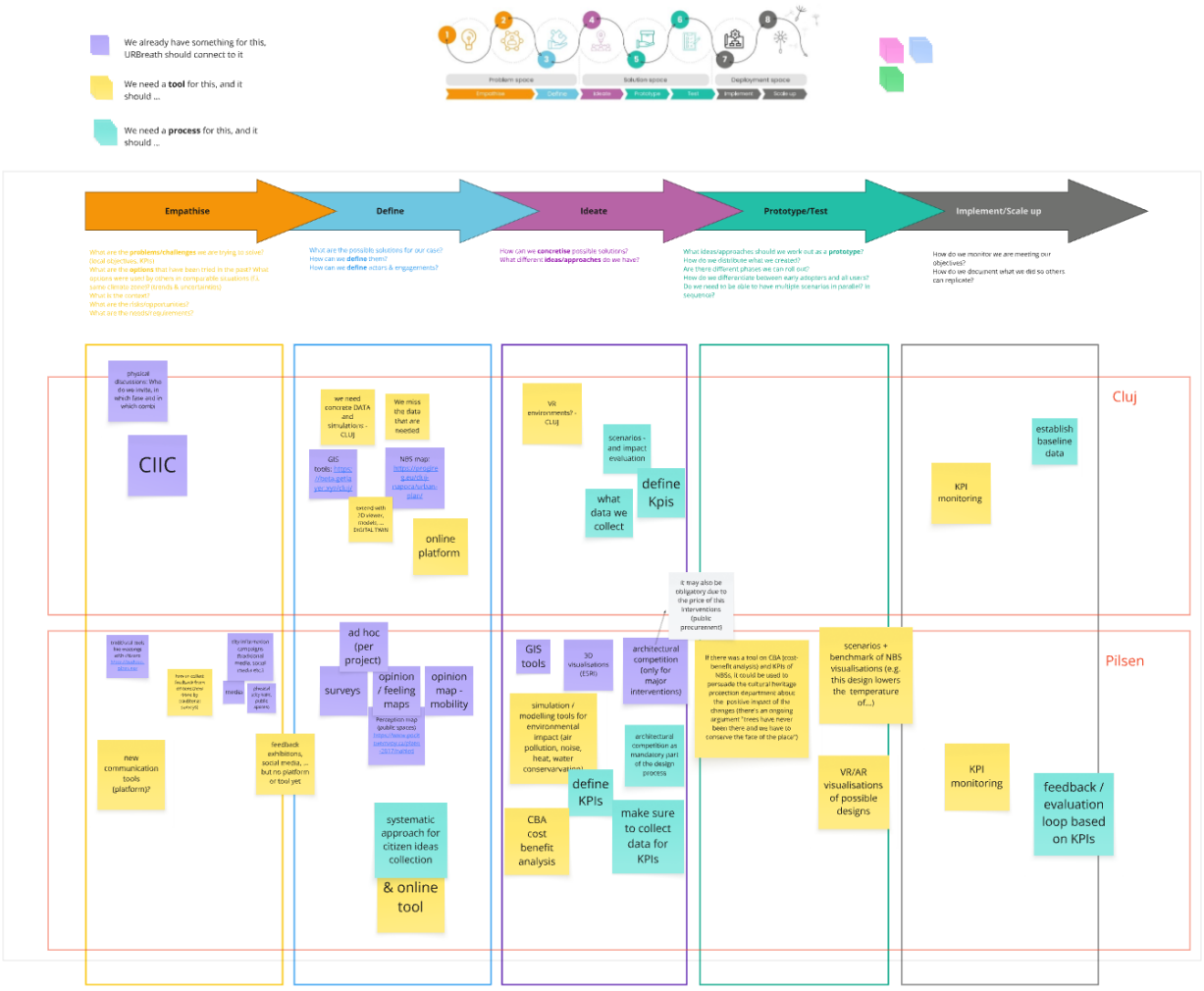
Concurrently, a preliminary assessment was done to evaluate the current ("as-is") and anticipated ("to-be") status of the LLLs across the pilot sites. This assessment is part of the empathise phase within the broader LLL timeline, and directly contributed to the activities under Tasks 5.1, 5.2, and 5.3.

Approach - tools and process

An interactive, participative sticky note MIRO whiteboard exercise (see figure 7) was organised online.

- During the first part of the workshop, participants jointly assessed the current ("as-is") and envisioned ("to-be") status of their LLLs. This included mapping LLL roles and composition, identifying involved stakeholders, reviewing existing tools in use, and analysing stakeholder involvement across the different phases of each pilot's use case. As this component primarily pertains to Task 5.3, further details will be addressed in Deliverable 5.5 and are not elaborated upon in this document.
- The second part of the workshop was dedicated to identifying pilot-specific needs concerning **tools, functionalities, and procedural workflows**. Using colour-coded sticky notes, participants distinguished between *what is available and what is missing*, considering both *tools and processes* relevant to each phase of the project timeline, from empathise to deployment.

Figure 7: MIRO whiteboard sticky-note co-creation exercise conducted with pilot cities in the Boreal climatic zone. The exercise captured and visualised the needs and available resources related to tools, processes, and functionalities for pilot use cases across the different phases of the URBREATH project.



Outcome

As a result of the MIRO board co-creation exercise, an initial assessment was obtained regarding:

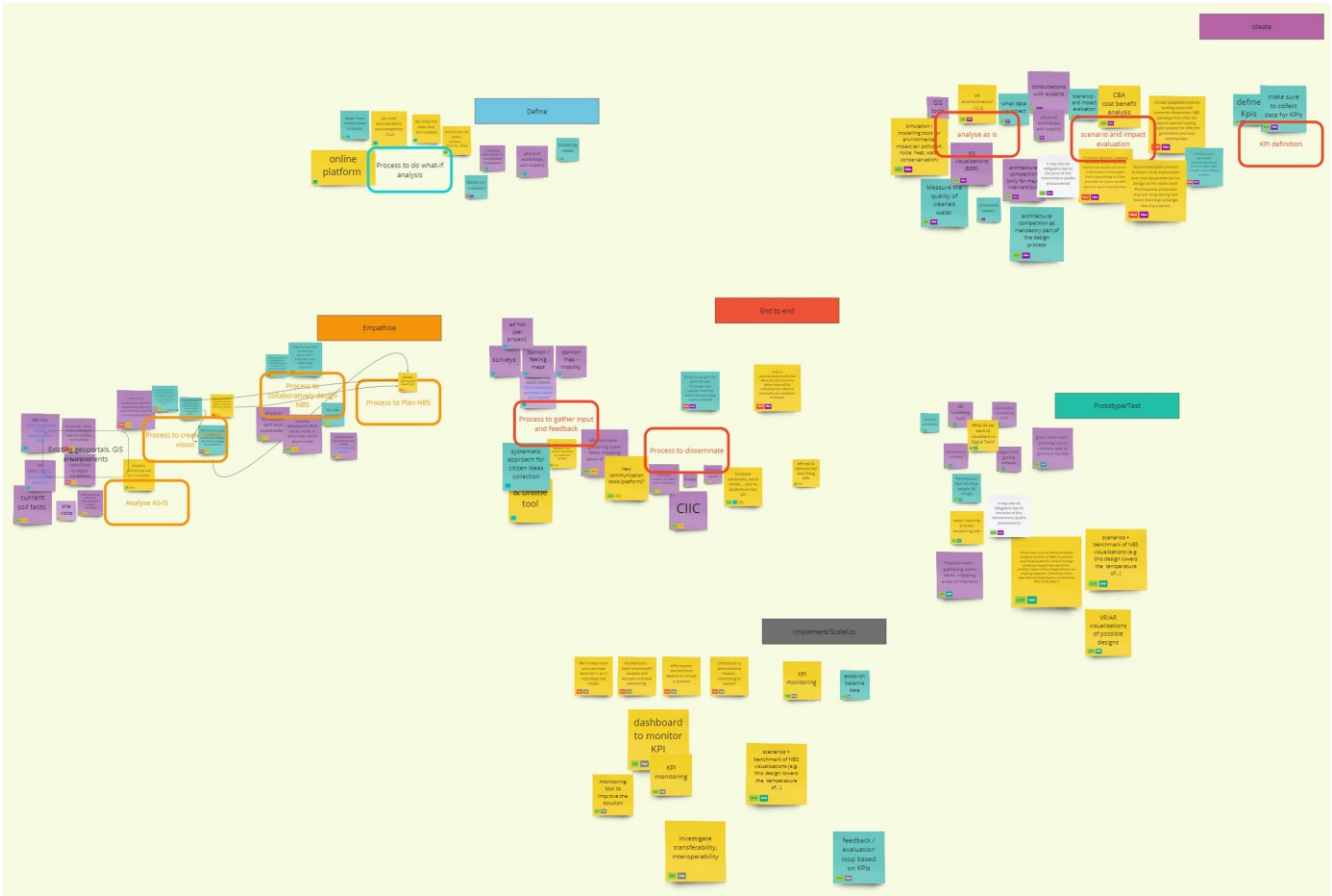
- The status and operational readiness of the LLLs.
- Stakeholder expectations and identified needs related to digital tools, processes, and functionalities across the various stages of the pilot use cases within the URBREATH project framework.

2.2.2 Grouping pilot cities' needs for functionalities, processes, and tools

In the weeks following the initial series of co-creation workshops with the pilot cities, the collected data were systematically analysed and processed. Participant feedback was thematically clustered and aligned with the corresponding phases of the URBREATH project framework (see figure 8).

These structured insights formed the basis for a second interactive workshop held in July 2024, during which the pilot-specific use cases were examined in greater detail to further refine functional and procedural requirements.

Figure 8: Thematic clustering of feedback from the initial MIRO whiteboard co-creation workshops. The clustered data are mapped onto the corresponding phases of the URBREATH project framework and serve as the analytical foundation for the second interactive workshop held in July 2024.



2.2.3 Mapping grouped pilot cities' needs to the project timeline

WP5 organised two workshops in mid-July 2024, building on the outcome of the first series. During the two-hour participative sessions, the efforts of two climatic zones were combined. This set of workshops also had a dual focus on requirement mapping and LLL status monitoring.

Objective

With these exercises, we organised a deep dive, gathering detailed information and insights on the processed results of the first series of workshops held in June. This exercise was the basis for the creation of a cross-pilot mind map (July 2024) and the definition of epics (grouped functional requirements) and finally, the functional requirements themselves (July/August 2024). These exercises also contributed to a first timeline, mapping URBREATH LLL project phases, actions and the planned Deliverables (end July 2024).

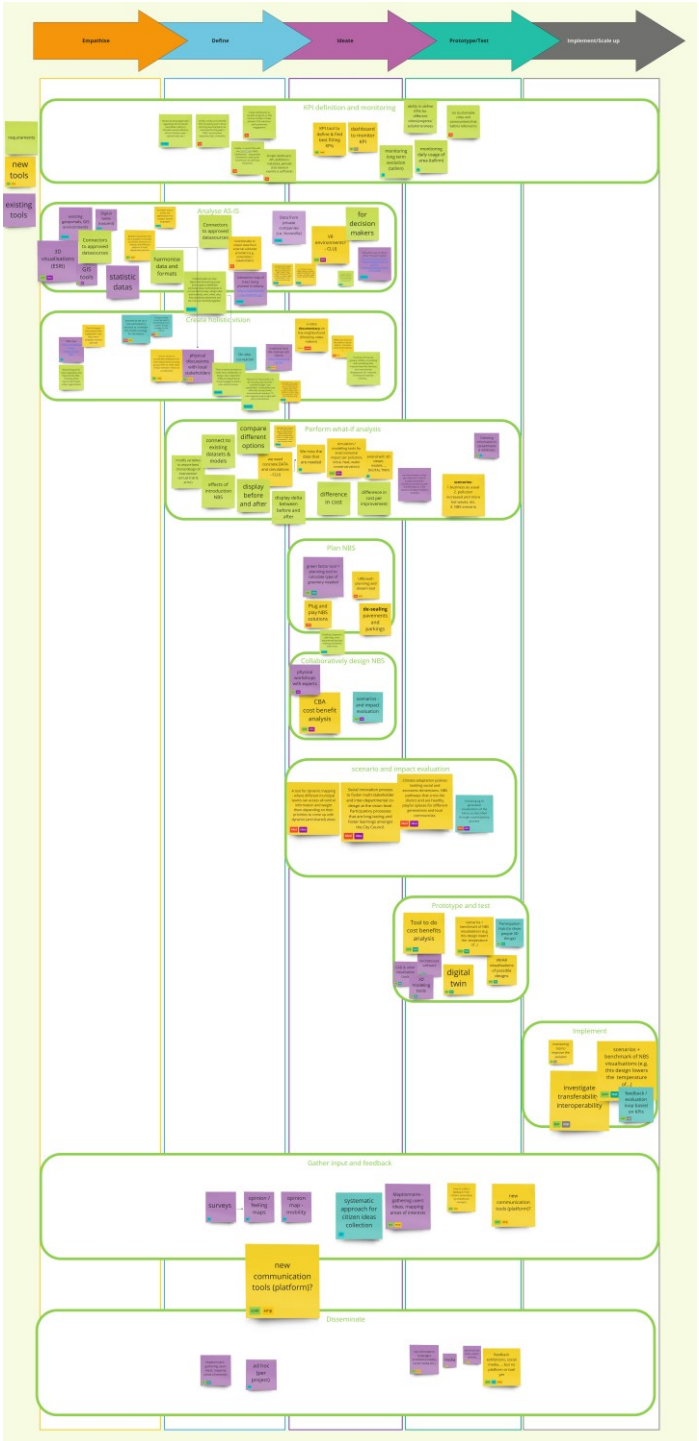
Tools and process

The workshop started with contextualising the exercises performed during the first two workshops in the framework of the project's macro-, meso-, and micro levels and the work of Work Packages 2 and 5. A deep dive was organised based on the processed results of the first series of workshops, where the availability and needs for tools, functionalities and processes were mapped for each phase of the project, as shown in the figure below. Based on this exercise, the available information was enriched and validated through a co-creative and moderated MIRO whiteboard exercise (see figure 9). For the LLL exercise, we streamlined the information gathered from previous workshops. We continued working on defining and understanding the co-creation and participation aspects of the LLLs, as-is and to-be, for each project phase.

Results - outcome

The outcome of this exercise provides a robust foundation for the subsequent phases of the roadmap, enabling the structured transition from conceptual mind mapping to the formalisation of functional requirements.

Figure 9: MIRO board visual from the second deep-dive co-creation workshop, detailing the mapped availability and identified needs for tools, processes, and functionalities across project phases for each local pilot use case.

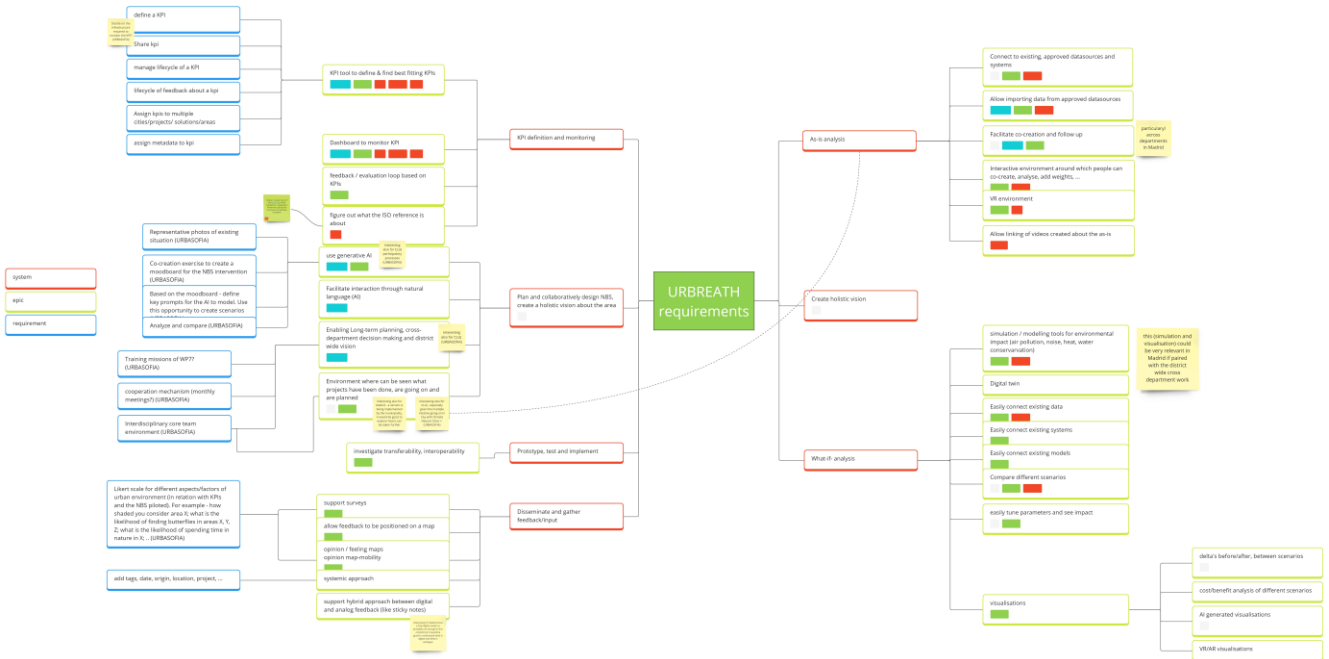


2.2.4 Mind mapping pilot cities' needs

Based on the outcomes of the first two series of workshops, a sufficient volume of data was collected to develop a **cross-pilot mind map** (see figure 10) synthesising the information across all climatic zones. This mind map organises the collected inputs into system-level, epic-level, and high-level functional requirements, thereby enabling a structured comparison and integration of insights across diverse urban and environmental contexts. This approach facilitated the organisation of user needs and system functionalities into coherent clusters, supporting the iterative refinement of requirements in alignment with the LL methodology.

We conceptualise the mind map as a cognitive structuring tool that captures and organises the central themes emerging from the previous series of workshops. This process involves identifying core ideas articulated by the pilot cities and systematically expanding upon them by generating related concepts that radiate outward from a central node. By focusing on key insights recorded during the sessions and exploring interconnections, WP5 can construct a visual representation of knowledge that facilitates a more profound understanding and improved retention. This method supports synthesising complex, multidimensional information and enhances the capacity for integrated planning and shared learning across pilot contexts.

Figure 10: Consolidated mind map derived from two series of co-creation workshops with URBREATH pilot cities. Identified functional requirements (blue) are grouped under thematic epics (green), which are further aggregated into high-level system epics (red), providing a structured overview of user needs and system functionalities.



2.2.5 Categorisation of pilot cities' needs: ten solid epics

Building on the exercises conducted in Sections 2.2.1 to 2.2.4, the next step involved translating the identified functional requirements into **epics** and **user stories**. User stories serve as a means to capture functional requirements from the user's perspective, an essential component in the **user-centred design** approach we are applying to designing, developing and implementing digital tools and NBSs. Human-centred design places the needs, experiences, and constraints of **end-users** at the core of the design process, ensuring that resulting systems, products, and services are both usable and contextually relevant.

User stories are concise, user-centred requirements or requests, typically articulated from an end user's perspective. These stories form the building blocks of ***epics***—larger units of work that can be decomposed into multiple stories.

A consolidated list comprising **19 epics** and **66 high-level user stories' functional requirements** was developed based on the structured analysis derived from the collaborative mind-mapping exercise. The applicability of the user stories to all URBREATH pilots is indicated, providing an initial indication of development prioritisation.

This list was presented to the pilot cities for review during the bi-weekly WP5 management meeting held at the end of July 2024. During this session, pilot representatives were assigned follow-up tasks to review and validate the mind map, as well as the proposed epics and user stories within their respective local contexts.

Following this validation process and the incorporation of minor revisions submitted by the pilots, the list of epics and user stories was formally endorsed on July 27th, 2024. The finalised list of epics and the complete set of high-level functional user stories can be found in *Annexes I and II*.

Later, these epics were further grouped to get a shortlist of 10 items:

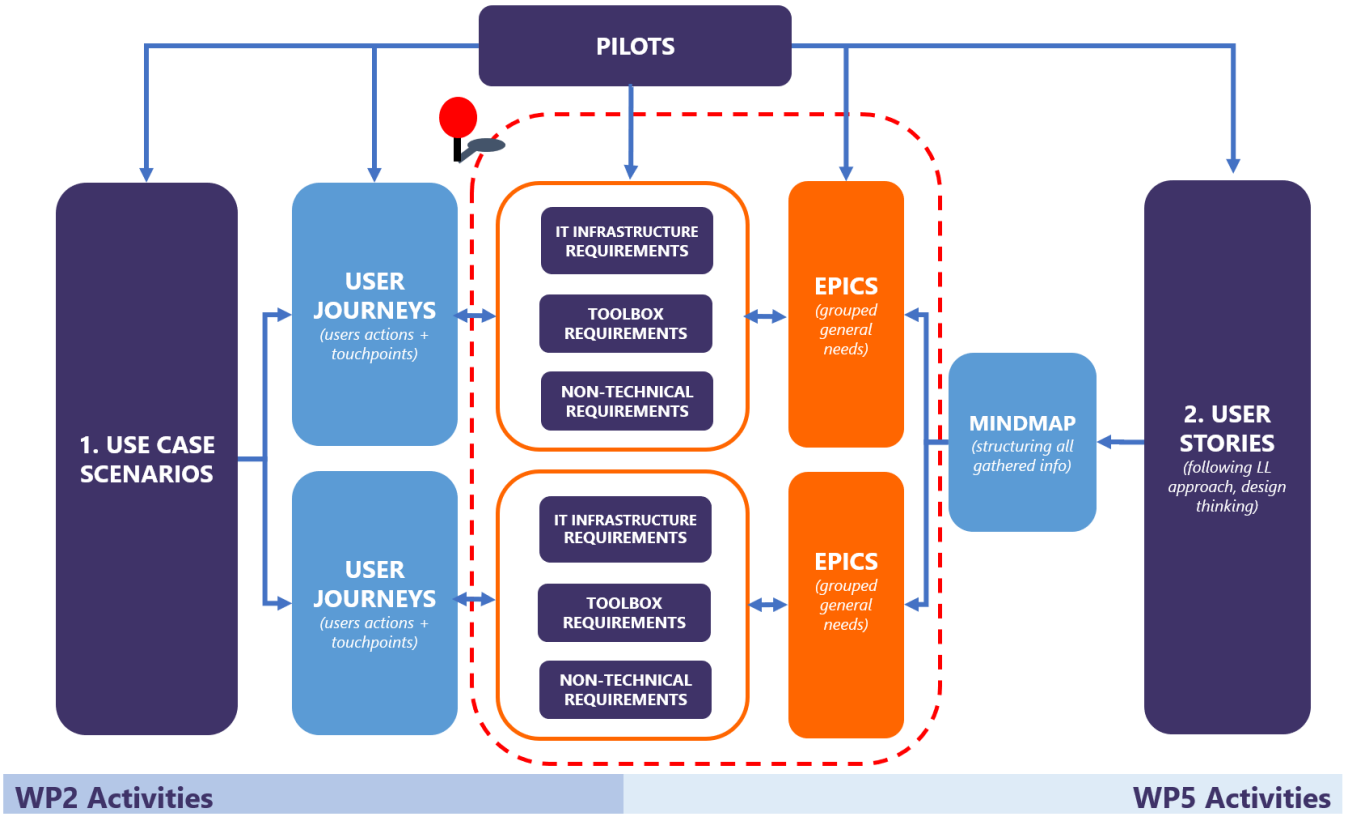
1. GENERAL specifications like availability on mobile devices, defined by front-runner cities.
2. Planning of NBS
    a. Holistic & up-to-date view on different aspects of NBS deployment
    b. Collaboration at different levels, considering all parties involved
3. KPI definition and monitoring NBS effects
4. Monitoring of the AS-IS situation, including the use of remote sensing
5. Use of Local Digital Twins (LDTs)
    a. Visualisation of pilot datasets and models via data catalogue
    b. Visualisation of scenarios
6. Use of generative AI to make visualisations
7. Evaluation and testing of technical developments by pilots
8. Transferability & interoperability
9. Dissemination and communication
10. Living Lab tools for users to co-create/participate

2.2.6 Merging macro, meso- and micro-level requirements

In mid-September 2024, the high-level **user stories' functional requirements** formulated within the framework of Work Package 5 were systematically integrated with the **macro-scale functional requirements** previously developed through the collaborative efforts of Work Packages 2 and 4. This integration, schematically represented in the figure below, produced a consolidated and cross-scale requirements overview. As a result, the total number of **user stories' requirements increased from 66 to 79**, encompassing a broader spectrum of functional needs across thematic and operational dimensions.

The **resulting unified list** now constitutes a foundational reference framework for the technical WPs, guiding the transition from conceptual-level functional requirements—currently conceptualised as a preliminary "wish list" of desired features—towards detailed technical specifications and actionable implementation pathways. WP5 continues to play a critical facilitative and coordinating role in this translation process, as elaborated in **Chapter 3**, ensuring that user-driven priorities are effectively aligned with technical development trajectories.

Figure 11: Schematic overview illustrating the complementary roles of the pilot cities, WP2, and WP5 in defining macro-, meso-, and micro-level requirements. WP2 focuses on use cases and user journeys to capture broader system needs, while WP5 employs local user stories and mind mapping to structure detailed user requirements and derive epics, supporting the iterative development of user-centred solutions.



2.2.7 Enriching functional requirements through tailored pilot workshops

In September 2024, a series of nine one-to-one workshops was conducted with each of the URBREATH pilot cities, including both front-runner and follower cities. Each session, lasting approximately 90 minutes, was designed to elicit detailed, city-specific information regarding the functional requirements previously identified through earlier phases of co-creation and analysis.

The workshops were strategically timed to align with recent updates provided by the pilot cities on September 9th and 20th, 2024. During these workshops, improved use case definitions and additional insights on data availability and outstanding information gaps were presented. This alignment enabled a deeper exploration of specific requirements and allowed for targeted discussions on the needs, constraints, and data-related challenges unique to each urban context.

Objective:

The primary aim of these guided workshops was to enrich the existing, **merged list of functional requirements, spanning macro-, meso-, and micro-levels**, with extra in-depth pilot-specific insights. This list, consisting of functional epics and user stories, had been compiled based on prior analyses and the most recent pilot use case presentations (September 2024). The workshops sought to gather in-depth information that was still missing to better understand each city's specific needs, challenges, and available resources. This enhanced understanding serves as the essential foundation for translating functional requirements (derived from the user stories) into technical specifications, thereby supporting the technical partners in the development of fit-for-purpose tools and models.

A secondary objective at this stage of the URBREATH project, and within the scope of this Deliverable, was to **initiate a preliminary gap analysis** (see Chapter 5), with a specific emphasis on assessing the availability and quality of datasets and models required for the development and implementation of locally relevant solutions. This process was designed to raise awareness among pilot cities regarding their data/model needs and to generate a more refined understanding of the relationship between those needs and the envisioned solutions.

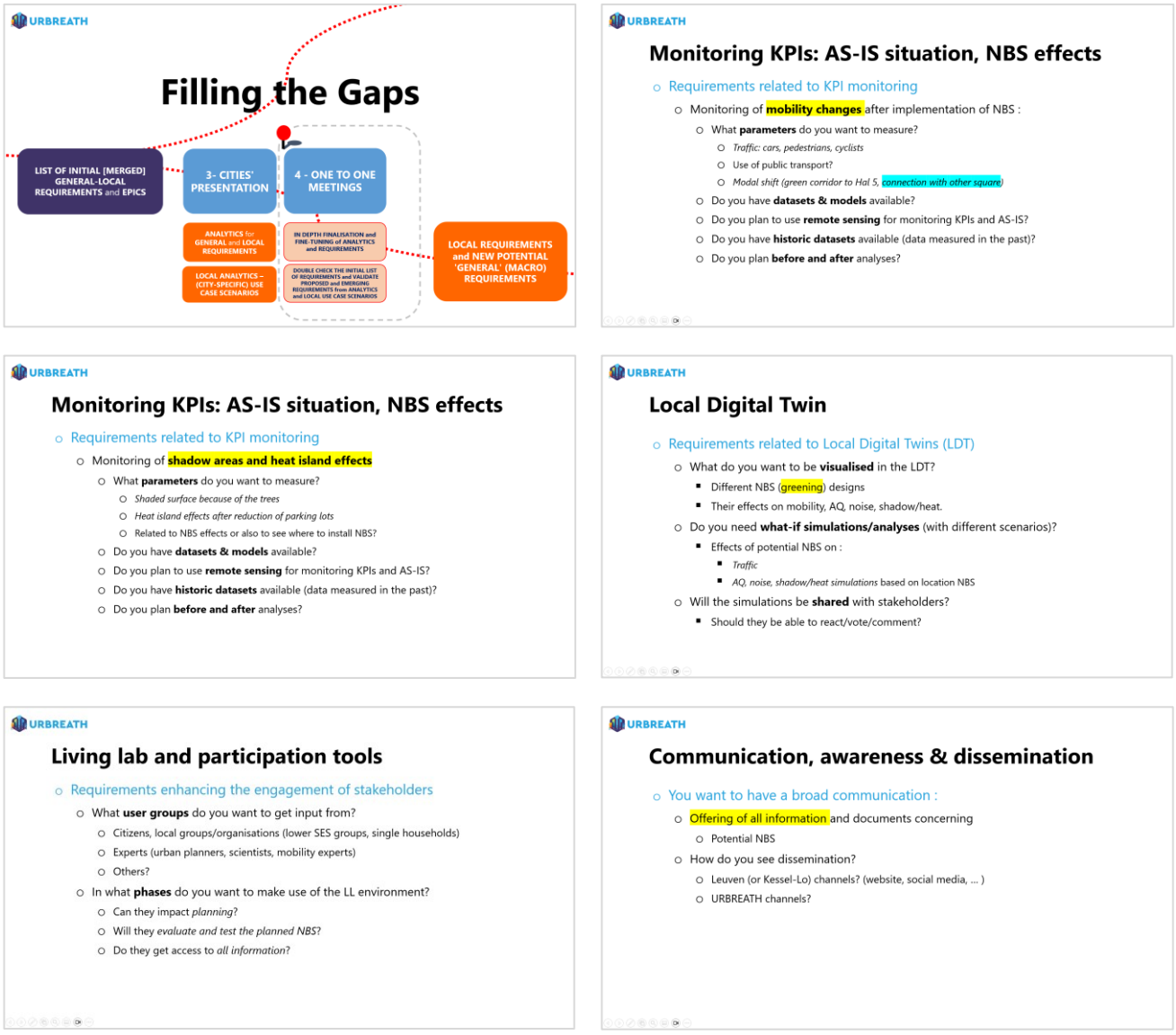
To this end, a series of targeted questions was directed at the pilot cities, supplementing the insights previously gathered during earlier workshops. These questions focused explicitly on the presence, accessibility, and granularity of existing datasets and models relevant to the selected use cases (as illustrated in Figure 12). While this stage of the analysis yielded valuable input, it is acknowledged that the data requirements of all pilots have not yet been comprehensively identified. This is partly due to the ongoing and iterative nature of LLL processes, which continue to shape and redefine the specific priorities and NBS demands of each pilot context.

Tools and Process:

For each session, a tailored presentation was prepared based on the specific context and progress of the respective pilot city. Each presentation began with an overview of the ten overarching epics. Subsequently, the epics relevant to the specific pilot were examined in greater detail. A set of targeted, practical questions was used to

deepen understanding of the functional requirements associated with each epic—for example, those related to remote sensing, KPI monitoring, and decision-support systems.

Figure 12: Example from front-runner city Leuven illustrating the use of tailored, use case-specific guiding questions to elicit detailed insights on local functional requirements and data/model gaps. For each of the nine pilot cities, a customised set of slides was developed to support structured information gathering and gap analysis.



Special attention was paid to the availability and quality of datasets (historical, real-time, and modelled future data), as these are critical for the effective operationalisation of the LDTs, models and monitoring tools. For the LLL tools, **stakeholder lists were validated**, and the specific phases in which each tool would be applied within the LL process were identified as described in Deliverable 5.5. All pilot representatives were also asked to

elaborate on their intended use of the URBREATH tools within their LL activities.

Outcome:

These workshops provided us with a wealth of information. All information was summarised and bundled with the WP2 use case scenario and user journey information.

At the level of **data/model gap analysis**, the current assessment should be regarded as an initial diagnostic effort, serving as a foundation for further refinement as pilot-specific insights continue to evolve. Following the workshop, the use cases of all pilot cities were systematically enriched with supplementary information concerning missing datasets and modelling components, based on inputs and observations gathered during these workshops. This enhanced dataset constitutes a valuable preparatory resource for the technically oriented WPs 3 and 4, supporting the development and adaptation of tools and models. Additionally, it directly informs the data inventory being established under Task 5.4 (see chapter 5), thereby facilitating a more targeted and context-sensitive technical implementation aligned with local data availability and needs.

2.2.8 Validation, prioritisation and presentation of use cases

The collaborative efforts of Work Packages 2 and 5 culminated in the finalisation of a comprehensive description of challenges, use cases, and requirements, which were presented at the **General Assembly held in Madrid** in October 2024. This presentation served four primary objectives:

1. To **validate** the enriched use cases, epics, and functional requirements in collaboration with the pilot cities.
2. To **communicate** the epics and functional requirements to the technical partners.
3. To **prioritise** the **use cases** specific to each pilot city.
4. To provide technical partners with **clear guidance** for developing tailored technical solutions aligned with pilot needs.

This joint validation established a robust foundation for subsequent activities, including the definition of KPIs and the development of monitoring tools under Tasks 5.5 and 5.6, a comprehensive dataset and model gap analysis under Task 5.4, and the further translation of functional requirements into technical specifications scheduled for November and December 2024 under the guidance of Task 5.2. Furthermore, these efforts facilitated the technical teams' initiation of the implementation phase for the URBREATH **Toolbox components**.

The methodology and outcomes of these exercises conducted during the General Assembly in Madrid are detailed in a published article on the URBREATH project's website:

Reflections of Digital Flanders on the URBREATH General Assembly: a milestone in co-creation and innovation

Living Lab activities - by Digital Flanders

From 2 to 4 October, we had the pleasure of participating in the General Assembly (GA) of the URBREATH Horizon Europe Project, organised by the Madrid Cluster in the Villaverde pilot district of Madrid. *The URBREATH project focuses on the design, implementation, and evaluation of Nature-Based Solutions (NBS) across nine pilot cities, grouped into four climatic zones. Using Living Lab principles, the project strives for maximum stakeholder participation and co-creation. Digital Flanders is proud to be one of the 37 partners in the project, leading the Living Lab work package and contributing to various others.*

A major milestone

After nine months of hard work, we reached a significant milestone at the GA, where we had the opportunity to co-present with WP2 the up-to-date challenges, use cases, and detailed requirements for all the pilots involved. This achievement was the culmination of a series of co-creative workshops, one-on-one meetings and pilot case presentations, forming the foundation for comprehensive mind maps, the distillation of epics and requirements, and the integration of macro-meso-micro scale needs. It was a collaborative effort across work packages 2-4-5-7, Climate Alliance and South Pole, demonstrating the power of the Living Lab approach.

Day 1: co-creation and validation

The first day of the GA started with a detailed explanation of the pilot requirements to the technical teams. After, these requirements were validated by the pilot cities, and a workshop brought together front-runner and follower cities, alongside technical partners, to fine-tune the use cases and define the main priorities. The discussions were lively, interactive and very productive, setting the stage for the next steps in technical development, Living Lab designs and Nature Based Solutions (NBS) implementations.

Day 2: from requirements to technical solutions

On the second day, Digital Flanders had the honour of presenting the overall approach for the next steps in the project to the technical teams. We discussed the upcoming feasibility check of the validated requirements list, the subsequent translation into JIRA tasks and the follow-up plan for JIRA tasks. During a joint exercise, we found a general approach to transforming use cases and requirements into tangible technical solutions - ranging from Digital Twins and KPI dashboards to co-creation and participation tools - leveraging the expertise of all technical partners to build a comprehensive and hands-on toolbox. During the upcoming weeks, the prioritised use cases of all front-runner cities will be worked out in detail, together with the involved climatic zone pilots.

Day 3: Living Lab insights and future directions

For Digital Flanders, the third day was dedicated to sharing the results of previous Living Lab exercises, which provided valuable insights into the current (as-is) and desired (to-be) users and processes for the Living Labs throughout the use case phases. The Madrid Cluster presented valuable lessons learned from their experience in Madrid, and we wrapped up the session with a co-creative workshop where enthusiastic pilots shared their expectations and visions for potential

approaches moving forward. Next on the radar is the Living Lab establishment to support the joint efforts to design, implement and evaluate Nature Based Solutions.

Final thoughts

This General Assembly was an intensive and highly rewarding experience. A huge thank you to the Madrid Cluster for their flawless organisation and insightful presentations. We also thoroughly enjoyed the tour of the Madrid Rio project and the bike ride through the Villaverde district, where we explored various nature-based solutions firsthand. We look forward to continuing this exciting journey with all partners, advancing our shared goals.

Figure 13: Atmospheric images from the URBREATH General Assembly held in Madrid, October 2024. The first row depicts the validation and prioritisation workshops; the second row captures the technical analysis session (photo credit: Caren Camiscia - itdUPM); and the third row showcases the Local LLL co-creation workshop.



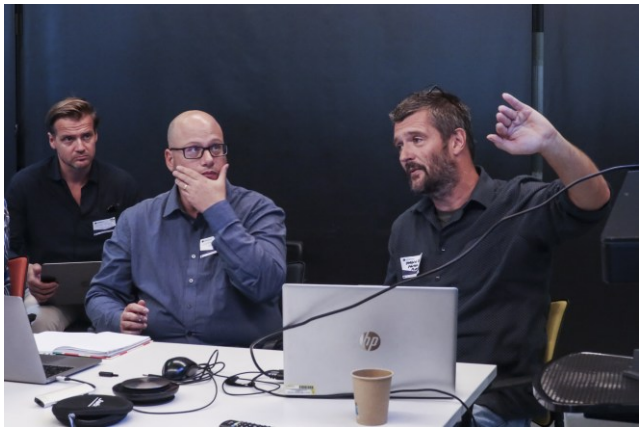



Figure 14: Selected PowerPoint slides presented at the URBREATH General Assembly in Madrid (October 2024), illustrating the epics and functional requirements derived from user stories for the Boreal climatic zone pilot cities, Tallinn and Kajaani. These materials reflect the outcome of the user-centred co-creation process and its translation into actionable development priorities.

URBREATH

1. Boreal CZ – Tallinn (FR) & Kajaani (FC)

- Monitoring tools for KPIs, the as is situation and NBS effects
  - What to monitor?
    - **Accessibility** of a site (Tallinn, sensors)
    - **Traffic and modal shift** (Tallinn, sensors)
    - **Biodiversity restoration** (Tallin, Kajaani, DT datasets and *on site* registrations)
    - **Invasive plants monitoring** (Tallin, Kajaani, DT datasets and *on site* registrations)
    - **Snowmelt follow up** (Tallin, Kajaani)
      - Investigate infiltration
      - Investigate water quality (chemical constitution – acidic load, PH, conductivity, heavy metals - sensor info available for Kajaani), amount of rubble/debris)
    - **Climate resilience** (Kajaani, sensors, datasets)
      - Temperature (weather station data available)
      - Flood control (weather station data & model data available)

URBREATH

1. Boreal CZ – Tallinn (FR) & Kajaani (FC)

- NBS investigation (WP6-related)
  - Analysis: **what NBS are suitable for this area**? (Tallinn, Kajaani)
    - This may affect parameters to be measured
  - Analysis: what is the **best location** to install the NBS? (Tallinn, Kajaani)
    - Based on simulations
  - Analysis: how can NBS help to reduce negative effects of **meltwater**? (Tallinn, Kajaani)
    - Very specific for this climate zone
  - Strong request to **increase expertise** (Tallinn, Kajaani)
    - NBS catalogue
    - Overview of available follow-up tools

URBREATH

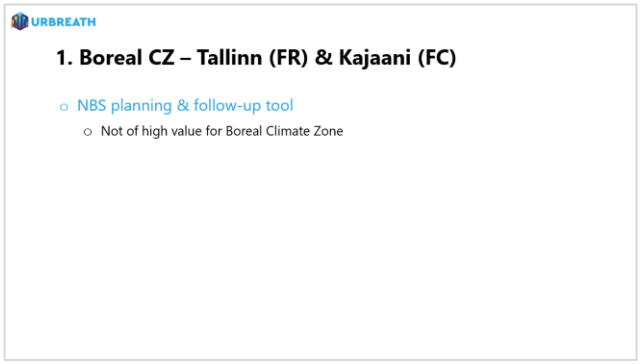
1. Boreal CZ – Tallinn (FR) & Kajaani (FC)

- Local Digital Twin
  - Visualisation of **data** (Tallinn, Kajaani)
    - All parameters mentioned before
    - Suggestion Thomas to map invasive species
  - **Simulations**, **scenarios** (Tallinn, Kajaani)
    - Find best location for NBS, based on modelling
    - Simulate effects of potential NBS
    - Find best location for new meltwater sites

URBREATH

1. Boreal CZ – Tallinn (FR) & Kajaani (FC)

- Co-creation and participation tools
  - To **engage** citizens to participate in planning (Tallinn, Kajaani)
    - Limited, methods available
    - In all phases, planning new NBS till evaluation
  - To get input from experts and universities (Kajaani)
  - To **assess the degree satisfaction** after NBS implementation (Tallinn, Kajaani)
  - Digital Twin should be connected (Tallinn, Kajaani)
  - *2 workshops done with experts, TALTER cocreation tool* (Tallinn)
  - *Co-creation mobile app (crowd-sourced), interactive social media campaigns* (Kajaani)



The **prioritisation of use cases** marked an impactful step in guiding the technical development of the URBREATH Toolbox. By selecting specific use cases as focus points, the technical teams can concentrate their efforts on building tools, functionalities and simulation models that respond to the most urgent and relevant needs identified by the pilot cities.

This prioritisation provides a **clear direction** for translating the validated list of functional requirements into concrete technical developments, as described in the next chapter.

The following list presents the prioritised use cases that will guide initial technical implementation efforts.

Table 1: Prioritised use cases selected by all URBREATH pilot cities.

	Use case 1	Use case 2	Use case 3
Tallinn	Explore NBS locations for treating snow meltwater & understand effectiveness.	Assess residents' satisfaction of redesigned NBS site.	Understand changes in accessibility of the NBS site.
Kajaani	NBS concepts for better water management (flood-proof city).	Cost-benefit estimation for different NBS.	Understanding on biodiversity support mechanisms related to NBS.
Leuven	Get input and interaction with stakeholders to shape their case (using LL and LDTs).	Monitor environmental effects and ecosystem services resulting from the redesign of the square.	Monitor social justice & wellbeing.
Aarhus	Monitor traffic changes after increasing pedestrian zone surface.	Monitor the residents' liveability after NBS implementation.	Simulation of square reorganisation in an LDT environment to inform the community.
Cluj-Napoca	Demonstrate value of NBS (f.i. green pockets) and involve community in co-creation.	Integrate greening simulations in the local digital twin.	Understand changes in shaded areas and CO2 emission after NBS implementation.
Pilsen	Investigate traffic impact of NBS, using a LDT.	Investigate impact on air quality, noise, heat & shadow impact using a LDT.	Monitor the perception of residential quality and safety of the square (after NBS).
Madrid	Centralise past/ongoing studies, plans, interventions for the Villaverde district.	Organisation training/codesign sessions. Centralise existing info about potential NBS Villaverde.	LDT-visualisation of datasets & simulations for better insights of district officials.
Parma	Engage technicians & administrations in NBS co-creation.	Simulations/tests of green renovation actions in a LDT.	Collect & share info on green strategies.
Athens	Detect potential areas for pocket parks, green walls & other NBS.	Analyse changes of heat island effects caused by NBS implementations.	Analyse changes of heat island effects caused by NBS implementations.

3. Translation to technical tasks

Following the General Assembly, Work Packages 3 and 4, supported by WP5, undertook a detailed **feasibility analysis** and initiated the **conceptual development of solutions** targeting the prioritised use cases of the front-runner cities. This process was guided by the user requirements articulated during earlier co-creation workshops. In parallel, a cross-referenced overview of the involved WPs was compiled to ensure clear delineation of responsibilities, promote interdisciplinary coordination, and support the integration of functional and technical inputs into the design of context-sensitive tools and models.

Table 2: Prioritised use cases selected by all URBREATH front-runner pilot cities and the WPs involved.

Use case	Use case (corrected by pilots)	Input needed from
Boreal - Tallinn		
BOR-TAL-1	Tallinn wants to explore possibilities of location of specific NBSs for snow meltwater solutions ON SITE. AND Tallinn wants to understand the effectiveness of the selected NBS for snow meltwater infiltration.	WP3-4, WP6
BOR-TAL-2	Tallinn wants to assess local residents' **satisfaction** with the area (after the implementation of the NBS).	WP3-4, WP5
BOR-TAL-3	Tallinn wants to understand the changes in accessibility in the area (after the NBS), i.e. visitors' number / more users from the vulnerable groups (for example children).	WP3-4, WP6
Continental – Cluj-Napoca		
CON-CLU-1	Cluj-Napoca wants to demonstrate the value of green pockets for multi-family housing areas. AND Cluj-Napoca wants to involve community in co-creation (i.e. trees selection and planting).	WP3-4, WP5, WP6
CON-CLU-2	Cluj-Napoca wants to integrate greening simulations in the local digital twin.	WP3-4, WP6
CON-CLU-3	Cluj-Napoca wants to understand the changes (increase?) in shaded areas (after the NBSs implementation). AND Cluj-Napoca wants to understand the reduction in CO2 emissions (after the NBS).	WP3-4
Mediterranean - Madrid		
MED-MAD-1	Madrid wants to centralise past/ongoing studies, plans, interventions for the Villaverde district.	WP3-4
MED-MAD-2	Madrid wants to organise training and codesign sessions. AND Madrid wants to centralise existing information **about potential NBS** for the Villaverde district.	WP3-4, WP6
MED-MAD-3	Madrid wants to offer LDT-visualisation of datasets, simulations to district officials to get a better knowledge and insights.	WP3-4

Atlantic - Leuven		
ATL-LEU-1	Leuven wants to get input and interaction with stakeholders to shape their case (using LLL and LDTs).	WP3-4, WP5, WP6
ATL-LEU-2	Leuven wants to monitor environmental effects and ecosystem services resulting from the redesign of the square.	WP3-4, WP6
ATL-LEU-3	Leuven wants to monitor social justice & wellbeing.	WP3-4, WP5

3.1 Preparative brainstorm sessions with the front-runner cities

Following several rounds of intensive deliberation, each front-runner pilot city was individually invited to participate in a series of weekly WP3-WP4 brainstorming sessions held throughout October 2024.

These dedicated 120-minute sessions served as focused exchanges during which preliminary solution concepts—developed by the technical partners based on their expertise and experience—were presented and critically discussed with the respective pilot cities. When necessary, alternative approaches were explored and evaluated. The direct feedback and contextual insights provided by the pilots enabled the refinement and adaptation of the proposed technical solutions to better align with local requirements and constraints.

WP5, within the scope of Task 5.2, played an active and moderating role in these sessions, fulfilling a dual function: on the one hand, consolidating the spectrum of technical solutions under consideration; on the other, safeguarding the interests of the pilot cities by ensuring that their identified needs and priorities remained central to the decision-making and development processes.

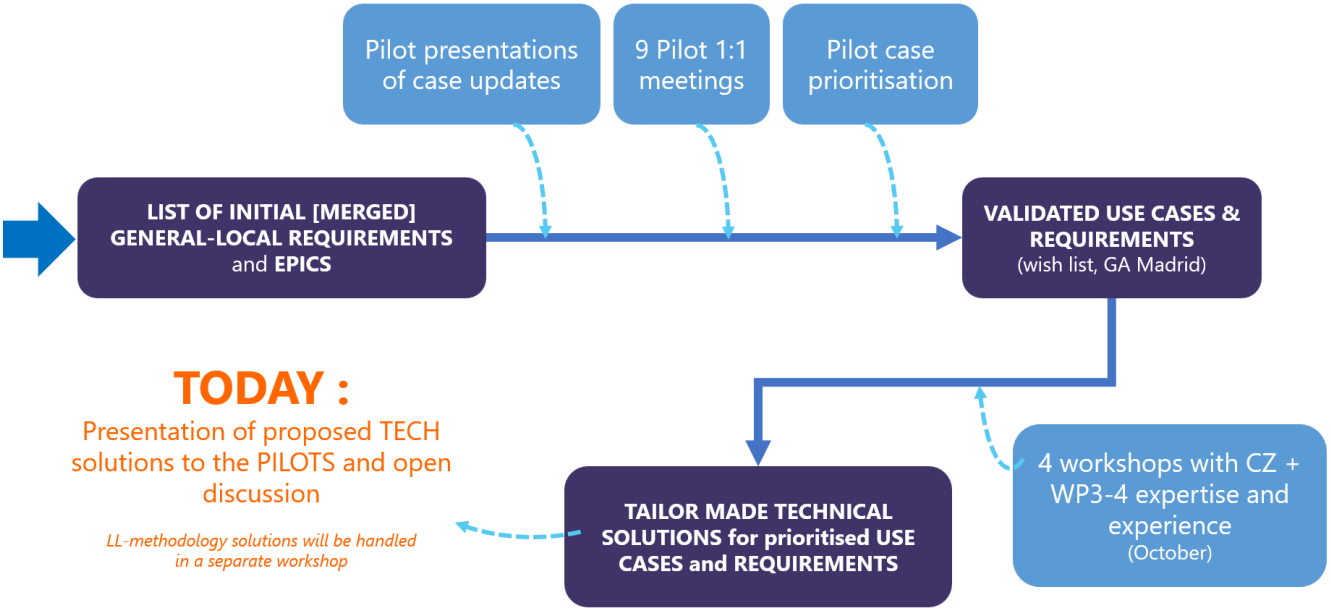
Figure 15: Brainstorming session with representatives from the front-runner city of Tallinn, featuring the presentation and discussion of potential solution concepts addressing prioritised use cases.

3.2 Tech partners presenting their technical solutions to pilots

After processing all feedback from the brainstorm sessions, a series of four 120-minute front-runner pilot sessions was organised, starting in mid-November, where the technical partners presented their mature solution ideas and alternatives to the pilot cities. During these interactive sessions, missing and additional information was gained from the pilots.

WP5 **prepared, chaired and moderated** these meetings in detail as part of Task 5.2.

Figure 16: Framing the roadmap for the development of tools and simulation models: Following the brainstorming sessions described in the previous chapter, the technical partners presented their proposed technical solutions to the front-runner pilot cities.



The following use case (front-runner city Leuven) illustrates the structured approach adopted during the technical consultation meetings. For each front-runner pilot, all three prioritised use cases were examined in detail. For every use case, various ideas were worked out and the corresponding functional requirements—enriched with information gathered during the brainstorming sessions of Chapter 3.1—were reviewed, and mature solution pathways were proposed.

This exercise also served as a **continued mapping of data and model availability, as well as identifying gaps**. Data that were confirmed to be available were highlighted in green, whereas missing or incomplete datasets were marked in orange. This visual coding facilitated a clear understanding of the data landscape associated with each use case. This gap analysis served as the basis for establishing a **data inventory**, as part of Task 5.4 and described in Chapter 5.

Where feasible, live demonstrations of tool functionalities were integrated into the sessions. In particular, within the LDT environment, selected data layers were already operational at the time of presentation. Notably, the shadow impact simulator was functional and demonstrated to stakeholders, providing an early example of how integrated tools could support spatial analysis and decision-making.

Figure 17: Overview of the approach applied during the November 2024 workshops with front-runner pilot cities. For each prioritised use case, multiple solution concepts were presented with detailed functional specifications, data availability assessments, and live demonstrations, such as the LDT shadow impact simulator.

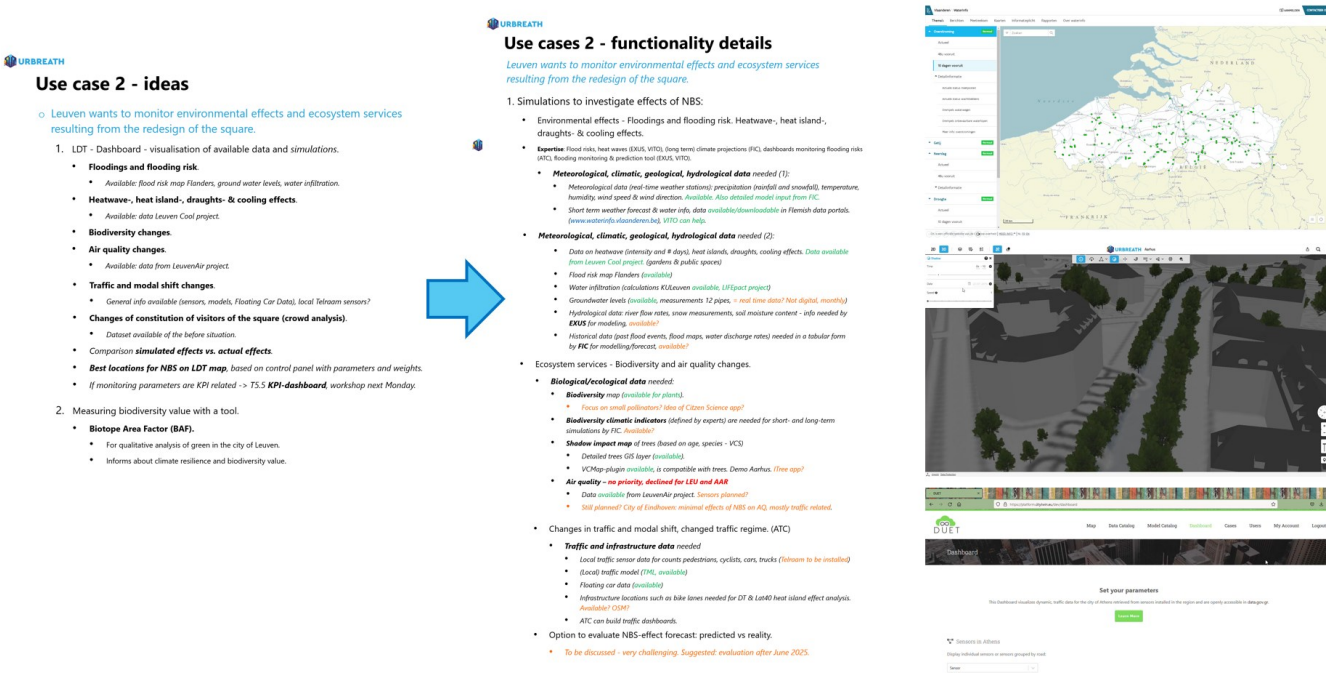


Figure 18: Detail of figure 17, showing functional details of an idea worked out by the technical partners of WP3-4.

URBREATH

Use cases 2 - functionality details

Leuven wants to monitor environmental effects and ecosystem services resulting from the redesign of the square.

1. Simulations to investigate effects of NBS:

- Environmental effects - Floodings and flooding risk. Heatwave-, heat island-, draughts- & cooling effects.
- **Expertise**: Flood risks, heat waves (EXUS, VITO), (long term) climate projections (FIC), dashboards monitoring flooding risks (ATC), flooding monitoring & prediction tool (EXUS, VITO).
  - ***Meteorological, climatic, geological, hydrological data*** *needed (1):*
    - *Meteorological data (real-time weather stations): precipitation (rainfall and snowfall), temperature, humidity, wind speed & wind direction. Available. Also detailed model input from FIC.*
    - *Short term weather forecast & water info, data available/downloadable in Flemish data portals. (www.waterinfo.vlaanderen.be), VITO can help.*
  - ***Meteorological, climatic, geological, hydrological data*** *needed (2):*
    - *Data on heatwave (intensity and # days), heat islands, draughts, cooling effects. Data available from Leuven Cool project. (gardens & public spaces)*
    - *Flood risk map Flanders (available)*
    - *Water infiltration (calculations KULeuven available, LIFEpact project)*
    - *Groundwater levels (available, measurements 12 pipes, = real time data? Not digital, monthly)*
    - *Hydrological data: river flow rates, snow measurements, soil moisture content - info needed by **EXUS** for modeling, available?*
    - *Historical data (past flood events, flood maps, water discharge rates) needed in a tabular form by **FIC** for modelling/forecast, available?*
- Ecosystem services - Biodiversity and air quality changes.
  - ***Biological/ecological data*** *needed:*
    - ***Biodiversity*** *map (available for plants).*
      - *Focus on small pollinators? Idea of Citzen Science app?*
    - ***Biodiversity climatic indicators*** *(defined by experts) are needed for short- and long-term simulations by FIC. Available?*
    - ***Shadow impact map*** *of trees (based on age, species - VCS)*
      - *Detailed trees GIS layer (available).*
      - *VCMap-plugin available, is compatible with trees. Demo Aarhus. ITree app?*
    - ***Air quality – no priority, declined for LEU and AAR***
      - *Data available from LeuvenAir project. Sensors planned?*
      - *Still planned? City of Eindhoven: minimal effects of NBS on AQ, mostly traffic related.*
  - Changes in traffic and modal shift, changed traffic regime. (ATC)
    - ***Traffic and infrastructure data*** *needed*
      - *Local traffic sensor data for counts pedestrians, cyclists, cars, trucks (Telraam to be installed)*
      - *(Local) traffic model (TML, available)*
      - *Floating car data (available)*
      - *Infrastructure locations such as bike lanes needed for DT & Lat40 heat island effect analysis. Available? OSM?*
      - *ATC can build traffic dashboards.*
  - Option to evaluate NBS-effect forecast: predicted vs reality.
    - *To be discussed - very challenging. Suggested: evaluation after June 2025.*

3.3 Listing and prioritising technical functionalities

Building upon the work outlined in the previous chapter, and following the integration of feedback collected from the front-runner pilot cities, a comprehensive and consolidated list of technical functionalities was developed. This list captures all functionalities required to address the prioritised use cases of the front-runner pilots and reflects their functional requirements in a structured and actionable format.

To enhance readability and facilitate coordination among the technical teams, the identified functionalities were organised into six thematic domains:

1. Central catalogue & library
2. Case demonstration tool
3. Digital Twin viewer
4. Simulations and scenario analysis
5. Impact and effect analyses
6. E-participation tools

Additional metadata was incorporated into the list to improve its operational value:

- The responsible technical teams for each solution were clearly indicated.
- Each entry includes a concise functionality description, an explanation of the proposed solution, and an overview of the required datasets.
- The applicability of each functionality to individual front-runner cities was documented, providing an at-a-glance view of commonly required features. This served as a proxy indicator for development prioritisation.
- A technical prioritisation exercise, carried out in close coordination with the technical partners and based on pilot input and use case relevance, further refined the implementation roadmap.

This deliverable marks a **major milestone** for Work Package 5—particularly Task 5.2—as it completes a comprehensive trajectory: from co-creative mapping of epics and user stories to the derivation of user requirements, translation into technical needs, and ultimately, the **formulation of a detailed development plan** for all required technical functionalities. Moreover, this list formed the foundational input for the **data inventory** process led by Task 5.4, as described in Chapter 5.

The finalised table is provided in Annex III. It was formally delivered to the technical partners in late December 2024 and has since served as a key reference for defining the subsequent detailed implementation tasks.

3.4 Task 5.2: facilitating and boosting technical development processes

Task 5.2 played a pivotal role in facilitating the translation of pilot-specific functional needs into actionable technical developments across Work Packages 3 and 4 (WP3-WP4). Beyond the co-creative workshops described earlier (Chapter 3), Task 5.2 remained actively engaged at multiple levels in supporting the technical teams to ensure the co-development of tools and simulation models was fully aligned with the contextual realities and requirements of each pilot city.

3.4.1 Active engagement in WP3-WP4 activities and meetings

Task 5.2 contributed substantially to the operationalisation of pilot city requirements through continuous participation in WP3-WP4 coordination meetings and technical activities. This included:

- Representing and safeguarding the functional interests of the pilot cities, ensuring that pilot-specific requirements were accurately communicated and continuously reflected in the technical development processes.
- Participating in and contributing to events such as the Demo Café during the General Assembly in Cluj-Napoca (May 2025), showcasing early-stage tools and simulations.
- Chairing critical technical meetings and workshops, including:
    - Internal WP3-WP4 workshops focused on translating pilot cities' functional requirements into technical specifications and simulation prototypes.
    - Four co-creation workshops involving direct interaction between pilot city stakeholders and technical development teams (referenced in Chapter 3).
    - The strategic face-to-face technical coordination meeting in Brussels (April 2025), which Task 5.2 prepared, moderated, and facilitated.

3.4.2 Strengthening pilot - technical team collaboration

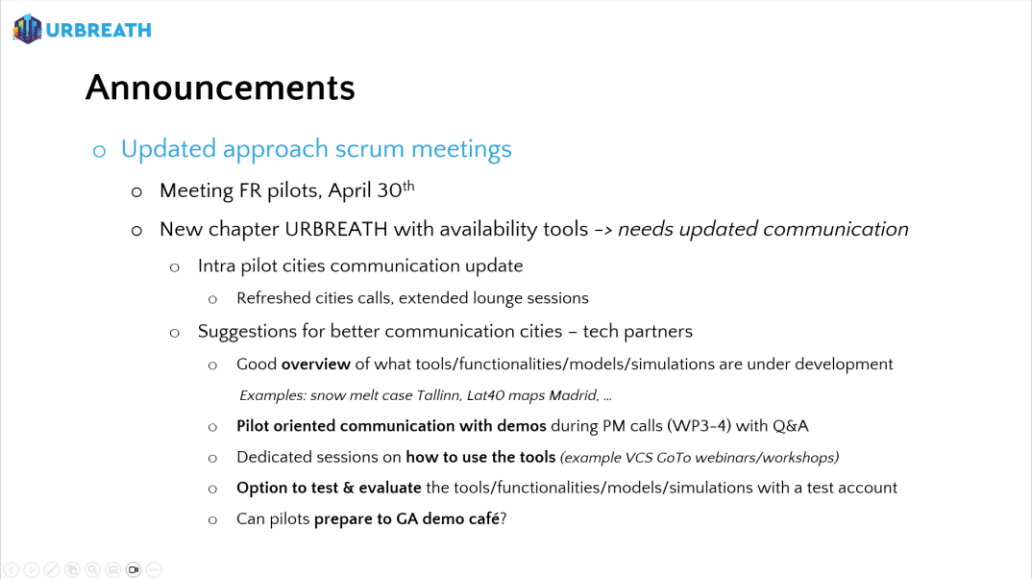
Task 5.2 acted as an essential interface between pilot cities and technical partners, actively promoting knowledge exchange and co-development. Key activities included:

- Following the initial demonstration of tools by the technical teams during the Cities Call on 9 May 2025, it became evident that the existing structure of the alternating bi-weekly Project Management and Cities meetings **required revision of their format** to better support ongoing technical collaboration and feedback integration.

  In response to this identified need, an **internal coordination meeting** was convened and facilitated at the end of April 2025, involving representatives from the front-runner pilot cities. The objective was to gather

targeted feedback and identify actionable improvements in communication and coordination mechanisms. The outcomes of this session, comprising concrete suggestions to enhance dialogue between pilot cities and technical teams, were subsequently presented during the following monthly cities call held in early May 2025.

Figure 19: Overview of various suggestions from URBREATH front-runner cities to streamline the communication with technical partners as presented to the URBREATH consortium in May 2025.



As a result, several consortium-wide improvements were implemented:

- A consolidated overview of tools, functionalities, models, and simulations currently under development made by the technical partners of WP3 and WP5.
- Tool-specific demonstration sessions led by the technical development teams.
- The introduction of a new format for the dedicated monthly pilot cities meetings chaired by WP5, more oriented to the pilot cities' needs.

- **Facilitating tailored interactions between pilots and technical teams**. Notable examples include the one-to-one in-depth sessions on:
  - The Tallinn snow melt use case
  - The use of the e-participation tool survey options in Kajaani
  - The integration of the 3-30-300 index, the exploration of augmented reality (AR), virtual reality (VR) options and the setup of a LDT environment with integration of traffic modelling in the city of Leuven

- The monitoring of well-being in Aarhus
- Climate risk modelling (heat stress, flooding) in Madrid
- Air quality sensor deployment in Cluj-Napoca

- **Representing WP5 and technical team interests** in meetings where pilot cities (Madrid, Leuven and Athens) proposed updates to their use-case locations, ensuring continuity and alignment with Tasks 5.4 (data needs), 5.5 (dashboards), and 5.6 (KPIs) and the tools and simulation models developed by the technical teams.

- Development of a **standardised reporting template** for pilots to summarise their case-specific progress, enabling consistent communication and technical alignment across the consortium. Pilots were encouraged to maintain and regularly update this documentation.

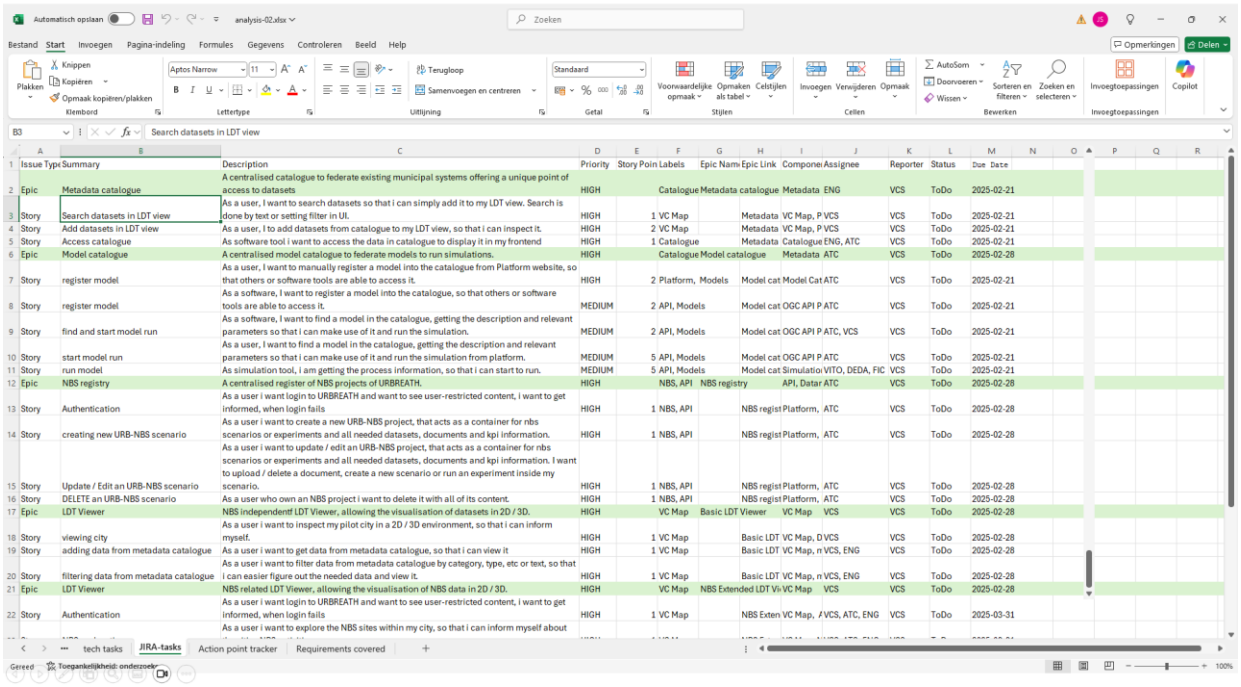
3.4.3 Provision of technical and methodological support

Task 5.2 also supported technical teams through structured project and workflow management mechanisms, most notably:

- Supporting the setup and implementation of a **JIRA-based project management platform** to monitor the progression of the technical teams in a structured way.

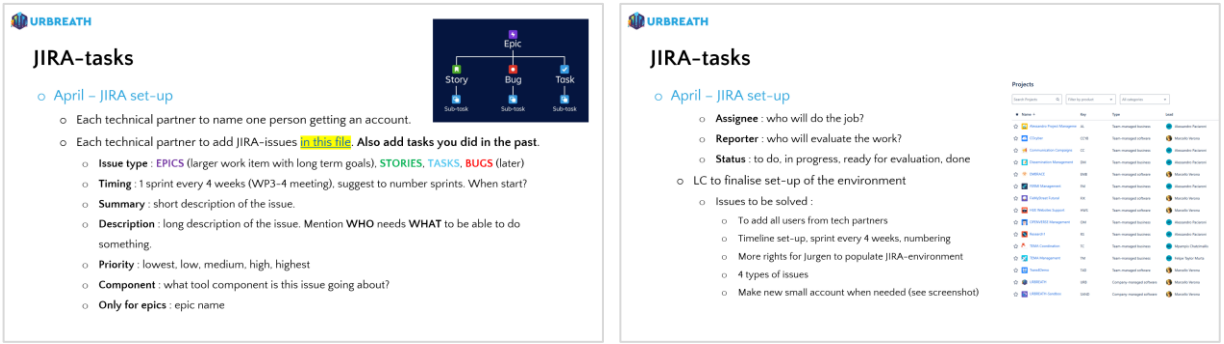
  Following collaborative JIRA training workshops in May and June 2024, WP5 identified and presented additional requirements to optimise the JIRA environment at a technical coordination meeting in Brussels (April 2025). The first draft of a series of technical tasks to be integrated into the JIRA environment was developed and circulated.

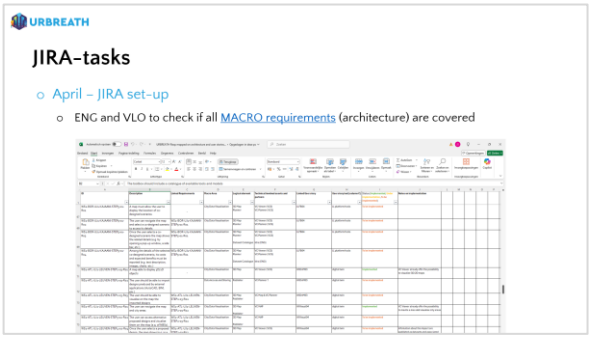
Figure 20: Initial translation of technical development tasks into JIRA stories and actionable items, supporting structured implementation and agile project management.

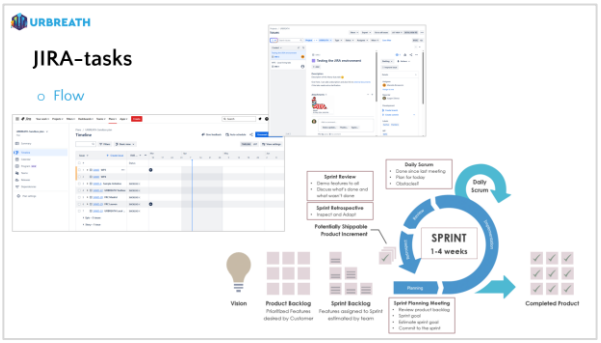


In April 2025, WP5 organised a dedicated training workshop to introduce and operationalise the use of the JIRA platform among all technical partners. During this session, the functionalities of JIRA for project coordination, task tracking, and sprint planning were systematically presented. In parallel, a comprehensive registry of JIRA accounts was established, ensuring the inclusion of at least one designated representative from each participating technical partner organisation.

Figure 21: Selection of instructive PowerPoint slides presented during the technical partners' training workshop on the use of the JIRA platform and ticketing system, held in April 2025.

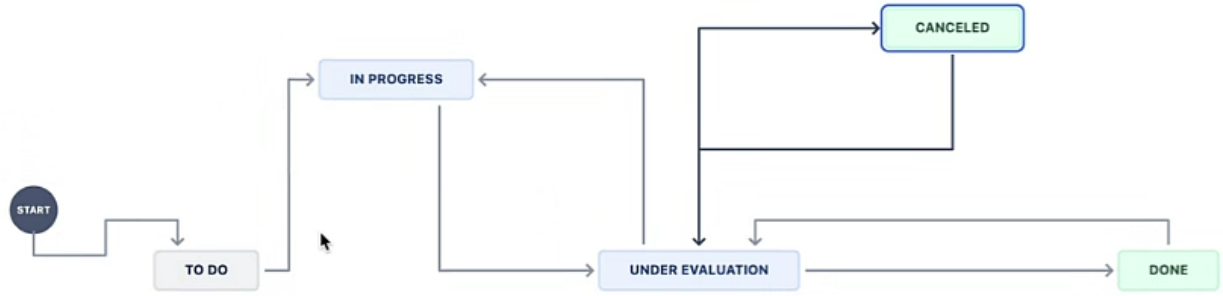






By mid-May, detailed technical specifications were provided to the Lisbon Council, allowing for the full configuration of the JIRA platform, including sprint definitions (every 4 weeks), a customised workflow, and the generation of JIRA tickets corresponding to active development stories, tasks, sub-tasks and/or bugs.

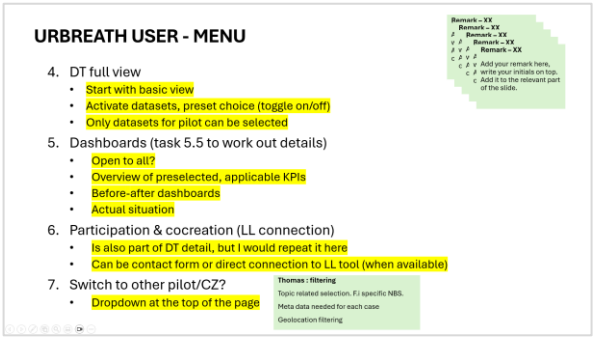
Figure 22: Schematic visualisation of the JIRA workflow for the URBREATH technical partners.

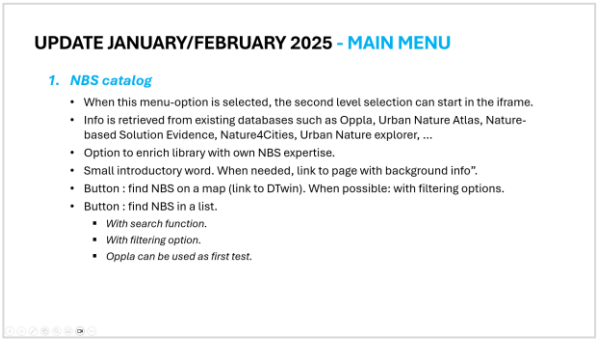


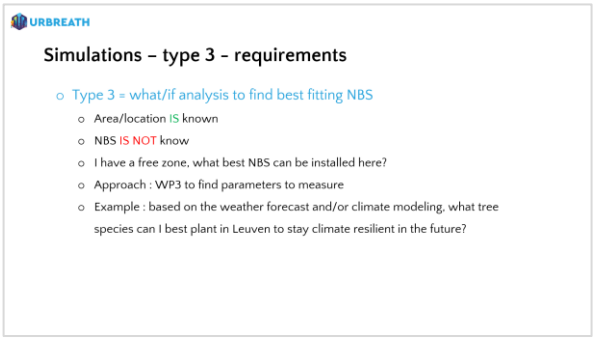
- **Contributing to User Interface (UI) and User Experience (UX) design processes**

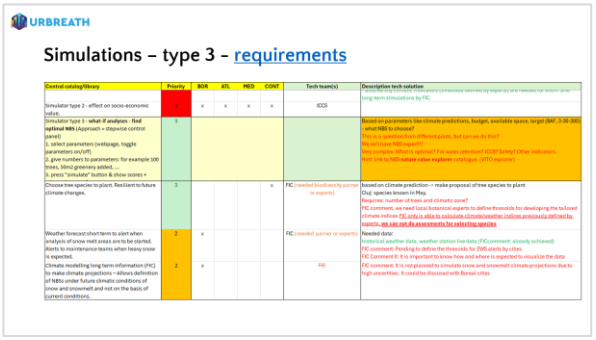
  Task 5.2 collaborated with technical partners to ensure end-user needs were reflected in the development of intuitive mock-ups and functional prototypes. This included structuring the URBREATH Toolbox landing page (in cooperation with ATC) and developing UI/UX approaches for simulations (with ATC and VCS).

Figure 23: Selected slides exploring the structure of the URBREATH Toolbox landing page and UI/UX design approaches for simulation interfaces, supporting the development of intuitive and user-oriented digital tools.









- Sharing our WP5 **General Data Protection Regulation (GDPR) related expertise** in the context of setting up test environments, including the implementation of GDPR-compliant test accounts and the formulation of appropriate legal disclaimers for the Toolbox landing page. These activities were carried out in close collaboration with DBC Diadikasia, ENG, and TEL to ensure full adherence to data protection regulations and ethical standards.

4. The quest for KPIs

KPIs serve as essential tools for the systematic **monitoring and evaluation of NBSs**. They offer quantifiable metrics that enable the assessment of NBS performance across environmental, social, and economic dimensions. The structured definition and continuous tracking of KPIs not only support evidence-based validation of NBS effectiveness but also facilitate the identification of areas requiring refinement. Moreover, KPI frameworks contribute to adaptive management practices and inform strategic decision-making in future NBS planning and implementation.

A critical milestone within the URBREATH project is associated with the development and delivery of the KPI framework: **Milestone 7**. This milestone stipulates that a consolidated and validated local/regional KPI list must be available by **June 30th, 2025 (M18)** of the project timeline. **Task 5.6** started in month 10 of the URBREATH project and takes a leading role in fulfilling this task.

Beyond its administrative significance, the KPI list also serves as a foundational input for a range of technical developments, including the design and implementation of monitoring dashboards (**Task 5.5**), the integration and alignment of relevant datasets (listed in the data inventory set up by **Task 5.4**), and the development of simulation and impact assessment models by the URBREATH technical partners. These tools are essential for enabling evidence-based monitoring of NBS implementations and for supporting decision-making within the pilot cities.

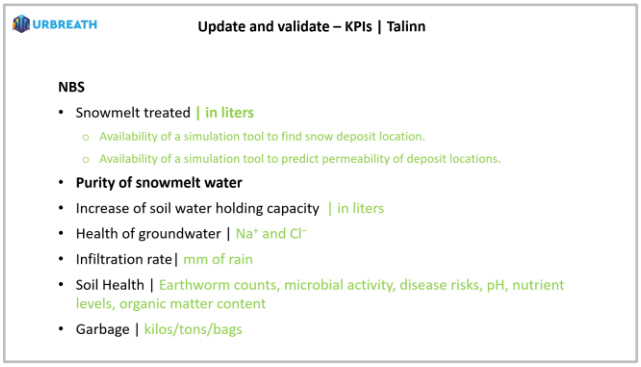
4.1 Pilot-driven KPI baseline analysis through Living Lab engagements

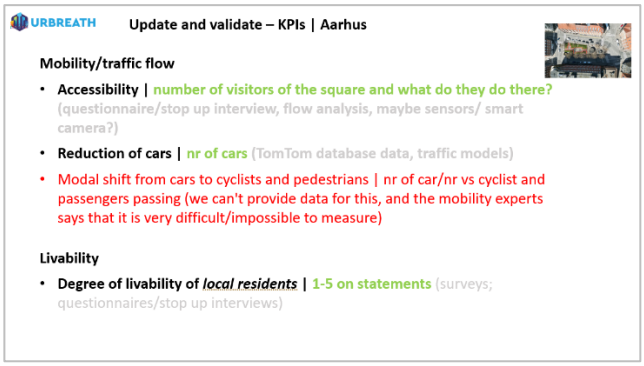
As part of a coordinated effort to advance KPI development within the URBREATH project, a series of four LL workshops was conducted in November and December 2024.

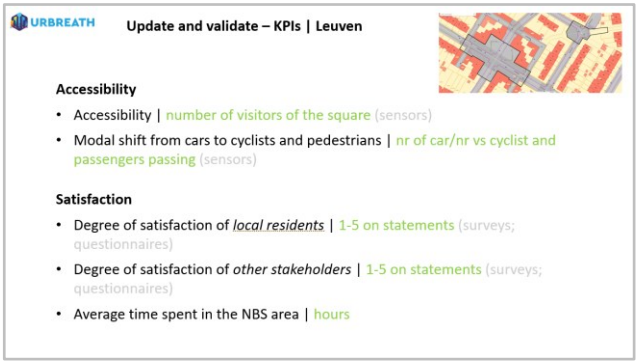
These workshops grouped pilot cities by climatic zone, enabling peer exchange and contextualised discussion. A primary objective of these sessions was to collect in-depth, qualitative, and quantitative input on KPIs relevant to each city's prioritised use cases, in addition to the information gathered during the one-to-one workshops with the pilots in September 2024 and separate meetings.

The workshops drew upon multiple sources to inform the discussions: citizen-led use case presentations, previously documented requirements, and the initial KPI framework outlined in the URBREATH Grant Agreement. Facilitators used targeted, guiding questions to elicit further insights from the pilot representatives, including challenges related to data availability, local relevance of specific indicators, and potential baselines.

Figure 24: Selection of slides from an initial exploratory exercise conducted in late 2024, aimed at defining the foundational aspects of KPIs—what to measure, how to measure it, and in which units—for the pilot cities of Tallinn, Aarhus, and Leuven.







As a follow-up to these sessions, each pilot city was assigned a homework task at the end of 2024 to complete and validate its KPI list. This exercise aimed to ensure that the selected KPIs reflected both the local LL context and the overall project goals.

In early 2025, a first provisional KPI list was compiled based on the contributions received from the pilot cities. This initial synthesis—summarising the state of KPI identification across all pilot contexts—can be found in Annex IV.

Additionally, a first plan of approach for further steps towards KPI definition was established and discussed with the T5.6 lead.

4.2 Monitoring and evaluation framework planning under Tasks 5.5 and 5.6

In December 2024, a **preliminary draft plan of approach** for Task 5.6 was developed and subsequently discussed with the task leads to establish a strategic framework for monitoring the implementation and performance of NBSs across the URBREATH pilot cities. The draft outlined the intended goals and explored the potential application of a suite of digital tools—such as LDTs, KPI monitoring dashboards, impact simulation models, scenario builders, and e-participation modules—as instruments for both qualitative and quantitative performance assessment.

Particular attention was given to the role of **LLLs as enabling platforms** for the iterative collection of stakeholder feedback, grounded in the tools developed within the URBREATH Toolbox. The plan also aimed to identify mechanisms for mapping impact expectations, collecting data from LLL managers, and integrating findings into a broader performance evaluation and replication strategy.

Moreover, the draft emphasised the necessity of developing **robust monitoring protocols** that would ensure cross-WP alignment, enable comparative KPI evaluation, support methodological consistency, and facilitate long-term monitoring, replication, and upscaling efforts. These protocols were envisioned as integral to linking local NBS implementation outcomes with the scientific and technical expertise distributed across Work Packages 2, 4, and 7.

Following this initial effort, the Task 5.6 leads refined and expanded the approach, resulting in a finalised work plan presented in mid-January 2025. This plan was structured into four complementary subtasks:

- Subtask 1: Development of a performance evaluation and impact assessment framework (M13–M24)
- Subtask 2: Ex-ante impact simulation (M18–M30)
- Subtask 3: Monitoring of NBS implementation (Until M42)
- Subtask 4: Ex-post performance evaluation (M37–M48)

For **Subtask 1**, which sets the foundation for the entire monitoring process, a clear sequence of methodological steps was defined:

1. Status quo analysis: Comprehensive assessment of the current situation, including existing baseline data in each pilot city and what objectives they aim to achieve through NBS interventions.
2. Selection of KPI sets and data collection methods: Identification of relevant KPIs, along with corresponding data sources and methodologies.
3. Organisation of climate zone-specific working sessions: Stakeholder engagement sessions to refine evaluation approaches and contextualise pilot objectives.

4. Development of a monitoring and impact evaluation methodology: Integration of partner expertise to ensure methodological coherence.
5. Formulation of local monitoring and data collection plans: Design of city-specific monitoring protocols aligned with the roadmap developed under Task 7.5.

This structured and participatory approach ensures scientific rigour while supporting locally contextualised monitoring strategies, thereby enabling the URBREATH project to assess the effectiveness, replicability, and long-term sustainability of implemented NBS solutions.

4.3 KPI maturation and validation: iterative coordination with pilot cities

The initial compilation of KPIs was further developed and refined by the Task 5.6 leads through an iterative, process. This refinement phase involved **enriching the preliminary list of KPIs** with complementary inputs from diverse sources such as other Monitoring and Evaluation Frameworks developed in EU Horizon Projects (e.g. EU CITYkeys, INTERLACE) as well es KPI Sets related to sustainable and climate resilient urban development (e.g. ISO 37123:2019, titled "Sustainable Cities and Communities – Indicators for resilient cities"), including bilateral consultations with pilot cities. Additional critical metadata—such as target values, units of measurement, and references to data sources—were incorporated to ensure the operational validity and analytical robustness of the KPIs.

In **early March 2025**, all pilot cities were formally briefed on the ongoing methodology. The objectives and necessity of developing a performance evaluation and impact assessment framework were explained. During these engagements, the procedural roadmap was clarified, and the essential components of a well-defined KPI—namely, its goal, metric, target value, and temporal scope—were illustrated using practical examples.

The KPIs were organised into eight thematic categories to ensure comprehensive coverage across domains:

1. Mobility
2. Biodiversity
3. Climate resilience
4. Environment and pollution
5. Liveability, social justice, and equity
6. Knowledge and awareness
7. Governance and participatory planning
8. Local economy

A preliminary KPI list was shared with the **Task 5.5 lead** to initiate the parallel development of technical NBS-monitoring tools and dashboards.

By the **end of March 2025**, Task 5.6 provided a draft KPI set for each pilot city. The city-specific KPIs proposed in this draft version are primarily based on the results of the LLL approach. Pilots were tasked with reviewing and confirming the applicability of each KPI, including the provision of target values, timelines, and data sources. The initial deadline for this validation was set for April 30, 2025.

However, by the deadline, it became evident that most cities had not completed the assignment. This delay was discussed during the monthly pilot coordination meeting on **May 9**, 2025. Several constraints were identified. In some cases, monitoring certain KPIs depended on external stakeholders, requiring formal contracts and budgetary allocations. In others, defining target values was politically sensitive or administratively complex, necessitating prolonged internal approvals.

To address these challenges, Task 5.6 revised the KPI list and adjusted the engagement strategy in **mid-May 2025**. KPI overviews were reorganised, and preliminary suggestions for target values were provided to facilitate validation. Pilot cities were encouraged again to engage directly with the Task 5.6 team to address context-specific concerns. Concurrently, technical partners were involved in assessing the feasibility and potential integrations of KPI monitoring into existing and forthcoming simulation models and digital tools.

A **revised KPI evaluation** was conducted during the URBREATH General Assembly held in Cluj-Napoca on May 21st, 2025. Based on this assessment, the final deadline for KPI validation needed to be postponed to June 6th, 2025. *A summary of the Task 5.6 presentation, including the adjusted approach and findings, was published on the URBREATH project website for broader dissemination and transparency.*

Highlighting the Technical Dimension of Living Labs: Cluj-Napoca Workshop Insights

On May 21st, 2025, during the URBREATH General Assembly in Cluj-Napoca, a dedicated technical session was held to assess progress under the Work Package 5 (Living Labs) tasks, more specifically T5.4 (Data Inventory and Digital Twin Integration), T5.5 (Dashboard Development), and T5.6 (KPI Definition and Monitoring). This session brought together the leads of each task and pilot city representatives to align technical efforts and address outstanding challenges.

Opening Remarks and Strategic Context

Jurgen Silence (Digital Flanders), lead of Work Package 5, opened the session by outlining the agenda and sharing preliminary reflections. He emphasised several critical issues currently affecting WP5 progress, chief among them the persistent lack of data across multiple pilot cities, particularly within T5.4's data inventory and T5.6's KPI framework. Jurgen underscored the interdependence of these data inputs with the functionality of the monitoring dashboards and the broader evaluation mechanisms for various URBREATH's digital tools.

To ensure feasibility and focus, Jurgen issued a clear directive: Key Performance Indicators (KPIs) deemed unmeasurable must be removed from the list, and a revised, finalised KPI selection must be submitted by a set deadline.

T5.4: Progress on Data Inventory and Local Digital Twins

Thomas Adolphi (VCS) provided a comprehensive update on Task 5.4, which has become increasingly central as the URBREATH digital tools enter the testing and evaluation phase in the pilot cities. His presentation followed a successful tool demonstration held earlier that day during the demo café, which generated considerable interest among pilot representatives.

Thomas detailed the recent activities undertaken to support the integration of Local Digital Twins (LDTs) with the broader data ecosystem. This included the development of a flexible webinar format that allows technical partners to showcase their tools, a series of webinars he gave focusing on the customisation of LDTs and their associated storytelling functionalities, and targeted one-on-one support sessions to tailor LDT configurations to local needs.

He presented an in-depth overview of the current status of the data inventory for each pilot city, along with plans for future support from **Zehra Koç**, who will assist in finalising these data sets. In addition, Thomas clarified the distinction between data types for visualisation versus those required for analysis and KPI monitoring. He concluded with a forward-looking outline of possible tool deployment scenarios at the local level, highlighting both opportunities and infrastructure prerequisites.

T5.5: Dashboard Development and Visualisation Frameworks

Antonella Tozzi (Municipia) followed with a detailed presentation on Task 5.5, focusing on the development of dashboards for monitoring and decision support. She outlined the developmental timeline and reported on the current status within that trajectory. Using a demo case, Antonella illustrated how real-world needs and stakeholder input are shaping the structure and functionality of the dashboards.

The preliminary interface design and visualisation logic were also shared, giving participants a first glimpse into the look and feel of the tools under development. The dashboards are being developed with a strong emphasis on usability, adaptability to local contexts, and the capacity to visualise both real-time and cumulative data, enabling evidence-based co-design decisions.

T5.6: KPI Framework and Monitoring Strategy

The final presentation was delivered by **Alisa Krumm** (Fraunhofer), who reported on the progress of Task 5.6 concerning KPI selection, definition, and data readiness. Despite extensive consultations, the KPI lists provided by the pilot cities remain incomplete. Alisa presented a detailed matrix of missing data elements of each pilot city and clarified the expectations for completion ahead of the internal deadline of June 6th.

She reiterated the critical role of KPIs in assessing the effectiveness of nature-based solutions and digital co-design processes, emphasising the importance of defining realistic target values, associated timelines, and data availability conditions. Moreover, cities were provided with assistance to define target values for their NBS KPIs. It was recommended that municipalities reference objectives from existing local climate and sustainability strategies or align with applicable national environmental standards to ensure consistency with broader policy frameworks. This approach facilitated the integration of local sustainability targets with established regulatory benchmarks and strategic climate commitments.

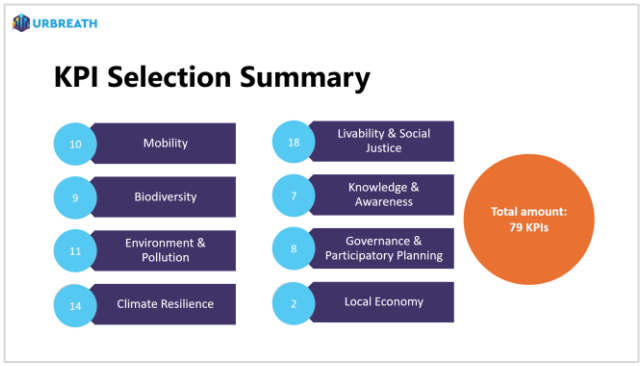
Alisa also outlined the next steps for each pilot city to meet Milestone 7 (Month 18), which requires fully defined and operational KPI frameworks by the end of June 2025.

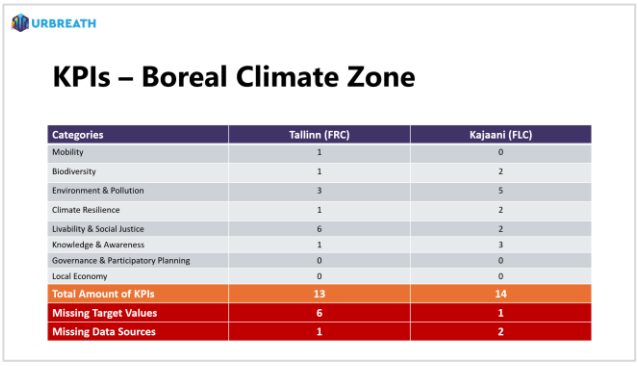
Throughout the 3-day General Assembly, WP5 task leads engaged directly with pilot representatives, offering technical guidance and hands-on support to overcome local bottlenecks. This collaborative approach reflects the project's Living Lab ethos, grounded in mutual learning and iterative development.

Conclusion

The technical workshop in Cluj-Napoca marked a pivotal moment in the operationalisation of URBREATH's Living Lab methodology. It reinforced the essential role of structured data collection, KPI alignment, and tool customisation in supporting urban transformation through nature-based solutions. As the project enters a more implementation-focused phase, coordinated technical action across all pilot cities remains crucial to realising the full potential of Digital Twins and participatory co-design in shaping resilient, inclusive urban futures.

Figure 25: Results of the pilot-specific KPI completeness analysis for Tallinn and Kajaani, presented by Task 5.6 at the General Assembly in Cluj-Napoca. The analysis revealed significant gaps, with many KPIs still lacking defined target values and identified data sources.





Following a new series of targeted direct consultations between pilot cities and the Task 5.6 leads—and a final coordination session during the monthly cities' call on May 30th, 2025, where pilots received specific guidance and clarifications—substantial progress was made in consolidating the KPI list.

By the established deadline of July 6th, 2025, most pilot cities had submitted their updated and refined KPI inputs. These inputs **included the key metadata elements** such as defined target values, temporal scopes, and data sources, in line with the framework developed under Task 5.6. A final tweaking round was organised by Task 5.6 between June 6th and 20th, addressing remaining data gaps and eliminating non-applicable KPIs from the assessment framework. From June 20th onward, the Task 5.6 team undertook the final consolidation of the KPI lists, ensuring thorough validation, standardisation, and quality control of the compiled datasets.

Following this, the consolidated KPI list was thoroughly reviewed in collaboration with the URBREATH project coordination team and relevant technical partners, **successfully fulfilling Milestone 7**. The final list of KPIs can be found in Annex V.

Notably, some target values remain undefined due to pending simulations, while others depend on NBS designs that are still under development. To address these challenges, a strategic plan was established to systematically manage incomplete entries and reduce uncertainty. This plan includes mitigation strategies, alternative data source identification, and technical feasibility assessments. The result is a more robust and context-sensitive framework for KPI monitoring and evaluation across all pilot cities.

4.4 Monitoring dashboards of Task 5.5.

Task 5.5 started in Month 10 of the URBREATH project. An **initial plan of approach** was presented by the Task 5.5 team during a series of four LLL workshops with the pilot cities at the end of 2024.

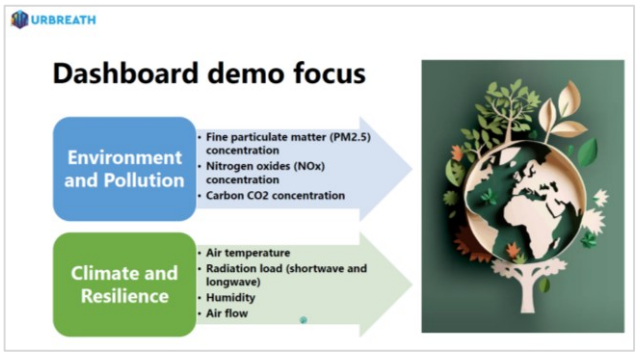
In the context of Task 5.5, the development of KPI monitoring dashboards is critically dependent on the availability of a validated and comprehensive list of KPIs. While KPI-aligned dashboards are central to performance tracking within the URBREATH framework, it is noteworthy that dashboards can also be leveraged for monitoring key environmental parameters even in the absence of direct KPI associations. In such cases, the monitored parameters are typically linked to the selection and implementation of NBSs at specific pilot sites. However, as of April 2025, detailed information regarding the selected NBS and their precise geographic deployment remains incomplete for several pilot cities. This data gap presents a significant limitation for the informed development and customisation of dashboards.

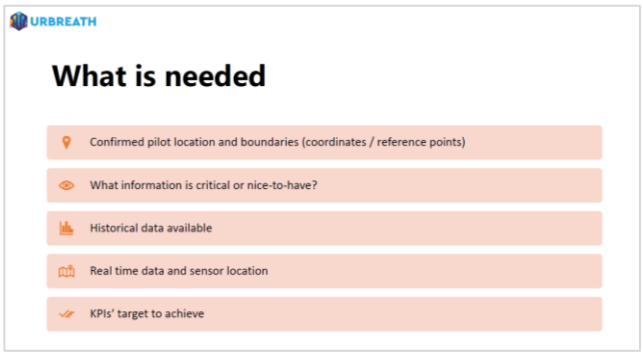
Despite these constraints, Task 5.5 proceeded with the foundational design of dashboard interfaces, ensuring visual alignment with the overall URBREATH identity and usability principles. Following the release of the preliminary KPI list in mid-April 2025, the task team initiated the development of two prototype dashboards intended to serve as demonstrators:

- An **“Environment and pollution” dashboard**, focusing on the continuous monitoring of fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), and carbon dioxide (CO_2) concentrations.
- A **“Climate and resilience” dashboard**, designed to track meteorological variables such as air temperature, radiation load, humidity, and airflow dynamics.

These dashboard prototypes were presented during the URBREATH General Assembly in Cluj-Napoca (May 2025), showcasing their analytical potential. Additionally, discussions were held on possible data acquisition strategies, including the use of open-access air quality datasets (e.g., OpenAQ), Sensor Things APIs, and calibrated high-resolution sensor networks.

Figure 26: Selected presentation slides by Task 5.5, showcasing the proposed plan of approach and initial dashboard prototypes during the General Assembly in Cluj-Napoca, May 2025.





The session concluded with a reiteration of the urgent need for pilots to provide missing data, particularly related to selected NBS implementations and associated monitoring priorities. This information is indispensable for refining the dashboard specifications and ensuring their relevance and accuracy in future iterations.

Figure 27: Preview of a dashboard prototype for monitoring Nitrogen Dioxide levels in the city of Madrid, developed as part of Task 5.5 activities, June 2025.

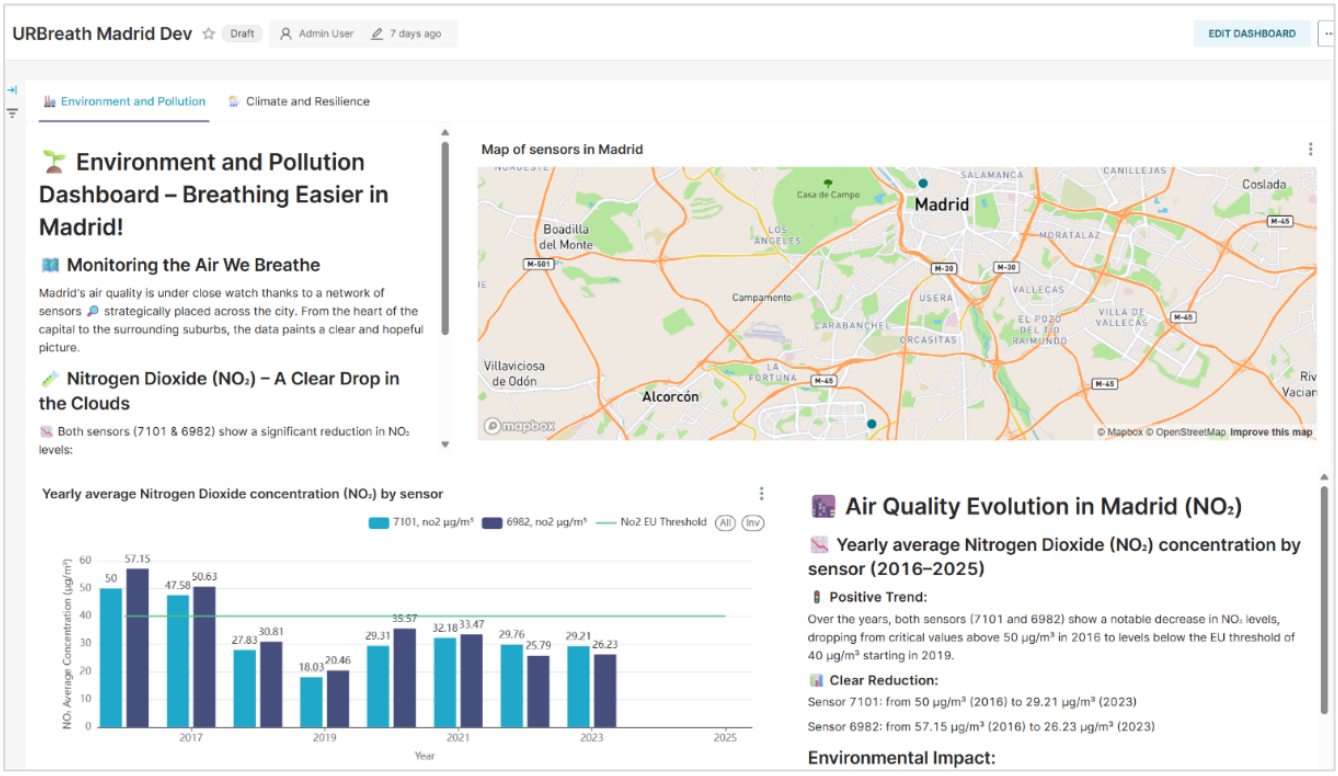
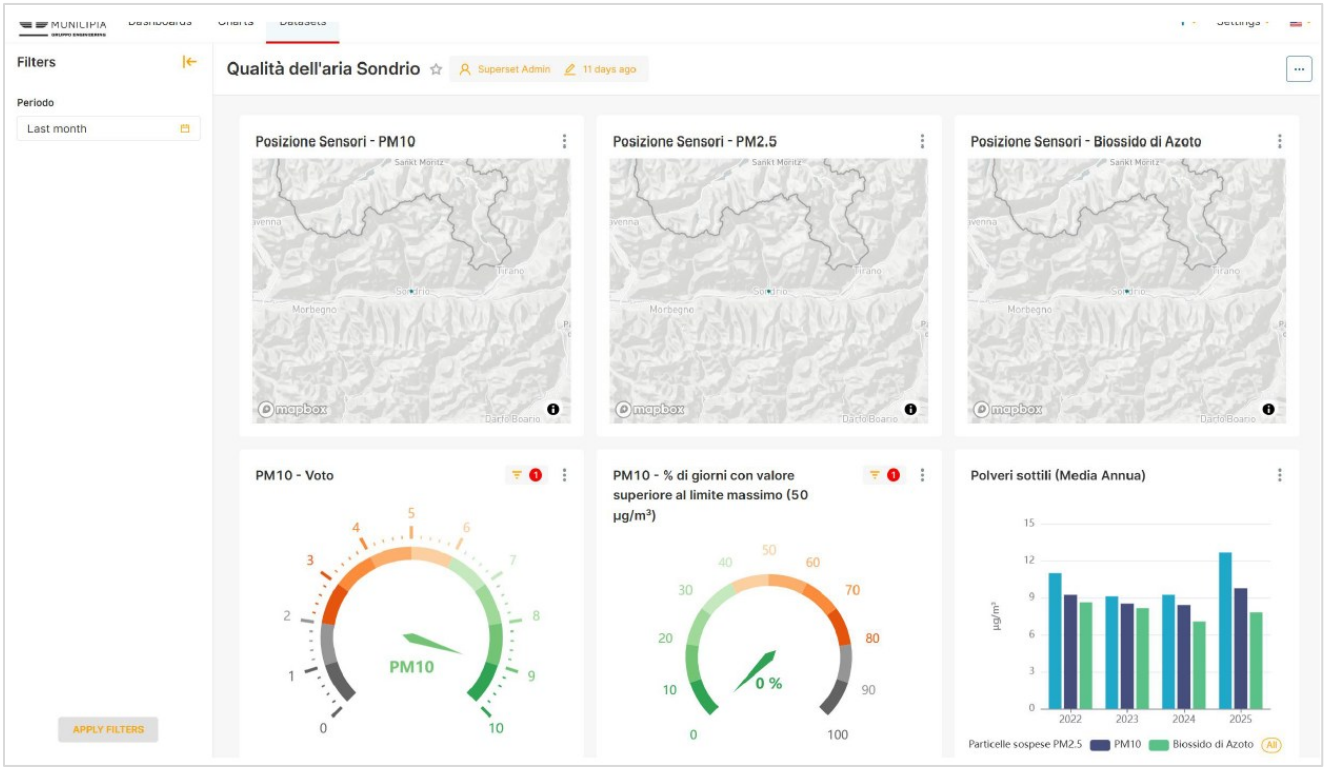


Figure 28: Demonstrator dashboard showcasing real-time visualisation of fine dust (PM) and nitrogen dioxide (NO_2) concentrations, presented by Task 5.5 in May 2025.



5. Gap analyses and local implementation support - T5.4

5.1 Analysis of data gaps across pilot cities

A **typical gap analysis** consists of four consecutive steps:

- identifying the **current state**,
- determining the **desired future state**,
- recognising the **gaps** between the two,
- and **formulating improvements** to bridge those gaps.

In the context of the URBREATH project, the first three steps of this process—assessing the current situation, defining future needs, and identifying existing gaps—were **initiated** in the second half of 2024. These steps were integrated into the various workshops conducted with the pilot cities, as detailed in Chapters 2 and 3, and focused specifically on datasets and models required locally for KPI monitoring, model simulations, and tool application.

Task 5.4 started in Month 10 of the project and subsequently built upon this foundational work..

As outlined in Chapter 3.2, by the end of 2024, a prioritised **list of technical functionalities** (see Annex III) was validated and formally adopted to guide the subsequent development of digital tools, simulation models, and related functionalities. This list, co-created through iterative engagement with pilot cities and technical partners, served as the foundation for a comprehensive technical analysis process. Task 5.4 contributed substantively to the preparatory phases leading up to the establishment of this list and subsequently assumed responsibility for initiating and coordinating a centralised gap analysis across the URBREATH pilot cities.

To facilitate this analysis, a **data inventory framework** was developed in February 2025. This inventory was initially populated with datasets already available within the pilot regions, identified through all co-creation workshops described in Chapters 2 and 3, desk research, and targeted one-to-one consultations with local stakeholders. Further refinement of this inventory was carried out in close collaboration with technical partners to ensure alignment with tool development requirements.

In March 2025, the **refined data inventory** was disseminated to pilot cities. Accompanying guidance emphasised the critical importance of identifying and procuring missing datasets, particularly those directly linked to the selection and monitoring of KPIs. For each technical solution or simulation model, the inventory specified its relevance to individual pilot cities (applicability: yes/no), and detailed the corresponding requirements in terms of datasets, APIs, data streams, and modelling infrastructure. Pilot cities were encouraged to augment the inventory by identifying data sources and indicating availability status.

At regular intervals, a **consolidated overview** was compiled to capture the level of interest expressed by the URBREATH pilot cities in the various tools included within the URBREATH Toolbox. A distinction was made between tools that have been formally adopted for use by the pilot cities and those still under consideration.

The table below reflects the status of tool interest and adoption as assessed at the end of June 2025.

Table 3: Overview of tool adoption and interest across URBREATH pilot cities, as of June 2025. The table distinguishes between tools already adopted for implementation and those still under evaluation by the pilot cities.

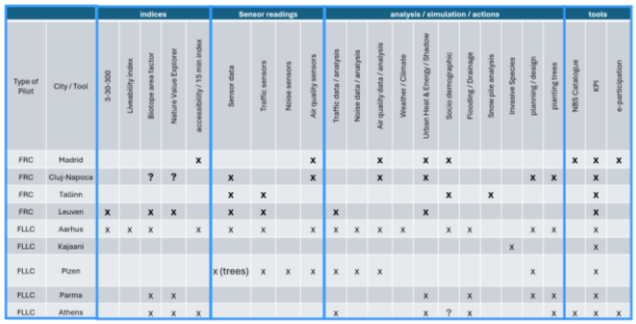
	Tool	AAR	ATH	CLU	KAJ	LEU	MAD	PAR	PIL	TAL
0	Heat Stress Analysis						?	?		
1	VCS Shadow plugin			x		x		?	?	
2	Adaptive Rainfall-Infiltration Tracking	?		?	?	x				
3	VCS Small scale BAF		?			x		x		
4	3-30-300 Analysis	x	?	x		x		?	?	x
5	Public Transport Accessibility Analysis					x	x			
6	15 minutes city (proximity index)	x	x	x				x	x	
7	VCS Growing Trees	x				x	x	x		
8	VCS snow pile sim				x					
9	Liveability index	x								
10	Optimal locations to deposit snow				x					x
11	green gentrification/property prices						?			
12	crime statistics									
13	Nature Value Explorer		?					?	?	
14	Biotop Area Factor	?	?	?		?		?	?	
15	Short term weather forecasts (0-15 days)	?	?	x	?	?	?	?	?	?
16	Seasonal forecasts (1-6 months)	?	?	x	?	?	?	?	?	?
17	Climate forecasts (long term)	?	?	x	?	?	?	?	?	?
18	Water infiltration model	x				x	?	?	?	
19	Urban Heat Island						x	?		
20	Water Discharge and Flooding prediction model	x								
21	Socio-demographic			x						
22	Sensors	x		x		x			x	x
23	Definitely used tools (x)	7	1	8	2	8	3	3	2	3
24	Maybe used tools (?)	5	7	2	4	4	6	10	8	3
25	Total tools used	12	8	10	6	12	9	13	10	6

The **data inventory** is maintained as a dynamic, continuously updated **living document**. Whenever new tools, functionalities or simulations are proposed for integration, the inventory is revised accordingly, and pilot cities are prompted to reassess and update their data contributions. In instances where required datasets were unavailable, alternative solutions, such as the use of satellite imagery or proxy data with lower granularity, were explored collaboratively. To improve completeness, one-to-one meetings were scheduled with several pilot cities. However, access to data—whether from local technical partners or central government sources—proved challenging to them. In many cases, data formatting and structuring issues further complicated integration.

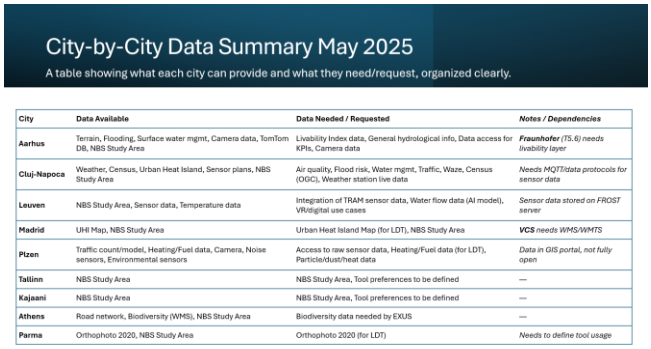
The urgency of resolving these data gaps was reiterated in multiple forums, including the monthly Project Management calls and during the General Assembly held in Cluj-Napoca (May 2025).

In a dedicated WP5 workshop session, Task 5.4 provided a comprehensive overview of outstanding data needs per pilot city (read also the article in Chapter 4.3). This presentation also introduced a structured approach to address these gaps, notably through the launch of a new series of joint pilot city coordination meetings, led and moderated by Task 5.4. The first of these collaborative sessions took place in early June 2025, with further bilateral meetings planned.

Figure 29: Overview of missing data across all URBREATH pilot cities, as presented by Task 5.4 during the General Assembly in Cluj-Napoca, May 2025. The visual highlights critical data gaps relevant for KPI monitoring, simulation modelling, and tool development.



		indices					Sensor readings				analysis / simulation / actions										tools		
Type of Pilot	City / Tool	3-30-300	Liveability index	Biotope area factor	Nature Value Explorer	accessibility / 15 min index	Sensor data	Traffic sensors	Noise sensors	Air quality sensors	Traffic data / analysis	Noise data / analysis	Air quality data / analysis	Weather / Climate	Urban Heat & Energy / Shadow	Socio demographic	Flooding / Drainage	Snow pile analysis	Invasive Species	planning / design	planting trees	NBS Catalogue	KPI	e participation
FRC	Madrid					x				x			x		x	x						x	x	x
FRC	Cluj-Napoca			?	?		x			x			x		x					x	x		x	
FRC	Tallinn						x	x								x		x					x	
FRC	Leuven	x		x	x		x	x			x				x								x	
FLLC	Aarhus	x	x	x		x	x	x		x	x	x	x	x		x	x			x	x		x	
FLLC	Kajaani																		x				x	
FLLC	Pizen						x (trees)	x	x	x	x	x	x							x			x	
FLLC	Parma			x	x										x		x			x	x		x	
FLLC	Athens			x	x	x					x				x	?	x				x	x	x	x



City	Data Available	Data Needed / Requested	Notes / Dependencies
Aarhus	Terrain, Flooding, Surface water mgmt, Camera data, TomTom DB, NBS Study Area	Livability Index data, General hydrological info, Data access for KPIs, Camera data	*Fraunhofer (T5.6) needs livability layer*
Cluj-Napoca	Weather, Census, Urban Heat Island, Sensor plans, NBS Study Area	Air quality, Flood risk, Water mgmt, Traffic, Waze, Census (OGC), Weather station live data	*Needs MQTT/data protocols for sensor data*
Leuven	NBS Study Area, Sensor data, Temperature data	Integration of TRAM sensor data, Water flow data (AI model), VR/digital use cases	*Sensor data stored on FROST server*
Madrid	UHI Map, NBS Study Area	Urban Heat Island Map (for LDT), NBS Study Area	*VCS needs WMS/WMTS*
Pizen	Traffic count/model, Heating/Fuel data, Camera, Noise sensors, Environmental sensors	Access to raw sensor data, Heating/Fuel data (for LDT), Particle/dust/heat data	*Data in GIS portal, not fully open*
Tallinn	NBS Study Area	NBS Study Area, Tool preferences to be defined	—
Kajaani	NBS Study Area	NBS Study Area, Tool preferences to be defined	—
Athens	Road network, Biodiversity (WMS), NBS Study Area	Biodiversity data needed by EXUS	—
Parma	Orthophoto 2020, NBS Study Area	Orthophoto 2020 (for LDT)	*Needs to define tool usage*

During this session, Task 5.4 also provided a detailed exposition on the various data categories relevant to tool development and simulation-based analyses within the URBREATH framework. These included:

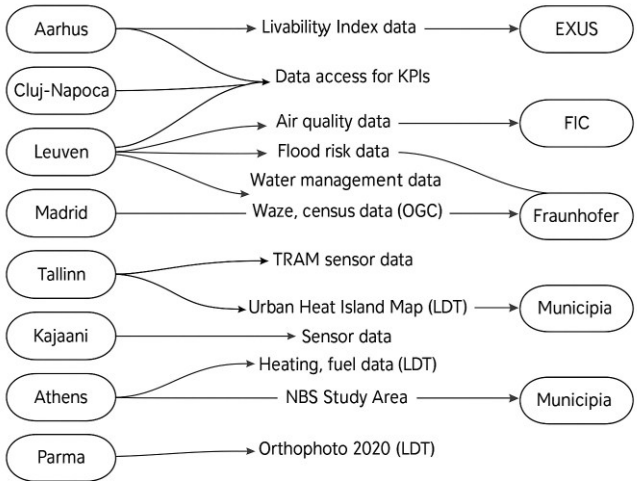
- Sensor-derived data
- Geospatial and environmental datasets (e.g., Geographic Information System layers)
- Qualitative data and stakeholder perception data
- Sociological and participatory datasets
- Urban infrastructure and activity data
- Data underpinning KPI definition, calibration, and monitoring

Special emphasis was placed on clarifying the functional roles of these datasets, whether intended for **analytical or visualisation purposes**, and how these datasets vary depending on the specific use cases of the pilot cities. The data integration process, from raw inputs to the generation of visual outputs (e.g., maps and dashboards), was illustrated through the 3-30-300 modelling approach, demonstrating how data is operationalised within the digital workflow.

Figure 30: Presentation slides illustrating the 3-30-300 modelling approach, as introduced by Task 5.4 during the URBREATH General Assembly in Cluj-Napoca, May 2025. The approach serves as a framework to assess urban green infrastructure at multiple spatial scales—individual, neighbourhood, and city-wide.

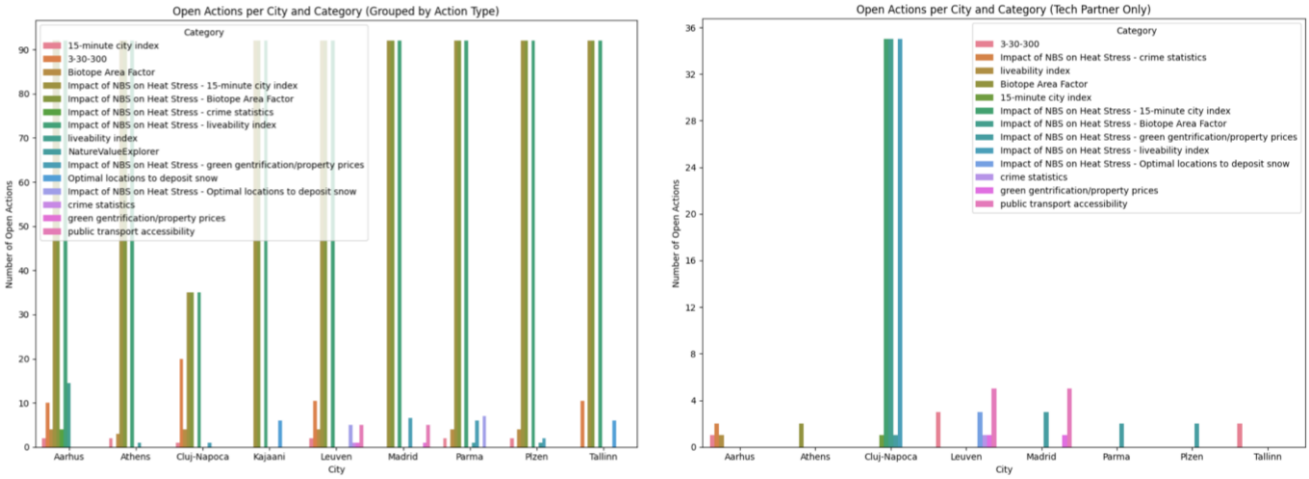
In conclusion, Task 5.4 highlighted the critical interdependencies between the pilot cities, the simulation models and analytical tools required, and the technical partners responsible for their development.
These interconnected relationships serve as the foundation for targeted model customisation and informed, data-driven decision-making across the URBREATH pilot network.
The most recent analysis of these interdependencies was conducted on June 25th, 2025. See the accompanying image for details.

Figure 31: Overview of interdependencies between URBREATH pilot cities, required simulation models and tools, and responsible technical partners, based on the latest analysis conducted by Task 5.4 on June 25th, 2025.



In mid-June, Task 5.4 delivered an updated overview of outstanding tasks for all pilot cities and technical partners, including pending evaluations of datasets submitted by the pilots. This served as a structured recap, ensuring clarity on remaining responsibilities. Subsequently, all tools and functionalities within the project scope were addressed in greater detail to support coordinated progress.

Figure 32: Overview of outstanding actions for pilot cities (left) and technical partners (right), as analysed and presented by Task 5.4 on June 12th, 2025.



5.2 Analysis of the local infrastructure and custom implementation of tools

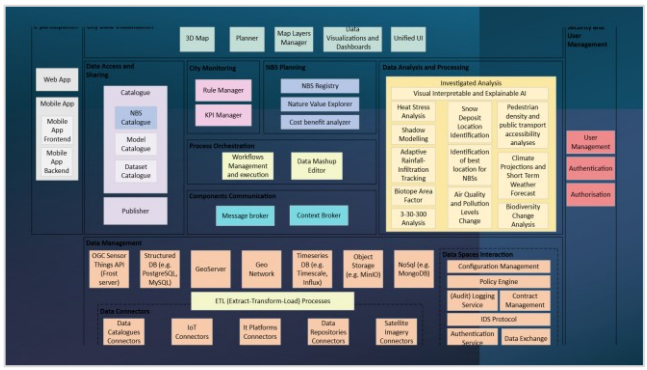
5.2.1 Initial demonstrations and local integration plans of Toolbox tools

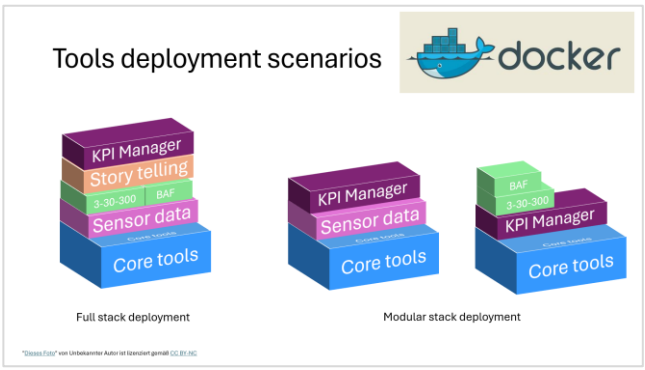
The initial demonstrations of the URBREATH Toolbox tools commenced in mid-May 2025, with a key highlight being the “Demo Café” held during the General Assembly in Cluj-Napoca on May 21st, 2025. These demonstrations were instrumental in enabling pilot cities to evaluate the available tools and determine their applicability for long-term use in monitoring local NBS and facilitating participatory processes within their respective LLLs.

Following the pilots’ future selection of preferred tools, Task 5.4 will focus on supporting the local deployment of the selected solutions, providing targeted input on the technical and infrastructural prerequisites required for effective integration into existing urban IT systems.

During a WP5 workshop at the General Assembly in Cluj-Napoca, Task 5.4 explained the options for locally integrating tools in detail.

Figure 33: Presentation slides used by Task 5.4 to explain local deployment options for tools and simulation models, as discussed with pilot cities during the General Assembly in May 2025.





5.2.2 Customisation of the Local Digital Twin and storytelling tool

Notably, two core tools, the LDT and the Storytelling Tool, were already operational at the beginning of 2025. They were demonstrated to the pilot cities by Task 5.4 for the first time during a series of four LLL workshops at the end of 2024. These tools have demonstrated significant utility in both NBS performance monitoring and the facilitation of co-creation within LLLs and have consequently been adopted by most pilot cities.

Given that VCS centrally hosts the Digital Twin platform and the integrated Storytelling Tool, local deployment is not required. However, city-specific customisation and user support are essential to ensure contextual relevance and effective utilisation. To this end, T5.4 has prioritised the collaborative development of customised Local Digital Twins, incorporating city-specific datasets and functionalities through a co-creation approach (one-to-one contacts with the individual URBREATH pilot cities representing local stakeholders).

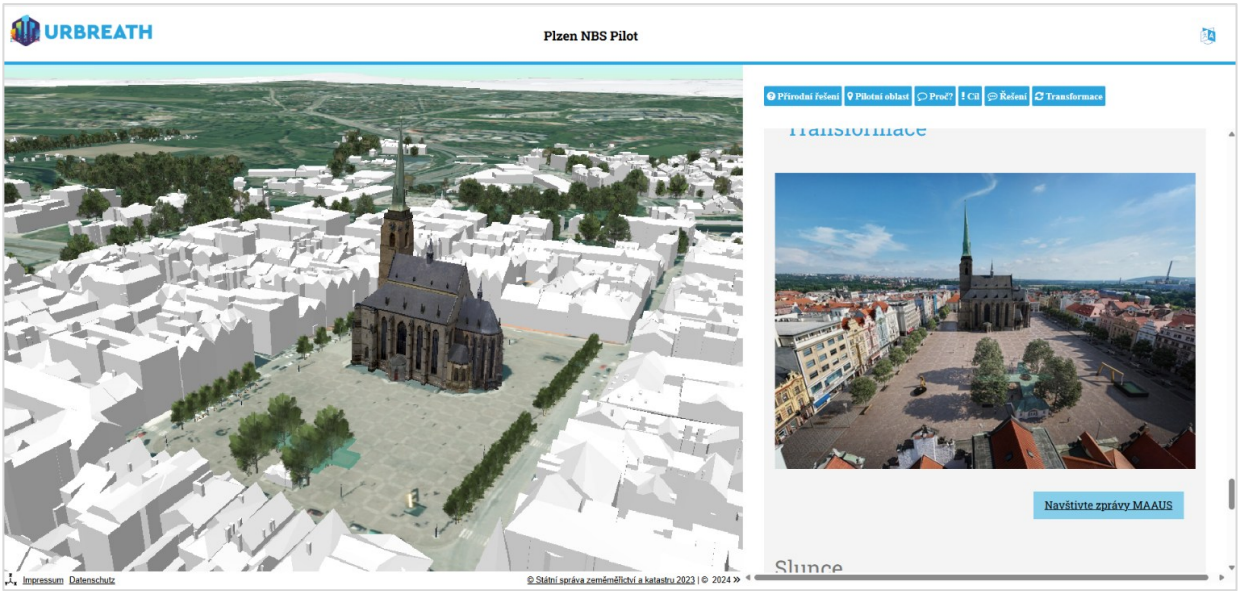
Illustrative examples of these tailored implementations include:

- The integration and visualisation of real-time traffic *Telraam sensor data* in the city of Leuven.

Figure 34: Visualisation of sensor data in the URBREATH LDT for the city of Leuven.

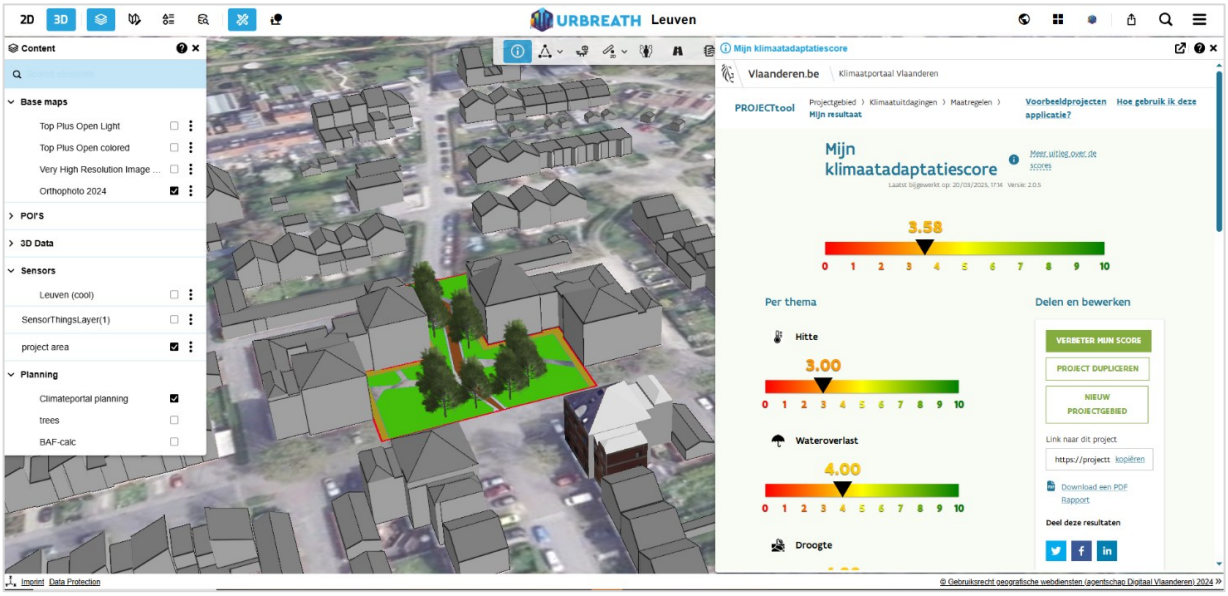
- The development of site-specific shadow impact simulations.
- The incorporation of species-specific tree growth modelling.
- The integration and visualisation of NBS plans.

Figure 35: Customisation of the NBS planning in the URBREATH LDT, city of Pilsen.



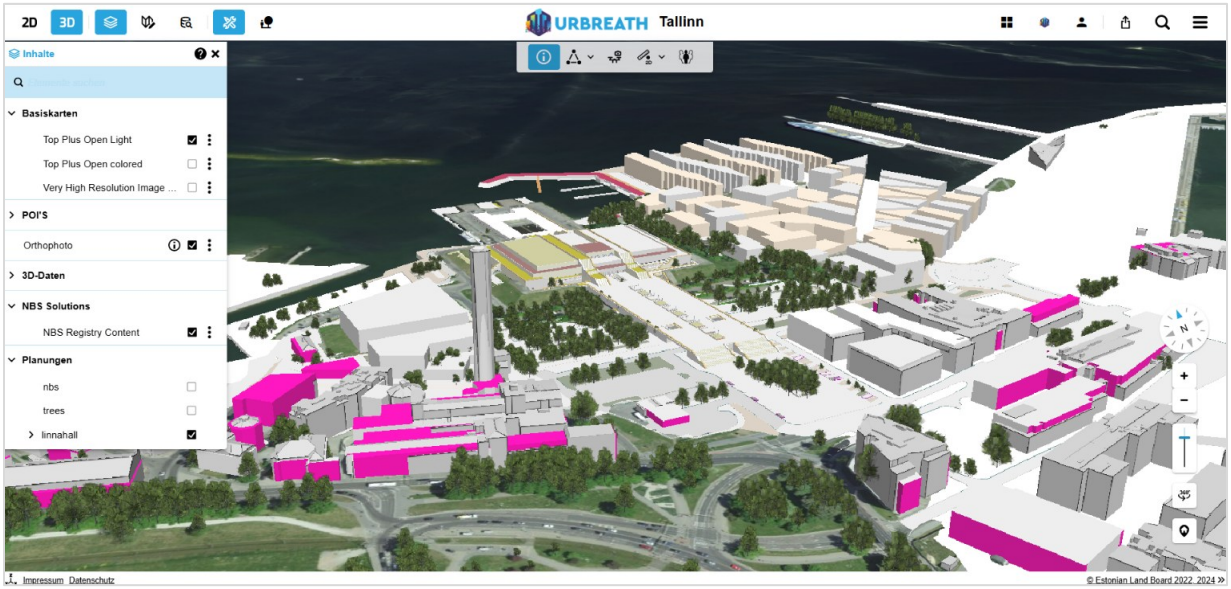
- Integration of other URBREATH Toolbox tools, such as the VITO tool, to determine climate adaptation scores.

Figure 36: The integration of VITO's climate adaptation score tool into the URBREATH LDT environment for the city of Leuven.



- The enhancement of planning tools with additional features to improve spatial visualisations of target intervention zones. A nice example is Tallinn's Linna Hall plan.

Figure 37: Integration of the Linna Hall plan into the Virtual City Planner tool of the URBREATH LDT for the city of Tallinn.



- Small-scale Biotope Area Factor (BAF) calculation based on the Virtual City Planner tool.
- Integration of external datasets, like the Leuven.cool weather data in the city of Leuven.

Figure 38: The integration of external weather data delivered in the framework of a related project in the URBREATH LDT for the city of Leuven.

- Integration of URBREATH catalogues (IDRA, Geonetwork).
- The early adoption of the URBREATH NBS catalogue.

These local adaptations not only enhance the usability of the tools but also contribute to more data-driven and context-aware urban planning and NBS impact assessment across the URBREATH pilot cities.

5.2.3 Capacity building and customisation through training and technical support

An essential component of effective local implementation of the URBREATH digital tools is the provision of structured training and capacity-building activities. Task 5.4 has played a central role in this effort by organising a series of targeted training sessions and fostering a decentralised learning environment that empowers both technical partners and pilot cities.

To facilitate knowledge transfer and skill development, multiple ***GoTo webinars*** were organised, complemented by the establishment of an open training platform. This platform allows technical partners, pilot city representatives, and their associated LLLs to initiate and host webinars autonomously, fostering continuous learning and collaborative engagement.

To date, the following training activities have been conducted:

- An external webinar introducing the Virtual City BREC platform, which supports the simplified generation of CityGML-compliant datasets.
- A dedicated training session on the use of the VCS Storytelling Tool.
- A series of three URBREATH webinars covering:
    - An overview of the Virtual City Map platform.
    - Application of the Virtual City Planner for the design and simulation of NBSs within the LDT environment.
    - Procedures for dynamically adding and managing spatial data layers.
- A series of one-on-one workshops was launched with the URBREATH pilot cities to provide hands-on support for the use of the LDT functionalities. In these sessions, end users were guided step by step through the platform in a practical setting, with real-time support provided by the LDT expert. The approach involved users sharing their screen while performing the full procedure under expert supervision and guidance.

  The first two-hour workshop took place on June 26th, 2025. During this session, the end user was trained to import external *AutoCad* files, develop an NBS ground plan (and add different tree species), apply the tree planting and growth simulator, generate shaded area simulation reports, and use the BAF tool for simulation and reporting. Additionally, the user learned how to create high-quality flyovers for dissemination purposes.

  A positive testimony from the participating end-user was shared during the monthly cities coordination call on June 27th, 2025.

All webinar recordings were made publicly accessible to ensure open knowledge dissemination and long-term usability.

In addition to these structured training formats, Task 5.4 has conducted a series of one-to-one technical consultations with individual pilot cities. These personalised sessions focused on configuring and refining LDTs and adapting storytelling elements using the VCS Storytelling Tool to reflect local narratives and stakeholder objectives.

Through this combined approach of group training and tailored technical support, Task 5.4 ensures that the digital tools are not only implemented effectively but are also embedded meaningfully within the local urban and governance contexts of each URBREATH pilot city.

6. WP5 as input for WP6 tasks on NBS

Task 6.1 (NBS Sites Implementation Plans and Monitoring), initiated in Month 6 and continuing through the end of the URBREATH project, plays a pivotal role in translating co-created NBS into tangible urban interventions.

Within the scope of Task 6.1, detailed implementation plans for the deployment of the selected NBS, originally developed under Task 5.3, are defined. It not only includes the planning of physical construction of interventions but also the design of operational procedures for continuous, in situ monitoring and adaptive management. This day-to-day oversight ensures that the progression of implementation aligns with strategic goals and facilitates timely corrective measures.

Task 6.1 is heavily informed by preceding activities in WP5, particularly **Task 5.1**, which provides baseline assessments of local environmental, social, and infrastructural conditions, and **Task 5.3**, which delineates the spatial and functional characteristics of the co-designed NBS in each front-runner city. These contextual foundations are further supported by the KPI framework established (**Task 5.6)** and NBS monitoring (**Task 5.5**) which offers methodological guidance for defining, calibrating, and operationalising expected outcomes of the interventions.

Through this structured knowledge transfer, Task 6.1 ensures that NBS implementation is both context-sensitive and performance-driven. Moreover, front-runner cities are expected not only to develop these implementation plans but to realise the actual deployment of NBS on the ground during the course of the project, thereby serving as demonstrators of integrated urban renaturing practices.

7. Further activities and further steps

The next follow-up version of this report is due for M24 (December 2025). For the upcoming six months, the following activities and steps to take are planned for Tasks 5.2, 5.4, 5.5 and 5.6.

- **Task 5.1** ends in M18. All work is reported in this Deliverable, so no further action is needed. We will continue reporting, however, giving updates on the proceedings with the tasks
- For **task 5.2**, we will continue working as described in **Chapter 3.4**. In the upcoming six months, Task 5.2 will continue to play a pivotal role in facilitating and accelerating the technical development processes within the URBREATH project. This will include sustained active engagement in WP3 and WP4 activities and meetings to ensure that the development of tools, models, and functionalities remains closely aligned with pilot-specific needs and project objectives.

  Efforts to strengthen the collaboration between pilot cities and technical partners will be further intensified through coordinated communication, targeted support, and co-creation activities.

  Additionally, Task 5.2 will maintain its role in providing technical and methodological guidance, ensuring that pilot requirements are effectively translated into implementable solutions.

  Building on the firm foundation of collaboration established in the first project phase, these efforts will contribute to a seamless and participatory development process, enhancing both the relevance and usability of the URBREATH Toolbox across diverse pilot contexts.
- Upcoming activities related to **Task 5.3** will be described separately in Deliverable 5.5.
- Over the next six months, **Task 5.4** will intensify its efforts to support data-driven implementation and local integration of URBREATH tools and simulation models across the pilot cities. Building on the foundational gap analysis and data inventory work conducted so far, the focus will shift to further identifying and addressing missing datasets that are critical for the operationalisation of technical tools and analytical models.

  This work will include a systematic reassessment of the existing data inventory in close coordination with pilot cities and technical partners. Task 5.4 will engage in targeted one-to-one consultations and cross-city coordination meetings to validate dataset availability, resolve data formatting or access issues, and explore alternative data sources (e.g., satellite imagery, open datasets) where local data remains unavailable. Particular emphasis will be placed on ensuring that datasets required for KPI monitoring and simulation scenarios, such as climate resilience, environmental health, and urban well-being, are adequately sourced, documented, and validated for use in URBREATH tools.

  Simultaneously, Task 5.4 will advance the localisation strategy for tool implementation. This includes conducting further analyses of each pilot city's digital infrastructure, data governance frameworks, and

IT systems to determine the optimal pathways for embedding URBREATH tools into existing urban technology ecosystems. Where technical partners maintain central hosting (e.g., for the Local Digital Twin and Storytelling Tool), efforts will focus on deepening contextual customisation by integrating local data layers and tailoring functionalities and tools, such as the LDT, to local decision-making workflows.

To support this, Task 5.4 will develop technical guidance and deployment protocols in collaboration with WP3 and WP4, ensuring technical coherence, usability, and GDPR compliance. The planned continuation of bilateral consultations and WP5-led workshops will provide structured spaces for sharing integration challenges, developing implementation plans, and aligning pilots' needs with technical development priorities.

- With the availability of the pilot cities' KPIs at the end of June 2025 (milestone 7 of the URBREATH project), a lot of action can be expected from **Tasks 5.5 and 5.6** in continuation of the work described in Chapter 4. Over the next six months, Tasks 5.5 and 5.6 will focus on consolidating and implementing the KPI monitoring framework developed in close collaboration with the URBREATH pilot cities.

  Task 5.6 completed the validation and final refinement of the KPI sets by conducting a final quality assurance round, ensuring that each indicator includes clearly defined metadata such as target values, temporal resolution, and source references. This also involved harmonising indicators across pilot contexts, improving comparability and analytical consistency.

  Where necessary, Task 5.6 will assist cities in resolving outstanding issues related to missing or uncertain data, helping them identify feasible alternatives, proxy sources, or adjusted measurement approaches in line with the project's analytical requirements. Also, KPIs will be classified according to their impact timeline (short vs long term) and their impact area (on site, neighbourhood level or city level).

  In addition, **Task 5.6** will support the development of practical monitoring protocols tailored to each city's context, outlining step-by-step guidance on how KPIs should be measured, tracked, and interpreted throughout the URBREATH project. These protocols will be aligned with the digital tools and simulations under development, thereby ensuring seamless integration into the broader evaluation framework. Furthermore, direct coordination with technical partners will continue to confirm the operational feasibility of integrating each KPI into the URBREATH dashboards and digital workflows.

- In parallel, **Task 5.5** will continue translating the final KPI inputs into fully operational monitoring dashboards. Building upon the two prototypes presented in May 2025, the task will now customise these interfaces for individual cities, incorporating both the KPI metadata and the real-time or periodic data streams required to populate the visual indicators. Where relevant, pilot-specific information on selected nature-based solutions (NBS) will be integrated to link performance metrics with local interventions. Task 5.5 will also support the technical integration of dashboards into local IT environments, ensuring data interoperability and system usability. As additional datasets become available from the cities, particularly

those related to environmental monitoring or infrastructure, these will be progressively integrated into the dashboards to enrich their analytical capabilities.

Close coordination between Tasks 5.6 and 5.5 will ensure consistency between the KPI definition and the monitoring implementation. Together, they will enable evidence-based decision-making across pilot cities, supporting the effective evaluation of NBS and broader urban resilience strategies within the URBREATH project.

8. Annexes

Annex I - List of URBREATH epics

Epic id	Persona	Action to be taken	Benefit to be realised
LLpilot	As a pilot	I want to use specialised tools that stimulate LL users to participate and cocreate	so they can contribute to the LL
LLuser	As a LL user	I want to use specialised tools that help me to participate and cocreate	so I can contribute to the LL
AllNf	As a citizen	I want to be able to use the solutions effectively	so I use them a lot and am effective
KPIDef	As a pilot	I want to define KPIs	so I have an idea about the effect of the NBS integrated in my case
KPIMon	As a pilot	I want to monitor KPIs	so I have an idea about the effect of the NBS integrated in my case
WIsimu	As a pilot	I want to do be able to simulate scenarios	so I get a clear understanding of the impact of the NBS I want to implement.
WIDnM	As a pilot	I want to do be able to use existing datasets and models to use in the what-if analysis	so I can reuse what is already available
WIVisual	As a pilot	I want to be able to use tailored visualisations	so I can properly inspect the scenarios
WIG-enAI	As a pilot	I can use generative AI to quickly generate visu-alisations of options based on natural language	so I have an idea how my NBS will look like
AsIsDnM	As a pilot	I want to clearly monitor the AS IS situation of my case with all relevant information	so I and other involved parties have a com-plete insight.
Design	As a pilot	I want to collaboratively design the NBS in my area	so I take into account all points of view.
DissCit	As a citi-zen/LL user	I want to be informed	so I am up-to-date
DissPil	As a pilot	I want to communicate and disseminate about my NBS	so all involved parties are up-to-date.
LLFB	As a LL user	I want to use specialised tools that help me to participate and cocreate	so I can contribute to the LL
LLProc	As a LL user	I want to use specialised tools that help me to participate and cocreate	so I can contribute to the LL

Part	As a pilot	I want to get feedback on simulations, prototypes, proposals and realisations	so I can make an evaluation
Plan	As a pilot	I want to get a holistic and up-to-date vision on all relevant aspects of my case	so I can make better decisions.
Sust	As a pilot	I want to investigate transferability, interoperability	so I can assess whether similar NBSs can be rolled out
Test	As a pilot	I want to evaluate and test prototypes developed by the technical team	so I can make the solution better and more custom

Annex II - List of macro-meso-micro user stories, Cluj-Napoca front-runner city

Ref	WP	Tool	Epic id	IDs from macro requirements (@cities do not consider them)	Requirement - Persona	Requirement - Action to be taken	Requirement - Benefit to be realised	CONT CZ Cluj	CONT CZ - Comments Cluj N.
AllNf01	WP4	All dashboards and tools	AllNf		As a citizen	I want to access all different tools from the toolbox from a mobile device	so I can inspect it on the go	yes	Possible integration with proGIreg NBS Urban Plan - see here https://progireg.eu/cluj-napoca/urban-plan/
AllNf02	WP4	All dashboards and tools	AllNf		As a pilot	I need to be able to work with the production environment and next to that have a testing environment where I can try the new functionality	so I can see progress and can validate new developments	yes	Functionality can prove very valuable when we will assess to replicate the NBS in the LL in other areas on the blue-green corridor
KPIDef01	WP4	Tool to define & find best fitting KPIs	KPIDef	WS2-CON-UJ1-CLUJNAPOCA-STEP2-07-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP2-07-R02 WS2-CON-UJ1-CLUJNAPOCA-STEP2-07-R03	As a pilot	I want to find a hands on solution to collect and interpret information	So I can better assess the AS IS situation	yes	The KPIs in the case of Cluj have to dimensions: NBS related: (1), (2), (5), (7), (11). The tools would be very helpful if it could also help collect data regularly for: (3) impact of the awareness campaign (4) NGOs involvement and impact (6) 10% traffic reduction compared to 2024; (8) neighbourhood satisfaction; (10) significant improvement on wellbeing and quality of life
KPIDef03	WP5	Tool to define & find best fitting KPIs	KPIDef		As a pilot	I want to browse datasets (environmental parameters, socio economic situation & vulnerability - policies, funding opportunities and funding) and models of other pilots	So I get inspired and can learn from others and build better KPIs	yes	For the purpose of creating a local NBS standard - potentially embedded in a local policy - it is very important to have a comprehensive view of the impact through multiple indicators, not just the KPI from the AF
KPIDef04	WP4, WP5	Tool to define & find best fitting KPIs	KPIDef		As a pilot	I want to **access/overview/review** existing data	So I know what is relevant/possible to monitor as KPI	yes	It will also be very helpful to have the timeline functionality, to see for example of heatisland changed from year to years, or how greenery evolved

KPIDef05	WP4, WP5	Tool to define & find best fitting KPIs	KPIDef		As a pilot	I want to **cross-compair** existing data	So I know what is relevant/possible to monitor as KPI	?	not sure what to compare with what?
KPIDef06	WP4, WP5	Tool to define & find best fitting KPIs	KPIDef		As a pilot	I want to **access/overview/review** existing documentation/plans	So I know what is relevant/possible to monitor as KPI	yes	Existing documentation and plans are extremely relevant to cross reference. Here is the General Urban Plan of Cluj http://clujpug.ro/ (not sure to what extend to integrate or to replicate) Additionally it would be very good if the tool can integrate the areas and key info for major on-going or planned investments that can relate to the GI development
KPIDef07	WP4, WP5	Tool to define & find best fitting KPIs	KPIDef		As a pilot	I want to **collect/review/define/shortlist** relevant KPIs for my city/project/solution/area	So my focus is on the most relevant and best fitting KPIs	yes	We can assess this coherently after we now the entire list of indicators that can be integrated/monitored, and after we advance with our NBS scenarios - to at least define the type of NBS to be implemented. For example if the priority would be to implement urban pastures/biodiversity friendly plantations - it will not relate to KPIs we have there, but the impact is relevant (reducing the heat island effect, resilience of GI etc...)
KPIMon01	WP4	Dashboard, automated periodic reporting tool with relevant stats	KPIMon	WS2-MED-UJ1-MADRID-STEP1-02-R01 WS2-MED-UJ1-MADRID-STEP1-02-R02 WS2-MED-UJ1-OTHERS-STEP1-03-R01	As a citizen	I want to **monitor/evaluate** the short- and long term **progress** of my KPIs during the URBREATH project. Should also work for a selection of KPIs.	So I am up-to-date and able to steer the NBS approach	yes	Depends on the type of NBS piloted. I suggest to create a matrix/brainmap of the expected NBS to be piloted by cities, and type of indicators relevant. And then we will assess for example the primary KPIs, and secondary/tertiary KPIs. Example: for a green corridor made of an alignment of vegetation along a street, the primary KPI would be the new shaded area, secondary air-pollution and carbon retention, tertiary the citizen satisfaction

KPIMon02	WP4	Dashboard, automated periodic reporting tool with relevant stats	KPIMon		As a citizen	I want to **monitor/evaluate** citizen/community engagement and hapiness	So I know how citizens feel about the NBS implementation	yes	
KPIMon03	WP4	Dashboard, automated periodic reporting tool with relevant stats	KPIMon		As a citizen	I want to **cross-reference** KPIs with other city KPIs and other (ex. ISO, EU-commission, sustainability standards) assessments	So I can see the broader picture	yes	Relevant for replication and securing funds from mainstream programmes/cohesion funds
KPIMon03	WP4	Dashboard, automated periodic reporting tool with relevant stats	KPIMon	WS2-MED-UJ1-ATHENS-STEP2-03-R01 WS2-MED-UJ1-ATHENS-STEP2-04-R01	As a citizen	I want to be able to create reports based on metrics (e.g. text + images, charts graphs, and map layers created through the use of data analysis)	So I can disseminate the results	yes	Relevant for replication and securing funds from mainstream programmes/cohesion funds
KPIMon04	WP4	Dashboard, automated periodic reporting tool with relevant stats	KPIMon		As a citizen	I want to record the daily usage/visits of the NBS site before the implementation of the NBS	So I can later evaluate the before/after progress	?	
AsIs-DnM01	WP4	AS IS analysis toolbox	AsIs-DnM		As a pilot	I want to be able to use existing datasets that are easily accessible	So the solution is integrated in our pilot	yes	
AsIs-DnM02	WP4	AS IS analysis toolbox	AsIs-DnM		As a pilot	I want to be able to use existing models	So the solution is integrated in our pilot	yes	
AsIs-DnM03	WP4	AS IS analysis toolbox	AsIs-DnM	WS2-MED-UJ1-MADRID-STEP1-01-R01 WS2-MED-UJ1-MADRID-STEP1-01-R02	As a pilot	I want to be able to search available tools and models in a catalogue using keywords, etc.	So I can use them for further analysis		
AsIs-DnM03	WP4	AS IS analysis toolbox	AsIs-DnM	WS2-MED-UJ1-OTHERS-STEP1-02-R01 WS2-MED-UJ1-OTHERS-STEP1-02-R02 WS2-MED-UJ1-OTHERS-STEP4-02-R01 WS2-CON-UJ2-OTHER-STEP1-01-R01 WS2-CON-UJ2-OTHER-STEP1-02-R01	As a pilot	I want to be able to search, filter and sort available datasets (data, data sources, documents, city plans, urban planning regulations,	So I can use them to create a complete insight.		

				WS2-ATL-UJ2-LEUVEN-STEP3-03-R01 WS2-ATL-UJ2-LEUVEN-STEP3-03-R02 WS2-ATL-UJ2-LEUVEN-STEP3-03-R03 WS2-MED-UJ1-PARMA-STEP1-02-R01 WS2-BOR-UJ1-KAJAANI-STEP2-05-R02 WS2-BOR-UJ1-KAJAANI-STEP2-05-R03 WS2-BOR-UJ1-KAJAANI-STEP2-05-R04		etc) also using different criteria such as geographic area of interest, contacts (if public), etc.			
AsIs-DnM03	WP4	AS IS analysis toolbox	AsIs-DnM	WS2-CON-UJ2-OTHER-STEP2-01-R01 WS2-CON-UJ2-OTHER-STEP2-02-R01	As a pilot	I want to be able to access (and export such as CSV) results from my searches as a list.	So I can inform other people.		
AsIs-DnM03	WP4	AS IS analysis toolbox	AsIs-DnM		As a pilot	I want to be able to import datasets that are not easily connectable	So I get the info I need	yes	
AsIs-DnM04	WP4	AS IS analysis toolbox	AsIs-DnM	WS2-MED-UJ1-OTHERS-STEP1-01-R01	As a pilot	I want to be able to use data from sensors	So I get the info I need	yes	
AsIs-DnM05	WP4	AS IS analysis toolbox	AsIs-DnM	WS2-MED-UJ1-OTHERS-STEP1-01-R01	As a pilot	I want to be able to use remote sensing data	So I get the info I need	yes	
AsIs-DnM06	WP4, WP5	Broker	AsIs-DnM		As a pilot	I want to have my datasets harmonised and standardised	So I can use/integrate and compair datasets	yes	
AsIs-DnM07	WP4	Baseline assessment tool, can be part of cocreation/participation platform	AsIs-DnM		As a pilot	I want to make a baseline assessment of my site	So I can better assess the AS IS situation	yes	
AsIs-DnM07	WP4	Baseline assessment tool, can be part of cocreation/participation platform	AsIs-DnM	WS2-CON-UJ2-OTHER-STEP3-01-R01 WS2-CON-UJ2-OTHER-STEP3-02-R01 WS2-CON-UJ1-PILSEN-STEP1-02-R01	As a pilot	I want to open details of an NBS identified in the catalogue into the Digital Twin	So I can visualise the NBS and better understand it status.		
Wisimu01	WP4	digital twin	WIsimu	WS2-BOR-UJ1-KAJAANI-STEP2-02-R01 WS2-BOR-UJ1-KAJAANI-STEP2-02-R02 WS2-CON-UJ1-CLUJNAPOCA-STEP2-06-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP2-	As a pilot	I want to be able to do simulations to check environmental impact (air pollution, noise, heat, water con-	So I can investigate the effects of the proposed NBS solution before implementing	yes	Very relevant

				06-R02 WS2-MED-UJ1-ATHENS-STEP2-02-R01 WS2-CON-UJ1-PILSEN-STEP1-01-R01		servarvation, socio economic, etc.) of proposed solutions. Should include export of the results.			
Wisimu02	WP4	digital twin	WIsimu		As a pilot	I want to be able to update relevant parameters of the NBS and see the impact	so I can finetune the solution	yes	Very relevant
WIDnM01	WP4	digital twin	WIDnM		As a pilot	I want to be able to use existing datasets that are easily accessible	So the solution is integrated in our pilot	yes	Data sets at neighbourhood level for Cluj are basically non-existent, or very little information. We will rely a lot on the AS IS functionality from above
WIDnM02	WP4	digital twin	WIDnM	WS2-MED-UJ1-MADRID-STEP2-01-R01 WS2-MED-UJ1-MADRID-STEP2-01-R02 WS2-CON-UJ2-PILSEN-STEP1-01-R01	As a pilot	I want to be able to use existing models	So the solution is integrated in our pilot	yes	
WIDnM03	WP4	digital twin	WIDnM	WS2-ATL-UJ2-LEUVEN-STEP2-03-R01 WS2-ATL-UJ2-LEUVEN-STEP2-03-R02 WS2-ATL-UJ2-LEUVEN-STEP2-03-R03	As a pilot	I want to be able to import datasets and models that are not easily connectable	So I get the info I need inside the digital twin	yes	
WIDnM04	WP4	AS IS analysis toolbox	WIDnM		As a pilot	I want to be able to use data from sensors	So I get the info I need	yes	
WIDnM05	WP4	AS IS analysis toolbox	WIDnM		As a pilot	I want to be able to use remote sensing data	So I get the info I need	yes	
WIVisual01	WP4	digital twin	WIVisual		As a citizen	I want to be able to see the delta in relevant metrics	so I can see the impact of the proposed solution	yes	
WIVisual02	WP4	digital twin	WIVisual		As a citizen	I want to be able to see the before status in relevant metrics	so I can see the current version	yes	
WIVisual03	WP4	digital twin	WIVisual		As a citizen	I want to be able to see the after in relevant metrics	so I can see the to be version	yes	
WIVisual04	WP4	digital twin	WIVisual	WS2-CON-UJ1-CLUJNAPOCA-STEP3-01-R01 WS2-BOR-UJ1-KAJAANI-STEP4-05-R01 WS2-BOR-UJ1-KAJAANI-STEP4-05-R02 WS2-BOR-UJ1-KAJAANI-STEP4-05-R03 WS2-BOR-UJ1-KAJAANI-STEP4-05-R04	As a citizen	I want to be able to see/compare the cost of different scenario and compare it with its benefits	so I can assess feasibility	yes	

WIVis-ual04	WP4	digital twin	WIVis-ual	WS2-ATL-UJ2-LEUVEN-STEP3-02-R01 WS2-ATL-UJ2-LEUVEN-STEP3-02-R02 WS2-ATL-UJ2-LEUVEN-STEP4-02-R04 WS2-ATL-UJ2-LEUVEN-STEP4-03-R01 WS2-ATL-UJ2-LEUVEN-STEP4-03-R02 WS2-MED-UJ1-ATHENS-STEP2-01-R01 WS2-MED-UJ1-ATHENS-STEP2-01-R02 WS2-MED-UJ1-ATHENS-STEP2-01-R03	As a citizen	I want to be able to see different scenarios of simulation models			
WIVis-ual05	WP4	digital twin	WIVis-ual		As a citizen	I want to be able to see/compare the different scenarios in VR	so I can see the impact of the proposed solution	yes	
WIVis-ual06	WP4	digital twin	WIVis-ual		As a citizen	I want to be able to see the different scenarios in AR	so I can see the impact of the proposed solution	yes	
WIVis-ual07	WP4	digital twin	WIVis-ual		As a citizen	I want to be able to visually overlay different spatial indicators to visualize multiple criterias at the same time	so I can see the impact of the proposed solution	yes	
WIG-enAI01	WP4	Gen AI visualisation builder	WIG-enAI		As a pilot	I want to be able to experiment with generative AI	so I can see the impact of the solution	yes	for co-creation purposes
WIG-enAI01	WP4	Gen AI visualisation builder	WIG-enAI	WS2-MED-UJ1-MADRID-STEP1-03-R01 WS2-MED-UJ1-MADRID-STEP1-03-R02	As a pilot	I want to be able to experiment with generative AI	so I can find the document I am looking for	yes	for co-creation purposes
Plan01	WP4	Planning tool	Plan		As a pilot	I want to use an online tool to plan my NBS	so I get a good idea of what is needed for the implementation of our NBS	yes	
Plan02	WP4	Planning tool	Plan		As a pilot	I want to create a Long-term planning using cross-department decision making and district wide vision	So I keep the overview and I can learn/connect to/from other parties	yes	
Plan03	WP4	Planning tool	Plan	WS2-BOR-UJ1-KAJAANI-STEP1-01-R01 WS2-BOR-UJ1-KAJAANI-STEP1-01-R02 WS2-BOR-UJ1-KAJAANI-STEP1-01-R03	As a citizen	I want to be able to see what NBS projects have happened in the past, are	so I can help make sure all initiatives are fitting under	yes	

				WS2-BOR-UJ1-KAJAANI-STEP1-01-R04 WS2-BOR-UJ1-KAJAANI-STEP1-01-R05 WS2-BOR-UJ1-KAJAANI-STEP1-01-R06 WS2-BOR-UJ1-KAJAANI-STEP1-02-R01 WS2-BOR-UJ1-KAJAANI-STEP1-02-R02 WS2-BOR-UJ1-KAJAANI-STEP1-02-R03 WS2-BOR-UJ1-KAJAANI-STEP1-03-R01 WS2-BOR-UJ1-KAJAANI-STEP1-03-R02 WS2-BOR-UJ1-KAJAANI-STEP2-01-R01 WS2-BOR-UJ1-KAJAANI-STEP2-01-R02		being created at the moment and are planned. Should include options like keywords, filtering, documentation, commenting, ...	the vision for our city/region		
Plan04	WP4	Planning tool	Plan	WS2-BOR-UJ1-KAJAANI-STEP1-04-R01 WS2-BOR-UJ1-KAJAANI-STEP1-04-R02	As a citizen	I want to have a broader and more holistic view (beyond the NBS). Should include export/import of information.	So I can relate other projects/aspects and share information	?	
Design01	WP4	Planning tool	Design	WS2-CON-UJ1-CLUJNAPOCA-STEP1-02-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP1-02-R02 WS2-ATL-UJ1-LEUVEN-STEP2-02-R03	As a pilot	I want to use an online collaboratively tool to plan our NBS together with other parties	so everybody is totally aware of each step in the process	yes	
Design02	WP5	Planning tool	Design		As a pilot	I want to see a set of plug & play NBS to choose from in the planning tool	So this helps me with the design	yes	
Design03	WP5	Planning tool	Design		As a pilot	I need input from the (local) technical teams to participate (meet, think, deliberate, co-design, test, implement)	So I can fine-tune my approach	yes	
Design04	WP5	Planning tool	Design		As a pilot	I want to make a cost/benefit analysis of my NBS	So this can support me in descision making	yes	
Sust01	WP4, WP5		Sust		As a pilot	I want to investigate transferability, interoperability	so I can assess whether similar NBSs can be rolled out	yes	

DissPil01	WP4, WP5	Storytelling tool	DissPil	WS2-CON-UJ2-PILSEN-STEP1-02-R02	As a pilot	I want to have storytelling options	so I can clearly describe the pilot case to LL users and other involved parties	yes	
DissPil02	WP5, WP8	Storytelling tool	DissPil	WS2-ATL-UJ2-LEUVEN-STEP2-02-R01 WS2-ATL-UJ2-LEUVEN-STEP2-02-R02 WS2-ATL-UJ2-LEUVEN-STEP2-02-R03	As a pilot	I want to be able to make documentaries/movies/reports explaining our ase and NBS	so I have a live/accurate visual explaining the pilot case clearly to LL users and other involved parties	not sure	
DissPil03	WP4, WP5, WP8	Communication tools, channels	DissPil		As a pilot	I want to use different channels and tools to communicate	So I can reach a broad audience	yes	
DissCit01	WP5, WP8		DissCit		As a citizen	I want to be informed about the pilot case global set-up, specifications and details	so I have a comlete and correct understanding before I give my input	yes	
DissCit02	WP5, WP8	publication of **news** on different media	DissCit		As a citizen	I want to be informed about the pilot case updates during the URBREATH project	so I can update my input when needed	yes	
Part01	WP4, WP5	Feedback tools	Part		As a pilot	I can create a survey and share it with the citizens and LL users	so I can gather feedback about the proposals, simulations, prototypes and realisations	yes	
Part02	WP4, WP5	Feedback tools	Part		As a pilot	I can combine digital feedback with analog (like sticky notes,...)	so I can get an overal view of the feedback	yes	
Part03	WP4, WP5	Feedback tools	Part		As a citizen	I can place feedback on a map	so I can give precisely located feedback about the proposals and realisations	yes	

Part04	WP4, WP5	Feedback tools	Part		As a pilot	I want to **interact & discuss** with citizens and stakeholders	So I know their opinion & I learn	?	
Part05	WP4, WP5	Feedback tools	Part		As a pilot	I can allocate metadata like project, location, origin, date, ... to feedback from citizens/LL users	so I can analyse trends, groups, ...	?	
Part06	WP4, WP5	Sentiment analysis	Part		As a citizen	I can express my personal feeling about a NBS	so pilots know how specific involved groups feel about the NBS design and result.	yes	
LLProc01	WP4, WP5	LL platform/tools	LLProc	WS2-CON-UJ1-CLUJNAPOCA-STEP2-02-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP2-02-R02 WS2-BOR-UJ1-KAJAANI-STEP4-02-R01 WS2-BOR-UJ1-KAJAANI-STEP4-02-R02 WS2-BOR-UJ1-KAJAANI-STEP4-02-R03	As a pilot	I want to to set up a new participatory process with the LL users	So they can co-design the holistic strategy for the district	?	
LLProc02	WP4, WP5	LL platform/tools	LLProc	WS2-CON-UJ1-CLUJNAPOCA-STEP2-02-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP2-02-R02	As a pilot	I want to to help local municipalities to set up a new participatory process with their LL users	So they can co-design the holistic strategy for the district	?	
LLProc03	WP4, WP5	LL platform/tools	LLProc	WS2-BOR-UJ1-KAJAANI-STEP3-01-R01	As a living lab user	I want to be able to publish documents on the on-line participatory platform.	So I can share knowledge and get feedback/comments		
LLProc03	WP5	LL platform/tools	LLProc	WS2-MED-UJ1-MADRID-STEP5-01-R01 WS2-MED-UJ1-MADRID-STEP5-02-R01 WS2-MED-UJ1-MADRID-STEP5-02-R02 WS2-CON-UJ1-CLUJNAPOCA-STEP1-01-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP1-01-R02	As a living lab user	I want to discuss with other LL members and understand their drives	So I can better understand the pilot case	yes	

LLProc04	WP5	LL platform/tools	LLProc	WS2-ATL-UJ1-LEUVEN-STEP1-02-R01 WS2-ATL-UJ1-LEUVEN-STEP1-02-R02 WS2-ATL-UJ1-LEUVEN-STEP1-02-R03 WS2-ATL-UJ1-LEUVEN-STEP1-02-R04	As a living lab user	I want to **meet** (& plan meetings) with other LL users	So I can better understand the pilot case and the drives of other LL users (so I can better position my input)	yes	
LLProc05	WP5	LL platform/tools	LLProc	WS2-ATL-UJ1-LEUVEN-STEP1-02-R01 WS2-ATL-UJ1-LEUVEN-STEP1-02-R02 WS2-ATL-UJ1-LEUVEN-STEP1-02-R03 WS2-ATL-UJ1-LEUVEN-STEP1-02-R04	As a living lab user	I want to **join workshops** with other LL users	so I can actively participate in defining the NBS for the pilot case	yes	
LLProc06	WP4, WP5	LL platform/tools	LLProc		As a pilot	I want to institutionalise (inter)departmental working groups	so ideas can be exchanged to build policies in a cross-sectoral way	?	
LLProc07	WP4, WP5	LL platform/tools	LLProc		As a pilot	I want to upgrade decision making to a higher level (inter departmental teams f.i.)	So we can make decisions together	yes	
LLProc07	WP4, WP5	LL platform/tools	LLProc		As a pilot	I want to participate in the fine-tuning phase of the LL tool	So I know it will work for my case	yes	
LLProc07	WP4, WP5	LL platform/tools	LLProc	WS2-ATL-UJ2-LEUVEN-STEP8-01-R01 WS2-ATL-UJ2-LEUVEN-STEP8-01-R02 WS2-ATL-UJ2-LEUVEN-STEP8-01-R03	As a LL user	I want to get notifications about new content and updates in the participatory process	So I am up-to-date and able to steer the NBS approach	yes	
LLProc07	WP4, WP5	LL platform/tools	LLProc	WS2-MED-UJ1-OTHERS-STEP4-01-R01 WS2-BOR-UJ1-KAJAANI-STEP4-04-R01	As a pilot	I want to get access to the statistics about paritipatory process.	So I can be aware of the participation level and of the content		
LLFB01	WP4	LL platform/tools	LLFB	WS2-CON-UJ1-CLUJNAPOCA-STEP2-01-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP2-01-R02 WS2-BOR-UJ1-KAJAANI-STEP3-02-R01 WS2-BOR-UJ1-KAJAANI-STEP3-02-R02 WS2-BOR-UJ1-KAJAANI-STEP3-02-R03 WS2-BOR-UJ1-KAJAANI-STEP3-02-R04 WS2-ATL-UJ1-LEUVEN-STEP3-02-R01	As a Living Lab user	I want to give **feedback** to the pilot (as part of the LL tool)	so my voice counts in the deployment of a case	yes	

LLFB02	WP4	LL plat-form/tools	LLFB	WS2-ATL-UJ1-LEUVEN-STEP2-01-R01 WS2-ATL-UJ1-LEUVEN-STEP2-01-R02	As a Living Lab user	I want to see DT simulations in the LL tool, that help me to understand pilot case scenarios	so I have a better understanding	yes	
LLFB03	WP4	LL plat-form/tools	LLFB		As a Living Lab user	I want to vote and com-ment on use case scenarios	so my voice counts in the deployment of a case	yes	
LLFB04	WP4	LL plat-form/tools	LL	WS2-ATL-UJ2-LEUVEN-STEP5-02-R01 WS2-ATL-UJ2-LEUVEN-STEP5-02-R02 WS2-ATL-UJ2-LEUVEN-STEP5-02-R03	As a Living Lab user	I want to be able to upload extra relevant information	so other LL users can profit and get a better insight	yes	
LLFB04	WP4	LL plat-form/tools	LL	WS2-ATL-UJ1-LEUVEN-STEP1-01-R01 WS2-ATL-UJ1-LEUVEN-STEP1-01-R02 WS2-BOR-UJ1-KAJAANI-STEP5-01-R01 WS2-BOR-UJ1-KAJAANI-STEP5-01-R02 WS2-BOR-UJ1-KAJAANI-STEP5-01-R03 WS2-BOR-UJ1-KAJAANI-STEP5-01-R04	As a Living Lab user	I want to get access to in-teractive maps	so different teams can access, weigh and analyze info and make f.i vul-nerability maps	yes	
LLFB04	WP4	LL plat-form/tools	LL	WS2-BOR-UJ1-KAJAANI-STEP4-03-R01	As a Living Lab user	I want to get access to the KPIs	so I can follow up the progress	yes	
LLFB04	WP4	LL plat-form/tools	LL	WS2-CON-UJ1-CLUJNAPOCA-STEP2-03-R01 WS2-CON-UJ1-CLUJNAPOCA-STEP2-03-R02 WS2-CON-UJ1-CLUJNAPOCA-STEP2-03-R03 WS2-CON-UJ1-CLUJNAPOCA-STEP2-03-R04 WS2-BOR-UJ1-KAJAANI-STEP4-01-R01 WS2-BOR-UJ1-KAJAANI-STEP4-01-R02 WS2-BOR-UJ1-KAJAANI-STEP4-01-R03	As a pilot	I want to co-decide with cit-izens how to allocate the budget of the municipality	so I can plan inter-ventions that are closer to their pri-orities	yes	

Annex III - URBREATH technical functionalities

	Central catalog/library	Priority	BOR	ATL	MED	CONT	Tech team(s)	Description tech solution
1	A centralised catalogue/library to federate existing municipal systems offering a unique point of access to documents, plans, datasets, models, … related to NBS f.i. in the district Villaverde.	1	x	x	x	x	ENG, ATC	Data connection - 3 options: via API access, dump files, web scraper Idra. Needed from pilots: lists and metadata of relevant catalogs, datasets, plans, pictures, …
1.1	A **NBS catalogue** to support the definition of NBS interventions. To be integrated into the centralised catalogue. F.i. to find an analysis of interest to evaluate the effectiveness of a NBS.	1	x		x		ATC, ENG, VCS	Allows cross referencing between NBS projects in the Villaverde district (Madrid). Needed from pilots : lists and metadata of relevant catalogs, datasets, plans, pictures, … requires: Schema definition for NBS (for now M18 and future)
1.2	**Connect** maps showing simulation/scenario results.	1	x		x	x	ATC, ENG, VCS	Make a connection to both LDT maps. Example: map where NBS are most needed & possible (opportunities). Requires: Geoserver, Analysis Tool / Simulation tool => tool needs to publish to Geoserver Requires NBS registry
1.3	**Connect** map with locations were NBS are implemented already. = LDT visualisation, see LDT viewer.	1	x		x	x	ATC, ENG, VCS	Make a connection to both LDT maps. Requires: geolocated NBS-Data (point and Picture and description) Start with OPPLA https://statics.teams.cdn.office.net/evergreen-assets/safelinks/1/atp-safelinks.html

1.4	Search function helps users to search/find/access/download specific datasets. Requires: Catalog	1	x			x	ENG, VCS, ATC	With filtering on different parameters (environmental, infrastructure, …) Idra to use as search tool?
1.5	Geolocated search. Draw an area to find all datasets in this area. Requires: Catalog and each datasets needs a geolocation and / or BBOX	2				x	**ENG, VCS**	Metadata of the datasets should include geographic location.
1.6	Notification/alerting of stakeholders when new datasets are available or data are updated in the central library.	3				x	ENG	Needed: specification of keywords, geolocation, …). Option for stakeholders to subscribe to topics/datasets of interest.
1.7	The use of generative AI (NotebookLM or other) to summarise documents.	3	x			x	VCS	Investigation and learn pilots how to use.
1.8	Option to publish new datasets.	1	x			x	ENG, VCS, others	Via API. Also results from simulations, analytics can be published as datasets.
2	**Case demonstration tools - to cocreate & participate (LLL)**	**2**	**BOR**	**ATL**	**MED**	**CONT**	**Tech team(s)**	**Description tech solution**
2.1	Case demonstration - split screen 1 : LDT.	1	x	x	x	x	VCS	Data needed from pilots : Baseline map (color/black&white). Height model. LOD1 or LOD2 buildings. Trees. Preselection of relevant layers LL-members should see, as defined by pilots. Tech needs : Set position, zoom level, tilt level. Add marks, polygons, markers, texsts. Instructive course how to use.

								Specific pilot sites (not available for all pilots right now)
2.2	Case demonstration - split screen 2 : story telling tool.	1	x	x	x	x	VCS	Data needed from pilots : Texts and documentation (pictures, movies, PDFs, plans, …) Link to e-participation tool components (contacts, surveys) Specific pilot sites (not available for all pilots right now) Tech needs : Instructive course how to use
2.3	Case demonstration - visualise different scenarios in the LDT.	2	x	x	x	x	VCS	With also the option to vote for a scenario & to comment (dis)satisfaction Requires: NBS catalog and scenario support
2.4	Case demonstration - visualise simulation results (VC-map connection) as a layer in the LDT.	1	x	x	x	x	VCS	So LL-members are well informed about the use cases Requires: Simulation tools to publish their results to geoserver and creation of catalog entry
2.5	Case demonstration - use of VR to demonstrate the TO BE situation.	1		x		x	VCS	Data needed from pilots : Baseline map, height model. LOD2.2. for buildings and trees (Cyclomedia, Leuven) & manual building reconstruction software VCS. Tech needs : Expertise and experience from VCS (support on datasets) Hololenses

3	**Digital Twin viewer. To visualise datasets.**	**3**	**BOR**	**ATL**	**MED**	**CONT**	**Tech team(s)**	**Description tech solution**
3.1	Viewer itself. Data to visualise are found in the catalogue.	1	x	x	x	x	VCS, ENG	Example Tallinn layers for snow deposition : infiltration efficiency vulnerability to extreme events & hazards like floodings
3.2	A Geoserver to publish geographic data.	1			x		ENG, DEDA, involved partners	
3.3	Map layers **produced by simulations** and **analyses** to visualise results.	1	x	x	x	x	ATC, VCS, ENG, DEDA, involved partners	Also the **produced** geographic data can be searched in the central catalogue/library. Example: map showing where NBS are most needed & possible (opportunities) = Simulation result, see *simulations tool* part.
3.4	Map with locations were NBS are implemented already.	3	x		x	x	ATC, ENG, VCS	Overview map, pins with basic info (pictures, title, date, NBS-type, …) and links to more information. Data should have geolocation as metadata.
3.5	Immediate access to district data via the catalogue.	1	x	x	x	x	VCS, ENG	Data locations or datasets needed : population density, air quality, green infrastructure, traffic patterns, energy use, …
3.6	Real-time data access needed for sensors: traffic.	3	x	x				Declined by Cluj recently. F.i. Telraam. Frost server will be deployed. Leuven not confirmed yet. Pilots need to give input: API connection to connect to Frost server, file with latest values, … VCS will provide a plugin for map for Telraam data access and supports querying data from FROST Server (Sensorthings API)

3.7	Real-time data access needed for sensors: air quality.	3			x	x		Remote sensing real-time data, including position. Model data available? Historical data available? Investigate API-models (f.i. Breezometer) Pilots need to give input: API connection to connect (push/pull) to Frost server, file with latest values, … VCS will provide a plugin for map for Telraam data access and supports querying data from FROST Server (Sensorthings API)
3.8	Modelled traffic information.	3			x	x		Trafficscout, floating car data, TomTom & Ways (Cluj) Pilots need to give input: API connection to connect (push/pull) to Frost server
3.9	Modelled air quality information.	3			x	x		Breezometer API (Google), open AQ Pilots need to give input: API connection to connect (push/pull) to Frost server, file with latest values, ...
	Real-time data access needed for sensors: noise.							DECLINED VCS supports querying data from FROST Server (Sensorthings API)
3.10	Add feedback-comments, and vote in the LDT environment	3	x			x	VCS, ENG	Strong connection to e-participation tool, avoid parallel commenting/voting. Procedure is covered by the e-participation tool, procedure can be worked out. F.i. take snapshot and comment.
3.11	Functionality for LL-members to draw/sketch (f.i. alternative route to the beach, Tallinn)	1	x				VCS	Draw/sketch is already included in the software. Refresh browser = gone. Needed : training by VCS
4	**Simulations and scenarios**. 3 types.	2	**BOR**	**ATL**	**MED**	**CONT**	**Tech team(s)**	**Description tech solution**

4.1	Simulator type 1 - **priority locations** to install NBS (Approach = stepwise control panel) 1. select parameters (toggle parameters on/off) 2. give weight to parameters (using sliders) 3. press "simulate" button & show result on map (LDT) or dashboard (KPI dashboard) in toolbox iFrame.	3	x	x	x	x	ATC, VCS	need clarification who is doing the simulation? ATC, VCS can visualize the result, but not doing the simulation / analysis!
4.1.1	Simulator type 1 - what locations should be **prioritised to deploy NBS**? Based on low 3-30-300 scores Based on lowest BAF scores Based on lowest recreational value scores Based on vulnerability concerning extreme events of floods and draughts as monitored by FIC	1	x	x	x	x	VITO, DEDA, VCS, ATC, ENG	Can be stand alone maps. BAF allows comparison of predicted improvement with real measured improvement. On the fly (simulator) or prepared? Responsibility of pilots Requires: Data catalogue, Geoserver
4.1.3	Simulator type 1 - Identification and evaluation of potential locations to deposit collected snow.	3	x				VCS, others	Data needed: Analysis of satellite image (Copernicus) Public cadastre to support area identification (Tallinn input) Distance to city, accessibility, presence of vulnerable plants, volume of snow Numerical model of meltwater infiltration on deposit spots (based on soil constitution, VITO) Hydrological characteristics of deposition area Climate modeling short term (FIC)

								Climate modeling long term (FIC) Hydrological data needed of target area and surroundings Requires: Analysis of satellite or ortho images and segmentation of areas as polygons and maybe add. information like buildings etc. to create something like distance to metrics
4.2	Simulator type 2 - **what-if analyses - NBS effects** (Approach = stepwise control panel) 1. select parameters (webpage, toggle parameters on/off) 2. give numbers to parameters: for example 100 trees, 50m2 greenery added, ... 3. press "simulate" button & show scores + other relevant information.	3	x	x	x	x	ATC, VCS, ENG	Parameters : NBS type (new green space, water retention, biodiversity corridors, extra trees, ...) list should be completed also effects of infrastructural changes? Like bike lanes, pedestrian zones, update public transport, ... NBS size, surface, extent ... Requires: - Standard Interface (OGC-API-Processes) and a Process server and the process itself - infrastructural data as vector geometries (point, line, polygon) for bike lanes, pedestrian zones, etc
4.2.1	Simulator type 2 - NBS effect on ecological value.	1	x	x		x	~~FIC~~	~~Needed from pilots :~~ ~~What are the parameters?~~ ~~Suggested: BAF, 3-30-300.~~ ~~Interface needed. Selection of area. Select simulation layer f.i. extra trees.~~ ~~Requires:~~ ~~- Standard Interface (OGC-API-Processes) and a Process server and the process itself~~

4.2.2	Simulator type 2 - NBS effect on shadow impact (trees, buildings), using Cesium simulator (hour/day)	1	x	x	x	x	VCS, ENG, VITO	FIC is not able to develop this task, our work is focused in supply climate,seasonal and weather data and related indices. We do not develop specific NBS assessments Data needed: GIS layer for trees Point cloud info for trees (ATL) As detailed as possible: species, height, … Citizen science tools to monitor trees: VCS plugin, itree, other EU tool Separate - shadow maps (python script? to be checked) Visual inspection is supported in map viewer, but no output of metrics or geometry
4.2.3	Simulator type 2 - NBS effect on traffic & on air quality, ATC model	3		x			ATC	Air quality based on traffic. Changing traffic -> effect on air quality. A lot of information needed from the pilot. Not in scope of project: connect traffic - AQ Option to connect AQ stand alone scan to NBS directly -> historic info -> no effect
4.2.4	Simulator type 2 - NBS effect on climate resilience - water retention, floodings & flood risks	1	x	x	x	x	VITO, EXUS	Data needed : - Meteorological data (real-time weather stations): precipitation (rainfall and snowfall), temperature, humidity, ~~wind speed & wind direction~~. Short term weather forecast & water info, data. - Flood risk map - Water infiltration - Groundwater levels

4.2.5	Simulator type 2 - NBS effect on climate resilience - heatwave-, heat island-, droughts- & cooling effects.	1	x	x	x	x	FIC, Lat40	- Hydrological data: river flow rates, snow measurements, soil moisture content - Historical data (past flood events, flood maps, water discharge rates) needed in a tabular form by FIC for modelling/forecast Linked to Nature Value Explorer - water retention (VITO) Deliverable EXUS M18 -> M24 info needed : - Meteorological data (real-time weather stations): precipitation (rainfall and snowfall), temperature, humidity, ~~wind speed & wind direction~~. Short term weather forecast & water info, data. (FIC comment: managing to obtain the real time models) - Data on heatwave (intensity and # days), heat islands, draughts, cooling effects. - Water infiltration (Not needed by FIC) - Groundwater levels (Not needed by FIC) - Historical data (past flood events, flood maps, water discharge rates) needed in a tabular form by FIC for modelling/forecast. - Biodiversity climatic indicators (thresolds defined by experts) are needed for short- and long-term simulations by FIC.
4.2.6	Simulator type 2 - effect on socio-economic value.	1	x	x	x	x	ICCS	
4.3	Simulator type 3 - **what-if analyses - find optimal NBS** (Approach = stepwise control panel)	3						Based on parameters like climate predictions, budget, available space, target (BAF, 3-30-300) - what NBS to choose?

	1. select parameters (webpage, toggle parameters on/off) 2. give numbers to parameters: for example 100 trees, 50m2 greenery added, ... 3. press "simulate" button & show scores + other relevant information.				This is a question from different pilots, but can we do this? We don't have an NBS expert!!! Very complex. What is optimal? For water retention? ICCS? Safety? Other indicators. Hint: link to NBS **nature value explorer** catalogue. (VITO explorer)
4.3.1	Choose tree species to plant. Resilient to future climate changes.	3	x	FIC (needed biodiversity parner or experts)	based on climate prediction -> make proposal of tree species to plant Cluj: species known in May. Requires: number of trees and climatic zone? FIC comment, we need local botanical experts to define thresolds for developing the tailored climate indices FIC only is able to calculate climate/weather indices previously defined by experts, **we can not do assesments for selecting species**
4.3.2	Weather forecast short term to alert when analysis of snow melt areas are to be started. Alerts to maintenance teams when heavy snow is expected.	2	x	FIC (needed parner or experts)	Needed data: historical weather data, weather station live data (FICcomment: already achieved) FIC comment: Pending to define the thresolds for EWS alerts by cities FIC Comment II: It is important to know how and where is expected to visualize the data
4.3.3	Climate modelling long term information (FIC) to make climate projections – Allows definition of NBSs under future climatic conditions of snow and	2	x	~~FIC~~	FIC comment: It is not planned to simulate snow and snowmelt climate projections due to high uncertities. It could be discused with Boreal cities

	snowmelt and not on the basis of current conditions.							
5	**Analyses of impact and effect measurements (before/after effects) NBS**	**3**	**BOR**	**ATL**	**MED**	**CONT**	**Tech team(s)**	**Description tech solution**
	ADD info from KPI analysis with pilots	**2**						**Requires: Standard Interface to access data from KPI Manager, or Map viewer, etc**
5.1	**BIOLOGY - ECOLOGY - HEALTH**	**3**	**BOR**	**ATL**	**MED**	**CONT**		
5.1.1	Biodiversity.	3	x	x	x	x	VITO	Data needed : - Biodiversity map (available for plants). - Focus on small pollinators? Idea of Citzen Science app?
5.1.2	3-30-300 index. For quantitative analysis & accessibility of green.	3	x	x	x	x	VITO, DEDA	For the "3" sub-rule: • Single tree crowns (vector, polygons) or tree canopy (vector, polygons) … or census of trees (vector, points). • Residential buildings (vector polygons) to be buffered (50m). • Digital Surface Model, at least with 1m resolution (raster). For the "30" sub-rule: • Single tree crowns (vector, polygons), tree canopy (vector, polygons), or NDVI highlighting high vegetation (raster, at least 5 m/pixel). • Administrative units such as districts, neighborhoods, barrios (vector, polygons), or statistical/census units (vector, polygons). • Alternatively: Residential addresses (vector, points) to be buffered (500m). For the "300" sub-rule:

5.1.3	Biotope Area Factor - BAF.	3	x	x	x	x	VITO - Manual Berlin https://www.berlin.de/sen/uvk/en/nature-and-green/landscape-planning/baf-biotope-area-factor/calculating-the-baf/ Leuven Ph.D. thesis for extended version.	• Green urban public spaces excluding cemeteries, private gardens, etc. (vector, polygons). • Gates/accesses to green urban public spaces, if available (vector, points). • Residential addresses (vector, points). • Road network (topological line network). Can help to find regions with high priority to install NBS. Data needed : vegetation infiltration NBS-type substrate thickness Sealed surface greened surface vertical greenery rooftop greening.
5.1.4	Air quality - CO2 (sensor or model info)	3				x		Only modeled information available (Breezometer)
5.2	**CLIMATE RESILIENCE**	**3**	**BOR**	**ATL**	**MED**	**CONT**		
5.2.1	Heat stress - draughts : shadow impact (buildings and trees).	3			x		VCS	Data needed - Shadow impact map of trees (based on age, species - VCS) => Shadow can be visualized, but no metrics or geometry output - Detailed trees GIS layer - VCMap-plugin available. ITree app? - Best is: trees cadastre as shape or geojson with

								species name and height => VCS can create a 3d tiles layer out of it => can be then used on VR / AR environment as well
5.2.2	Climate analyses and forecasts modeling (heat island effects, heat waves).	3			x	x	FIC	Data needed: heat stress map weather information Data availability on project geoserver as a service FIC comment: we can provide basis data for island effect analyses, about heatwaves we can develop specifical indexes on all timescales, could be interesting co-design indices with cities, but not mandatory
5.2.3	~~Climate modelling~~ short term information (FIC) to predict the volume of snow & needed capacity of deposit spot(s). Historical weather info and weather station live data needed.	3	x				FIC	Data availability on project geoserver as a service Fic comment: Just for clarification, we are providing this data (pending to define how to deliver it exactly) but not a tool for visualization
5.3	**MOBILITY - ACCESSIBILITY**	**3**	**BOR**	**ATL**	**MED**	**CONT**		
5.3.1	Mobility & modal shift.	3	x		x		VCS, ICCS	Data needed: Tallinn : sensor data, counts of all transport modes (g-move, Telraam): pedestrians, cyclists, cars, trucks. Monitoring public transport: tram (Tallinn) Modal shift: more pedestrians and cyclists after NBS Find optimal location to install sensor (single entry point area) Connect data to the LDT to visualise Leuven :

								Local traffic sensor data for counts pedestrians, cyclists, cars, trucks (Telraam to be installed) (Local) traffic model (TML, available) Floating car data (available) Infrastructure locations such as bike lanes needed for DT & Lat40 heat island effect analysis. Available? OSM? ATC can build traffic dashboards.
5.3.2	Accessibility - To detect critical conditions about accessibility from specific locations	3	x				ICCS, VCS	Indicate start point -> best fit analysis (with AI-support) -> best accessibility, best path (economical, ecological, citizen conditions)
5.4	**SOCIO ECONOMIC**	**3**						
5.4.1	Recreation value.	3	x	x	x	x	VITO	Based on Nature Value Explorer (Belgium), interoperability for CZ to be investigated. Includes societal, economic value measurement (surveys needed).
5.4.2	Land use, crowd monitoring.	3	x		x		VCS, ICCS	Data needed: - sensor data, counts of all transport modes (g-move, Telraam) - best fit analyses on economic, ecological, citizen condition, shadow, … perspective (AI-based). - Based on information of parking sensors (Cluj) Crowd analysis of visitors of the square before/after NBS. (Leuven) - Monitoring of the time spent in NBS area - Survey-based, diary, maybe extra information from Telraam sensors? - Qualitative monitoring of visitors - Differentiation in older adults, children, lower

5.4.3	socio-economic value/impact.	3	x		x	x	ICCS	SES groups, … - Survey-based - Socio-economic changes (before/after) -Survey based, lots of expertise in Leuven Tools : Crowd-measuring sensors (crowdscan sensor) Surveys Simulate effects on socioeconomic parameters (cost of living, city life index, other) Data needed: Census data (demographic, economic, & geographic) Cluj, yes. Actual cost of living & housing and its distribution in the city Business activities distribution in the city
5.4.4	*3-30-300 index also fits here*	*3*						
6	**E-participation tool**	**3**	**BOR**	**ATL**	**MED**	**CONT**	**Tech team(s)**	**Description tech solution**
6.1	Tool to participate/cocreate : share content (docs, plans, scetches, …) with stakeholders.	1	x	x	x	x	VCS, TEL, ENG, others	Requires plugin from map viewer to connect to DECIDIM (read and write) OR full integartion of map viewer into DECIDIM
6.2	- Get info from universities	1	x			x		
6.3	- Share results, ideas, options, good practices	1	x	x	x	x		
6.4	Tool to participate/cocreate : interact with stakeholders through communication channels (meeting rooms, chats)	1	x	x	x	x		Decidim offers forums to debate. Assemblies can include blogpost, where users can participates in discussions. In addition, there is the possibility to set events (such as meetings also online) and associate online communication channel (e.g. MS Teams invitation).

6.6	Tool to participate/cocreate : connected LDT & other visualisation tools (for datasets & simulations)	1	x	x	x	x		Investigate the integration of VC Map showing specific location, map layer, and information. Investigate possible integration with Mobile App
6.7	- visualisation of NBS (projects) on a map	1	x		x		VCS	Requires plugin to connect to DECIDIM (read and write)
6.8	Tool to participate/cocreate : geolocation of NBS	1	x		x			Decidim, integrate map layer, showing location of NBS and the possibility to access their related information. For the mobile app, the same + investigate the possibility to offer direction to a specific NBS.
6.21	Tool to participate/cocreate : support for decision-making	1			x			possibility to comment, discuss, vote,
6.24	Tool to participate/cocreate : public channel to interact with citizens	1	x	x	x	x		E-participation tools want to offer this kind of channel.
6.26	NBS scenarios & simulations : comment/feedback, vote (not for Leuven), suggest ideas	1	x	x	x	x		If an nbs scenario is translated into a participatory process, these capabilities can be integared, to let user create comments, feeback, vote, suggets ideas, debate, etc. See previoius points.

Annex IV - Provisional list of KPIs components, outcome of the LLL workshops of December 2024

Accessibility	Remarks	Measure what	Measure how	Tallinn	Kajaani	Leuven	Aarhus	Cluj	Pilsen	Madrid	Parma	Athens	popularity
Accessibility		Number of visitors using the area (pedestrians, cyclists, cars, vans)	Sensors, smart camera, counting, flow analysis, parking sensors (Pilsen), FCD (Pilsen)	x		x	x	x	x	x	x	x	8
Modal shift from cars to pedestrians/cyclists		Number of cars, cyclists, pedestrians	Sensors (Telraam Leuven), TomTom database data, traffic models	x		x	only reduction of cars	x	x	not a priority	x	x	8
What do visitors of the area do?		Kind of activity	Questionnaire/stop up interview.				x						1
Satisfaction/livability, awareness & knowledge increase	**Remarks**	**Measure what**	**Measure how**	**Tallinn**	**Kajaani**	**Leuven**	**Aarhus**	**Cluj**	**Pilsen**	**Madrid**	**Parma**	**Athens**	popularity
Satisfaction/livability local residents & stakeholders		Degree of satisfaction - per social group (elderly, young, cultural background, low income, woman) - score 1-5	questionnaire - 1-5 on statements	x		x	x	x	x		x	x	7
Awareness of local residents & stakeholders		Number of interactive communications related to nature-conservation plans and actions	Surveys, questionnaires, actions		x								1
Average time spent in the NBS area		Hours	Under investigation			x							1
Knowledge/experience increase		Number of Expertise of the participating organisations in NBS	Survey (baseline and final)		x								1
Knowledge/experience increase	Related to line above	Increased understanding on how to increase understanding climate resilience.	Surveys							x	x		2
Socio-economic monitoring	Applicable to all?	Socio-economic status of an area	ICCS analysis					x					1
NBS	**Remarks**	**Measure what**	**Measure how**	**Tallinn**	**Kajaani**	**Leuven**	**Aarhus**	**Cluj**	**Pilsen**	**Madrid**	**Parma**	**Athens**	popularity
Snowmelt		Treated snowmelt	Liters, m3 or tons	x	x								2
Snowmelt		Purity/health of snowmelt water, environmental load	Heavy metals and nutrients	x	x								2
Soil		Water holding capacity	Liters or m3	x									1

Soil		Health of groundwater	Na+ and Cl-	x									1
Soil		(Biological) health of soil	Earthworm counts, microbial activity, disease risks, pH, nutrient levels, organic matter content	x	x								2
Soil		Infiltration rate, mm of rain	Measured by expert or modelled	x			x				x		3
Garbage		Volume removed	Measured by the experts	x									1
Trees	Madrid uses adapted itree tool	shadow impact in m2	Based on model & LDT simulations			x		x	x	x			4
Air quality		NOx and (PM), also CO2 (Cluj)	Sensors, modelled data from luftenpådinvej.au.dk, model Cluj (no sensors)			no longer	x	x	x	not sure, only model		x	5
Noise		Noise levels, decibels	Sensors, police data						x				1
Biodiversity - biodiversity restoration	Madrid investigates method beyond counting plants /diversity	Nr of insects/butterflies/small pollinators/other species (Cluj: plants & animal)	Citizen science or expert service	x	x	x		x		x			5
Biodiversity - biodiversity restoration		Nr of recognised biodiveristy support actions	Counts by experts		x								1
Biodiversity - invasive plants		Numbers of detected or destroyed plants	Local app		x								1
Habitat / urban area regeneration due to NBS	Criteria? Biodiversity?	Urban area regenerated, m2	not specified for Cluj, Madrid					x		x			2
Desealed surface	Covered BAF? Or is this habitat regeneration? Sattellite data?	m2	Measured by experts			x		x		x	x		4
Habitat renaturation due to NBS	Criteria?	Urban area regenatured, m2	not specified					x					1

Cost-benefit analysis of NBS		Number of analyses	Model								x		1
NBS - models & simulations	**Remarks**	**Measure what**	**Measure how**	**Tallinn**	**Kajaani**	**Leuven**	**Aarhus**	**Cluj**	**Pilsen**	**Madrid**	**Parma**	**Athens**	popularity
Flooding risk		Decrease/increase	Based on model & simulations			x	x				x	x	4
Heat island effects & heat stress (heat waves, heat islands, draughts)		Decrease/increase	Based on model & simulations			x		x	x	x	x	x	6
Cooling effects	may be part of heat stress analysis?	Decrease/increase	Based on model & simulations			x						x	
Biotope Area Factor (BAF, Nature quality)		Value from 0 to 1	Based on model & simulations	x	x	x	x	x	x	x	x	x	9
3-30-300 index (green quantity, livability)		Percentage of homes and neighbourhood	Based on model & simulations	x	x	x	x	x	x	x	x	x	9
Recreational/nature value		Decrease/increase	Nature Value Explorer Tool based on qualitative, quantitative & monetary indicators	x	x	x	x	x	x	x	x	x	9
Snowmelt		Number of potential locations	Simulation tool with different parameters (distance, permeability, …)	x									1
Participation	**Remarks**	**Measure what**	**Measure how**	**Tallinn**	**Kajaani**	**Leuven**	**Aarhus**	**Cluj**	**Pilsen**	**Madrid**	**Parma**	**Athens**	popularity
Participation - tool usage		Counts of usage	E-participation tool							x			1
Participation - usage of URBREATH products	can be joined with item above	Counts of usage	Tools, strategies, frameworks, processes - based on meeting notes, photographic records							x			1
Participation - satisfaction of URBREATH products	can be joined with item above	Before / after analysis - score 1-5	Tools, strategies, frameworks, processes - based on questionnaire - 1-5 on statements							x			1
Participation - training/co-design sessions		Number of municipal officials following training/co-design sessions	List of participants							x			1

Participation - number ofpartners		Number of private partners involved in the process	Counts		x	1

Annex V - Milestone 7 KPI-list, status June 30th, 2025

Mobility																
KPI-ID	**Objective**	**Target Trend**	**Metric**	**Calculation**	**Unit**	**LE**	**AA**	**TA**	**KA**	**CN**	**PI**	**MA**	**PA**	**AT**
MOB-KPI1	Decrease motorized transport	Decrease	Share of motorized traffic in the modal split in NBS area	(Journeys or route of a transport carrier / Total journeys or routes) x 100	Percentage (%)	X					X		X	
MOB-KPI2		Decrease	Total number of cars driving in NBS area	Counting	Absolute Numbers (#)		X				X		X	X
MOB-KPI3	Decrease motorized traffic speed	Decrease	Allowed traffic speed in NBS area	Capturing the value	Speed limit in kilometres per hour (km/h)							X		
MOB-KPI4	Decrease area used for parking spaces	Decrease	Share of space used for car parking in NBS area	(Total area used for car parking / Total area of NBS area) x 100	Square metres (m^2)		X				X			
MOB-KPI5	Promotion of cycle traffic	Increase	Share of cyclists in the modal split in NBS area	(Journeys or route of a transport carrier / Total journeys or routes) x 100	Percentage (%)	X				X	X			
MOB-KPI6		Increase	Lenght of bicycle lanes in NBS area	Measurement	Kilometres (km)		X			X				
MOB-KPI7	Promotion of pedestrian traffic	Increase	Share of pedestrians in the modal split in NBS area	(Journeys or route of a transport carrier / Total journeys or routes) x 100	Percentage (%)	X				X	X			
MOB-KPI8		Increase	Number of pedestrians in NBS area	Counting	Absolute numbers (#)			X						
MOB-KPI9		Increase	Expansions of sidewalks and pedestrian paths in NBS area	Measurement	Metres (m) or square metres (m^2)		X			X	X	X	X	
MOB-KPI10	Promotion of public transport	Increase	Share of public transport in the modal split in NBS area	(Journeys or route of a transport carrier / Total journeys or routes) x 100	Percentage (%)						X			

Biodiversity														
KPI-ID	**Objective**	**Target Trend**	**Metric**	**Calculation**	**Unit**	**LE**	**AA**	**TA**	**KA**	**CN**	**PI**	**MA**	**PA**	**AT**
BIO-KPI1	Increase size of greened area	Increase	Total greened area	Measurement	Square metres (m^2)	X	X		X	X		X	X	X
BIO-KPI2	Expand high-quality biotope areas	Increase	Biotope Area Factor (BAF)	Using Tool and VC Planner	BAF 0 - 1	X				X	X		X	X
BIO-KPI3	Increase fauna diversity	Increase	Number of pollinators/insects/butterflies in NBS area	Counting	Absolute numbers (#)	X		X		X				
BIO-KPI4		Increase	Number of animals (other than pollinators/insects/butterflies) in NBS area	Counting	Absolute numbers (#)					X				

BIO-KPI5	Increase flora diversity	Increase	Number of detected plant species in NBS area	Counting	Absolute numbers (#)					X					
BIO-KPI6		Increase (/Preservation)	Total number of trees per species in NBS area	Categorisation and counting	Absolute numbers (#) per species	X	X			X	X	X	X		
BIO-KPI7		Increase	Share of NBS area covered by tree canopy	Using Tool and VC Planner	Percentage (%)	X					X	X	X		
BIO-KPI8	Reduce invasive plant species	Increase	Areas freed of invasive plant species	Measurement	Square metres (m^2)				X						

Environment & Pollution

KPI-ID	Objective	Target Trend	Metric	Calculation	Unit	LE	AA	TA	KA	CN	PI	MA	PA	AT
EP-KPI1	Decrease noise pollution	Decrease	Noise level	Measurement	Decibel (dB)		X			X				
EP-KPI2	Improve soil health	Decrease	Sodium level (NA+) in snow meltwater	Measurement	Milligrams per kilogram (mg/kg) or milligrams per litre (mg/l)			X	X					
EP-KPI3		Decrease	Chloride level (Cl-) in snow meltwater	Measurement	Milligrams per kilogram (mg/kg) or milligrams per litre (mg/l)			X	X					
EP-KPI4		Decrease	Level of heavy metals in snow meltwater or soil	Measurement	Milligrams per kilogram (mg/kg)				X					
EP-KPI5		Decrease	Level of phosphorus in snow meltwater	Measurement	Milligrams per litre (mg/l)				X					
EP-KPI6		Decrease	Level of nitrogen in snow meltwater	Measurement	Milligrams per litre (mg/l)				X					
EP-KPI7	Decrease litter pollution	Decrease	Amount of litter in the plowed snow	Measurement	Kilograms (kg)				X					

Climate Resilience

KPI-ID	Objective	Target Trend	Metric	Calculation	Unit	LE	AA	TA	KA	CN	PI	MA	PA	AT
CR-KPI1	Decrease flooding risk	Increase	Water infiltration rate	EXUS	Millilitres per hour (mm/h)	X	X				X		X	
CR-KPI2		Increase	Total area of permeable surfaces	Measurement	Square metres (m^2)	X					X	X	X	

CR-KPI3	Improve snowmelt water treatment	Increase	Size of permeable snow deposit area	Measurement	Square metres (m^2)				X							
CR-KPI4		Increase	Total amount of treated snow-melt water	Quantifiction of the volume of meltwater that has been collected and treated (e.g., for use in irrigation, drinking water, or other purposes)	Cubic metres (m^3)			X	X							
CR-KPI5	Decrease drought risk	Increase	Soil moisture level	Measurement	Percentage (%)	X				X	X					
CR-KPI6		Decrease	Groundwater level	Measurement	Meters above sea level (MASL)					X						
CR-KPI7		Increase	Rainwater retention capacity	Measurement	Litres (l)					X						
CR-KPI8		Increase	Grey and rainwater re-use	Measurement	Litres (l)					X						
CR-KPI9	Decrease Urban Heat Island (UHI) Effect	Decrease	Surface Temperature	LAT40	Degrees Celsius (C°)	X				X	X	X	X			
CR-KPI10		Increase	Shaded areas	Using Tool and VC Planner	Square metres (m^2)	X				X	X	X	X			

Livability & Social Justice

KPI-ID	Objective	Target Trend	Metric	Calculation	Unit	LE	AA	TA	KA	CN	PI	MA	PA	AT
LSJ-KPI1	Improve natural area access for recreation	Increase	Number of users/visitors of the NBS area	Counting	Absolute numbers (#)		X						X	X
LSJ-KPI2		Increase	Size of accessible NBS area per capita	Total accessible NBS area / total population	Square metres per capita (m^2/capita)							X		
LSJ-KPI3		Increase	Degree of perceived recovery from the stay in the NBS area	Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)	X	X			X				X
LSJ-KPI4		Increase	Number and type of new recreation facilities/installations	Counting	Absolute numbers (#)	X	X	X		X	X		X	X
LSJ-KPI5	Increase overall satisfaction with the NBS area	Increase	Degree of satisfaction with NBS area	Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5)	Percentage of the individual responses (%) and mean value (M)	X	X	X	X	X			X	X

LSJ-KPI6		Increase	Degree of perceived safety in NBS area	Sum all response values Divide by the total number of respondents Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)												
LSJ-KPI7		Increase	Degree of perceived aesthetic of the NBS area	Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)												
LSJ-KPI8	Provide social communication spaces to reduce loneliness	Decrease	Degree of perceived loneliness in NBS area	Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)												
LSJ-KPI9	Provide cultural offerings	Increase	Number of cultural offerings (events, etc.) in NBS area	Counting	Absolute numbers (#)												
LSJ-KPI10	Provide opportunities for physical activity	Increase	Degree of satisfaction with physical activity infrastructure in NBS area	Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)												
LSJ-KPI11	Prevent "Green Gentrification"	Maintain at the level prior to NBS implementation	Median housing value in NBS area	Inflation-adjusted housing value = Median housing value in n years / (1 + inflation rate)n	National currency												

LSJ-KPI12	Provide inclusive urban environments	Increase	Share of users satisfied with accessibility features of the NBS area	<u>Percentage:</u> (Number of responses for each individual option / Total number of respondents) x 100 <u>Mean Value:</u> Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)		X							
LSJ-KPI13	Provide public sanitation and premises	Increase	Provision of drinking water fountains	Counting	Absolute numbers (#)							X		

Knowledge & Awareness														
KPI-ID	**Objective**	**Target Trend**	**Metric**	**Calculation**	**Unit**	**LE**	**AA**	**TA**	**KA**	**CN**	**PI**	**MA**	**PA**	**AT**
KA-KPI1	Raise citizen climate adaption/NBS knowledge and awareness	Increase	Share of citizens aware of climate change adaptation and NBS	<u>Percentage:</u> (Number of responses for each individual option / Total number of respondents) x 100 <u>Mean Value:</u> Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)					X			X	X
KA-KPI2		Increase	Number of climate change adaption and NBS knowledge and awareness actions/publications implemented/released for citizens	Counting	Absolute numbers (#)	X			X	X			X	
KA-KPI3		Increase	Share or Number of schools that teach climate change adaption and NBS (in relation to the NBS on site, e.g. through a visit)	(Number of schools teaching / Total number of schools) x 100 Counting	Percentage (%) Absolute numbers (#)					X		X	X	
KA-KPI4		Increase	Number of citizens reached by knowledge and awareness campaigns on climate change adaptation and NBS	Counting	Absolute numbers (#)	X		X	X		X		X	X
KA-KPI5	Raise city staff climate adaption/NBS knowledge and awareness	Increase	Share of city officials working in NBS-related departments aware of/knowing about climate change adaptation and NBS	<u>Percentage:</u> (Number of responses for each individual option / Total number of respondents) x 100	Percentage of the individual responses (%) and mean value (M)				X			X		

KA-KPI6		Increase	Share of city officials working in NBS-related departments who have participated in the UR-BREATH training program	Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents (Number of "Yes" responses / Total number of city officials working in NBS-related de-partments) x 100	Percentage (%)							X				

Governance & Participatory Planning

KPI-ID	Objective	Target Trend	Metric	Calculation	Unit	LE	AA	TA	KA	CN	PI	MA	PA	AT
GPP-KPI1	Foster greater recognition and in-tegration of NBS in local governance practices	Increase	Number of regulatory and policy frameworks on climate change adaptation and NBS that have been reworked/improved	Counting	Absolute num-bers (#)							X		
GPP-KPI2		Increase	Implementation of governance mechanisms to foster cross-de-partmental collaboration in im-plementing and managing NBS	Counting	Absolute num-bers (#) of new governance mechanisms							X		
GPP-KPI3		Increase	Number of projects within the city administration utilizing UR-BREATH tools	Counting	Absolute num-bers (#)	X								
GPP-KPI4	Maintain long-term citizen interaction and local stewardship	Increase	Number of citizens involved in the local stewardship (maintenance or conservation)	Counting	Absolute num-bers (#)					X			X	
GPP-KPI5		Increase	Community garden area	Measurement	Square metres (m^2)					X			X	
GPP-KPI6	Build long-term stakeholder part-nerships	Increase	Number of stakeholder partner-ships established, categorized by group representation (e.g., NGOs, businesses, etc.)	Counting	Absolute num-bers (#)					X		X		X
GPP-KPI7		Increase	Number of participants in city-hosted events for local partner-ships related to NBS	Counting	Absolute num-bers (#)					X				X
GPP-KPI8		Increase	Degree of partner satisfaction with NBS partnerships	Percentage: (Number of responses for each individual op-tion / Total number of respondents) x 100	Percentage of the individual re-sponses (%) and mean value (M)					X				X

				Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents											
GPP-KPI9	Provide open data on NBS to the public	Increase	Number of published governance documents on NBS (strategies, plans, concepts, etc.)	Counting	Absolute numbers (#)						**X**				
GPP-KPI10		Increase	Number of open datasets on NBS (geospatial data, performance, etc.)	Counting	Absolute numbers (#)		**X**				**X**				

Local Economy															
KPI-ID	**Objective**	**Target Trend**	**Metric**	**Calculation**	**Unit**	**LE**	**AA**	**TA**	**KA**	**CN**	**PI**	**MA**	**PA**	**AT**
LE-KPI1	Revitalize NBS area for businesses	Increase	Number of businesses actively using the NBS area (e.g. through outdoor seating areas)	Counting	Absolute numbers (#)		**X**				**X**			
LE-KPI2		Increase	Degree of satisfaction of business owners with NBS area	Percentage: (Number of responses for each individual option / Total number of respondents) x 100 Mean Value: Assign numeric values to each response (1-5) Sum all response values Divide by the total number of respondents	Percentage of the individual responses (%) and mean value (M)		**X**							