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

D5.9 Customized URBREATH decision making framework for Pilots

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Document description	The deliverable reports on the information gathered on the current systems and solutions used in the urban planning process within the URBREATH pilot cities. Further, it elaborates on how and to what extent the overall framework is tailored according to the specific pilots' needs, integrating selected components into their existing IT systems, as well as on the activity of data ingestion, collection and harmonisation to feed KPIs calculation. This deliverable is linked to T5.4, and the first iteration is submitted at M24.

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Disclaimer

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Executive Summary

The deliverable "D5.9 – Customized URBREATH Decision-Making Framework for Pilots" presents the outcomes of "Task 5.4 – Customisation and deployment of the URBREATH decision-making framework into pilots" within Work Package 5 (WP5) – *Local Living Labs*. The document provides a comprehensive overview of how the URBREATH decision-support framework and digital tools have been adapted, tested, and aligned with the specific planning and governance contexts of the pilot cities.

It introduces a comparative workflow analysis, contrasting "Before URBREATH" and "After URBREATH" planning processes to identify integration opportunities for digital and Nature-Based Solutions (NBS). The document synthesizes the findings of co-creation workshops, stakeholder interviews, and tool testing sessions conducted with pilot cities and supporting partners.

The second part of the deliverable focuses on the *URBREATH Toolbox* and its technical integration potential. It describes how Local Digital Twins (LDTs) and shared analytical tools, such as the KPI Manager, URBREATH Catalogue, GeoCacher, and E-Participation platforms, support planning workflows through data visualization and scenario analysis. The mapping of tool readiness and local deployment potential provides insights into interoperability, local infrastructure constraints, and technical maturity levels.

Finally, the document concludes with recommendations for future deployment and replication in follower cities (FLCs), linking WP5 activities to WP6 (implementation) and WP7 (scaling and replication). The deliverable contributes to a shared understanding of how URBREATH's integrated digital framework can facilitate evidence-based, participatory, and climate-resilient urban planning across Europe.

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List of Terms and Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
API	Application Programming Interface
BAF	Biotope Area Factor
FLC	Follower City
FRC	Frontrunner City
FROST-Server	Fraunhofer Open-Source SensorThings API Server
GIS	Geographic Information System
KPI	Key Performance Indicator
LDT	Local Digital Twin
LLL	Local Living Lab

MIM	Minimal Interoperability Mechanism
MQTT	Message Queuing Telemetry Transport
NBS	Nature-based Solution
NGSI-LD	Next Generation Service Interface – Linked Data
REST API	Representational State Transfer Application Programming Interface: a lightweight web service style that allows clients to access and interact with resources through standard HTTP requests.
T	Task
WCS	OGC – Web Coverage Service: a standard service that provides access to raster-based geospatial data, such as elevation or satellite imagery, allowing retrieval of actual data values for analysis.
WFS	OGC - Web Feature Service: an internet-based service that provides access to geographic vector data, like roads or rivers, from a distributed Geographic Information System (GIS).
WMS	OGC - Web Map Service: standard providing a simple HTTP interface for requesting geo-registered map images.
WP	Work Package

1 Introduction

The URBREATH project aims to support European cities and regions in achieving climate neutrality through the systemic integration of NBS and digital planning tools. As part of this effort, **Task 5.4** – *Customisation and deployment of the URBREATH decision-making framework into pilots* focuses on mapping the existing urban planning workflows of pilot cities and exploring how URBREATH tools can be integrated into local planning processes.

This deliverable (D5.9) is the main outcome of Task 5.4. It provides an overview of current planning practices in each pilot city, identifies relevant digital tools and data infrastructures, and analyzes the potential for integrating URBREATH toolbox components. The goal is to customize the decision-making framework for each city by aligning it with their planning structures, digital readiness, and local needs.

The findings are based on responses to a standardized set of guiding questions, workshops with city representatives, and crosswalk analyses linking existing workflows to URBREATH tools. This first version of the deliverable serves as a foundation for further tool adaptation, capacity building, and integration work in the next phase of the project.

Throughout Task 5.4, regular coordination meetings were held with pilot cities, technical partners, and local partners to ensure continuous feedback and alignment between the tool developers and end users. These sessions enabled a shared understanding of local planning workflows, data structures, and institutional processes, which shaped the customization of the URBREATH decision-making framework.

1.1 Purpose and Scope

The purpose of this deliverable is to document and analyze the existing urban planning workflows in URBREATH pilot cities and assess the integration potential of digital and Nature-Based Solutions (NBS) within those workflows. It aims to identify key decision-making processes, digital infrastructures, and opportunities for incorporating URBREATH toolbox components such as spatial analysis tools, KPI tracking systems, and participatory platforms.

This first version (v1.0) focuses on:

- Mapping current planning processes across cities based on a standardized workflow framework.
- Identifying gaps and overlaps between existing tools and URBREATH tool capabilities.
- Highlighting initial tool interests expressed by cities and their level of readiness.
- Providing visual representations of city workflows to guide further integration steps.

The scope covers four frontrunner cities: **Madrid, Cluj-Napoca, Leuven and Tallinn,** together with the follower city **Kajaani** and draws on their self-reported data, interviews, and internal reviews conducted under Task 5.4. Among the follower cities, Kajaani is included here because it is the only FLC that

provided a complete set of inputs during the current reporting cycle. The findings are used to inform later phases of the project, including technical alignment, capacity-building, and long-term uptake of URBREATH tools.

1.2 Relation to other Work Packages and Deliverables

This deliverable is part of **Work Package 5 (WP5) – Local Living Labs**, which plays a transversal role in the URBREATH project by grounding digital and Nature-Based Solutions (NBS) in the local realities of pilot cities. Specifically, it contributes to **Task 5.4**, which focuses on the ***customization and deployment of the URBREATH decision-making framework*** within pilot sites. The task involves identifying existing systems and planning workflows, assessing readiness for integration, and aligning the technical framework with pilot-specific needs.

This deliverable also has strong interconnections with several other work packages:

- WP2 provides the methodological foundation and co-creation tools used during the initial engagement and scenario-building phases. The baselines and urban regeneration needs defined in Task 2.4 – *Use case scenarios and baselines* are key inputs for Task 5.4. In addition, Deliverable D2.2 (M24) will further outline the different workstreams carried out in the first two years of the project, while Deliverables D2.5 and D2.4 (M12) provide the first set of requirements that inform the analyses conducted in WP5.
- WP3 defines data strategy and analytical components, including climate and socio-economic models, AI tools, and weather forecasts. These are the core analytical engines feeding into the visual and simulation interfaces used in WP5.
- WP4 delivers decision-making tools and technical components, including the Digital Twin viewer, KPI Manager, and E-Participation platforms. These tools are assessed and piloted in WP5 through real-world applications. As outlined in the Description of Action (DoA), the decision-support tools and Digital Twin components developed under WP4 form the technical foundation for the framework deployed in WP5 (URBREATH Consortium, 2025).
- WP6 focuses on the implementation of co-created NBS solutions in the pilots. The decision support framework documented here is used to select and monitor the NBS interventions described in WP6.
- WP7 supports scaling and replication, using the learnings from WP5 to generate toolkits, training materials, and investment strategies for Follower Cities (FLCs). This deliverable will contribute evidence-based inputs to WP7 roadmaps and policy guidance.
- Finally, WP8 addresses impact creation and dissemination. The documented workflows, visual tools, and integration findings are key content for communication campaigns, stakeholder engagement, and standardization efforts, particularly in Tasks 8.2 and 8.4.

In summary, this deliverable serves as a bridge between methodological design (WP2–WP4) and practical implementation and learning cycles (WP5–WP7). It informs the technical customization,

supports decision-making, and ensures that URBREATH tools are locally embedded and interoperable across different planning systems and city contexts.
The initial outcomes of Task 5.4 are presented in alignment with the structure of this deliverable.

- Chapter 1 introduces the purpose and scope of the work and outlines how the decision-support framework is positioned within WP5.
- Chapter 2 describes the methodological approach used to gather and organize inputs from the pilot cities. A shared workflow template was applied to ensure consistent structuring of information on planning processes, digital tools, and data systems. This methodological basis enables comparability across cities and supports the analysis presented in subsequent chapters.
- Chapter 3 presents the City Use Cases, examining each pilot city's existing workflows and local infrastructural conditions. This chapter identifies the first integration pathways for adapting URBREATH tools to the specific needs and capacities of the cities.
- Chapter 4 provides an overview of the URBREATH Toolbox. It summarizes the level of interest expressed by cities and outlines the technical requirements for potential deployment, framing the feasibility of tool adoption within each local context.
- Chapter 5 discusses data interoperability and integration practices, including APIs, standards, and the compatibility of existing infrastructures with the URBREATH tools. These aspects form the technical foundation for sustainable integration.
- The main challenges identified during this initial assessment phase are outlined in Chapter 6. These include institutional limitations, technical and infrastructural barriers, data-related constraints, and training needs observed across the pilot cities.
- Finally, Chapter 7 summarizes the conclusions of this early assessment and presents initial recommendations to guide the refinement of the integration framework and the next stages of WP5 activities.
- The annexes complement these chapters with workflow diagrams, detailed tables, and referenced materials that support the analysis and findings.

2 Methodology

2.1 Data Collection and Analysis for Urban Planning Integration

The assessment of urban planning systems and their potential integration with the URBREATH decision-making framework was conducted through a systematic, multi-stage approach. Information from pilot cities was collected, analyzed, and synthesized to provide a clear understanding of their current practices and readiness for URBREATH adoption.

2.1.1 Guiding Questions and Checklist

The process commenced with the development of a structured questionnaire, known as the "Guiding Questions and Checklist." This tool was distributed to each pilot city to gather comprehensive details on several critical aspects: existing planning frameworks, public engagement methods, NBS strategies, spatial data infrastructures, interoperability, sensor utilization, and interest in URBREATH tools. The targeted questions ensured that consistent and relevant information was obtained across all participating cities.

2.1.2 Standardized Workflow Template Development

Following the collection of responses, a standardized workflow template was created. This template mapped each city's urban planning processes and cataloged their digital tool environments. The use of uniform categories across cities facilitated the identification of common patterns, unique local practices, and potential opportunities for URBREATH integration. This comparative framework enabled efficient cross-analysis and highlighted areas where the decision-making framework could be most effectively deployed.

2.1.3 Supplementary Qualitative Summaries

In addition to the mapped workflows, qualitative summaries were compiled for each city. These narratives highlighted the principal digital tools, data systems, and governance models in use. Insights obtained from follow-up interviews and clarification emails were incorporated where necessary to enrich the analysis and ensure accuracy.

2.1.4 Outcomes and Integration Planning

The final outputs of this process provide a foundational overview of the urban planning landscape in each pilot city. These findings form the basis for customizing the URBREATH framework to local requirements, guiding the development of tools, supporting data standardization efforts, and shaping long-term integration strategies within the project.

2.2 Workflow Data Collection Methodology

The data collection process for urban planning workflows commenced with the development of a unified workflow template and a comprehensive set of guiding questions. These guiding questions, detailed in Annex-1, were carefully crafted to facilitate the systematic collection of structured information from each participating city. The design of these materials ensured the consistency and comparability of data across all pilot cities, enabling a robust cross-city analysis.

The questions addressed the full spectrum of the urban planning process, encompassing stages such as plan development, stakeholder engagement, public participation, the application of digital tools and platforms, and the degree of data interoperability within municipal systems. By covering these aspects, the questionnaire provided a holistic overview of the planning environment and digital maturity in each city.

To ensure local accuracy and relevance, the guiding questions were distributed to local partners in each pilot city. These partners completed the questionnaires by drawing on internal discussions, reviewing available documentation, and consulting with experts from relevant municipal departments. In instances where responses required further clarification, the process was supplemented by follow-up emails and targeted interviews, thereby enhancing the completeness and accuracy of the collected information.

Once collected, the responses were thoroughly reviewed, cleaned, and synthesized by the task lead. This synthesis process involved creating structured narrative summaries and visual workflow diagrams that accurately depicted current planning procedures and identified key digital tools in use. The intent of this approach was to establish a clear and coherent understanding of each city's baseline prior to the integration of URBREATH tools or methodologies.

In addition to providing this foundational overview, the structured workflow data also serves as a critical resource for identifying gaps in integration, assessing tool readiness, and highlighting potential areas for the deployment of digital twin technology and e-participation processes in the subsequent stages of the project.

2.3 Crosswalk Matching to Workflow Template

To ensure comparability and structured analysis across cities, a standardized workflow template was developed. The template consists of five core categories reflecting the key components of urban planning relevant to nature-based solutions and digital integration:

(1) Urban Planning,
(2) Nature-Based Solutions (NBS) Development,
(3) Geoportals and Data Systems,

(4) Sensor Monitoring and Feedback,
(5) URBREATH Tool Integration Potential.

Once responses to the guiding questions were collected from each pilot city, a crosswalk matching process was performed. This process involved systematically mapping the raw inputs to the corresponding workflow sections. Information was restructured and categorized based on content relevance, regardless of the order in which it was originally provided.

This cross-referencing allowed the identification of recurring patterns, data gaps, and local variations, which in turn informed the customization of the URBREATH decision-making framework. Where information was ambiguous or incomplete, further clarification was requested through bilateral exchanges with city representatives.

2.4 Visualization Logic

To clearly and uniformly present the findings, a standardized Excel format was used to summarize each city's responses according to the workflow structure. Each pilot city occupies a column, while workflow elements are organized row-wise based on the five main categories. This tabular format allows side-by-side comparison and supports the identification of common challenges, digital maturity, and integration potential.

The structure also helped visualize the completeness and coverage of answers from each city, guiding further follow-up for missing or unclear inputs.

The tabular visualization format is shown in Annexes, 9.2.

3 City Use Cases

3.1 Digital Tools and Data in Urban Planning

The information presented in this chapter has been derived primarily from two key sources, in the footsteps of the activities initiated in WP2 (Deliverable "D2.4 Use case scenarios and baselines" [1]):

1. The **Guiding Questions and Checklist – Before URBREATH** document (9.1), which was distributed to all pilot cities to capture their existing urban planning workflows, decision-making structures, and digital practices prior to the URBREATH interventions.
2. The **Data Inventory Excel** (Figure 9), maintained under Task 5.4, which consolidates tool usage, data formats, NBS study areas, training feedback, and integration readiness across all pilot cities.

URBREATH involves nine pilot cities in total — four *Frontrunner Cities* (Madrid, Leuven, Tallinn, and Cluj-Napoca) and five *Follower Cities* (Parma, Athens, Aarhus, Kajaani, and Pilsen).

However, at this stage, complete responses to the Guiding Questions were received from the four Frontrunner Cities and one Follower City (Kajaani). Therefore, the sections below focus on these five cities, reflecting their reported workflows, digital tools, and data practices as the main evidence base for the current analysis. As several pilot activities are still ongoing, additional inputs from the remaining cities are expected to be incorporated in the updated version of this deliverable at M36.

Madrid
Madrid's urban planning process makes use of a combination of desktop and cloud-based tools. GIS platforms such as ArcGIS are widely used for mapping and spatial analysis. Building plans and urban design elements are typically handled with tools like AutoCAD and Revit. The city also maintains internal databases for zoning, transportation, and infrastructure.

The city has strong interoperability through open data and API-based connections. Its main spatial data infrastructure IDEAM (*Infraestructura de Datos Espaciales del Ayuntamiento de Madrid*) provides WMS/WFS/WCS services, while the Decide Madrid portal *(plataforma de participación ciudadana del Ayuntamiento de Madrid)* and the open data platform (data.madrid.es) expose REST APIs for real-time access. Data formats comply with INSPIRE and ISO 19115 standards, supporting seamless integration with other planning and environmental tools. Publicly documented examples include the municipal WMS service for base cartography available through datos.madrid.es.

A central component of this ecosystem is the Visor Urbanístico del Ayuntamiento de Madrid , the official digital platform for accessing planning regulations, land-use classifications, development rights and protected areas. This viewer is fed by the Base Cartográfica Municipal and the Planeamiento Urbanístico datasets, which are maintained and updated by the municipal cartography and planning

departments. These datasets are made available through the Geoportal del Ayuntamiento de Madrid, an integrated platform that provides access to authoritative geospatial layers, metadata and download options.

While the city does not provide a unified REST API for all planning datasets, many resources on the open data portal include machine-readable formats and API endpoints for selected datasets such as mobility, environmental and administrative information. These complement the geospatial services offered through the Geoportal and IDEAM.

Finally, Public participation is actively integrated through Decide Madrid (https://decide.madrid.es), the city's open-source civic engagement platform, which allows residents to propose, discuss and vote on urban and environmental initiatives. The portal is open source, hosted on municipal servers, and linked to Madrid's broader open data ecosystem. The platform is linked to the broader municipal open data ecosystem, enabling alignment between participatory processes and planning information accessible through the Visor Urbanístico *(Urban Planning Map Viewer)* and the Geoportal.

Leuven

Leuven uses a variety of tools in its urban planning process, including the Stappenplan Ontwerp Openbaar Domein (*Steps for design of public domain*), which structures the design of public spaces. The main tool used for design is AutoCAD. For visuals, the town regularly requests external work from the architecture office to create a render for the project to showcase it to the citizens.

- The city utilizes GIS tools (containing many different data layers, such as the tree layer) for spatial analysis and has adopted participatory platforms in certain projects. Usually, physical meetings with the citizens are organized for the participatory processes, to be able to capture the nuances compared to an online platform. Online participation is used in cases where it is harder to reach the target public, such as the station square where many people pass through, compared to residential areas. There was also a temporary action in the past "Hier dringt het door" (*Here It Gets Through, a temporary civic campaign focused on urban regreening*), where citizens could suggest projects for regreening in the city, and there is an ongoing "Kom op voor je wijk" action *(Stand Up for Your Neighborhood initiative, ongoing civic participation program)* which allows citizens to suggest general projects or desires (such as a table to play table tennis in the area, a library for books around, etc.). Some projects are published online: Ontwerpplannen heraanleg straten | Stad Leuven
- There are several sources of data available, yet not all data is publicly available.
    - Leuven in Cijfers (Local)
    - Provincie in cijfers (Regional)
    - Statbel (National)

- Moreover, some resources are present at Flemish level, such as the climate portal, waterinfo (flooding maps), geopunt (also containing historical data, zoning plans, etc.), Flemish Subsoil Database DOV soil platform among other relevant data portals.

Although many tools are still desktop-based, there is increasing interest in integrating cloud platforms and improving API-based interoperability. The Smart City department uses the "UrbanSense platform" to store and share specific sensor data; yet it works project based. The city broadly uses sensors for weather data and mobility data – the latter are also open source (Telraam.be).

Tallinn

Tallinn operates a centralized digital planning system. The Tallinn Planning Registry (https://tpr.tallinn.ee/) is used to process and publish planning documents. The city also uses ArcGIS, AutoCAD, Revit, Rhino, and ArchiCAD for geospatial data and 3D planning. Sensor-based data is actively integrated into planning processes, and APIs are available through the city's ArcGIS server. Tallinn is also developing a Digital Twin of the city, which integrates real-time data and supports advanced simulation.

Cluj-Napoca

Cluj-Napoca applies digital mapping tools for spatial planning and maintains several online geoportals supporting land-use and infrastructure management. The municipality uses both proprietary and open-source GIS solutions to manage urban data and support planning workflows.

Cluj-Napoca has made consistent progress in digitizing its planning processes. Several municipal systems already allow data exchange through national and local platforms such as data.gov.ro and the city's own servers. The municipality operates online services for environmental monitoring and traffic planning, which support interoperability across departments.

Public participation is well established through the Participatory Budgeting platform and the Center for Innovation and Civic Imagination (CIIC), both of which enable citizens to propose and debate community projects.

The city also developed a Digital Twin prototype under the NZC project in the Mănăștur district. The model integrates energy, comfort, and air quality data to simulate renovation scenarios and support communication between planners and citizens, providing an early example of scenario-based and sensor-supported planning.

Kajaani

Kajaani's planning department applies standard desktop software for mapping and planning, including AutoCAD and GIS-based tools. Planning data is managed through both municipal and national systems,

for example, the city's online map service provides zoning and land-use data through a WMS endpoint, and additional datasets are hosted by the Finnish Environment Institute (SYKE).

The city's digital systems already support interoperability through open data services and standard formats such as PDF, Excel, DWG, and geospatial data files. While sensor-based monitoring is not yet in use, Kajaani has expressed interest in expanding its digital infrastructure under the URBREATH project, particularly through the development of a Digital Twin concept for scenario-based design and stakeholder engagement.

Public participation is mandatory by law and implemented through project presentation events and public display periods, where citizens can submit comments or written feedback on draft plans.

3.2 Current Urban Planning Workflow (Before URBREATH)

Urban planning workflows across the URBREATH pilot cities follow distinct institutional structures but share a common goal: integrating sustainable, climate-responsive decision-making into local development processes. To understand how NBS and digital tools can be embedded effectively, it is essential to assess how planning procedures currently operate before URBREATH interventions. The following sections outline the existing urban planning workflow in each city, focusing on planning authority distribution, community involvement practices, and the extent of digital and environmental integration.

Madrid

Urban planning in Madrid follows a two-stage approval process: municipal preparation and internal review, followed by public consultation and final authorization by the *Comunidad de Madrid*. The Urban Planning Department leads the drafting of plans (e.g., PGOU, *Plan Parcial*, *Proyecto de Actuación Especial*), with contributions from thematic municipal teams and regional authorities.

Nature-based solutions (NBS) are increasingly implemented through strategic frameworks such as *Madrid + Natural* and the *Green Infrastructure and Biodiversity Plan*. Projects are initiated via departmental or community proposals, and co-created through collaboration with residents, scientists, and NGOs.

Citizen participation is institutionalized through multiple channels. The *Decide Madrid* platform allows citizens to propose, debate, and vote on planning ideas, while municipal departments conduct targeted workshops, neighborhood forums, and online consultations. NBS pilots are monitored through social and environmental KPIs, enabling adaptive management and continuous community feedback.

Leuven

Urban planning in Leuven follows a structured and iterative process defined by the "*Stappenplan Ontwerp Openbaar Domein"*, which guides the design phases of public domain interventions. The process involves several rounds of approval by the political council, based on preparations made by the administrative departments and early alignment with the deputy mayor.

Multiple municipal departments, including Mobility, Heritage, Green, Economy, and Citizen Engagement, collaborate from the initial concept stage, with additional input from external actors, such as the police, public transport companies, and utility providers.

Public participation is a core component of the workflow. Neighborhood meetings are organized at key design stages to gather residents' needs, comments, and concerns, while final designs are presented in follow-up sessions or written communications. In EU-funded projects, Leuven complements this with creative co-creation formats such as door-to-door conversations and educational workshops. NBS are not yet formalized in the workflow yet considered in every project. (Support and) Grants are present for citizens that want to install green tiles or roofs. Sometimes more technical solutions are chosen (such as buffers, infiltration-sewage systems, infiltratable substructures instead of grasstiles for parking lots, etc.). Departmental prioritization (e.g. old sewage systems) and citizen input drive projects that incorporate green and sustainable design elements. The city is working on a plan for climate adaptation, which will also consider concrete heat-vulnerable areas, flooding zones, and attempts to make guidelines for design. Moreover, a tree-plan is under development, to sculpt a vision regarding the planting and maintaining of the trees. A green plan already exists but is a high-level vision for the future greening of the town. There are strict rules regarding water management at regional level, which must be considered in redesign projects.

Tallinn

Tallinn applies a two-tier spatial planning system consisting of a citywide Comprehensive Plan and district-level Detailed Plans. The Comprehensive Plan defines long-term development goals and land-use zoning, while Detailed Plans specify building parameters, public spaces, and infrastructure at the neighbourhood scale. Both plan types are subject to public consultation and approval under Estonia's Planning Act.

Public participation is mandatory and supported by digital tools such as the *Tallinn Planning Registry* and *Maptionnaire*, which allow citizens to review, comment, and provide map-based feedback on draft plans.

Nature-based solutions (NBS) are increasingly integrated through strategic urban planning initiatives and EU-funded projects. The city promotes NBS in various forms — including green corridors, rain gardens, and urban forests — and coordinates their implementation through collaboration between

departments such as Urban Planning, Environment, and Infrastructure. Community groups and NGOs also contribute by initiating small-scale NBS projects, supported by participatory budgeting and local grants.

NBS components are now commonly included in public space renovations, with measures like bioswales, permeable pavements, and native planting enhancing resilience and biodiversity across Tallinn.

Cluj-Napoca

Urban planning in Cluj-Napoca follows a structured approval process combining citizen participation and expert evaluation. The workflow begins with participatory consultation, followed by professional assessments and multiple approvals — including opportunity clearance, the Chief Architect's endorsement, and the reviews of the Esthetics Commission and the Technical Committee for Spatial Planning and Urbanism — before final adoption by the City Council.

Citizen engagement is institutionalized through both physical and digital platforms. The Center for Innovation and Civic Imagination (CIIC) serves as an open forum for public debates, while the Participatory Budgeting platform enables residents to propose and vote on improvement projects. All planning documents are also subject to legal public consultation on the municipal website.

Greening actions are developed through a co-creation process involving the public, private, and academic sectors. This methodology includes idea proposals, collaborative design, pilot implementation, and scaling-up successful interventions. Several projects are already being developed following this approach, strengthening the city's capacity for sustainable and nature-inclusive urban transformation. In terms of proper NBS actions, there are not that many experiences, but a notable best practice is the example of Feroviarilor Park, where a bioswale solution was implemented – creating a natural system of collecting rainwater and making the area resilient to flooding events.

Furthermore, the most relevant practice of the city in terms of sustainability, performance design, and citizen-driven solutions, is the international competition practice. These competitions are organized with the coloration of the OAR (Romanian Order of Architects) – with the main added value that the best solution is the winner, not the smallest bid (in the case of acquisition procedures). The design theme is constructed through citizens consultations and co-creation activities, followed by the competition phase, design phase, approvals, implementation.

Kajaani

Urban planning in Kajaani follows a transparent and legally regulated multi-phase process. The workflow begins with an initiation phase where a participation and assessment plan is prepared and publicly announced. Draft plans are then displayed for public review and feedback, followed by a proposal phase that includes written reminders and stakeholder consultations. Final approval is granted

by the City Council, City Board or a decision by a public official, depending on the significance of the plan, after which the decision enters into force once it gains legal validity.
The process involves multiple authorities: the Environmental Technical Board (minor plans and feedback collection), the Permit and Supervision Board (special permits), the Kainuu ELY Centre (regional consultation), and the Kainuu Regional Council (regional land-use planning). Public participation is mandatory by law and typically takes place through public presentation events, where citizens can comment in person or submit written feedback during the display period (14–30 days).

Nature-based solutions (NBS) projects follow a similar structured sequence from its initiation and planning (site assessment and ecological evaluation) to citizen engagement (workshops and consultations), implementation (rain gardens, permeable materials, green corridors), and maintenance and monitoring (tracking vegetation, water flow, and quality). Under the URBREATH framework, Kajaani aims to strengthen data interoperability and explore digital tools to support these sustainable practices.

3.3 URBREATH Tool Interests of Pilots

The current mapping of tool interests across pilot cities reflects an ongoing exploration and training phase rather than full integration. Each city is assessing the potential of URBREATH tools in relation to its local planning workflows, digital readiness, and specific environmental or governance priorities.

This analysis has been prepared based on the **Guiding Questions** responses and the **Data Inventory Excel**, which jointly capture the cities' levels of engagement, preferred analytical and participatory tools, and their expected benefits. The findings highlight how each city's needs and priorities align with selected URBREATH tools — from monitoring and scenario analysis to participation and policy support.

In parallel, Task 5.4 maintains continuous communication with pilot cities to facilitate this matching process, support training activities, and explore opportunities for connecting existing local platforms and datasets with the URBREATH environment.

Madrid is currently exploring the integration of selected URBREATH tools to support co-creation, interdepartmental collaboration, and environmental analysis. The city has shown interest in analytical tools such as the **Heat Stress Analysis** and medium and long-term climate prediction, which can enhance understanding of microclimatic conditions and prioritize areas for NBS within districts.
Future adoption will depend on the compatibility of these tools with existing municipal infrastructure, as well as licensing, maintenance, and open-source considerations. Relevant departments - including Urban Regeneration, Energy and Climate Change, and Green Areas - are involved in assessing potential use cases and data interoperability options.

Leuven is exploring the integration of URBREATH tools within its 3D Digital Twin environment to support spatial analysis, participatory design, and policy development. The city has shown interest in using analytical modules such as **Biotope Area Factor (BAF)**, **Shadow Analysis**, **3-30-300 Analysis**, **15-**

Minute City (Proximity Index), **Water Infiltration Model**, and **Urban Heat Island** to inform green and climate adaptation strategies. So far, the Small Scafe BAF Analysis and Shadow Analysis have already been applied and used as a demo-case for internal departments as well as to showcase and explain the new plan to the citizens.

Potential applications are being assessed across departments including Green, Urban Planning, Participatory Department, Smart City and Sustainability, with a focus on linking these tools to local living labs and participatory planning workflows. More technical analysis has been explored as departmental evaluation of the current planning workflows by the departments. Micro-scale modelling would be very useful for urban planning developments, as well as to be able to communicate with citizens about the local situations. Full integration will depend on the compatibility of data formats and sensor connections currently under investigation.

Tallinn is expected to further explore a range of URBREATH tools that can strengthen its climate adaptation and urban resilience strategies. These tools will be used primarily by city planners, municipal staff responsible for daily city maintenance, and the Department of Urban Sustainability and Energy Efficiency, all of whom depend on reliable data to guide strategic and operational decisions. Among the tools under consideration are analytical modules such as the **3-30-300 Analysis** and the **Optimal Locations to Deposit Snow tool,** which supports efficient and environmentally responsible winter maintenance practices. By adopting these modules, Tallinn can enhance its assessment of green accessibility, seasonal management needs, and long-term environmental performance. Integrating such data-driven methods into routine planning, maintenance, and sustainability workflows will help the city improve livability, reinforce climate resilience, and ensure that future development aligns with its broader sustainability and environmental objectives.

Cluj-Napoca is interested in URBREATH tools that enhance data collection, and environmental monitoring. The city highlighted interest in Sensor Monitoring, Data Collection, and KPI Monitoring & Feedback, as well as analytical tools such as the **3-30-300 Analysis, 15-Minute City (Proximity Index), and short-, seasonal-, and long-term weather and climate forecasts** to support scenario testing and impact assessment of NBS pilots.

Cluj-Napoca also intends to connect its existing platforms to the URBREATH environment, particularly the Center for Innovation and Civic Imagination (CIIC) for e-participation and digital simulations, and the “Adopt a Green Space” program, which aligns with the NBS Registry and community engagement framework.

Kajaani has expressed interest in applying the **Digital Twin concept** to support scenario-based urban design and strengthen stakeholder involvement in planning. Within the URBREATH framework, the city is particularly interested in analytical tools such as **Optimal Locations to Deposit Snow**, which can improve winter management and climate resilience. The Regional Planning Department and the City’s

Maintenance Division are expected to be key users, exploring how these tools can enhance coordination and decision-making in local planning processes.

In summary, while pilot cities are still exploring tool adoption according to their local needs and readiness levels, several URBREATH tools — including the User Interface (UI), NBS Registry, Data Dashboard, E-Participation Tool, URBREATH Catalog and the Local Digital Twin (LDT) have already been prepared as available to usage of all pilots. Within the LDT environment, many analytical components are now integrated and visualized directly on the map, ensuring cross-accessibility and supporting shared decision-making across cities.

3.4 Workflow Graphics

The following Figure 1 present a visualization of the current urban planning workflows collected from each city through the guiding questions. These workflows follow a harmonized template structured into five key domains:

1. Urban Planning
2. NBS Development
3. Geoportals & Data Systems
4. Sensor Monitoring & Feedback
5. URBREATH Tool Integration Potential

Each city's responses were mapped and synthesized according to this template, allowing for cross-comparison while maintaining local specificities. The workflow visualizations provide insight into the maturity of each planning ecosystem and help identify integration points for the URBREATH tools.

The workflow below illustrates the current urban planning process in Madrid. It highlights the two-stage approval system (local and regional), the role of the Urban Planning Department, and the integration of citizen participation through mandatory consultation rounds. The workflow also identifies the points where URBREATH tools can support visualization and monitoring of NBS interventions.

The complete workflows for other pilot cities (Leuven, Tallinn, Cluj-Napoca, and Kajaani) are provided in Annex-3 for reference and cross-comparison.

Figure 1: Madrid – Urban Planning Workflow

4 Toolbox Integration

This section presents how the URBREATH decision-making framework can be integrated into existing urban planning processes across the pilot cities. Based on the analysis of local workflows, data environments, and tool readiness, we identify specific opportunities where URBREATH tools can support planning, monitoring, citizen engagement, and impact assessment. The toolbox includes a variety of digital services—ranging from Digital Twins and NBS modelling to e-participation platforms and KPI tracking systems.

The following subsections provide:

- An overview of available URBREATH tools and their capabilities.
- A summary of tool interest expressed by each city.
- An outline of candidate tools selected for each use case.
- Visual diagrams showing where and how toolbox components align with urban planning workflows.

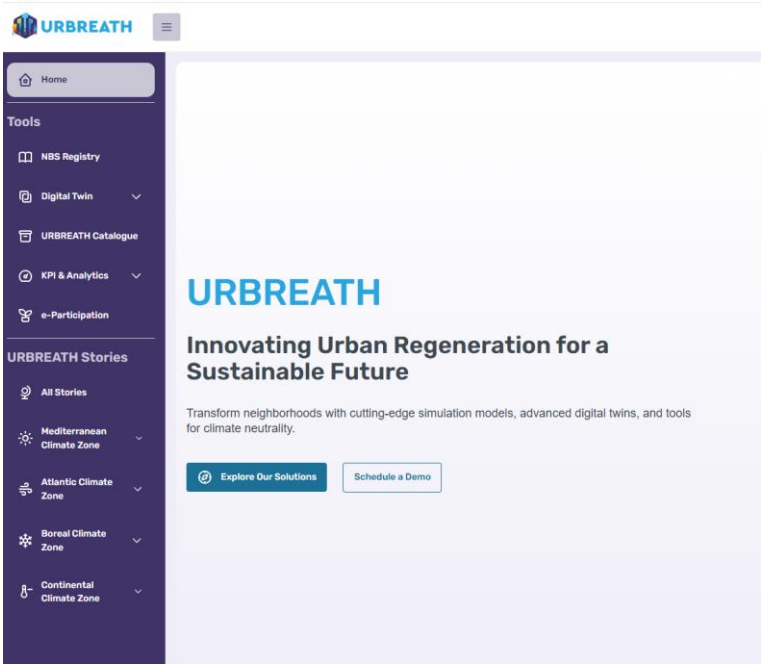
These insights are intended to guide tool customization and ensure that local implementations are relevant, technically compatible, and impactful.

4.1 Overview and Structure of the URBREATH Toolbox

The URBREATH Toolbox (https://dashboard-dev.urbreath.tech/home) is a collection of digital tools designed to help cities adapt to climate change, enable decisions based on evidence, and encourage citizens to get involved. It is designed to be flexible and interoperable with each city's digital infrastructure, offering a shared digital environment where stakeholders can co-create, monitor, and evaluate NBS.

At the core of the Toolbox is a set of interconnected web interfaces that allow cities to access a variety of tools for planning, data exploration, performance monitoring, and community engagement. The main entry point is the URBREATH Toolbox UI, which connects dedicated modules: **NBS Registry, Digital Twin platforms, URBREATH Catalogue, KPI & Analytics, e-Participation, URBREATH Stories.** Through a single authentication system, cities can securely access both common and city-specific tools and datasets.

Figure 2: URBREATH Toolbox



Every city's Digital Twin brings together multiple tools and shows baseline datasets related to NBS, such as climate projections, urban heat islands, and planning metrics like the 3-30-300 rule. The toolbox lets users see simulation results and indicators, though these are presented as static visuals and aren't recalculated in real-time for new planning actions.

The URBREATH Toolbox also centralizes access to important data sources. Through the URBREATH Data Catalogue (powered by Idra, *Open Data Federation Platform, unique point of access to aggregate the catalogues that already exist*), cities can browse over 3,000 datasets and interact with structured NBS data via the NBS Registry platform. Where needed, these datasets are integrated into the Digital Twin viewers, making urban data more transparent and accessible.

Beyond its planning and data utilities, the Toolbox offers ways for the public to participate and for performance to be tracked. The KPI Manager, for example, helps monitor key indicators covering areas like climate, biodiversity, and mobility, while platforms like Decidim (e-Participation platform) support participatory processes through interactive surveys.

All together, the URBREATH Toolbox provides a unified and scalable digital structure that connects tools, data, and cities through a common system. The following sections describe each part in greater detail.

4.1.1 Modular Components and Web Interfaces

The URBREATH Toolbox is organized as a modular suite of integrated digital services, each available through dedicated web interfaces. This architecture enables municipalities to select, evaluate, and implement specific tools tailored to the municipal requirements and technical capabilities. Additionally, the system's design facilitates incremental adoption, allowing cities to gradually incorporate additional components at their own pace.

Core elements are deployed as distinct modules on a shared infrastructure, with unified authentication and access controls managed through Keycloak *(is a tool providing Identity Manager, Authentication and Authorization functionalities)*. Each tool is accessible via a direct web link and fulfills a targeted role within the planning and monitoring processes. For instance, the Digital Twin platform offers visual exploration and simulation capabilities, while the KPI Manager delivers access to indicator definitions and real-time performance metrics.

All modules adhere to standardized architecture that promotes usability and interoperability. Data catalogues, dashboards, simulation applications, and e-participation platforms operate within a cohesive environment, minimizing technical fragmentation. The web interfaces prioritize user experience, enabling planners, analysts, and community members to efficiently navigate and utilize the tools.

This modular, web-based framework ensures that the toolbox can be effectively deployed in diverse urban contexts, while also facilitating centralized updates and ongoing technical support.

4.1.2 Access to Data and APIs

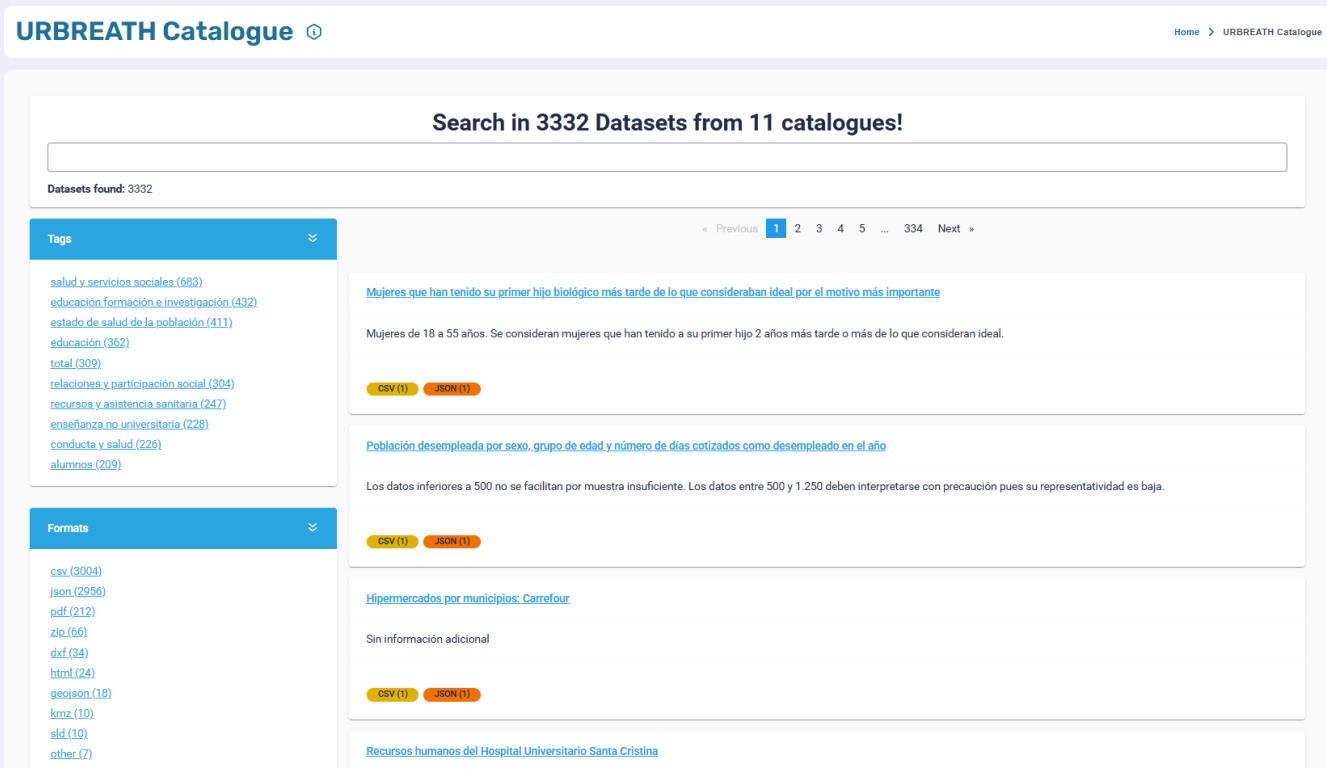
The URBREATH Toolbox provides structured access to datasets, indicators, and services via a range of API endpoints and catalogue interfaces. This ensures that different tools can retrieve, share, and update data seamlessly, and that cities can connect their own systems to the toolbox infrastructure.

At the core of the Data Management layer (i.e. macro area of the logical architecture of the URBREATH Toolbox as defined in previous deliverables such as "D2.5 URBREATH platform requirements" and "D4.7 URBREATH NBS ICT integrated solution") is a set of services like GeoServer (open-source geospatial data server), FROST Server, and InfluxDB(time-series database for sensor and temporal data), MinIO (high-performance object storage platform), etc., providing access to both real-time and static data (e.g. for geospatial and sensor-based applications). These services support standard protocols (e.g., WMS, WFS, MQTT, NGSI- LD) and are designed to be interoperable with other systems, such as GIS platforms and analytics tools [2], [3].

In addition, the Data Discovery and Sharing layer offers standardized metadata, dataset discovery, and API-based retrieval. Data can be downloaded, filtered, or queried directly via RESTful APIs, and is also visible within the Digital Twin environments.

Cities also benefit from access to the KPI Manager API, which allows automatic population of indicators based on incoming sensor or statistical data. Similarly, e-participation tools and NBS Registries expose their own APIs to enable integration with public websites or planning platforms.

Figure 3: URBREATH Catalogue



The consistent use of open standards and well-documented APIs across the toolbox ecosystem ensures flexibility, promotes reuse, and supports long-term maintainability of the digital infrastructure.

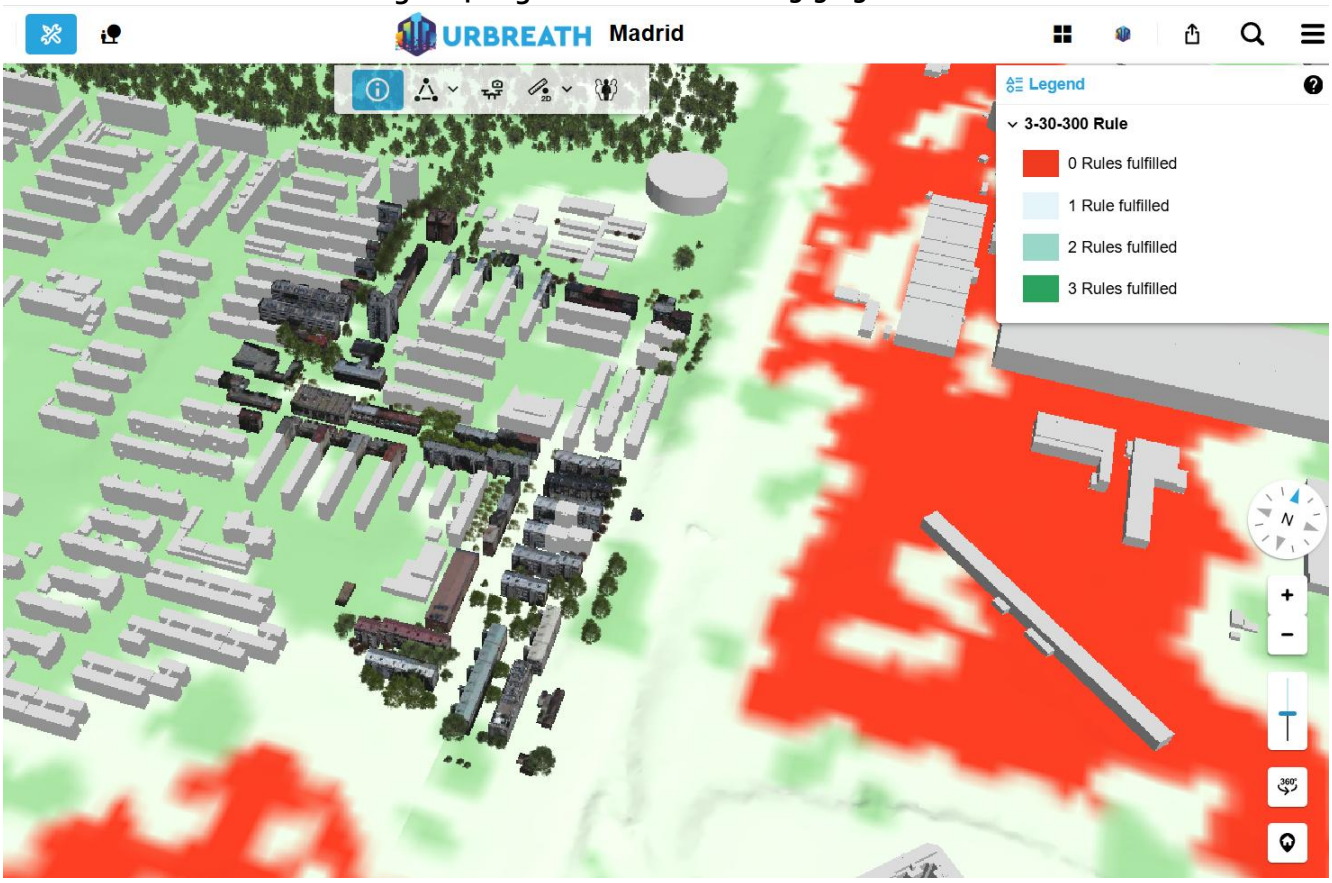
4.1.3 Embedded Tools in the Digital Twin

Recent research demonstrates that coupling digital twins with Nature-Based Solutions can significantly enhance climate-resilient design and predictive urban planning [4]. From this point of view, each pilot city in the URBREATH project has been provided with a customized Digital Twin environment that serves as a central access point for data visualization, planning tools, and impact assessments. These web-based environments are publicly accessible and allow cities to communicate planned interventions, explore spatial scenarios, and interact with citizens.

Within the Digital Twins, several URBREATH toolbox components have been embedded directly or made accessible through linked interfaces. For example, **layers such as Urban Heat Island zones**, **BAF calculations**, **15-minutes city index**, **Weather Forecasts**, **Water infiltration**, and **3-30-300 indicators**

are preloaded as static baseline data and can be turned on or off via the content panel. These layers help cities assess current environmental conditions and prioritize areas for NBS implementation.

Figure 4: Digital Twin Embedded 3-30-300 Rule

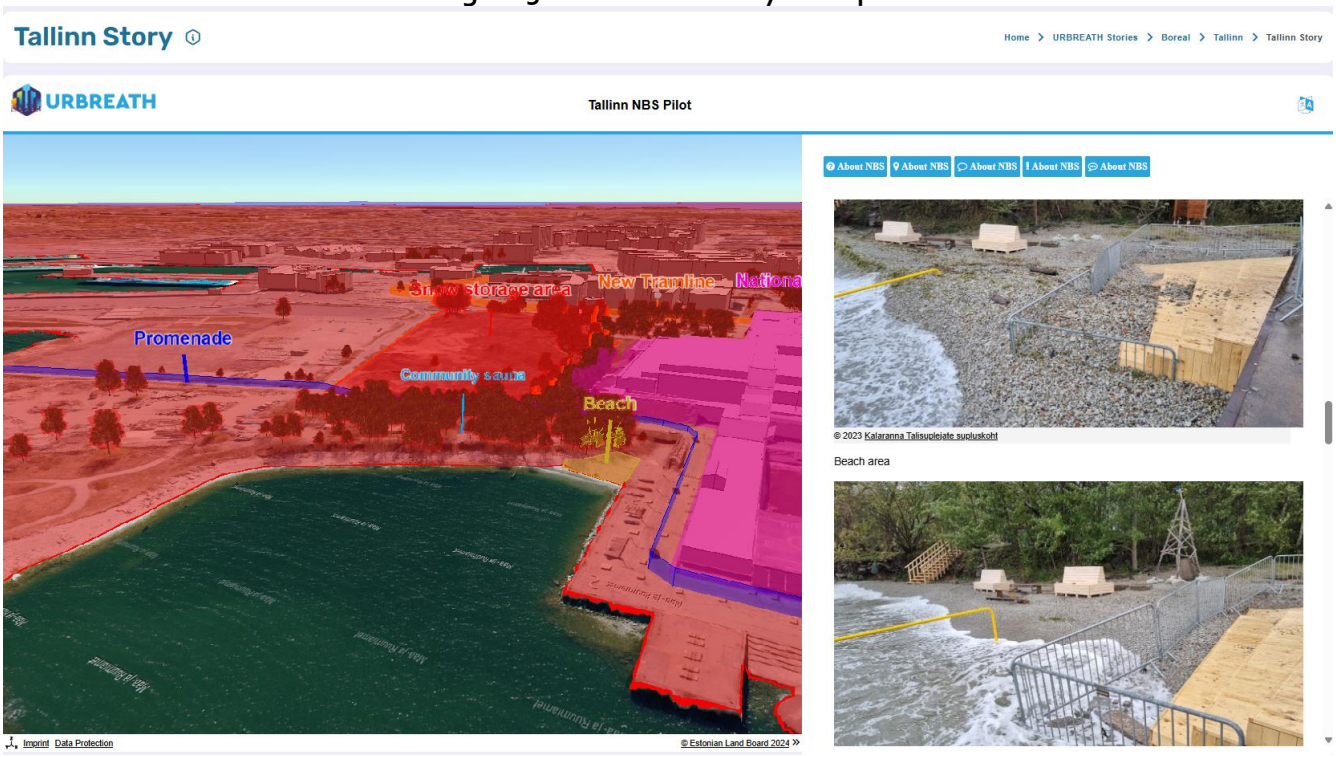


The **Planner Tool** within the Digital Twin allows users to make spatial and visual interventions within their area of interest, upload a variety of 2D and 3D vector or raster data formats that can be stored permanently (not session-based), and explore different scenarios in their NBS areas while comparing the results of various analyses provided by the Digital Twin.

Cities have also integrated accessible links to the official European Data Portal, URBREATH Data Catalog, NBS Registry, Data Dashboards, KPI Manager, URBREATH Toolbox and E-Participation Tool within the Digital Twin interface. This allows users to explore available spatial data within the map content, filter datasets with given options such as formats, categories and access or download provided data as well.

Additionally, **story maps** have been created to showcase selected projects or strategies using narrative and visual elements. These are tailored for each city and can highlight planned actions, existing challenges, or community contributions.

Figure 5: URBREATH Story Example



While the analytical models (such as flood or heat stress simulations) are not yet dynamic or real-time, they provide a valuable spatial baseline to support planning discussions and stakeholder engagement. These embedded tools help cities move toward more transparent, data-driven, and participatory urban governance.

4.1.4 Links to KPI Manager, NBS Registry, E-Participation Tool

Beyond spatial visualization, the URBREATH toolbox provides functional services that support decision-making, monitoring, and participatory planning. These include the **KPI Manager**, **NBS Registry**, and **e-Participation tools** (Web and mobile), which are designed to be accessible both independently and—where relevant—through integration with the Digital Twin.

The **KPI Manager** allows each city to define, monitor, and compare performance indicators related to climate resilience, biodiversity, mobility, and citizen well-being. The interface provides filtering by thematic area, timeline, and location, enabling dynamic reporting and benchmarking across use cases. Cities can connect to their own datasets or use harmonized baseline values provided through the URBREATH Data Catalogue.

The **NBS Registry** serves as a collaborative inventory of implemented or planned Nature-Based Solutions, also beyond the URBREATH project. It includes georeferenced information on intervention types, status, partners involved and expected outcomes. This platform not only supports

documentation and tracking but also acts as a shared learning tool across cities, highlighting good practices and common challenges.

Citizen engagement is facilitated through e-Participation tools (i.e. the URBREATH customized version of Decidim and the mobile e-participation app). These tools allow for surveys, comments, co-creation activities, and spatial feedback collection [5]; [6].

Figure 6: KPI Manager interface displaying a sample KPI about average temperature in Pilsen

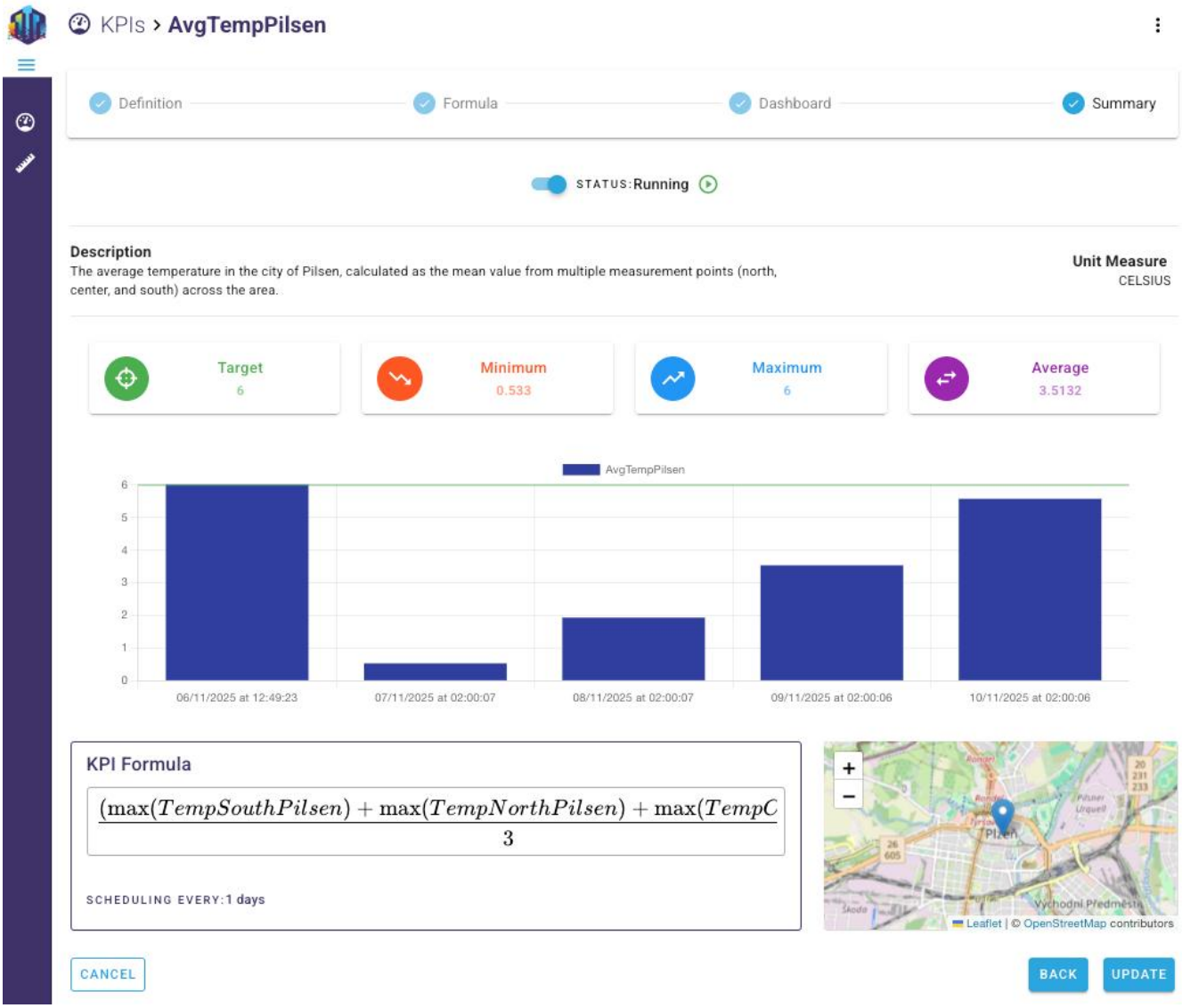


Figure 7: NBS Registry Interface with Filter and Map View Possibility

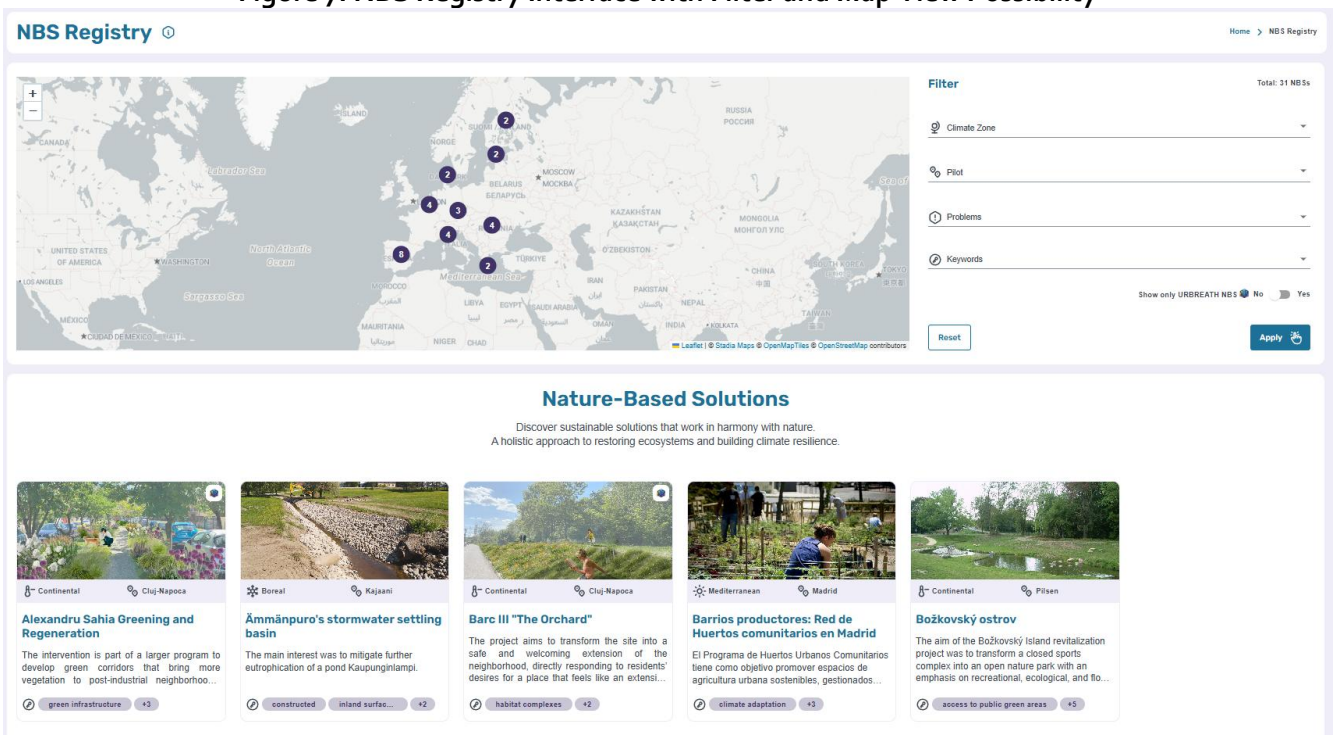
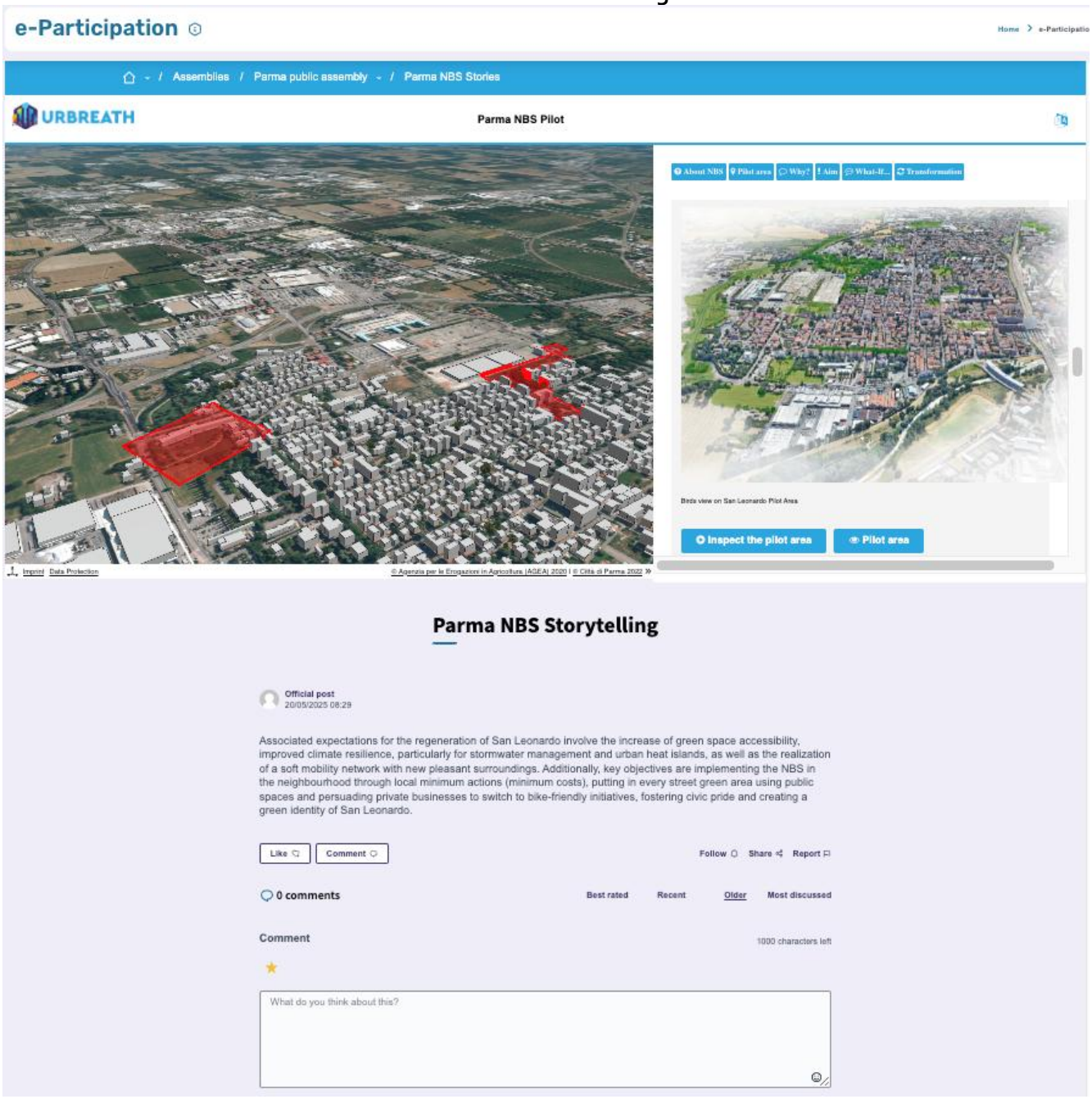


Figure 8: e-Participation Web application Interface displaying the integration with NBS Storytelling in Parma based on URBREATH Digital Twin



Combined, these tools help bridge the gap between strategy, implementation, and evaluation. Their modular structure ensures that cities can adopt only the components they need while maintaining interoperability with local systems.

4.2 Tool Interests Across Cities Investigation

As part of the URBREATH pilot preparation phase, all cities were asked to indicate which tools from the URBREATH Toolbox they were interested in/or planning to test. This overview helped identify both FRCs already engaged in testing activities and FLCs with a clear intention to explore the tools during later phases of the project.

The interest covers a wide range of tools, including digital planning viewers (such as VC Map, VC Planner, and VC Story), simulation tools for heat stress or flooding, nature-based solutions monitoring tools (like tree growth or 3-30-300 analysis), environmental forecasting, dashboards, and mobile/web-based participation apps.

Initially, cities responded by marking the tools they were interested in or had already received training for. In many cases, tools were marked with the date of the training session (for example, “26/06”), indicating a hands-on session was already completed. An “x” indicates that the city expressed interest but had not yet been trained. Some cities added tools they are considering or evaluating with a “?” symbol. In a few cases, tools remain unmarked—not necessarily indicating disinterest, but often because the tools are still under internal discussion or are planned for a later stage depending on project maturity and local capacities.

This mapping provided a useful overview of where each city stands regarding tool testing. Main intention was to utilize the trainings between cities and the tech partners / tool owners according to city interest and finally most of the cities have been given the training which is helping them as they want to explore and learn more a about the tools. It also helps guide future support and training sessions and supports alignment between the technical tool providers and local needs.

Figure 9 below provides a matrix of URBREATH tool interest across cities, showing which tools have already been explored. As descriptive colors, pink boxes represent ‘no interest’ whereas the green boxes represent interest based on the latest exercise conducted by cities within the concept of Task 5.4 in a Cities Call on 19/11/2025. Training sessions between cities and the tech partners helped to outline the results. This mapping reflects both the technical readiness and the thematic relevance of tools within each urban context as the given categorization.

Figure 9: Overview of URBREATH Tool Interest Across Cities

		Tools interest indicated on 19/11/2025								
Ref Partner	Tool name	LEU	AAR	TAL	KAJ	CLU	PIL	MAD	PAR	ATH
Aarhus / Bloxhub	Liveability index									
ATC	NBS Registry									
ATC	Unified UI									
DEDA	Geo Network									
DEDA	Sensors / FROST sever or similar									
DEDA/ICCS	15 minutes city (proximity index)									
ENG	E-Participation Web App (Decidim)									
ENG	GeoCacher									
ENG	KPI Manager									
ENG	URBREATH Catalogue									
EXUS	Adaptive Rainfall-Infiltration Tracking (Water infiltration model)									
EXUS	VIE-AI									
EXUS	Water Discharge and Flooding prediction model (under design)									
FICLIMA	Climate forecasts (long term)									
FICLIMA	Seasonal forecasts (1-6 months)									
FICLIMA	Short term weather forecasts (0-15 days)									
ICCS	crime statistics									
ICCS	green gentrification/property prices									
ICCS	Public Transport Accessibility Analysis									
ICCS/LAT40	Optimal locations to deposit snow									
LAT40	Heat Stress Analysis									
MUNICIPIA	Data Visualisations and Dashboards (Apache Superset)									
TEL	E-Participation Mobile App									
VCS	Growing Trees									
VCS	Map									
VCS	OpenAQ Sensors									
VCS	Planner									
VCS	Shadow plugin									
VCS	Shadow plugin									
VCS	Small scale BAF (Biotope Area Factor)									
VCS	Small scale BAF (Biotope Area Factor)									
VCS	Small-scale waterflow analysis									
VCS	snow pile sim									
VCS	Story									
VCS	Telraam sensors									
VITO	Biotop Area Factor									
VITO	Climate tools									
VITO	Nature Value Explorer									
VITO / LAT40	Urban Heat Island									
VITO/DEDA	3-30-300 Analysis									

The data and tool information presented in Figure 9 are extracted from the **URBREATH Data Inventory Excel**, which serves as the central operational document for Task 5.4. Beyond listing city-specific tool interests, the Excel file consolidates multiple aspects of project data management. It includes dedicated sheets on datasets, data formats, and NBS study areas, where technical partners describe required

input formats, coordinate systems, and fallback datasets. Additional sheets contain training evaluation feedback from pilot cities, contact and documentation links for tool owners, and detailed explanations of data provisioning workflows.

This integrated structure allows URBREATH partners to trace every dataset from input format and data provider to its registration in the Catalogue and visualization within the LDT viewer, ensuring transparency and consistency across all pilot cities.

The latest mapping (as of November 2025, Figure 10) also includes information on each tool's implementation status, KPI relevance, and local deployment readiness as an overview. While most tools are still accessed via the central Toolbox or Local Digital Twin (LDT) environments, several have been evaluated as technically ready or not for local deployment depending on municipal IT capacity, possible restrictions and licensing conditions.

Figure 10: Overview of URBREATH Tool Integration Options

			Demo stack		Training on tools		Integrated in / for		
Ref Partner	Tool name	implemented (accesible/ produced result so far)	Presented at Demo Caffè	Demo online	Training done	Feedback form	integrated	FRC's	FLC's
Bloxhub	Liveability index	No	No	No	No	No	No	No	No
ATC	NBS Registry	Yes	Yes	No	Yes	No	LDT&Toolbox	No	No
ATC	Unified UI	Yes	Yes	No	Yes	No	Toolbox	No	No
DEDA	Geo Network	Yes	No	No	No	No	No	No	No
DEDA	Sensors / FROST sever or similar	Yes	No	No	No	No	LDT	No	No
DEDA/ICCS	15 minutes city (proximity index)	Yes	Yes	Yes	No	No	LDT	Yes	No
ENG	GeoCacher	Yes	Yes	Yes	planned	No	No	No	No
ENG	E-Participation Web App (Decidim)	Yes	Yes	Yes	planned	No	Toolbox	Yes	Yes
ENG	KPI Manager	Yes	Yes	No	planned	No	No	No	No
ENG	URBREATH Catalogue	Yes	Yes	Yes	planned	No	Toolbox	No	No
EXUS	VIE-AI	unclear	Yes	No	No	No	No	No	No
EXUS	Adaptive Rainfall-Infiltration Tracking (Water infiltration model)	Yes	Yes	Yes	planned	No	LDT	Yes	No
EXUS	Water Discharge and Flooding prediction model (under design)	unclear	No	No	No	No	No	No	No
FICLIMA	Short term weather forecasts (0-15 days)	Yes	Yes	No	ongoing	No	No	No	No
FICLIMA	Seasonal forecasts (1-6 months)	Yes	Yes	No	ongoing	No	No	No	No
FICLIMA	Climate forecasts (long term)	Yes	Yes	Yes	ongoing	No	LDT	Yes	No
ICCS	Public Transport Accessibility Analysis	unclear	No	No	No	No	No	No	No
ICCS	green gentrification/property prices	unclear	No	No	No	No	No	No	No
ICCS	crime statistics	unclear	No	No	No	No	No	No	No
ICCS/LAT40	Optimal locations to deposit snow	unclear	No	No	No	No	No	No	No
LAT40	Heat Stress Analysis	Yes	Yes	Yes	Yes	No	LDT	Yes	No
MUNICIPIA	Data Visualisations and Dashboards (Apache Superset)	Yes	Yes	Yes	Yes	No	LDT&Toolbox	No	No
TEL	E-Participation Mobile App	Yes	Yes	Yes	Yes	No	No	Yes	Yes
VCS	VCS Shadow plugin	Yes	Yes	Yes	Yes	Yes	LDT	Yes	Yes
VCS	VCS Small scale BAF (Biotope Area Factor)	Yes	Yes	Yes	Yes	Yes	LDT	Yes	Yes
VCS	VCS Growing Trees	Yes	Yes	Yes	Yes	Yes	LDT	Yes	Yes
VCS	VCS snow pile sim	Yes	No	Yes	Yes	Yes	LDT	Yes	Yes
VCS	VC Map	Yes	Yes	Yes	Yes	No	LDT&Toolbox	Yes	Yes
VCS	VC Planner	Yes	Yes	Yes	Yes	No	LDT	Yes	Yes
VCS	VC Story	Yes	No	Yes	Yes	No	LDT&Toolbox	Yes	Yes
VCS	Small-scale waterflow analysis	Yes	No	Yes	Yes	No	LDT	Yes	Yes
VCS	OpenAQ sensors	Yes	No	Yes	Yes	No	LDT	Yes	Yes
VCS	Telraam sensors	Yes	No	Yes	Yes	No	LDT	Yes	Yes
VITO	Nature Value Explorer	Yes	No	No	No	No	No	No	No
VITO / LAT40	Urban Heat Island	Yes	Yes	Yes	No	No	LDT	Yes	No
VITO/DEDA	3-30-300 Analysis	Yes	Yes	Yes	No	No	LDT	Yes	No
VITO	Biotop Area Factor	Yes	Yes	No	No	No	No	No	No
VITO	Climate tools	Yes	Yes	No	No	No	No	No	No

In parallel with the technical readiness assessment, several URBREATH tools and modules have been released as open repositories to facilitate transparency, reuse, and long-term sustainability of project outcomes. The repositories include both core applications (e.g., GeoCacher, KPI Manager, URBREATH Catalogue, E-Participation modules) and backend components such as the FROST Server and GeoNetwork. These releases ensure that pilot cities and external stakeholders can review, test, or replicate the URBREATH digital infrastructure in their own environments (URBREATH GitHub, 2025).

4.3 Available Tools and Access Structure

The URBREATH Toolbox is currently deployed in a centralized, cloud-based environment to facilitate access, testing, and co-evaluation of tools across all pilot cities. At this stage of the project, no local deployments have been made within municipal IT infrastructures. Instead, cities are accessing the tools via dedicated development platforms provided by the technical partners. This shared environment supports joint training sessions, pilot exploration, and tool validation using either publicly available city data or pre-integrated demonstration layers.

Cities interact with the tools through a combination of graphical user interfaces (e.g. the Toolbox Dashboard, Digital Twins, and KPI Manager) and dedicated APIs. Each tool is accessible through a unique URL. This architecture allows for structured testing while maintaining security and data access control.

Urban digital twins increasingly function as data-driven environments that connect critical infrastructure with planning and monitoring systems, enabling interoperability and resilience assessments [7]. For each city, a tailored Digital Twin platform has been configured, providing access to visual layers and embedded analysis tools. These twins are preloaded with relevant baseline datasets such as urban heat islands, 3-30-300 indicators, and NBS implementation areas, enabling visual inspection and discussion of spatial strategies. Climate projection areas have also been added to each Digital Twin, offering a shared entry point for long-term adaptation planning.

Within the Local Digital Twin (LDT) environments, dynamic tools such as VC Map, VC Planner, and VC Story can already be tested through the shared infrastructure. Other modules, such as the 3-30-300 Analysis, Biotope Area Factor, and Heat Stress Analysis, currently provide static visual results within the LDT or Toolbox. The readiness assessment confirms that these tools can be locally deployed once pilot cities decide to integrate them into their municipal infrastructures.

The flexible access structure of the URBREATH Toolbox enables cities to experiment with tools in a non-disruptive way, fostering co-learning and feedback before any decisions are made regarding long-term adoption or integration into local IT systems.

At this stage, as the URBREATH Toolbox remains as cloud-based environment, several tools have been technically assessed and confirmed as ready to deploy locally, including the GeoCacher, KPI Manager, URBREATH Catalogue, Digital Twin and E-Participation tools. Local deployment is not yet implemented but foreseen for future testing and validation within pilot cities.

4.4 Tool Dependency and KPI Relevance

The mapping of tool dependencies across the URBREATH Toolbox also reveals how analytical and visualisation tools directly contribute to the measurement of Key Performance Indicators (KPIs).
Each KPI represents a specific environmental or social target such as climate adaptation, biodiversity enhancement, or citizen participation, and several of them can be calculated using outputs from URBREATH tools.
This interconnection ensures that digital analyses, such as shading, flooding, or vegetation coverage, are not stand-alone results but feed directly into the project's evaluation framework.
Based on the information collected from the Task 5.6 KPI excels, the following associations have been identified:

- **BIO-KPI2 – Expand high-quality biotope areas** → *VC Map*, *VC Planner*
- **BIO-KPI7 – Share of total area covered by tree canopy** → *VC Map*, *VC Planner*, *VCS Growing Trees*, *Small-scale BAF*
- **EP-KPI1 – Decrease noise pollution** → *Sensors*, *Workflow Manager*, *FROST Server*
- **CR-KPI1 – Decrease flooding risk** → *Water Discharge and Flooding Prediction Model*
- **CR-KPI7 – Decrease Urban Heat Island (UHI) Effect** → *Urban Heat Island*, *Heat Stress Analysis*
- **CR-KPI8 – Increase shaded areas** → *VC Map*, *VC Planner*, *VC Shadow Plugin*, *VCS Growing Trees*
- **KPI Counting – Performing Surveys** → *E-Participation*, *KPI Manager*, *Data Visualisation Dashboards (Apache Superset)*

The alignment between KPIs and URBREATH tools enables the integration of performance monitoring directly into digital workflows.
By linking analytical outputs (e.g., shading, tree coverage, or flood simulations) with key indicators, cities can track progress toward climate resilience and social co-benefits within the same digital environment.
This connection also allows consistent, cross-city evaluation of results and facilitates data exchange between the technical tools and the URBREATH KPI Manager for ongoing reporting.

4.5 Toolbox Diagrams

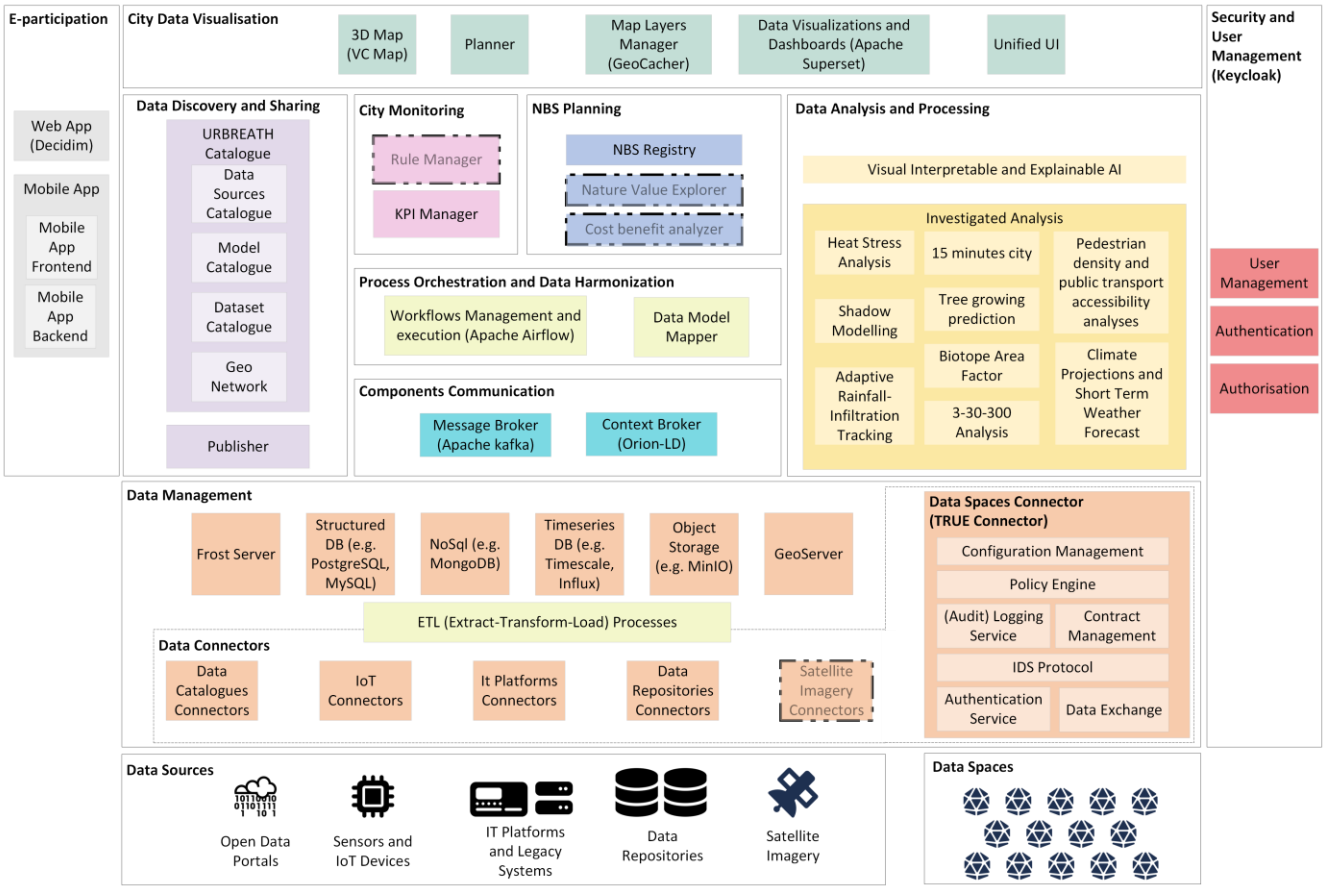
The URBREATH Toolbox is designed as a modular system composed of interoperable components, serving different categories of URBREATH tools within a single user interface (UI).
It provides cities with unified access to explore, test, and use various tools, not necessarily to select or permanently adopt them, depending on their needs, infrastructure, and level of digital readiness.

Each module can function as a standalone tool, be locally deployed by cities with sufficient IT capacity, or operate as part of the centralized Toolbox environment, where tools are linked and/or visualized within the Local Digital Twin (LDT).

The diagram below illustrates the main architectural structure of the Toolbox:

- **Authentication and User Management** are handled via Keycloak, enabling secure login across all components.
- **Data Management and Storage** capabilities are enabled by tools supporting different data types, such as Minio (as object storage), FROST Server for sensor data, Influx DB (for timeseries), GeoServer (for geographic layers), etc., ensuring scalable and harmonized data access.
- **Components Communication** is managed through Apache Kafka and Orion-LD Context Broker.
- **Data Discovery and Sharing** is handled via Idra APIs that is the baseline tool of the URBREATH Catalogue
- **Process Orchestration and Data Harmonization** functionalities are based on Apache Airflow and the Data Model Mapper (an open-source tool offering capabilities to transform input information into NGSI-LD entities)
- **Data Analysis and Processing** offers tools able to analyse data for specific purposes, such as 15 minutes city index, Heat stress, Shadow Analysis, Tree Growth Simulation, 3-30-300 Indicator, etc., as well as the VIA-AI that supports AI explainability.
- **NBS Planning** allows to keep track of NBS related information through the NBS Registry
- **City Monitoring** offers capabilities to keep track of KPI of interest through the KPI Manager
- **E-participation** allows to build and manage participatory process, engaging stakeholders in co-creating and evaluating NBSs, through the Web based application (i.e. Decidim) and the mobile one.
- **City Data Visualization** includes high level capabilities such as the Digital Twin (which embeds selected tools and results of analysis such as Shadow Analysis, Tree Growth Simulation, and 3-30-300 Indicator), Dashboards and Story Maps, offering summarized overviews of tool outputs for citizen communication and policy engagement**,** as well as visualize chart and graphs representing relevant city-related information.

Figure 11: Logical architecture of the URBREATH Toolbox



This design is intended to support both individual tool usage and cross-platform integration, depending on local preferences and IT readiness.

5 Interoperability & APIs

5.1 Data Interoperability Across Cities

Several cities participating in URBREATH already have existing spatial data infrastructures (SDIs), urban planning registries, and legacy GIS systems. The degree of data interoperability varies significantly across cities, with some using standardized formats like GeoJSON and SHP, while others rely more heavily on PDFs or DWG files.

URBREATH promotes data harmonization by encouraging the use of open formats and web services (such as WMS, WFS, NGSI-LD, DCAT-AP, OGC SensorThing, and REST APIs). As part of this effort, URBREATH tools are designed to support integration with these local data formats and APIs wherever feasible.

In some pilot cities, WMS/WFS services and REST APIs are already actively used to feed data into URBREATH tools. In others, static data exports (e.g., Excel, SHP, GeoPackage) are used to update the platform periodically.

From a legal and governance standpoint, interoperability across cities is compliant with the GDPR, the Data Governance Act and the Data Act, ensuring that any data exchange, particularly where personal or geolocated data is involved, adheres to principles of purpose limitation, data minimization and security. Further details on interoperability principles, data harmonization approaches and cross-city standardization requirements are elaborated in "Deliverable D7.12 – Standardisation Report (V1**)"**, which provides a more comprehensive overview of the technical and governance frameworks relevant to URBREATH [8].

5.2 MIMS / MIM+ Guidelines

The minimal interoperability mechanisms (MIMs) enable a minimal but sufficient level of interoperability for data, systems and services specifically in the context of smart city solutions. A MIM provides easy-to-use solutions, both technical and non-technical.

To ensure long-term interoperability and alignment with broader European digital standards, URBREATH tools aim to follow the MIMS (Minimum Interoperability Mechanisms) and MIM+ guidelines developed under the Living-in.EU initiative.

A MIM helps cities to:

- avoid getting stuck with one supplier's tools
- make digital investments more futureproof
- improve cooperation between departments and public services

- roll out digital solutions more quickly and efficiently
- improve the ability to use technology to solve local and global societal challenges

MIMS/MIM+ are essential for enabling data exchange, cross-border service delivery, and vendor-neutral tool deployment. URBREATH technical partners (such as VCS, ATC, DEDA, EXUS, etc.) follow these guidelines when designing APIs, UI integrations, and data pipelines.

URBREATH tools bring together a diverse collection of tools, with varying levels of interoperability and degrees of alignment with MIMs/MIMs+ and the use of adequate standards. Deliverable D7.12 provided a first assessment of the tools in the toolbox along this dimension. There is already a good proportion of tools that are, by design, aligned with MIMs/MIMs+ specifications. However, more work is required to ensure that all tools in the toolbox meet these interoperability requirements.

Also, while individual tools follow MIMs/MIMs+ recommendations, it is vital that their combination in specific city use cases results in an overall interoperable system. For this, additional deployment considerations are necessary that account for how the tools work together and with existing legacy systems in the cities.

To summarize, by complying with MIM+ principles, the URBREATH Toolbox ensures compatibility with future extensions and replication in other EU cities and digital twins.

Table 1 summarizes how the URBREATH Toolbox addresses with the latest available version of MIMs Plus (version 8.0, released on 30th June 2025) concerning technical aspects. Information reported in Table 1 should be considered an updated of what reported in the deliverable "D4.7 URBREATH NBS ICT integrated solution".

Table 1: URBREATH Toolbox position with respect to MIMs Plus version 8.0

MIMs[1]	URBREATH Toolbox position
MIM 0 – Accessing Data (under development) **This MIM helps cities and communities to overcome the challenges of accessing data that currently reside in silos and are often fragmented across different systems and locked away by making recommendations of how data should be made accessible so it can**	With respect to version 7.5, this MIM is less documented; however, position of the URBREATH Toolbox is still valid: The URBREATH Toolbox includes solutions for data management based on well-known opensource project that offer documentation and API specifications. Among them, it is important to mention the FROST Server (that

1 MIMs' description from "MIMs Plus Specification 8.0": https://living-in.eu/sites/default/files/files/mims-plus-v.8_2.pdf

be easier accessed and reused in an interoperable way.	follows OGC SensorThings APIs) and the Orion-LD Context Broker (that follows NGSI-LD Specifications). Furthermore, the toolbox offers technical solutions to build catalogues of datasets, software models/tools, data sources, and Nature Based Solutions (that are the focus of the project).
MIM 1 – Interlinking Data (under development) **This MIM supports interlinking datapoints across domains, departments or use cases. It aims to realise semantic interoperability across potentially different data models and ontologies, by providing mappings, translations, linking databases, etc. It also includes a consistent set of identifiers of individual instances of each entity, so that data about any entity can be combined with other data referring to that entity, and every instance of that entity, with the certainty that they point to the same thing.**	The URBREATH Toolbox offers tools for Data Management Layer able to interconnect with heterogeneous and scattered software systems, establishing a uniform access to those data. Connectors and tailored ETL process can be employed to harmonise, aggregate, and interlink data, leveraging standard formats and Web based APIs such as ETSI NGSI-LD and OGS SensorThings APIs. Both offers support for unique identifies; in addition, datasets are represented using DCAT-AP format which offers also unique identifiers.
MIM 2 - Representing Data **This MIMs allows cities and communities to overcome the challenges of working with data that are represented in different ways by providing recommendations for the use of consistent and machine-readable representations of data so that data from various sources can be efficiently used with confidence across the organisation and shared with collaborators as part of a local data ecosystem.**	The URBREATH Toolbox relies on two main standards that offers specifications for data models; OGS SensorThings APIs specification offers "SensorThings Data Model". On the other hand, ETSI NGSI-LD specifications define a "meta data model" (i.e. NGSI-LD Meta Model). Alongside, other common format is considered, to feed data analysis tools that require compact formats, such as CSV.
MIM 3 - Exchanging Data **It tackles the challenges of how data can be stewarded and used across diverse systems of different organisations into a common data ecosystem that enables data providers and users to exchange data in a trusted way with confidence and derive value from it. It also aims to ensure that interactions related to**	The URBREATH Toolbox includes three catalogues: Dataset Catalogue, Models/Tools Catalogue, Data sources Catalogue, as well as a connector enabling interconnection with Data Spaces. Tehe catalogues offer capabilities for the management and search of relevant information associated to

data exchange in different local data ecosystems of other cities and communities are interoperable.	• datasets (e.g. coming from relevant systems connected to the toolbox and/or produced by the analysis that are part of the toolbox). • models and tools available within the toolbox (including the ones for data analysis). • data sources connected to the toolbox. Information managed by the three catalogues follows the DCAT-AP and are managed also on the Context Broker as NGSI-LD entities. For the sake of clarity, it is important to report that MIM3 covers aspects also related to offers and order, revenue sharing, service level agreements, feedback and reputation, party management, customers, transparency and accountability, that move towards the establishment of "marketplaces", that are out of the scope of URBREATH. For this reason, the URBREATH Toolbox, focused mainly aspect related to the establishment of catalogues.
MIM 4 - Personal Data **MIM4 focuses on Personal Data Management in other words how to provide easy to use methods for individuals to control which data sets/attributes they want to share with solution, application, or service providers under transparent circumstances, enabling trust between the different parties. The role of MIM4 is to identify the key capabilities required and identify pivotal points of interoperability between the different solutions to help build confidence and support implementation.**	Despite the general relevance of the topic, the URBREATH project does not specifically focus on personal data management, and currently the toolbox does not include a tool for this purpose, neither this point emerged from investigations performed with the cities. However, the URBREATH project recognises the importance of this topic. Among its tools, the e-Participation Web application (following its purposes) allows the registered users to manage their information and to ask for download / deletion. In addition, the dialogue with the nine cities involved in the project is still in progress and will continue until the end of the project; if the need for IT solutions suited for allowing end users to manage personal data raise, the project will commit to identify one or more tools that can be employed for this purpose.

MIM 5 – Interoperable AI **The definition of this MIM is not yet available.**	Not available since a definition of this MIM is not provided.
MIM 6 - Securing Data **In order to deliver reliable digital services for citizens, cities must continuously evaluate the cyber risks and to put in place security measures to prepare for cyber-attacks. MIM 6 focuses on addressing interoperability for secure data transfer. The limited scope is to get progress, and later iterations can and probably will expand the scope.**	One of the aims of the URBREATH Toolbox is to offer a series of IT tools that can be employed within existing cities' platforms according to specific needs (e.g. by selecting and integrating specific ones) and/or by adopting the entire architectural stack, and related tools. In the first case, security aspects concerning internal data transfer should be addressed considering existing technical approaches and in compliance with possible local policies, regulations, technical prescriptions, etc. in force. In the second case, the URBREATH Toolbox can leverage the adoption of secure communication channels between its components (e.g. SSL); furthermore, the toolbox includes solutions for user and role management, that allows to define who can access specific resources. Concerning he possible transmission of data with external platform, the toolbox includes software solutions for the interconnection with Data Spaces (see D4.7 section 4.2.5).
MIM 7 - Geospatial Data **MIM7 aims to provide Minimal Interoperability Mechanisms related to geospatial data, to tackle the challenge faced by cities and communities of being able to integrate and transfer data between internal and external IT systems. It also takes into account the fact that spatial assets need to be accessed as linked data by many IT- and IoT-systems, and over a long period of time, and thus the vital role of the use of persistent identifiers.**	The URBREATH Toolbox employs tools dedicated to the management of geo-spatial information, GeoServer (D4.7 section 4.1.4) and GeoNetwork (D4.7 section 4.8.2). The first is able expose WFS/WMS compliant interfaces to access geospatial information, whereas the second to manage metadata associated to this information. In addition, the GeoCacher (i.e. Map Layers Manager, D4.7 section 4.9.3) can generate map layers (in GeoJSON format) from NGSI-LD compliant entities managed by the Orion-LD Context Broker (D4.7 section 4.3.2). GeoCacher can also export those layers into the GeoServer, making them available through its APIs. The adoption of both Orion-LD Context Broker and FROST Server (compliant with OGC

	SensorThings APIs) allows to link and integrate geospatial and spatiotemporal information.
MIM 8 - Local Digital Twins **This MIM describes interoperability in terms of the application domain of Local Digital Twins, to ensure communication with other data ecosystems, scale up and easy integration with new data sets, services and components.** Depending on their functionalities, Local Digital Twins can be commonly categorised as: Awareness LDT, Experimental LDT, Predictive LDT, and Intelligent LDT.	The URBREATH Toolbox addresses interoperability for Local Digital Twins by implementing mechanisms that correspond to specific MIMs. It begins by ensuring semantic and syntactic interoperability through NGSI-LD and OGC SensorThings API, which allow data from heterogeneous sources to be harmonized and accessed via standardized web APIs. This approach directly addresses MIM0 (Accessing Data), MIM1 (Interlinking Data) and MIM2 (Representing Data), because it enables consistent entity representation and interlinking across systems. For data exchange and discoverability, the toolbox integrates catalogues based on DCAT-AP and uses the TRUE Connector, which is IDS-compliant, to enable secure and policy-driven data sharing across Data Spaces. These features fulfill MIM3 (Exchanging Data) by providing mechanisms to find, access, and share datasets and analytical services under clear governance rules. Visualization and planning capabilities are provided through VC Map and VC Planner, which support 2D and 3D geospatial views using open formats like CityGML and GeoJSON. Additionally, GeoServer and GeoNetwork expose geospatial data through OGC-compliant services, meeting MIM7 (Geospatial Data) by making spatial assets interoperable within and across cities. Security and trust are addressed through Keycloak for identity and access management, offering single sign-on, multi-factor authentication, and role-based access control. Combined with encrypted storage in MinIO and secure communication protocols, these measures comply with MIM6 (Securing Data) by

	ensuring that data transfer and user authentication are secure and interoperable

Figure 12: Categories of LDTs according to MIMs Plus version 8.0

Category of LDT	Visualisation	Simulation	Analytics	Autonomous
Awareness	X			
Experimental	X	X		
Predictive	X	X	X	
Intelligent	X	X	X	X

5.3 Integration with Existing Infrastructure

At the current stage, the cities access the tools via online environments and evaluate them using their own datasets or sample data provided by the technical partners. While tools are primarily accessed through the centralized URBREATH infrastructure, several have been tested in simulated local environments to validate interoperability and data exchange readiness.

This setup allows for testing and validation before committing to any specific integration method. In future phases of the project, local deployments may be considered for cities with the appropriate IT infrastructure and long-term interest.

Insights from the Local Living Labs, as documented in Deliverable D5.8 [9], provided critical feedback on how Toolbox components could align with existing municipal infrastructures and workflows [9]. The current focus remains on understanding each city's existing systems, mapping the integration points, and collecting feedback through workshops and training on how the tools can complement or enhance existing workflows.

Future phases will also assess the need for Data Protection Impact Assessments (DPIAs) for tools processing potentially identifiable data and for data-sharing agreements to ensure legal interoperability and compliance with privacy-by-design and security-by-design principles.

6 Challenges

This chapter summarises the common barriers and enabling conditions related to the adaptation of URBREATH tools. The depth of available information currently varies across cities, as several pilot activities are still ongoing and some inputs remain incomplete. The analysis presented here reflects the material received to date and will be further expanded in the second version of this deliverable at M36. In addition, some pilot cities indicated that they prefer not to publicly display internal operational or institutional processes. These considerations have been taken into account in the way the findings are presented in this chapter.

6.1 Common Barriers to Tool Adaptation

Some cities face technical and institutional barriers when introducing new planning tools. These include data fragmentation, lack of standardized formats, IT staff shortages, or rigid administrative processes.

In several cases, cities require custom adaptations to make tools relevant to local planning tasks or regulations. Furthermore, aligning new digital workflows with legally binding planning instruments remains a challenge in certain national contexts.

Cluj-Napoca

Cluj-Napoca notes that connecting existing municipal digital tools with new URBREATH tools may present challenges. The city operates several parallel systems, including its own municipal server, GIS layers, online databases, and national platforms such as data.gov.ro, and acknowledges that integrating these with the URBREATH environment may require additional effort. Although digital transformation is a clear priority, progress can be slowed by the need to update and harmonize existing tools, datasets, and workflows to ensure interoperability and consistency.

Madrid

One of the main barriers Madrid faces in using some of these tools is their duplication or overlap with existing tools. This rules out any added value they might have over those currently in use. Another major challenge is the integration of new tools into the City Council's system due to security and bureaucratic controls, but above all because it does not currently have teams that can maintain these tools in the long term so that they remain useful, i.e., provide them with new data and values that allow them to be updated beyond being a snapshot of a specific moment in time.

6.2 Legal, Political and Institutional Gaps

Legal approval procedures differ greatly among cities. In some cases, planning regulations or data governance rules create obstacles to implementing digital co-creation platforms or open data portals. Some cities have limited mandates to make long-term infrastructural changes or adopt external tools within city networks or current urban planning processes.

Therefore, collaboration with supporting partners is essential to navigate these barriers, and URBREATH actively facilitates this dialogue through co-creation events.

Cluj-Napoca

The urban planning process in Cluj-Napoca is highly formalized, beginning with opportunity approval for the investment project and continuing through the Chief Architect's endorsement, the evaluation of the Urban Aesthetics Commission, the review of the Technical Committee for Spatial Planning and Urbanism, and final approval by the City Council. Because each stage follows established legal procedures, embedding new digital tools directly into these mandatory phases can be difficult. Public consultation is also legally required and carried out according to transparency rules, meaning that any new digital platform must comply with existing legislation and administrative protocols before it can be integrated into official workflows.

Another challenge under legal, political and institutional gaps is the unclear collaboration between departments. For business-as-usual, the institution procedures work very well, but when adding digital tools use, like the ones prototyped by URBREATH, the situation becomes unclear. Further in URBREATH project, the project team must define the potential roles and responsibilities of departments that must be linked to the type of initiative and urban resources to be managed. Another challenge emerges: the digital tools must improve decision-making, but to be feasible it must not be perceived as a burden to implement and use these tools.

Madrid

The consolidation of an interdepartmental working team is enabling greater collaboration and efficiency in the use of resources, as well as the possibility of using tools from different perspectives. For now, the greatest benefit is in predicting heat islands and climate forecasts from six months to one year in order to design project implementation and select plant species with greater precision.

Politically, changes in municipal priorities and electoral cycles can interrupt long-term NBS strategies and weaken continuity of participatory programs. Organizationally, coordination between different departments (environment, urbanism, participation, mobility) is complex and often slow, which fragments responsibilities and delays implementation. Legally, regulations on public space, maintenance responsibilities and liability make it difficult to test experimental or community-managed NBS in the city. Finally, data on social impact, environmental performance and local knowledge is dispersed and not always accessible in usable formats, which limits informed decision-making and meaningful co-design with residents.

As mentioned, integrating new tools into the Council's working structure is complex given the difficulty of incorporating new tools into the system and the duplication of issues, objectives or solutions addressed.

6.3 Capacity Building and Training Needs

Across the pilot cities, there is a consistent demand for further training on URBREATH tools. While initial workshops and demos have been conducted, deeper hands-on sessions are required to build local capacity for sustained use.

Cities also highlight the need for ongoing technical support, training materials in local languages, and simplified UIs. These efforts will be critical for ensuring adoption beyond the project phase

Cluj-Napoca

Cluj-Napoca expresses interest in URBREATH tools related to sensor monitoring, data collection, and KPI monitoring and feedback, which indicates the need for further training to operationalize these functions effectively. The city highlights the Public Consultation phase and the Pilot Implementation of NBS as the two moments where these tools would be most useful, both requiring staff capable of interpreting sensor outputs, understanding KPI frameworks, and working with GIS and environmental datasets. The document also references the municipality's Digital Transformation Strategy (HCL 3/2022), a living framework that evolves with new technologies, suggesting that long-term technical support and hands-on training will be essential to ensure full integration of URBREATH tools across municipal departments.

Madrid

Training is always welcome and desired, especially by municipal technicians, but they require that it be carried out within the training channels established by the City Council so that it can be done during working hours and count as internal training for the subsequent benefits that this entails in terms of their administrative status.

7 Conclusions

7.1 Summary of City Readiness

All URBREATH cities have shown strong interest in the digital tools proposed by the project. Some cities, such as Leuven and Madrid, have already begun integrating select tools into their planning workflows. Others are still in the evaluation and capacity-building phase.

The availability of existing digital infrastructure and familiarity with similar tools are key enablers of city readiness. Institutional support and cross-departmental collaboration also enhance the likelihood of successful integration.

7.2 URBREATH Decision Support Potential

The URBREATH Toolbox holds significant potential for improving climate-sensitive and participatory urban planning. By centralizing tools for visualization, impact modelling, citizen engagement, and performance monitoring, it offers an integrated decision support environment.

Pilot activities indicate that digital tools such as the KPI Manager, the E-Participation App, Digital Twins, and NBS simulation models are well-received when directly supporting active planning needs. However, insights from Task 5.4 activities show that many cities already rely on established digital solutions provided through local, regional, or national platforms. As a result, they do not always perceive a strong need to integrate additional tools into their existing IT environments, which has likely contributed to the limited adoption of the URBREATH tools so far. Moreover, the current maturity level of several URBREATH tools does not yet fully align with the technical and functional capabilities required by cities' already operational systems.

7.3 Recommendations for Phase 2

Phase 2 of URBREATH should focus on targeted tool customization based on feedback from pilot cities. Key recommendations include:

- Supporting local deployments where feasible
- Enhancing interoperability and automation in data flows
- Scaling up training activities with language-specific resources
- Aligning tool outputs with city KPIs and reporting formats
- Expanding citizen outreach via the E-Participation platform

These steps will ensure that the URBREATH Toolbox becomes a practical and scalable asset for sustainable urban planning across Europe.

The replication approach outlined in Deliverable D7.2 provides guidance for scaling the URBREATH Toolbox to follower cities, ensuring long-term sustainability and knowledge [10].

8 References

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[9] URBREATH Project, "D5.8 Local Living Labs report - V4," 2025.

[10] URBREATH Project, "D7.2 European Nature-Based Solutions Manager Certificates," 2025.

[11] URBREATH Project, "D2.2 URBREATH methodological framework for urban greening Living Labs and hybrid/NBS interventions and adaptive pathways - V2," 2025.

9 Annexes

9.1 Guiding Questions & Checklist for Mapping Urban Planning Workflows

A. Current Urban Planning Process (Before URBREATH)

- What is the general approval process for urban planning projects in your city?
- Which departments or authorities are typically involved in decision-making?
- How are NBS-type projects (like parks, green corridors, rain gardens) currently initiated?
- Is there a public participation process?
    - If yes, how is it usually conducted?
- Which tools, datasets, or platforms are currently used in urban planning?
- Where are these tools or datasets hosted?
- Are they running on the city's own servers, a national platform, or cloud-based systems?
- Do the systems currently in use allow for data exchange with other platforms or tools?
    - And if so, how is the data exchange working? What kind of formats are used to exchange data (PDF, Excel, DWG, DXF, or geodata formats like GeoJSON, Shape files, etc.)
- Is there any API connection, export/import option, or interoperability available?
- Is there any use of sensor-based data in the current planning or monitoring processes?
    - If yes, which types of sensors are used (e.g. air quality, temperature, soil moisture) and how is this data collected and processed?

B. Potential Future Process (After URBREATH)

- Has the city expressed interest in any specific URBREATH tools?
- Which parts of the current process could benefit from URBREATH tools?
- Which department might be interested in using URBREATH tools in the future?
- Are there any existing city tools that need to be connected to URBREATH?

C. Additional Notes

- Are there any barriers or challenges that you foresee?
- Is the city open to meetings or workshops to further explore these workflows?

9.2 Urban Planning Workflow of Pilot Cities – Before URBREATH

	Category	Leuven	Madrid	Kajaani	Cluj- Napoca	Tallinn
Urban Planning	**Planning Framework**	Location selection → general requirements → final plan.	Urban planning follows a two-stage approval: local drafting with internal reviews and public consultation, followed by regional evaluation and final authorization by Comunidad de Madrid.	Assessment of plan → draft plan → plan proposal with public showcase, gathering feedback and announcing reminders.	Public participation → Professional consultations (Chief Architect, Esthetics Commission, Technical Committee) → Final City Council approval → Implementation (public-private-academic partnerships).	Urban planning in Tallinn follows a two-tier system. First, a Comprehensive Plan defines long-term spatial development goals and land-use zones. Then, Detailed Plans are created for specific areas in alignment with the comprehensive plan. Both require public consultation and are approved by the city government.
	Stakeholder Departments	Mobility, Heritage, Green, Economy, Archaeology, Citizen Engagement, Diversity & Inclusivity. External: Police, Fire Brigade, Public Transport, Utilities, Advisory Boards.	Municipal planning, environmental, and legal teams contribute internally. Regional bodies and external evaluators also issue formal assessments.	City Council, City Board, Environmental Technical Board, Permit Board, Kainuu ELY Centre, Regional Council.	City Hall departments, National Environmental Agency, Somes Water Company, Environmental Guard, Technical Committees, City Council.	The Tallinn Urban Planning Department leads the process, with involvement from other local and national authorities depending on the project's scope.
	Public Participation	Physical meetings, EU project-based activities, scenario visualizations, feedback sessions.	A multi-channel participation model is used: Decide Madrid platform, municipal organizations and EU project-based co-creation workshops.	Legally mandatory. Conducted via public events, Q&A sessions, written feedback periods.	CIIC (Center for Innovation and Civic Imagination), Participatory Budgeting app, City Hall website consultation section, public debates.	Participation is mandatory under Estonia's Planning Act. Citizens can submit feedback during a one-month public display period and attend public hearings. Tallinn also uses digital tools like the Tallinn Planning Registry and Maptionnaire for online engagement.
	Planning Approvals	Prepared by city departments and pre-discussed with deputy mayor; approved by political council.	Projects move from internal preparation to technical/legal review, followed by regional reports and final adoption	Approval by City Council or responsible board depending on significance.	Opportunity approval, Chief Architect, Esthetics Commission, Technical Committee, City Council.	Comprehensive and detailed plans undergo formal review and public consultation before final approval by the City Council.

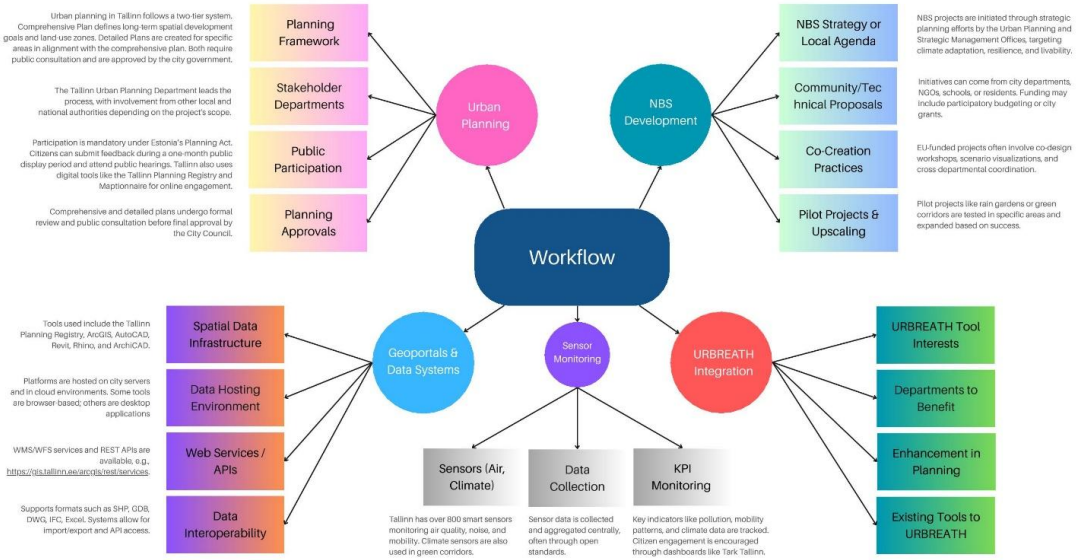
			by the relevant authority.			
NBS Development	**NBS Strategy or Local Agenda**	Priority from departments, political level, or citizen initiatives.	NBS initiatives stem from policies like Madrid + Natural and the Green Infrastructure and Biodiversity Plan.	Needs identified by city departments, residents, or strategic plans.	Macro vision integration of NBS into large/medium-scale developments	NBS projects are initiated through strategic planning efforts by the Urban Planning and Strategic Management Offices, targeting climate adaptation, resilience, and livability.
	Community / Technical Proposals	Initiated by departments, residents, or NGOs depending on context.	Both city departments and citizens can initiate NBS ideas, aligned with strategic priorities.	Experts assess site conditions, water flow, vegetation, and ecological impact.	NBS idea proposals ubmitted either by the municipality or by citizens, aligned with the city's broader strategic vision and are shaped in dialogue with stakeholders before entering the formal planning process.	Initiatives can come from city departments, NGOs, schools, or residents. Funding may include participatory budgeting or city grants.
	Co-Creation Practises	EU projects support interaction: workshops, scenario visualization, community activities.	Project design incorporates participatory methods, such as the CLEVER framework, to include residents and scientists.	Public and stakeholders involved via surveys, workshops, and consultations.	Collaborative planning involves the public, private, and academic sectors. CIIC platform and participatory workshops.	EU-funded projects often involve co-design workshops, scenario visualizations, and cross-departmental coordination.
	Pilot Projects & Upscaling	Pilots tested in real environments; outcomes guide full implementation.	Small-scale pilots are used to test feasibility before wider implementation.	Implementation using permeable materials, rain gardens, green corridors, etc. Maintenance includes performance monitoring (e.g. water quality, vegetation).	Pilot actions to observe small scale impacts, successful pilots are scaled up into medium/large scale invterventions integrated into the city's planning framework.	Pilot projects like rain gardens or green corridors are tested in specific areas and expanded based on success.
Geoportals & Data Systems	**Spatial Data Infrastructure (SDI)**	GRB – Base layers: parcels, buildings, streets RIS – Sewerage system data GROEN – Vegetation datasets Geopunt – Flemish national geodata portal KLIP – Utility platform AutoCAD, Civil3D – Drawing and design Vehicle tracking –	IDEAM (Madrid's Geoportal) and Comunidad de Madrid Geoportal serve as SDIs, offering thematic layers via WMS/WFS.	National core datasets from SYKE, NLS, FMI, GTK, and Statistics Finland provide environmental, topographic, demographic, and climate data via WMS/WFS and APIs. Locally, Kajaani uses the Map Portal, GIS Services, Trimble Locus, and the Zoning	GIS, topographic layers	Tools used include the Tallinn Planning Registry, ArcGIS, AutoCAD, Revit, Rhino, and ArchiCAD

		Mobility flow data Sensor data – Environmental data via Urban Sense VMM, DOV – Ecosystem and climate data sources		Database—mainly operated by the Environmental and Land Use Unit—for zoning, planning, and construction purposes.		
	Data Hosting Environment	GIS system is internally hosted on the city's own servers. Geopunt, GRB, and KLIP are accessed as national platforms.	Hybrid model: IDEAM is hosted on the municipal SDI; Decide Madrid runs on city IT infrastructure. Regional and EU platforms are externally or cloud-hosted.	Mixed hosting. City-managed tools (e.g. Kajaani Map Portal, GIS Services) run on municipal servers, while national datasets (from SYKE, NLS, FMI, etc.) are hosted on government platforms.	City Hall database in city's own servers.	Platforms are hosted on city servers and in cloud environments. Some tools are browser-based; others are desktop applications.
	Web Services / APIs	Internal ArcGIS web services exist; no public APIs available. Telraam has direct API.	Standard OGC Web Services: WMS, WFS, WCS via IDEAM REST APIs: Decide Madrid, data.madrid.es .	WMS available via Kajaani Map Service; additional open data and APIs provided by national agencies (e.g., SYKE, NLS).	Air quality monitoring (public site), traffic monitoring (internal), open data portal (data.gov.ro).	WMS/WFS services and REST APIs are available, e.g., https://gis.tallinn.ee/arcgis/rest/services
	Data Interoperability	ArcGIS system supports export of GIS data in various formats (e.g. Shape, GeoJSON) depending on platform needs. Manual ETL tools are used for interoperability.	Geospatial formats: SHP, GeoJSON, GML, GeoTIFF CAD formats: DWG, DXF Tabular formats: CSV, XLSX Metadata: XML Documents: PDF, DOCX	Supports PDF, Excel, DWG, and standard geodata formats (e.g., SHP, GeoJSON).	Open portal & APIs.	Supports formats such as SHP, GDB, DWG, IFC, Excel. Systems allow for import/export and API access.
Sensors	**Sensors (Air, Climate, Soil, etc.)**	Monitoring weather, mobility and soils moisture	Air quality sensors (NO_2, PM, etc.) are active. Soil sensors are piloted in selected NBS projects.		Temperature, humidity, pressure, PM1/PM2.5/PM10, formaldehyde, ozone, CO_2, VOCs, noise.	Tallinn has over 800 smart sensors monitoring air quality, noise, and mobility. Climate sensors are also used in green corridors.
	Data Collection	Leuven.coon + Senzemostick (weather), Telraam (mobility)	Sensor data is aggregated centrally and shared via open standards to support			Sensor data is collected and aggregated centrally, often through open standards.

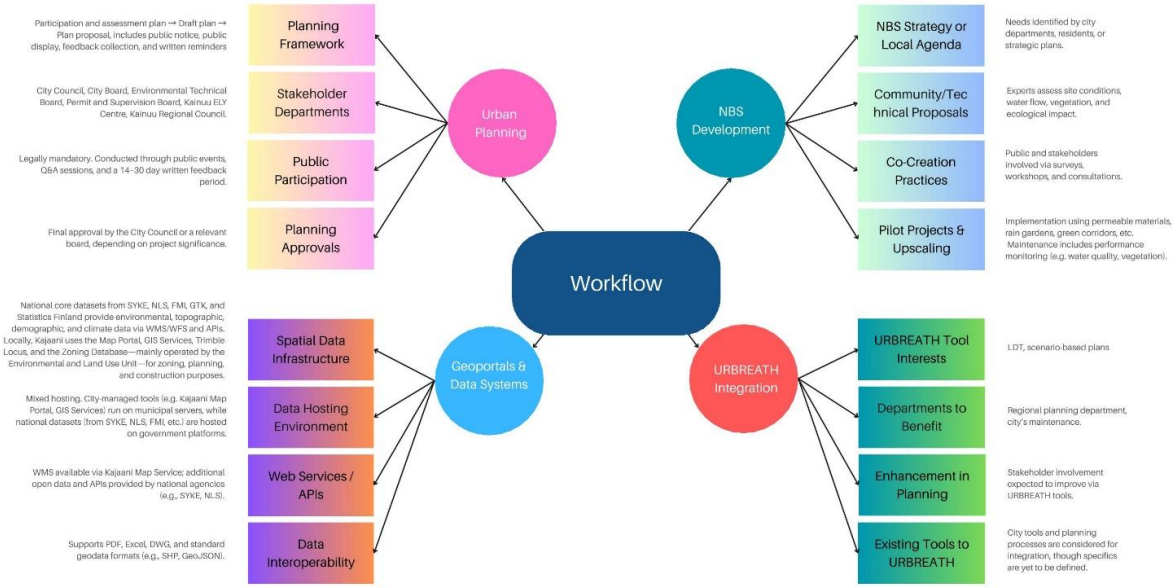
URBREATH Integration			monitoring and evaluation.			
	KPI Monitoring	Environmental and social KPIs monitored via Urban Sense platform.	Environmental KPIs are tracked to assess NBS effectiveness. Citizen engagement in monitoring is also considered.			Key indicators like pollution, mobility patterns, and climate data are tracked. Citizen engagement is encouraged through dashboards like Tark Tallinn.
	URBREATH Tool Interest	LDT (BAF, Shadow - VCS) 3/30/300; under investigation.	Ongoing internal meetings explore potential tool adoption, based on integration feasibility and licensing models.	LDT, scenario-based plans	Sensor Monitoring, Data Collection, KPI Monitoring	
	Departments to Benefit	Green, Urban Planning, Sustainability departments.	Likely users include Urban Regeneration, Energy and Climate Change, and Green Areas departments.	Regional planning department, city's maintenance.	Urban Strategies Office, Green Spaces Department, IT, Public Relations, External Relations & Investors Dept.	
	Enhancement in Planning	Planning with tools, citizen/ stakeholder engagement, KPI monitoring and policy validation.	URBREATH could strengthen co-creation, participation, and cross-departmental coordination.	Stakeholder involvement expected to improve via URBREATH tools.	Public Concultation - Sensor monitoring data support outcomes Pilot implementation actions more succesful with sensors, KPIs and GIS Tools in NBS Developement.	
	Existing Tools to Connect to UB	GIS and sensor data planned for connection	City tools and planning processes are considered for integration, though specifics are yet to be defined.	City tools and planning processes are considered for integration, though specifics are yet to be defined.	CIIC, "Adopt a Green Space" program.	

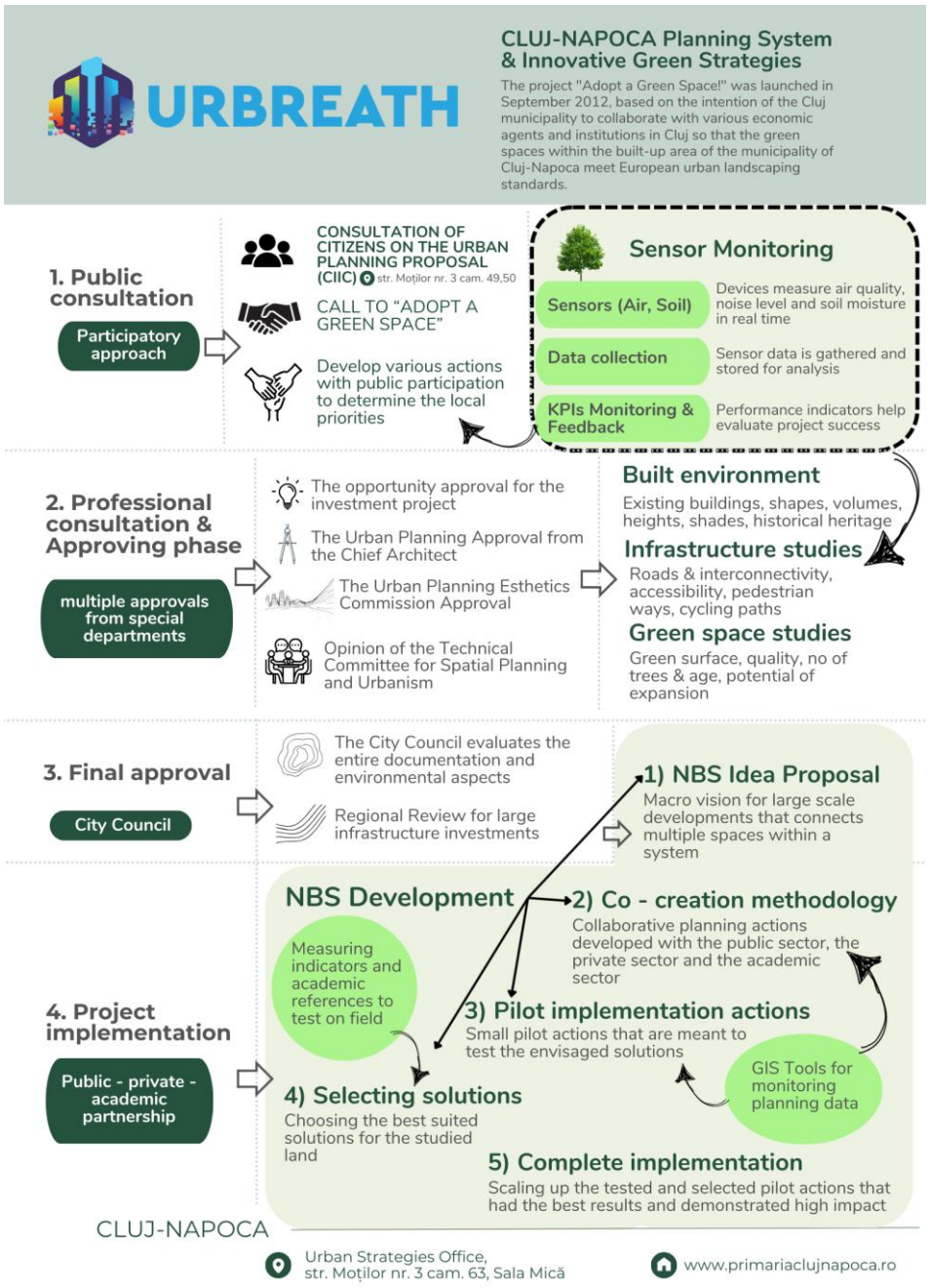
9.3 Urban Planning Workflow of Pilot Cities – Before URBREATH Graphics

Urban Planning Workflow - Tallinn



Urban Planning Workflow - Kajaani





These diagrams serve as the basis for aligning tool requirements and ensuring meaningful integration into the existing planning and monitoring frameworks. They also illustrate the scope of sensor usage, interoperability potential, and stakeholder engagement across the pilot cities.