

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



D4.5 URBREATH Participatory tools - V2

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Disclaimer

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Executive Summary

Deliverable D4.5, URBREATH Participatory Tools – V2, is an accompanying report to the 2nd prototype releases of ICT e-participatory tools of URBREATH project, scheduled for M24 (December 2025). This report aims to detail the implementation progress of these tools during the period M13-M24, regarding their architecture integration with other URBREATH solutions but also their functionality upgrades and implementation.

This accompanying report focuses on the maturity of the e-participation tools from their conception documented in deliverable D4.4. URBREATH participatory tools –V1 (submitted on M12) up to their current implementation status regarding the e-participation web application, based on the Decidim platform, and the e-participation mobile application, designed and developed for URBREATH project needs.

This report documents the updates of the web and mobile application (e.g. assemblies, participatory budgeting, surveys with detailed statistics, Near me maps, NBS projects, and issue reporting), as well as their integrations with VCS Stories tool, Whiteboards, and planned integration with the NBS Registry tool, all carefully designed and implemented to offer more visualization capabilities and a more interactive, user-friendly, and holistic approach for co-creation and co-decision activities framing a comprehensive and complete e-participation suite.

In parallel with documenting all the implementation upgrades, updates and current status, this document additionally focuses on the adjustment and validating iterations process that has been performed through this reporting period, aiming to tailor the solutions based on Front Runner pilot cities' needs. To this end all requirements, especially at this time from FR pilot cities have been assessed, and a continuous iteration process, including live demonstrations, training workshops and materials and an open feedback dialogue have led to improvements made and planned, ultimately targeting to facilitate the pilot cities needs based on continuous feasibility assessments. As this is an ongoing process, this deliverable advocates into forming the customization path for all pilot cities and the next years activities to be respectfully reported in deliverable D4.6. URBREATH participatory tools – V3 on M36.

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List of Terms and Abbreviations

Abbreviation	Definition
AAB	Android App Bundle (Mobile application distribution format for Android Google Play internal testing)
APK	Android Package (Android distribution format)
DoA	Description of Action
FLC	Follower Cities (Pilot priority classification)
FRC	Frontrunner Cities (Pilot priority classification)
ICT	Information and Communication Technologies
IPA	iOS App Store Package (mobile application distribution format for iOS platform)
JWT	JSON Web Token (Secure authentication mechanism)
KPI's	Key Performance Indicators
M	Month
NBS	Nature-based Solution
SPID	Sistema Pubblico di Identità Digitale
T	Task
UI	User Interface
WP	Work Package
Y	Year

1 Introduction

Deliverable D4.5, details the development and refinement of the URBREATH e-participation tools during the second year of the project, during M13-M24. It focuses specifically on the progress made in the implementation, integration, and enhancement of the digital tools designed to facilitate citizen and stakeholder engagement in urban planning processes. The tools consist of a web-based application built upon the Decidim platform and a native mobile application, together forming a comprehensive e-participation suite tailored to the needs of the URBREATH pilot cities.

The document outlines the technical evolution of the e-participation suite, emphasizing advanced functionalities such as user authentication unified across platforms via Keycloak, integration with other URBREATH components including NBS Stories, the URBREATH Catalogue, and whiteboard tools for collaborative work. It highlights implementation milestones like the delivery of the first and second prototypes, integration of third-party whiteboard tools, and improvements in user experience both on desktop and mobile devices. This ensures that participants can easily explore, contribute, and co-decide on urban nature-based solutions and projects.

Special attention is given to the user interface, accessibility, and multilingual capabilities, acknowledging different usage contexts—mobile users benefit from geolocation features and quick access to ongoing NBS projects and other URBREATH solutions, while desktop users have enhanced data management building tools. The report also discusses the interactive elements that enable transparent dialogue and co-creation such as assemblies, issue reporting, and participatory budgeting, as well as surveys supported with analytics for better decision-making evaluation.

The document further covers the adaptation of the tools for the pilot cities of URBREATH, describing how feedback from workshops, live demos, and training sessions influenced adjustments in features, content workflows, user roles, and guest access policies. It also addresses ongoing and planned improvements to boost efficiency and user satisfaction, laying out a roadmap for further enhancements leading up to the final version of the tools.

Ultimately, Deliverable D4.5 serves as a comprehensive status update portraying the e-participation tools as a mature, integrated, and user-centric system that empowers cities and citizens to engage in sustainable urban development. It documents both successes and points for improvement while preparing the foundation for continued development toward the project's completion.

1.1 Purpose and Scope

This report accompanies the updated 2nd prototype release of the ICT e-participation tools of URBREATH project, as those have been developed and improved during the second year of the implementation process. In this sense this report further elaborates on the implemented functionalities of the e-participatory tools, from M13 to M24, describing the technical implementation progress and updates, their internal integration status enabling a more comprehensive e-participation suite, and their integrations with other components and other URBREATH solutions.

While depicting the current state of these tools, this document emphasizes their adaptation progress based on feasible requirements as extracted both from the Description of Action and also additional needs stressed by the pilot cities of URBREATH.

To this end, this document intends to serve as a roadmap to all stakeholders, aiming to offer a comprehensive overview of the participatory features as those were interpreted and validated at the current stage of URBREATH project.

1.2 Approach for Work Package and Relation to other Work Packages and Deliverables

Deliverable D4.5 is the result of the activities performed under Task 4.2, “e-participation tools,” an integral part of Work Package 4, “URBREATH decision-making framework.”

Task 4.2 is designed to develop and provide the stakeholders with suitable tools to facilitate the co-creation and co-decision activities that take place in cities' urban planning processes. More specifically, the objective of the task is to release user-friendly web and mobile tools, enabling diverse stakeholders' communication, idea exchange, engagement, and participation in co-creation activities managed by the urban planning authorities. These solutions serve as means for inclusive decision-making within the city's environment, offering an open channel for transparent dialogue among all the city's stakeholders as well as competent authorities supporting the adoption of more sustainable urban planning strategies.

Deliverable D4.5, “URBREATH Participatory Tools – V2,” builds on and maps the natural progress made since the previous version, D4.4 “URBREATH Participatory Tools – V1,” submitted at M12. This version serves as a key milestone, laying the foundation for further implementation, improvements, and enhancements that will be further detailed at the final deliverable for T4.2, “URBREATH Participatory Tools – V3,” scheduled for M36.

1.3 Structure of the Deliverable

This accompanying report is structured to provide the implementation map towards the 1st and ultimately the 2nd prototype deliveries of the e-participatory tools, detailing all the advancements and technical progress. The logic behind some implementation choices and the adjustments made are also included to provide a comprehensive overview of the results delivered by Task 4.2 on M24. More specifically:

- **Chapter 2** includes the overview and updates of the e-participation suite architecture schema and the integration status between the web application and the mobile application, as well as a short overview of their integrations with other URBREATH solutions.
- **Chapter 3** focuses on the advancements of the e-participation web application, as those took place from M13 to their current state on M24.
- **Chapter 4** focuses on the advancements of the e-participation mobile application, as those were performed from M13 to their current state on M24.
- **Chapter 5** records the current and future adjustments for both participatory tools aiming to better serve the needs of the URBREATH pilot cities, based on requirements, feedback, and suggestions for improvements as those were extracted leveraging demonstrations, workshops, and training support sessions during this reporting period.
- **Chapter 6** summarizes the Deliverable D4.5, setting the baseline for the next steps of the activities to be performed under Task 4.2.

2 E-participation tool-box schema

Following the course of action and architecture schema as described in the deliverable D4.4, “URBREATH participatory tools – V1,” the URBREATH e-participatory suite incorporates:

- The e-participation web application based on the open-source Decidim participatory platform, and
- The e-participation mobile application, a native mobile application designed and implemented based on the URBREATH project needs.

Both solutions have been designed and customized based on the Description of Action (DoA) requirements but are also in continuous development, adding new and adjusting the existing functionalities based on pilot-specific requirements after careful consideration of feasibility assessments.

Utility and user experience efficiency were also considered, assessing the advantages of using a laptop/desktop device compared to those using mobile devices, highlighting the strengths of each platform. For example, while it is straightforward and productive to be able to manage complex datasets from a desktop/laptop device, it is not so efficient to do so from a mobile device. On the other hand, being informed of the outcomes and updates, able to access the different capabilities offered by URBREATH toolbox and engage easily “on the go” from a mobile device, coupled with geolocation features, highlight the value of establishing a native mobile application

Subsequently, the two solutions combined, upon their established integration, offer a diverse set of capabilities, tailored to specific needs, leading to the complete e-participation suite in its current state.

2.1 Integration Progress and Updates

Until M12, as reported in deliverable D4.4, the initial state of the e-participation web application was implemented based on the open-source Decidim platform. At the same time, the e-participation mobile application had implemented its initial UI and had proceeded with partial integration of the web application to the extent of retrieving the relevant content.

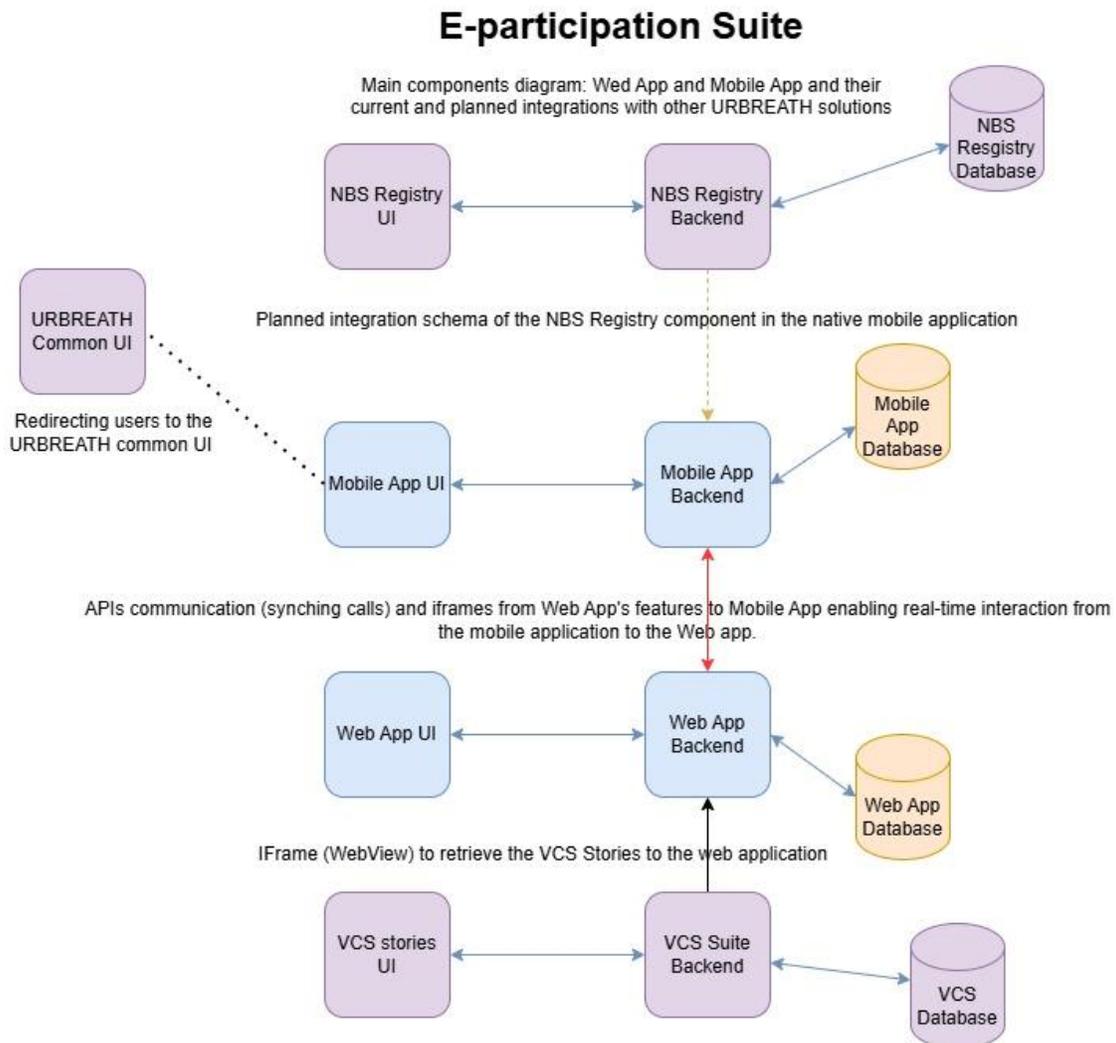
During M13-M24 the integration progressed as planned, enabling stakeholders to interact with the web application's components in real time from their mobile application. The process of this integration is further elaborated upon later in this document and more specifically under section 4.2.1. Technical implementation progress until the 1st prototype delivery (M18)..

Moreover, the two solutions have been further matured, implementing more functionalities and features but also integrating other URBREATH solutions into their environment, enabling more capabilities. As illustrated in the following figure (Figure 1), the e-participation web application has integrated, through the usage of iframes (Web View), the NBS Storytelling tool from the VSC suite. This enables 3D visualizations of the pilot areas while also fostering an open dialogue space for stakeholders

to engage. This integration has also been extended to the e-participation mobile application through the web application integration, leading to real-time synchronization of visualization, available data, and details, as well as real-time open dialogue engagement via the native mobile app.

The mobile application has incorporated a dedicated space for the users to be redirected to the URBREATH UI, a common space designed to incorporate most URBREATH solutions, providing easy access to other URBREATH solutions. The e-participation mobile application is also planning to integrate the NBS Registry outcomes in its native environment, allowing users real-time access to information registered in the NBS Registry, alongside all relevant figures, pictures, information links, etc., while also connected to the geospatial map that is built in-app. This feature is foreseen to include an open dialogue section.

Figure 1. The e-participation suite architecture schema illustrating the two main components and their current and planned integrations with other URBREATH solutions.



It is important to mention that Figure 1 represents two distinct databases, one for the Web App Backend (i.e. Decidim) and one for the Mobile App Backend.

Due to technical limitations of Decidim's API, the Mobile App can only read content from Decidim because its API does not allow creating new content (except comments). With a recent release¹, Decidim introduced limited API support for content creation.

In the current scenario, Decidim's database represents somehow the "authoritative" source for e-participation content (proposals, meetings, debates, etc.), while the mobile app database stores app-specific data and content that, at the moment, cannot be created on Decidim due to the above-mentioned limitations.

Nevertheless, the new release of Decidim offers the opportunity to explore a deeper and stronger integration between the two e-Participation applications, Web and Mobile.

3 E-participation Web-application

The e-Participation Web-Application (based on Decidim) incorporates a set of advanced features that improve interaction between its users towards data driven and evidence based participatory process. The platform now integrates expanded functionalities such as commendable NBS Stories (i.e. Digital Twin), an updated Whiteboard module with embedded selection capabilities, and the URBREATH Catalogue. In addition, it also includes a unified authentication compliant with the URBREATH Toolbox and based on Keycloak Bearer Tokens.

3.1 Implementation Progress and Updates

With respect to deliverable "D4.4 URBREATH Participatory tools - V1", the E-participation Web-Application underwent extensive improvements across its functional and architectural layers. Three major components² (i.e. **NBS Stories**, URBREATH Catalogue, and **Whiteboard**) were implemented; two of them (NBS Stories and Whiteboards) as fully commendable modules within Decidim, following the platform's native patterns for interactions, permissions, and moderation.

The embedded interface received several refinements, including an **adaptive main menu**, **removal of the header**, and an **updated footer** aligned with the URBREATH design system. These adjustments ensure a seamless experience when the application is integrated inside external dashboards.

Authentication flows were unified through **Keycloak**, providing **single sign-on** across the overall URBREATH UI, Decidim, and the default Whiteboard platform (**Spacedeck**). The Keycloak gem was also

¹ Version 0.31.0, released on 20th November 2025; <https://decidim.org/blog/2025-11-20-new-version-0-31-0/>.

² Integration of NBS Stories, URBREATH Catalogue, and Whiteboard was previously introduced in the deliverable D4.7 URBREATH NBS ICT integrated solution (June 2025) and finalised in the further course of our activities.

extended to support **Bearer Token authentication for Decidim APIs**, enabling secure reading, commenting, and other authorised operations through a single identity management system.

A notable addition is the **new Whiteboard selection workflow**, implemented through an **embedded modal**. Users can browse and select existing Spacedeck whiteboards from their personal workspace **without leaving Decidim**, thanks to secure token-based access.

Finally, **translations were added for all new and existing components**, ensuring full coverage of every project-required language and consistent localisation across the interface.

Integration efforts were centred on creating smooth interoperability between tools; NBS Stories and Whiteboard were integrated as native Decidim components with full commenting capabilities.

Keycloak now provides consistent authentication and session handling across all systems; Embedded workflows were reinforced through modal-based interactions, unified layouts, and enhanced UI consistency.

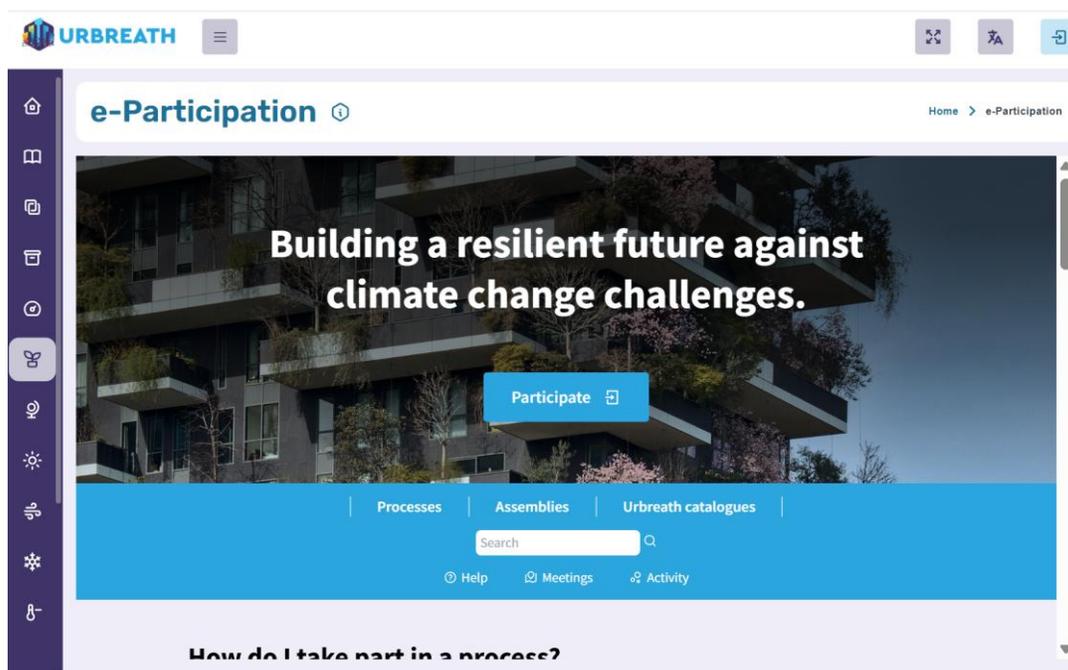
Together, these integrations significantly strengthened the coherence, extensibility, and multilingual readiness of the Web-Application.

3.2 Current Status

The current state of the e-Participation Web-Application reflects a system in which the main architectural elements, authentication mechanisms, and embedded workflows are now well established. The Keycloak-based authentication flow is fully implemented and stable: the URBREATH UI sends a first `postMessage` containing the authentication token to Decidim, which processes the information and forwards it through a second `postMessage` to the embedded iframe. This ensures that tools such as the integrated whiteboard system receive a valid token without requiring additional login steps. Achieving this required solving several issues related to token propagation across different applications, managing cross-origin communication, and guaranteeing that the identity data contained in the token could be consistently interpreted at each stage of the process. The backend now correctly decodes the token, extracts identity attributes, creates or updates the Decidim user, and supports detection of admin roles for future access to administrative areas directly from the dashboard.

Substantial work was also invested in stabilising the embedded interface. Decidim's conditional rendering logic originally caused visible flickering when hiding or restructuring interface elements such as the header and navigation menus. To address this, templates, layouts, and helper methods were refactored so that the embedded mode loads smoothly without showing transitional states. The header has been removed entirely, the menu adapts automatically to the embedding context, and the footer has been updated to reflect the URBREATH design. Frontend logic ensures that all navigation remains within the embedded environment, preventing redirections that would disrupt the dashboard experience.

Figure 2. The e-participation web application integrated in the URBREATH UI.



The user registration flow inside the embedded Decidim interface is now fully functional. When a new user registers, Decidim receives the Keycloak token, decodes the relevant information, and creates the corresponding user locally. At the same time, the system prepares the necessary data for the whiteboard tool so that the same identity can be created or recognised there as well. This required changes in Decidim’s backend and in the gems involved (especially decidim-keycloak and decidim-whiteboard) to ensure that login and sign_in behave correctly across systems. Coordinating these steps was complex because each tool originally implemented its own user management rules.

The integration of the Whiteboard component, released as a gem and based on Spacedeck, required extensive backend work. A dedicated embedded modal within Decidim allows users to access their Spacedeck personal space, browse existing boards, and choose one to attach to an assembly—all without leaving the page. To support this workflow, Spacedeck’s backend was modified to accept Keycloak authentication, interpret the token, and automatically create or log in users based on the data sent from Decidim. This required rewriting large sections of Spacedeck’s original authentication logic and redesigning how sessions and identity information are handled.

Figure 3. E-participation web application – create a whiteboard.

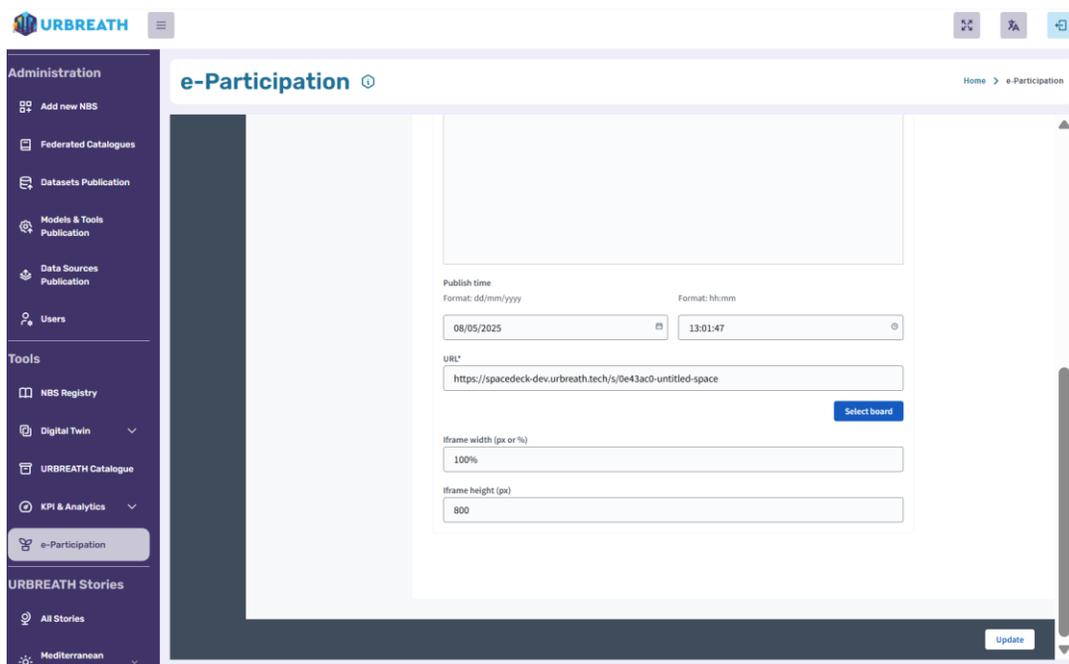


Figure 4. E-participation web application – selecting a whiteboard from Spacedeck.

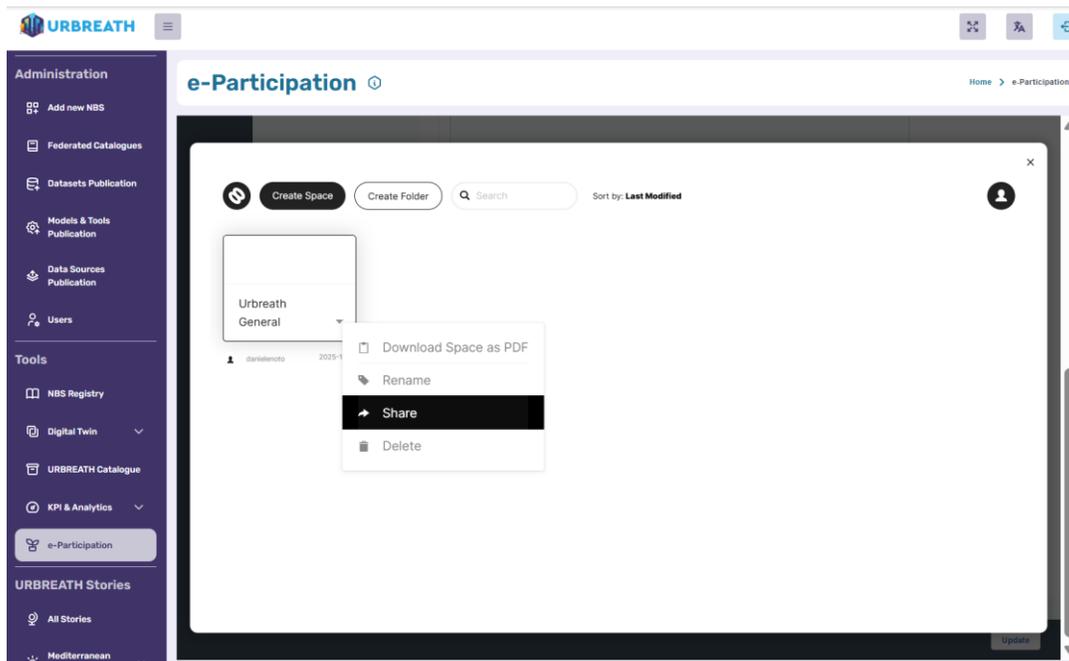
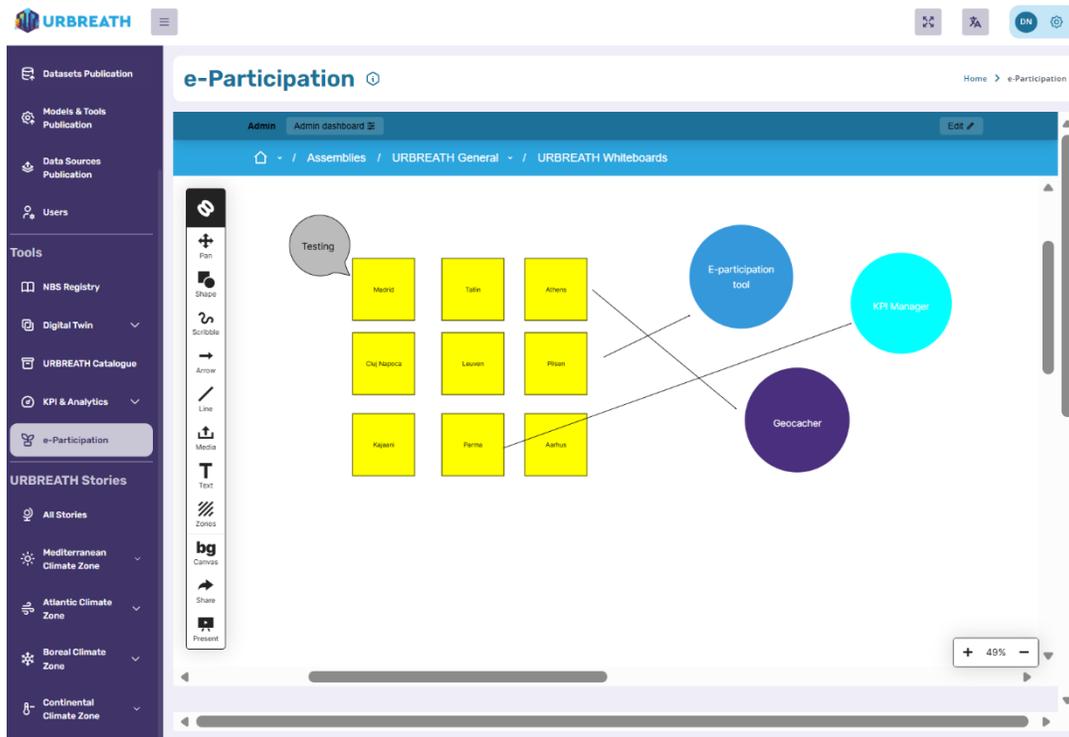
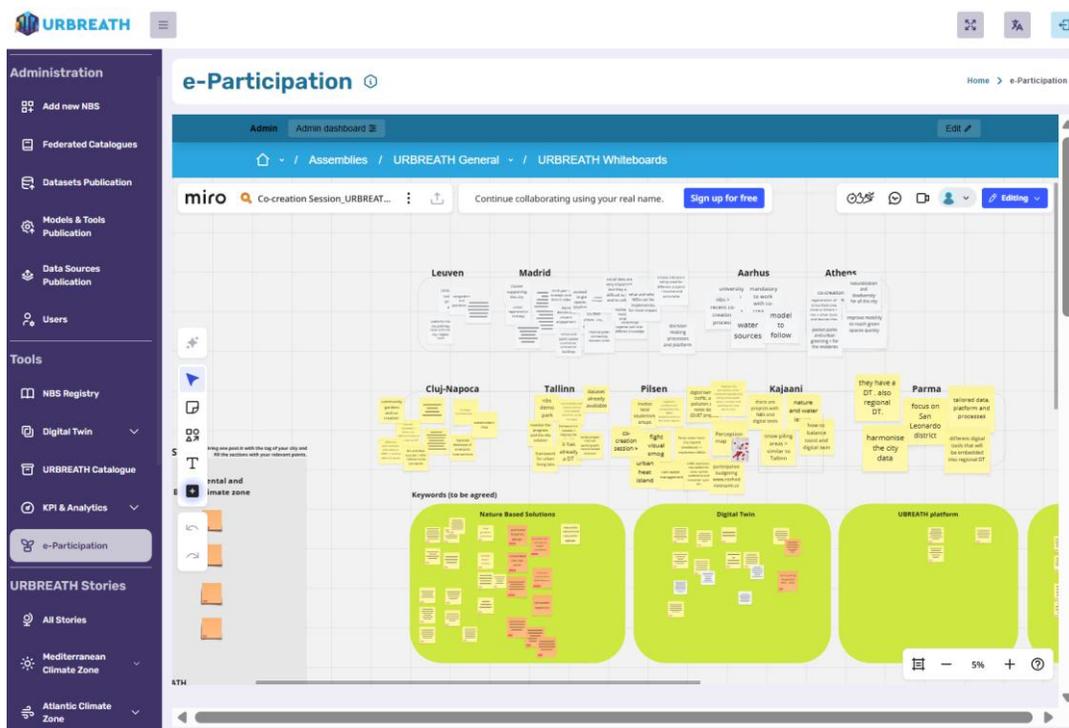


Figure 5. E-participation web application – accessing a Spacedeck whiteboard.



It is also possible to use other Whiteboards different from Spacedeck, just sharing the url, as shown below using Miro:

Figure 6. E-participation web application – accessing a Miro whiteboard.



The URBREATH Catalogues integration also plays a central role in the current system. The internal module developed for this purpose retrieves datasets from the external URBREATH Catalogues platform and makes them available directly inside the E-Participation Web application. Users can save datasets as favourite and reference them during participatory activities, such as assembling proposals, writing comments, or completing text fields. This ensures that relevant data is readily accessible for collaborative processes and greatly enhances the usefulness of assemblies.

Figure 7. E-participation web application that integrates the URBREATH catalogue (1-2).

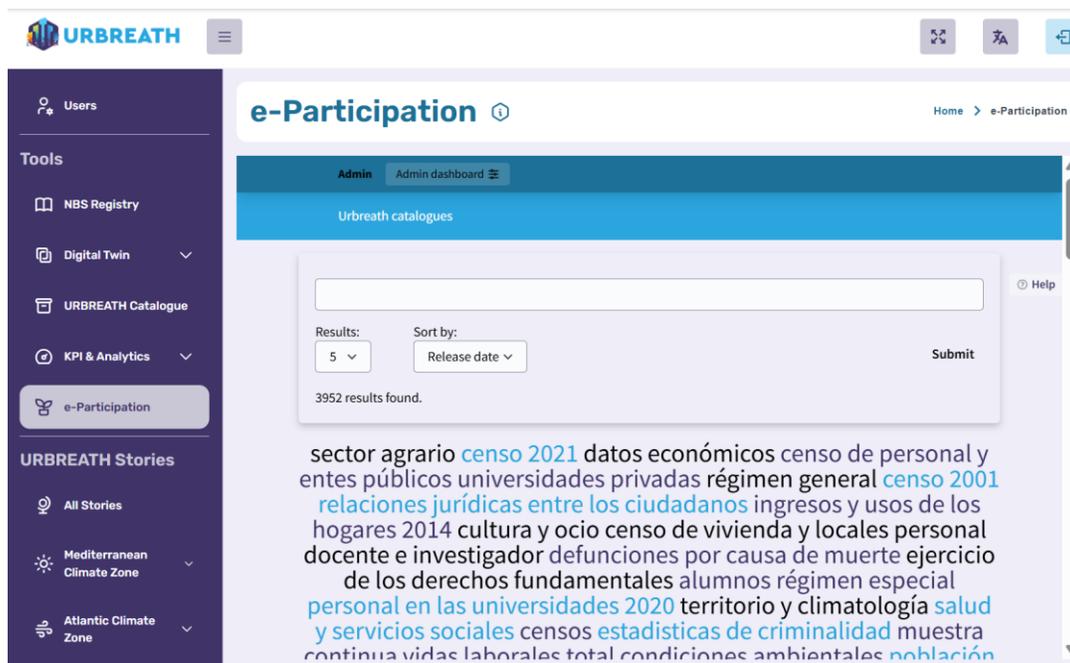
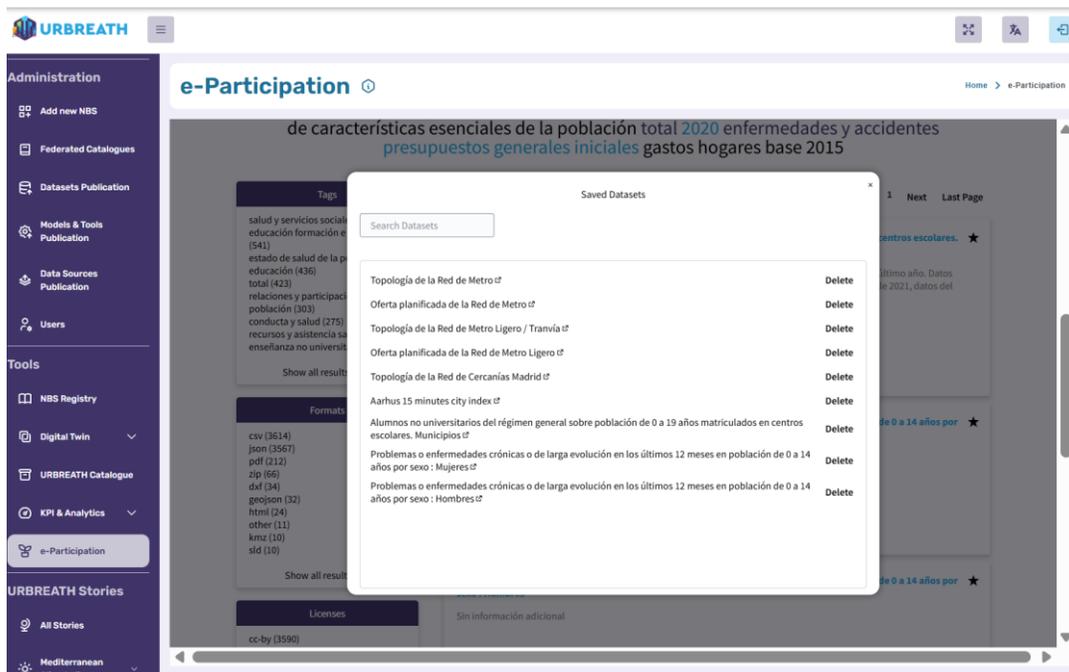


Figure 8. E-participation web application that integrates the URBREATH catalogue (2-2).

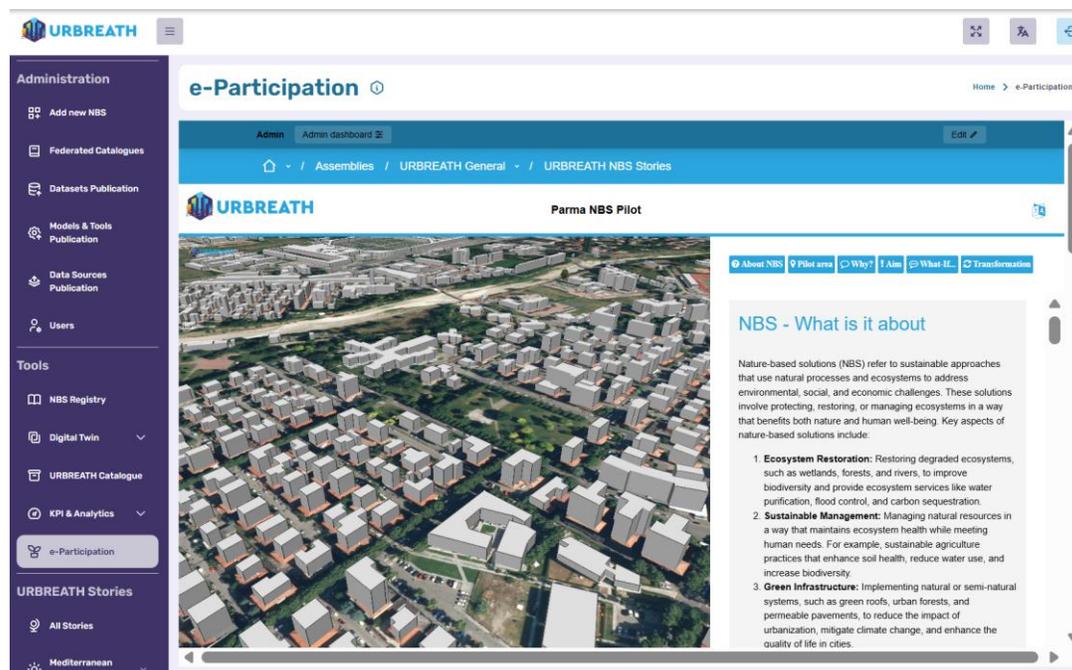


Figure 9. E-participation web application – management of favourite datasets.



NBS Stories was also implemented as a standalone gem. Built initially on top of decidim-blogs to reuse comments and permissions, it was progressively refactored into an independent component adapted to the needs of the project. This required restructuring inherited logic, adjusting controllers, and aligning the component with Decidim’s architectural patterns.

Figure 10. E-participation web application that integrates NBS Stories (Digital Twin).



Bringing collaborative whiteboards, navigable digital twin visualizations, and dataset catalogues together in a single environment (i.e. e-Participation Web Application) aims to radically improve the participatory experience. Instead of jumping between different websites and applications, users can brainstorm ideas, explore interactive 3D models, and access dataset catalogues without moving out from the platform. This seamless integration saves time, reduces friction, and keeps the focus on collaboration rather than on managing multiple tools.

Within e-Participation Web Application, participants can co-create proposals visually (whiteboards), simulate real-world scenarios (NBS Stories), and validate decisions with transparent datasets, while linking related documents, images, and videos to enrich discussions, towards evidence-based participatory process. Having everything in one place allows to establish a unified digital space where participation becomes more efficient, transparent, and impactful.

To demonstrate the platform’s capabilities and provide concrete examples for end users, assemblies have been created for each city involved in the project. These assemblies showcase how offered functionalities (both native in Decidim and implemented in URBREATH project, i.e. integration with Whiteboard, NBS Stories, and URBREATH Catalogue) can be used together. Each assembly includes the relevant components configured in realistic scenarios, allowing users to understand how to attach

whiteboards, create stories, insert catalogued datasets, and navigate the integrated workflow. This setup provides a practical demonstration environment that illustrates the possibilities of the system and supports training, onboarding, and evaluation activities.

Figure 11. E-participation web application – assembles for the project’s cities (1-2).

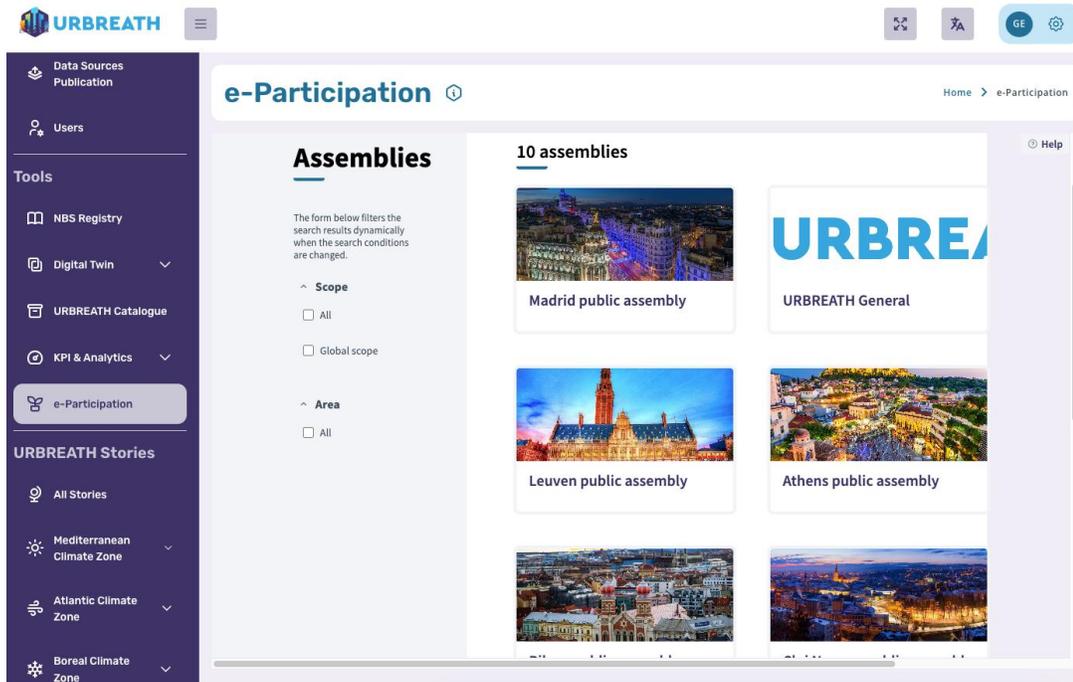
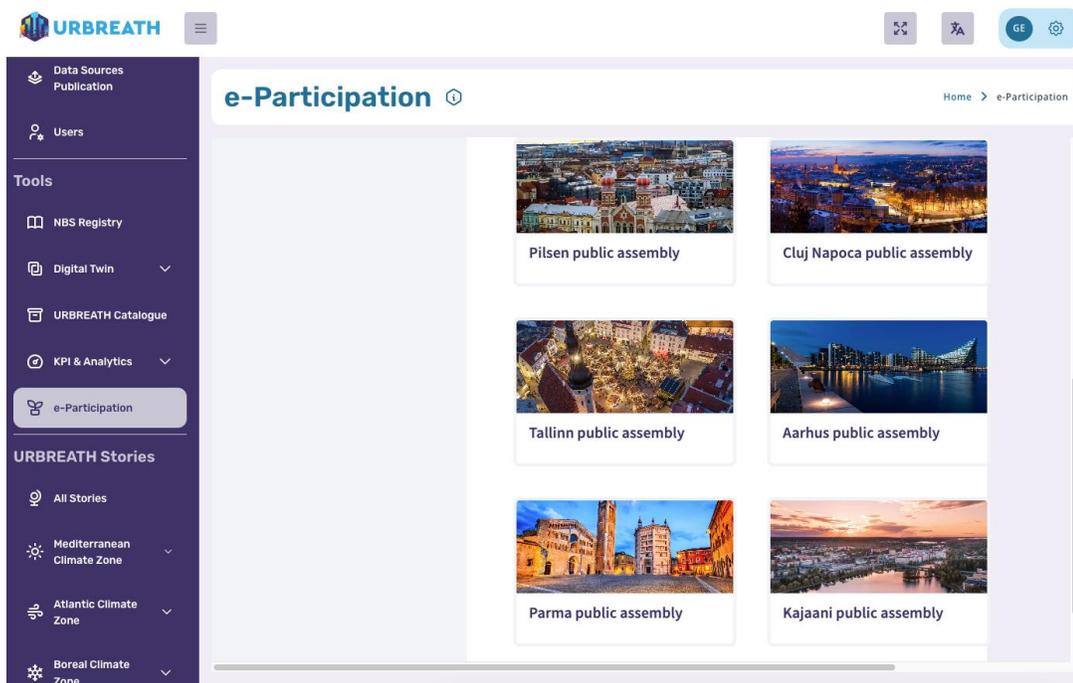


Figure 12. E-participation web application – assembles for the project’s cities (2-2).



At this stage, in addition to native Decidim’s functionalities, assemblies can include both the Whiteboard (using Spacedeck or third-party tools) and NBS Stories as components, and users can reference datasets from URBREATH Catalogue within their interactions. The system supports embedded authentication, cross-app identity creation, whiteboard selection from the user's Spacedeck space, and stable UI behaviour within the dashboard. Remaining work focuses mainly on improved logout handling (especially when switching user accounts) and enabling admin access through the token, using the backend enhancements already implemented.

4 E-participation mobile app

Following the course of action as outlined in the first deliverable, D4.4, “URBREATH participatory tools – V1,” the e-participation mobile application, has proceeded as planned, with full implementation based on key narratives:

- A user-friendly interface promoting an intuitive user experience.
- Better interaction and integration with the web e-participation platform.
- Geolocation features and interactive maps enable users to explore NBS projects, submit proposals, or report issues directly on the map.
- Explore integration prospects with other URBREATH tools and outputs, enhancing user engagement.

4.1 Updated overview of functionalities implemented.

More specifically, by M24, as foreseen in the D4.4, the e-participation mobile application has implemented, both in the front-end and backend, the following core features:

- **NBS Categories:** A recent addition providing the space where users can currently redirect to other URBREATH solutions and outputs (Figure 13). Users can redirect to the URBREATH Dashboard, where most of the URBREATH solutions have been integrated into one common user interface (Figure 14). It serves as an “on the go” easy access point for users to access the tools from their mobile devices. In addition, this space could also redirect users to the project’s website and other informative pages according to pilot needs.

Figure 13. The NBS categories. This space offers redirect links to other URBREATH solutions and the project's website.

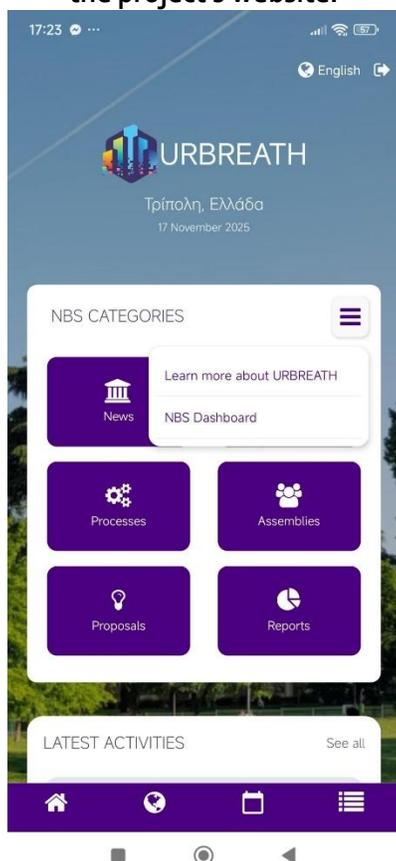
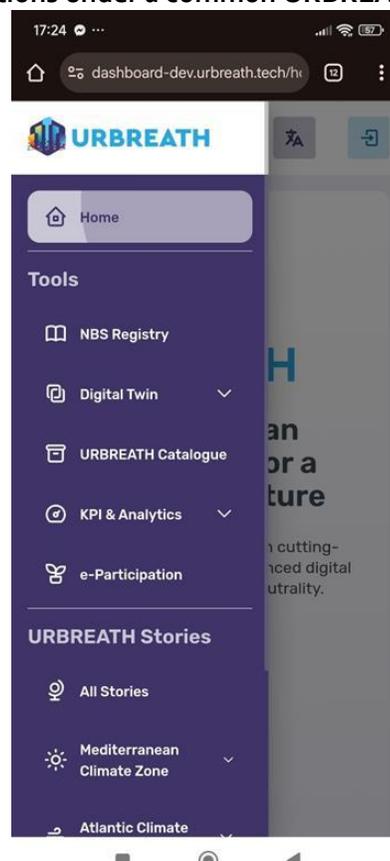
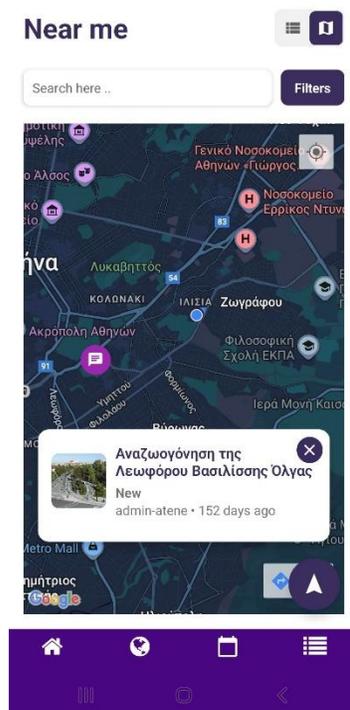


Figure 14. The easy access to the URBREATH UI Dashboard allows the users to access other solutions under a common URBREATH UI.



- **NBS Projects:** This feature promotes awareness and transparency in the city’s planned or ongoing interventions. Each project has a detailed description, timeframes, and relevant files for users to have an overview and an open dialogue section. This feature is currently planned to be updated and integrated with the NBS Registry.
- **Proposals and reporting issues on the map:** These features enable users to provide their ideas and proposals or indicate an occurring issue or invasive species directly on the map. These features include a mobile-efficient stepper approach for the creation of a new report/proposal while also incorporating a discussion panel, as foreseen.
- **Near me:** A geospatial feature providing a centralized interactive map showcasing NBS projects, proposals, and issues reported as pins for geolocation and navigation capabilities. Users can navigate to see what is happening near their location and how all these actions are distributed on the map, tap on the pins to have a brief of the specific activity, access its details, and engage in constructive dialogue in the dedicated spaces (Figure 15).

Figure 15. "Near me" feature, allows users to view on the map of the NBS projects, reported issues, and proposals how they are distributed in the area on the map and tap on each pin for a brief overview or redirect to the relevant space for more details and engage



- **Assemblies, Participatory Processes, and Calendar:** These features are integrated from the e-participation web application. With this integration, all components created by the administrators in the web application are accessed by the users of the mobile application, enabling them to interact with the content through their mobile devices. For quick access, all the meetings scheduled in the web application and their details are retrieved in the Calendar feature of the mobile application.
- Moreover, the integrations performed within the Assemblies feature, connecting to whiteboards but also to the **VCS Storytelling tool**, have also been integrated within the Assemblies in the mobile application. This integration establishes 3D visualizations within the e-participation tools (Figure 16). Apart from relevant information, 3D views, and incorporated content, this feature also offers unique capabilities such as a 3D “fly through” the intervention site (Figure 17). This feature has a dedicated open dialogue space embedded (Figure 18).

Figure 16 The integration of VCS Stories allows users to access 3D visualizations and all relevant information incorporated.



Figure 17. This also offers the ability of "fly through" the relevant NBS implementation sites.



Figure 18 A dedicated open dialogue section has been implemented, encouraging idea exchange and constructive discussions about the NBS project.



- Surveys/Polls:** A feature enabling in-app survey creation and distribution for users to respond to. The creation of a survey follows the same mobile-optimized stepper approach for efficiency and ease of use. The administrators of the platform can create a survey utilizing a schema of multiple-choice answer options promoting engagement and mobile efficiency (Figure 19). Analytics are incorporated for statistical results distribution (Figure 20). It is important to mention that this specific functionality, together with the corresponding ones of the e-Participation Web Application, provides support for implementing, keeping track and evaluating KPIs defined by cities involved in the project, since different ones are based on surveys.

Figure 19. For survey creation, a multiple-choice option for users to choose from is currently designed.

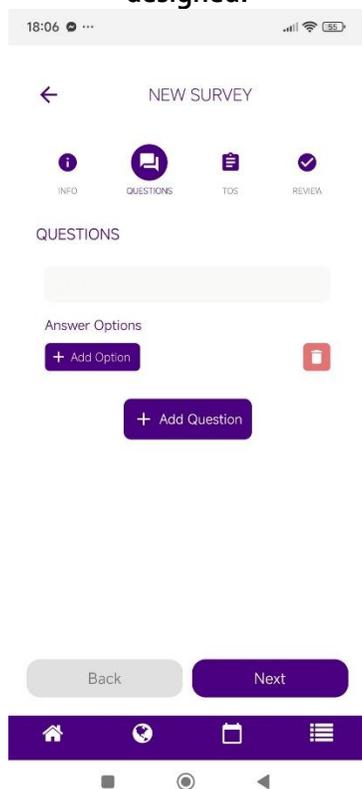
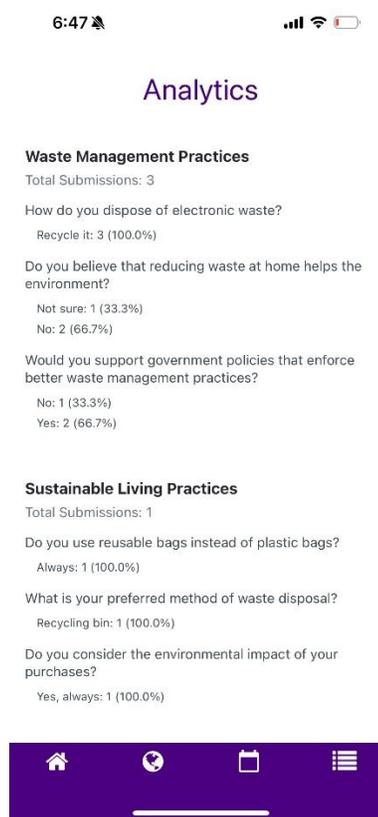


Figure 20. Analytics for statistical results on surveys are incorporated.



4.2 Implementation progress and Updates (M13-M24)

As reported in D4.4, the e-participation mobile application by M12 had already started its development journey, and by M12, its initial front-end user interface and its partial integration with the e-participation web application had been developed.

The development process of Year 2 evolved by building upon the initial technical foundation and introducing its further developed functionalities. The app is built using React Native and Expo for cross-platform compatibility, with MobX³ employed for efficient state management and JWT for secure authentication. Technical implementation remained aligned with the incremental approach described in the deliverable D4.4 by adding functionality in a step-by-step approach while at the same time priorities were established to ensure core functionalities established by M18 and the 1st prototype delivery to delve deeper in enhancements and adjustments until M24 for the 2nd prototype delivery.

4.2.1 Technical implementation progress until the 1st prototype delivery (M18).

More specifically, from M13, the development process continued by evolving the integration with the e-participation web application, enhancing their collaborative environment and synchronization capabilities. Communication between the mobile application and Decidim's API is established via secure HTTPS requests, utilizing a base URL that points directly to the Decidim GraphQL endpoint⁴. Each request is carefully configured with the necessary headers and query parameters, and authentication is managed through JWT tokens to ensure secure, token-based access and real-time data synchronization⁵, allowing direct interaction with it through the mobile application. Some features that the API did not permit a direct interaction with traditional methods⁶ were integrated utilizing iframes, enabling interaction from the end users of the mobile app by directly interfacing with various graphical elements of the web application, offering a more comprehensive e-participation suite access and interaction from the native mobile application.

In parallel, the e-participation mobile app proceeded with the implementation of its own backend to support the additional in-app core features as already designed and documented in D4.4, to complement and enhance e-participation capabilities. To this end, a RESTful API architecture is employed for robust data handling, secure storage and retrieval, and comprehensive user authentication and sessions management.

³ About MobX: <https://mobx.js.org/README.html>

⁴ Decidim API documentation: <https://docs.decidim.org/en/develop/develop/api.html>

⁵ Introduction to JSON Web Tokens: <https://www.jwt.io/introduction#what-is-json-web-token>

⁶ Decidim API documentation: <https://docs.decidim.org/en/develop/develop/api.html>

The backend implementation prioritized and focused on enhancing user engagement by fully implementing the geolocation-based features as proposals and issue reporting capabilities following its design logic of a stepper process in their creation, to promote efficiency and leverage at the same time the advantages of mobile applications regarding geolocation capabilities. The process continued with the development of NBS projects on a location-based schema as well, enabling users to track the initiatives and under-development projects within their city. These components were, as foreseen, incorporated in a unified interactive map, leading into developing the “Near me” feature.

The next addition in the backend implementation at this stage was surveys. The implementation of this feature was based on efficiency and enhancing engagement, providing a structured frame for city administrators to create in-app surveys or polls tailored to the specific needs. Its iteration provides the ability to include a questionnaire with different choices for users to choose from and select the deadline for users to respond to the survey. This functionality was designed to additionally support analytics. In this case users can see the number of participants and retrieve statistical results of the questionnaire enabling full transparency on the outcomes. A PDF report generation is also implemented, supporting the work of the city’s administrators.

The integration process with the Keycloak service has also reached its final maturity level by M18. Originally the e-participation mobile application was designed to incorporate different Keycloak realms for sign-in for each pilot city. However, at a second iteration, the original sign-in of the e-participation web application was integrated, replacing the original design and supporting the interaction capabilities of the two applications. At the end, a common Keycloak service for all URBREATH tools was decided, facilitating a better user experience, resulting in the final integrated common Keycloak realm.

For the first prototype delivery on M18, the implementation progress concluded by bundling the front-end and backend technical implementation, leveraging EXPO to achieve cross-platform delivery both for iOS in an IPA form and Android in an APK form for distribution and testing.

4.2.2 Technical implementation progress until the 2nd prototype delivery (M24).

From M18 until the end of Y2, the technical implementation advanced based on key enhancements, improvements, and additions:

The mobile application started and is continuously building on a multi-language schema by prioritizing pilot cities' native languages and incorporating translations based on feedback from the pilot cities. For expanding the multi-language support, the i18next library has also been incorporated with a dynamic language detection based on device settings, supporting 11 languages (English, Greek, Italian, French, German, Spanish, Dutch, Swedish, Danish, Serbian, and Romanian) with automatic fallback to English. This is an ongoing process, based on the continuous identification of translation corrections.

User role differentiation was incorporated by designing and assigning more capabilities to the admin users, while allowing non-registered (guest) users to be able to respond to surveys. With this improvement, admin users of each city can create in-app surveys for everyone else to participate in, including guest users, and they can also export a comprehensive PDF analytics report containing the various analysis results.

The UI colour palette was further customized to align with the unified URBREATH toolbox UI principles as decided among technical teams.

Another addition during this period was the integration of the VCS Stories, adding enhanced visualization and co-creation space. This feature provides a 3D visualization of the pilot cities' NBS sites accompanied by detailed information and relevant content. This feature is integrated to the e-participation web application incorporating the ability of feedback and dialogue engagement for users. The e-participation mobile application proceeded with its integration by leveraging iframes using WebView technology, allowing the visualization and interaction directly from the mobile application.

The e-participation mobile application during the last months of Y2 expanded its distribution infrastructure to the official testing environments for both mobile OS platforms, TestFlight for iOS and the Google Internal Testing environment for Android. For iOS, the system automatically submits mobile application builds to TestFlight, while Android builds are configured to generate Android App Bundle (AAB) files for the Google Play Store internal testing track. This way registered user testers can more easily download and access the mobile application.

Finally, the latest integration is currently planned and aims to connect through real-time API calls the space of NBS projects with another relevant URBREATH solution output, the NBS Registry. This feature is foreseen to incorporate filtered NBS actions for each pilot city, as registered by the administrator users of each city, enabling all the relevant information, picture files, links, etc., that accompany it from the NBS Registry, promoting efficiency and easy access natively from the mobile device. A dedicated section for encouraging idea exchange and an open dialogue among users is also foreseen.

4.3 Implementation Status on M24

Summarizing the implementation progress and status by the end of M24, the e-participation mobile app has implemented:

- ✓ Improved integration with the e-participation web application enabling interaction and better synchronization.
- ✓ Fully functional geospatial and geolocation core features.
- ✓ Additional survey functionality with embedded statistical analytics—also downloadable in PDF.
- ✓ Access and interaction with VCS Stories with 3D visualizations enabling open dialogue in real-time synchronization with the web application.

- ✓ Different user roles enable restrictions for unauthorized users (guests) while allowing better admin management.
- ✓ Planned integration with the NBS Registry providing access to further details, accompanied documents, images, links, etc.

5 Adaptation of the e-participation tools for Frontrunner cities

From the initiation of activities performed under Task 4.2, the core objective was to adjust the solutions based on the actual needs of the pilot cities. As detailed in D4.4, “URBREATH e-participation tools- V1” the tools selection and architecture were based and adjusted for the pilot cities needs and additional requirements. These initial requirements have been further assessed to provide the best feasible options to support them.

All core features of the open-source Decidim, which was the foundation of the web application, were subject to adjustment to the maximum of their capacity, and at the same time additions were created based on tailored Ruby gems, building step-by-step the e-participation web application in its current state. At the same time, the e-participation mobile application was developed not only to become the native mobile environment of the web application but also to build additional complementing features and further enhance the functionality options for the pilot cities.

At the same time, initial enhancements, technical improvements, and plans for next integration capabilities started to take form, incorporating suggestions and feedback from the 1st Demo Cafe live demonstration that took place in Cluj-Napoca during the URBREATH General Assembly on M17. A second round of assessment and validation for both solutions took place during the 2nd Demo Cafe live demonstrations of the URBREATH General Assembly in Tallinn on M21. Additionally, during this reporting period, documentation, user guides, and video materials were also distributed, while also dedicated workshops for user support, training, and exploration of the functionalities have taken place, leading to an enriched pool of suggestions for improvements and feedback retrieved from the pilot cities.

The mapping of user requirements and suggestions for enhancements and improvements regarding the e-participation tools is an ongoing process and under evaluation pending feasibility.

5.1 Adaptation of the tools for Frontrunner cities roadmap

More in depth, the adaptations made for the FR cities during this reporting period can be further categorized as such:

- Adaptations based on pilot requirements for functionalities and features.
- Adaptations in content creation processes, utility objectives, and expanding user choice options.
- Adaptations based on user experience and efficiency.

5.1.1 Adjustments in functionalities and features

There are various adjustments in features and functionalities that have already been implemented during this period, addressing the following initial phase additional requirements from FR pilots, as those were listed, for reference, on the Deliverable D4.4.

Table 1: Participatory tools—Initial FR pilot requirements from workshop with pilot cities, addressed during M13-M24.

Requirement ID	Requirement Details.	Implementation details
WS2-CON-UJ1- CLUJNAPOCA- STEP2-02-R01	Possibility to implement awareness campaigns about the importance of NBS by creating a dedicated sections (in e-participation tool) with educational materials, infographics, videos, and webinars, encouraging users to learn and spread awareness within their communities.	Within the e-participation tools there are multiple features that allow the creation of NBS specific campaigns while also enabling the incorporation of informative content such pictures, links, chart figures, diagrams, etc. as fit to each action.
WS2-CON-UJ1- CLUJNAPOCA- STEP2-02-R02	Citizens can navigate different sections and discover NBS related content.	Different sections are implemented both generic and focused in NBS.
WS2-CON-UJ1- CLUJNAPOCA- STEP2-03-R01	Launch participatory budgeting initiatives that allows citizens to submit proposals and initiatives for municipal consideration.	Participatory budgeting is a component incorporated in the e-participation web app also available to respond via the mobile application.
WS2-CON-UJ1- CLUJNAPOCA- STEP2-03-R02	Offer the possibility to set and manage participatory budget campaigns	The administrators can manage the e-participatory budget campaign in the web application.
WS2-CON-UJ1- CLUJNAPOCA- STEP2-03-R03	The “administrator” must be able to set the total budget of the participatory budget campaign and possible alternatives solutions (e.g. build a bike lane, deploy new benches, plant trees, etc.) with their related costs	Implemented as part of the participatory budgeting creation process.
WS2-CON-UJ1- CLUJNAPOCA- STEP2-03-R04	Citizens can choose among the proposed alternative solutions and their combination until the total cost does not exceed the total budget.	Implemented.
WS2-ATL-UJ1- LEUVEN-STEP1-01- R01	The e-participation tool offers the list/map of the NBS related initiatives/projects planned/under implementation/implemented by the Municipality	The NBS related initiatives/projects are offered in both solutions. Within the mobile application the NBS projects can be viewed either on a list or on map as pins.
WS2-ATL-UJ1- LEUVEN-STEP1-01- R02	The user can select one the of available initiatives/projects and access its details (e.g. full description, location, expected impact, etc.)	All details provided by the administrator for an initiative/project are available for users.
WS2-ATL-UJ1- LEUVEN-STEP2-01- R02	The user should be able to access report (e.g. documents and/or web pages that includes charts graph, may layers, etc.).	Within the initiatives/project focused spaces, the administrators can include figures, charts, links, etc. as fit for each occasion, available to other users.
WS2-MED-UJ1- MADRID-STEP5-01- R01	e-Participation toll should allow the user to publish and integrate 3D visualisation of possible NBS (e.g. co-created) together with content such as text, images, documents, reports, etc.	Through the integration with VCS storytelling tool 2D/3D visualizations are available to the e-participation

		tools users, alongside with their details included in VCS Stories.
WS2-MED-UJ1-MADRID-STEP5-02-R01	Stakeholders (e.g. citizens) can access published content.	Published content is available for all stakeholders
WS2-MED-UJ1-MADRID-STEP5-02-R02	Stakeholders (e.g. citizens) can add comment, feedback, etc.to published content.	All spaces include dedicated discussion panel.
WS2-CON-UJ1-CLUJNAPOCA-STEP1-01-R01	Citizens can discover published content and interact (e.g. post comment, reply, etc.)	All spaces include dedicated discussion panel.
WS2-CON-UJ1-CLUJNAPOCA-STEP1-01-R02	Citizens can comment, provide feedback, debate and propose solutions to topics of interest.	All spaces include dedicated discussion panel. Furthermore, proposal features are available and a separate section for debates can be included in the Assemblies feature.
WS2-ATL-UJ1-LEUVEN-STEP3-02-R01	Enable users to submit observations, track progress, and give feedback through a mobile app.	Implemented both for in app features but also via real-time synchronization for web app features.
WS2-ATL-UJ2-LEUVEN-STEP5-02-R01	The Municipality can publish informative material (e.g. reports including charts, graphs, images, etc.) explaining the proposed design of an NBS	Within the initiatives/project focused spaces, the administrators can include figures, charts, links, etc. as fit for each occasion, available to other users.
WS2-ATL-UJ2-LEUVEN-STEP5-02-R02	Citizens can navigate the proposed NBSs and access the related informative material, also from a mobile application.	Implemented as mentioned before.
WS2-ATL-UJ2-LEUVEN-STEP5-02-R03	Citizens can provide feedback, comments about the proposed NBSs, also from a mobile application.	Implemented as mentioned before.
WS2-ATL-UJ1-LEUVEN-STEP1-02-R01	The e-Participation tool must offer a calendar reporting the events scheduled by the Municipality.	A Calendar for events functionality is implemented.
WS2-ATL-UJ1-LEUVEN-STEP1-02-R02	The administrator of the Municipality must be able to create a new event (e.g. by editing the title, description, date, time, location if physical event or link to online meeting) to be included in the calendar.	Implemented in process when creating an event.
WS2-ATL-UJ1-LEUVEN-STEP1-02-R03	On his/her side, the user should be able to access the calendar and the planned events on the mobile app.	Through calendar feature on the mobile app user can view the details of the event.
WS2-ATL-UJ1-LEUVEN-STEP1-02-R04	On the mobile app the user can select an event and access its details (e.g. by title, description, date, time, location if physical event or link to online meeting).	Through calendar feature on the mobile app user can view the details of the event.

Additionally, other core features that were identified as needed, such as the creation and distribution of surveys, have been implemented during this reporting period.

5.1.2 Adaptations in content creation processes, utility objectives, and expanding user choice options

Some functionalities have been implemented for offering different utility objectives and options.

In this regard, there are spaces dedicated to a specific action or theme (e.g., an NBS project, issue reporting, etc.) and spaces offering a more generic approach, an open space for expressing ideas (e.g., proposals, blogs, etc.).

Front Runner Cities, firstly expressed during the live Demo Café demonstrations, the need to establish different user roles. The logic of this classification was to allow unregistered users or guest users to respond to surveys. The surveys meant to be leveraged to provide further insights to “what the people want” and they were at that time already anonymized, so pilot cities wanted to provide the chance to the wider audience to respond whether they register or not. To this end, both platforms have already adjusted their functionalities. However, allowing guest users to provide other kind of content is still an ongoing discussion because that could jeopardize the accuracy and accountability of the content.

Another point in user roles was to establish the management of content for the admin roles. That lead to the ability of the administrators to manage the content, the components and the processes. On the web application administrators can create the components they see fit on each occasion providing the narrative to foster a more focused co-creation and co-decision environment. That means that they can create participatory budgets, surveys, debate spaces, focused blogs, etc.

For the e-participation mobile application, the admin users can create surveys, tag the content on proposals or issues as “in progress” or “completed” if the city plans to follow through or resolve the issue and so on. They can also delete inappropriate content if identified.

Figure 21. An adjustment provides the ability for guest users to access the e-participation mobile application. Guest users while can access all content, the only action they can perform, currently, is to respond to surveys.

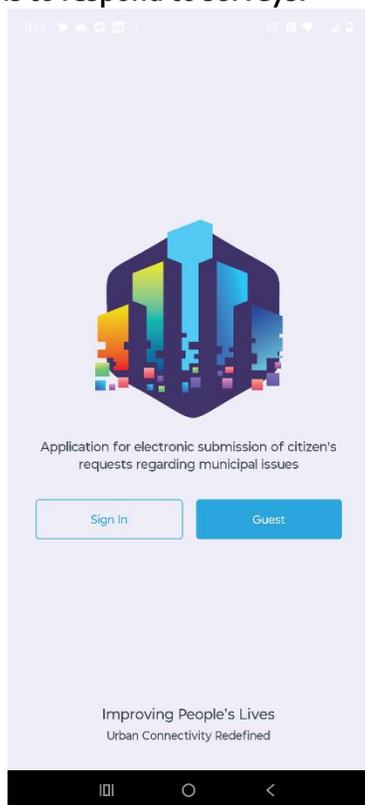
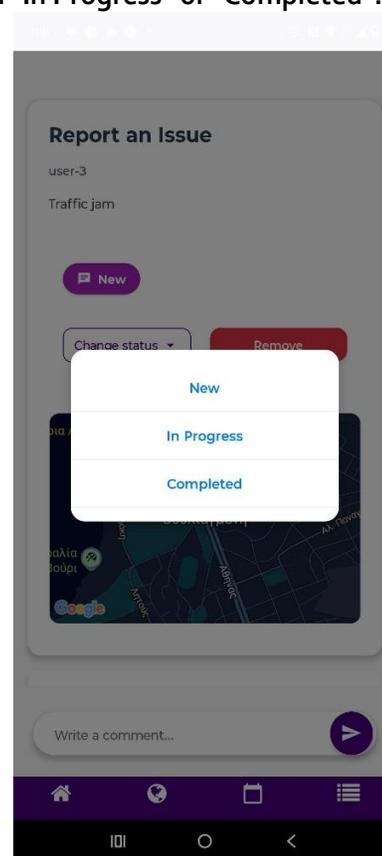


Figure 22. Admin users when accessing the details on a proposal or a reported issue can change its status on "In Progress" or "Completed".

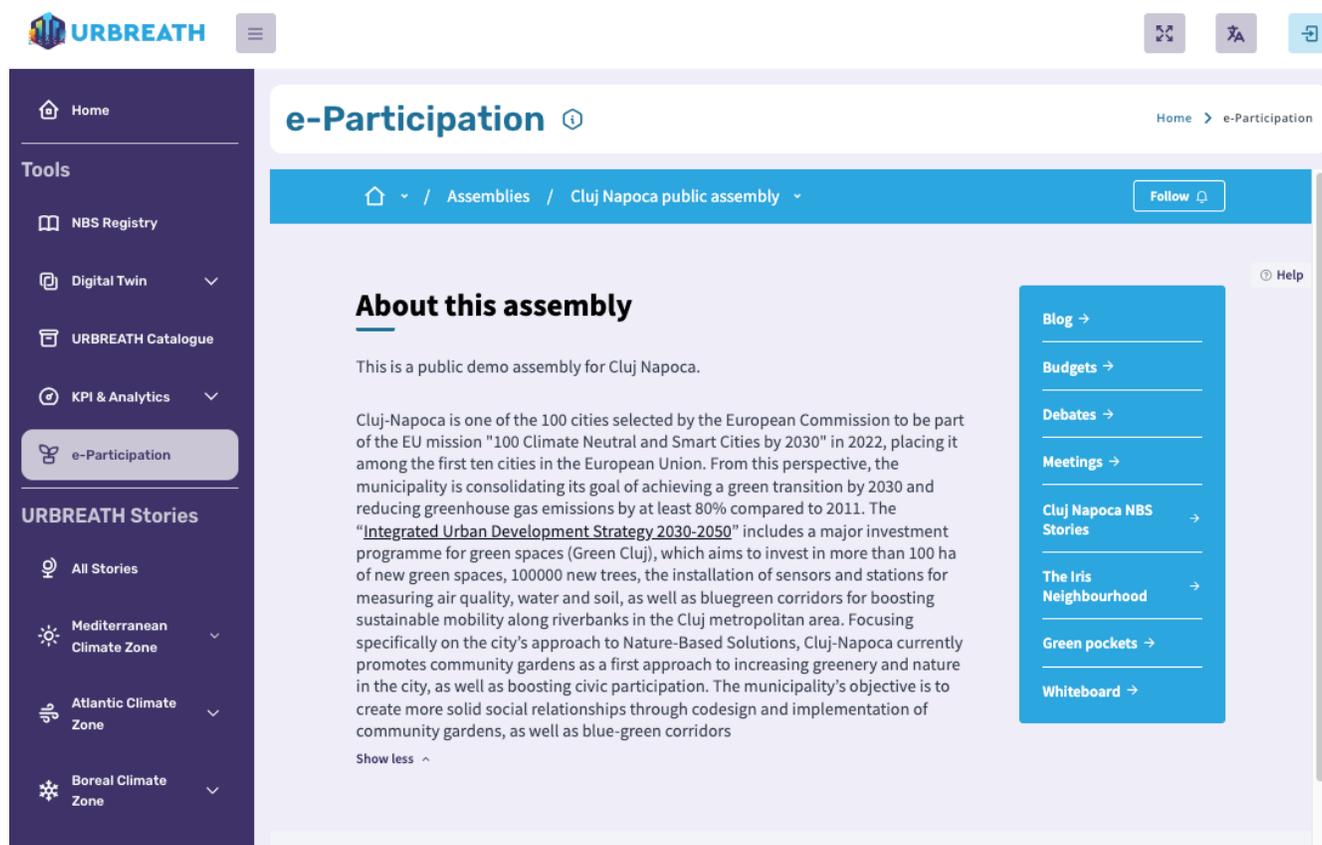


Additionally, surveys are considered an essential functionality; thus, they are approached in a versatile spectrum and implemented both in the e-participation web application and as a built-in mobile application feature to offer a dynamic set of different options to choose from fit for every occasion. For example, long, in-depth surveys can be designed and structured on the web application and made accessible for response via the mobile app. On the other hand, shorter surveys emphasizing multiple-choice options or quick polls can be generated “on the spot” within the mobile application environment.

Moreover, the surveys features, are designed and implemented specifically focusing on offering different options to pilot cities, providing them technical solution as means for addressing and measuring KPI’s of qualitative nature. Since qualitative KPI’s could potentially involve surveys for acquiring stakeholders’ opinions, the e-participation tools suite has proceeded in necessary adjustments proactively ensuring that multiple types of surveys can be fostered, fully adjustable to meet the specific needs on most occasions.

Concerning the e-Participation Web application, as mentioned in section 3.2, nine dedicated assemblies for the cities involved in the project have been created and populated with Decidim’s components, such as Blog, Debate, Meetings, Proposals, etc, as well as NBS Stories.

Figure 23 Example of assembly with Decidim’s components.



In addition, for the FR cities, the air quality monitoring dashboard have also been included to the Assemblies via the Whiteboard component.

Figure 24 Example of air quality monitoring dashboard integrated in an assembly through the whiteboard component (1-3).

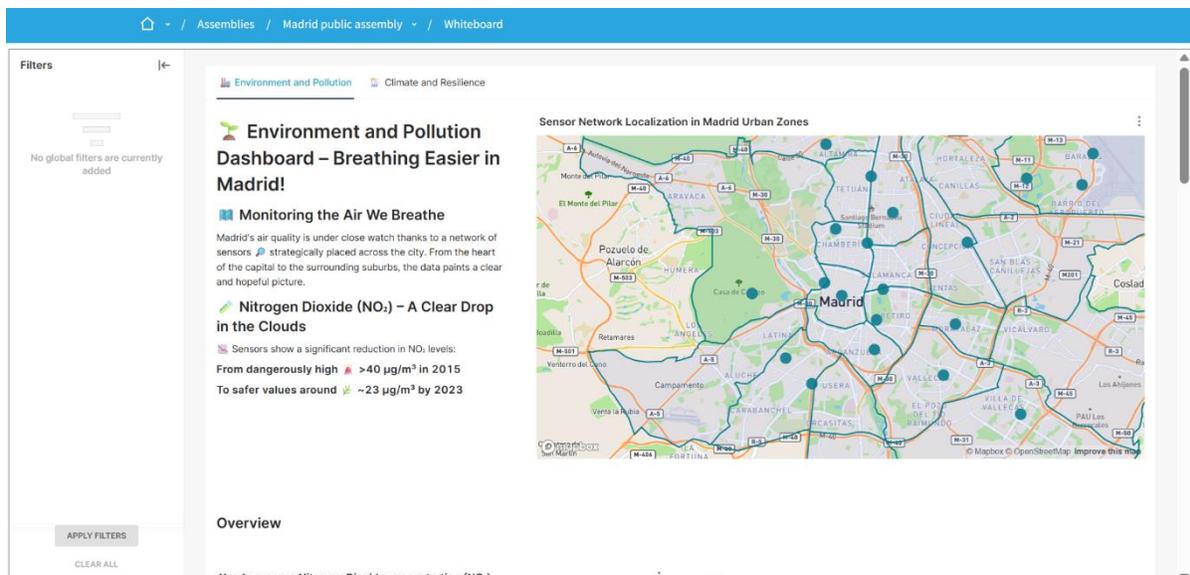


Figure 25 Example of air quality monitoring dashboard integrated in an assembly through the whiteboard component (2-3).

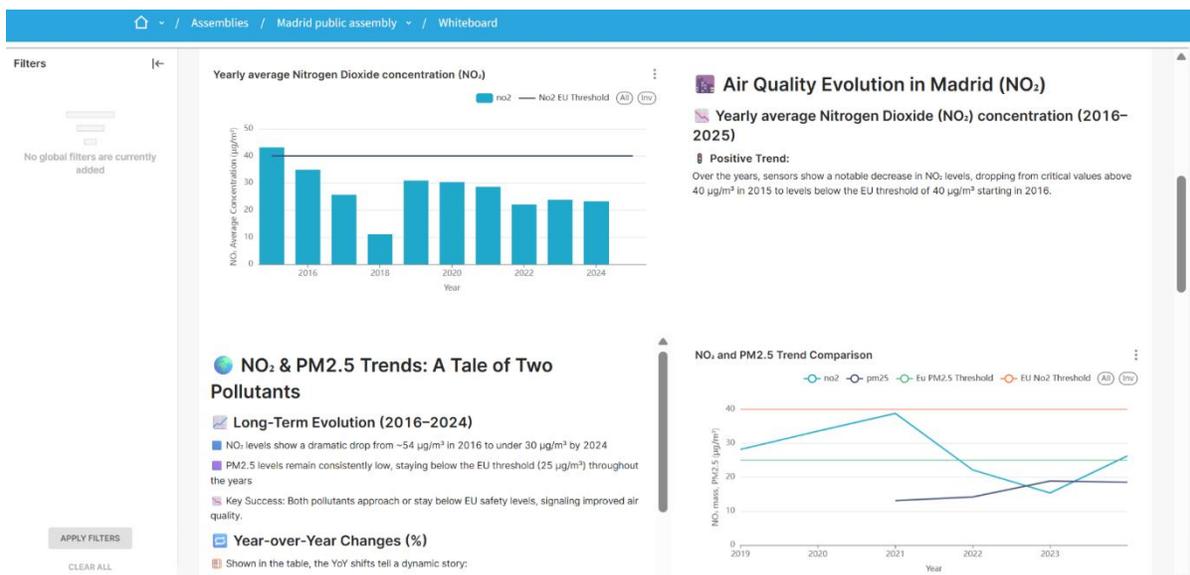
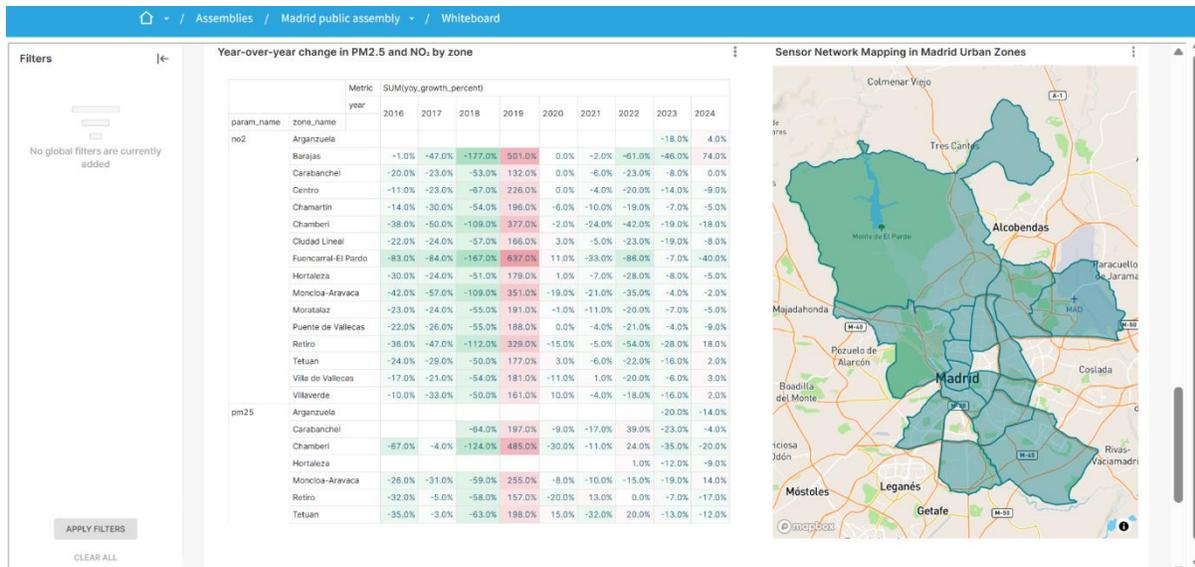


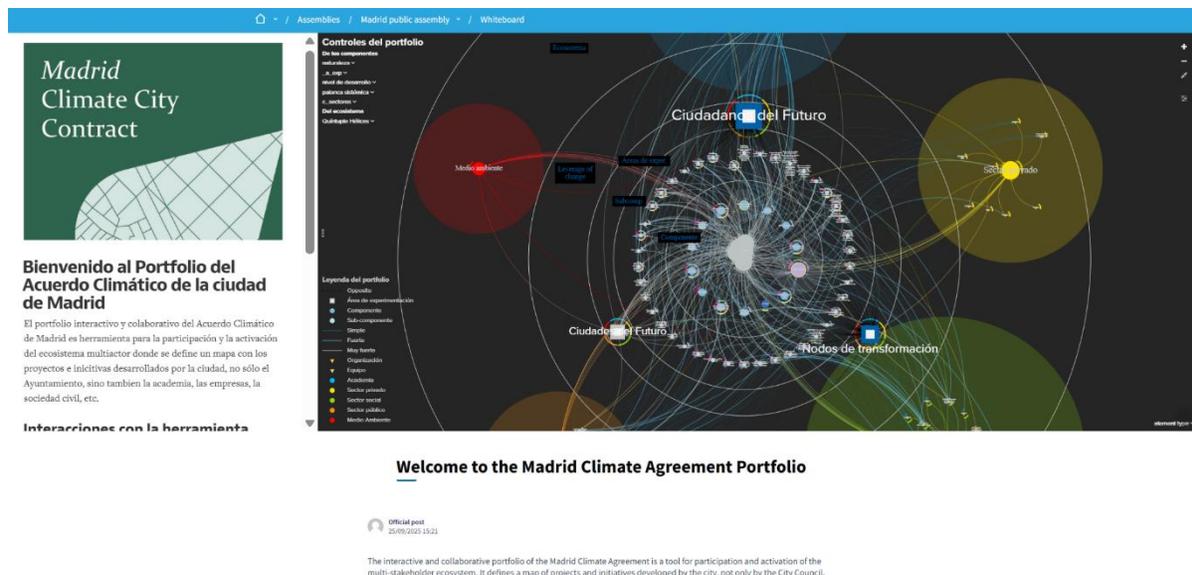
Figure 26 Example of air quality monitoring dashboard integrated in an assembly through the whiteboard component (3-3).



Furthermore, in the case of Madrid, the whiteboard component was used to integrate also the navigable Madrid Climate Contract Portfolio⁷.

⁷ Alméstár, M.; Romero-Muñoz, S.; Mestre, N. Breaking Silos: A Systemic Portfolio Approach and Digital Tool for Collaborative Urban Decarbonisation. Sustainability 2025, 17, 5145. <https://doi.org/10.3390/su17115145>

Figure 27 Madrid Climate Contract Portfolio integrated in the Madrid’s assembly through the whiteboard component.



5.1.3 Adaptations based on user experience and efficiency

Another set of adaptations made are focused more on user experience and efficiency. More specifically:

- UI improvements: The adoption of a common UI colour palette offering a unified UI as well as adjustments in the UI based on user efficiency have been made during this period.
- Translations have been incorporated, offering a dynamic environment based on native languages, promoting user experience, and ease of access within the pilot cities.
- Regarding the e-participation mobile application, another distribution channel was also offered, addressing some restrictions and challenges that pilots faced during the training sessions on M20. Apart from the APK and IPA distribution methods, the mobile application extended its distribution mechanism to the official application testing environments of TestFlight for iOS and Google internal testing for Android.

5.2 Documentation and technical support for training

During this reporting period, as already mentioned, video materials⁸ were distributed on numerous occasions, followed by live demonstrations, training workshops, and support. Documentation and user guides were also distributed accompanying the 1st prototype delivery to further assist the pilot cities.

⁸ For the e-participation mobile application a short video is also available on URBREATH YouTube Channel here: <https://www.youtube.com/shorts/yX-OedEnE34>

This process has been unveiled in steps over the year to offer the time and the space to the pilot cities to further analyse and validate step-by-step the implementation process. Another key aspect was to ensure optimal and efficient technical support addressing different needs for each city.

Another key aspect to better serve the functionalities trainings and options was to create mock content based on information shared by the pilot cities during the project’s dedicated meetings, Cities Calls, and their presentations. This information was filtered, visualized and contextualized in the functionalities offered by the e-participation tools (Figure 28, Figure 29, Figure 30, Figure 29, Figure 30).

Figure 28. Demo content created in the e-participation web environment based on information shared by the pilot city of Cluj-Napoca. Multiple demo components, such as participatory budgeting and different blogs like “The Iris Neighbourhood” and “Green Pockets,” were added to better depict the content creation capabilities based on the interests of Cluj-Napoca as well as the relevant NBS story.

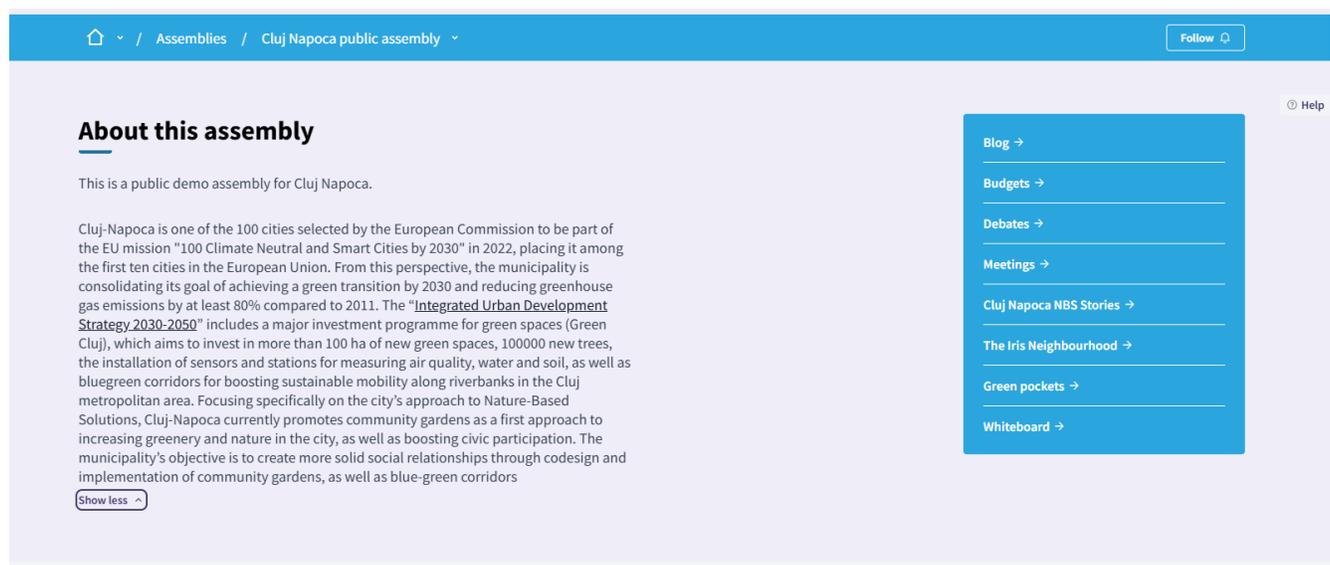


Figure 29. The same demo content displayed in Figure 28, as retrieved via the mobile application with full interaction capabilities.

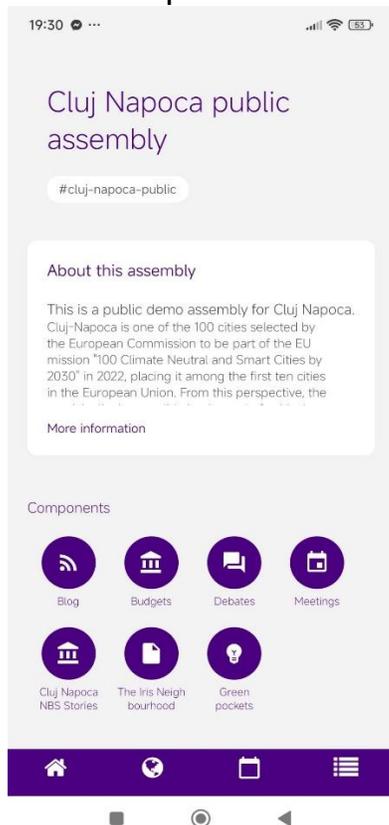
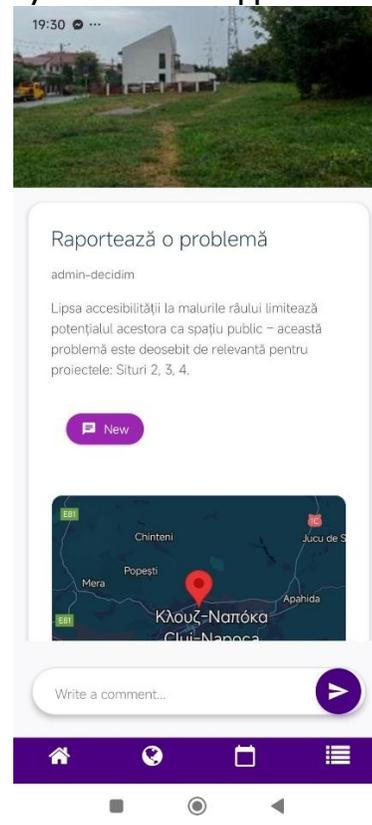


Figure 30. The issues that Cluj-Napoca is facing on the NBS sites contextualized via issue reporting functionality of the mobile app.



As the technical advancements result in 2nd prototype delivery on M24, updated versions of the relevant documentation and user guides will be issued as necessary.

5.3 Feedback received from FR cities and suggestions for improvements

All the demonstrations, live café demos, and workshop iterations aimed to receive valuable feedback from the FR cities as well as the FL cities and suggestions for further improvements and new or improved functionalities. All the feedback gathered provides potential further additions and enhancements that are currently addressed or in the process of being addressed in the next steps of the implementation process.

Feedback and suggestions for improvements regarding the e-participation mobile app include:

- UI improvements for better system response (e.g., better response for text boxes and keypad support) and more efficient touch points.
- UI improvements for better visualization, such as bigger fonts and changes of icons displayed.
- Translations corrections.

- Additional mobile application distributing mechanisms apart from APK and IPA forms for easier download and installation.
- Connect the NBS Projects space with the NBS Registry, avoiding duplicates in the URBREATH toolbox.
- Additional answer options for surveys (e.g., an automated Likert scale, open text answer boxes, and the option to include an image in the question).

Concerning the e-Participation Web application, the only remarkable suggestion is the integration of SPID⁹ authentication system. It's important to mention that extensions (gems) for Decidim for integrating SPID already exist¹⁰. However, this functionality would be limited only to Italian adoption scenarios.

All this feedback is retrieved and evaluated for feasibility and efficiency through the iterations process, while also prioritizing the feasible improvements in a step-by-step approach. As the technical development advances, pilot cities will continue to be actively involved for further feedback and enhancement evaluation. To this end, we consider this process as an ongoing one, until the end of the project, to the extent of continuously welcoming new suggestions and ideas for improvements or more features to provide the best feasible options to potentially address them.

⁹ SPID (Sistema Pubblico di identità Digitale - Public Digital Identity System) is an Italian national authentication system that allows both citizens and businesses to access all online services of the Public Administration using a single digital identity (<https://developers.italia.it/en/spid/>).

¹⁰ <https://github.com/dipartimentofunzionepubblica/decidim-module-spid-cie>

6 Conclusions

The deliverable D4.5, “URBREATH participatory tools – V2,” provided in-depth the implementation progress and results achieved during the period M13-M24. As the natural advancement of the initial version, D4.4, “URBREATH participatory tools – V1,” this document builds upon the initial foundations and thoroughly elaborates the advancements of the e-participation tools, all the way from the 1st prototype release up to the 2nd prototype release on M24.

These developments are aligned with the initial implementation plan as documented in D4.4 and further improved based on specific needs and opportunities identified as the technical implementations progressed. At the same time, the e-participation tools continued to actively seek opportunities to connect and build upon other solutions of the whole URBREATH toolbox.

Addressing additional pilot requirements, emphasizing and prioritizing the ones from Frontrunner cities, remained the key goal of the technical implementation of this period's activities. After dedicated demonstrations and workshops, further ideas and suggestions for improvements were collected. This is an ongoing process and subject to further feasibility and efficiency assessments for both tools to understand better and to align with needs.

The e-participation tools are currently releasing their 2nd updated versions and will continue improving, potentially enhancing their capabilities by M36, documenting respectively their updates on the deliverable D4.6, “URBREATH participatory tools – V3.”