CHRONICLE

Building Performance Digitalisation
and Dynamic Logbooks
for Future Value-Driven Services

Deliverable 5.2
Pre-validation, demonstration, and pilot roll-out activities report (Part 2)

Funded by
the European Union

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Contents

Abbreviations

Abbreviation	Definition
API	Application Programming Interface
BIM	Building Information Model
CDE	Common Data Environment
DBL	Digital Building Logbook
DoA	Document of Action
DHW	Domestic Hot Water
EC	European Commission
HVAC	Heating, Ventilation and Air-Conditioning
IAQ	Indoor Air Quality
IFC	Industry Foundation Classes
IoB	Internet of Buildings
IoT	Internet of Things
KPI	Key Performance Indicator
LC	Life Cycle
MMP	Minimal Marketable Product
SCADA	Supervisory Control And Data Acquisition
UC	Use Case
WLC	Whole Life Cycle
WP	Work Package

Executive Summary

This deliverable presents the results of the pre-validation, demonstration, and pilot roll-out activities of the CHRONICLE project carried out between Months 31 and 42 under Work Package 5. It builds directly on Deliverable D5.1 and documents the transition from early validation to extended, real-life deployment of the CHRONICLE solution across multiple European pilot sites. The report provides consolidated evidence of the technical maturity, functional stability, and user acceptance of the CHRONICLE ecosystem under realistic operational conditions.

During the reporting period, all CHRONICLE components were fully integrated and operated within the Common Data Environment, enabling consistent data flows, traceability, and coordinated workflows across tools. Small-scale pre-validation activities confirmed interoperability, functional completeness, and data integrity, while full-scale demonstrations extended testing to a larger number of users and longer operational periods. The pilots, implemented in diverse geographical and regulatory contexts, demonstrated the adaptability of the solution to different building typologies, stakeholder profiles, and local conditions.

End users, including both professionals and non-professionals, were actively recruited and engaged throughout the pilot activities. Training sessions, co-creation workshops, and iterative feedback cycles ensured meaningful participation and supported continuous refinement of the tools and user interfaces. This user-centred approach strengthened usability, increased adoption, and ensured that validation results reflect real decision-making and operational practices rather than controlled testing environments.

Operational monitoring and data logging were systematically implemented, generating a robust empirical evidence base. The collected datasets capture technical performance, system usage, workflow execution, and user interactions, supporting the evaluation of technical robustness and functional stability. The sustained and reliable operation of the CHRONICLE ecosystem across pilots confirms its readiness for extended use and large-scale deployment, with minor issues addressed through iterative improvements during the demonstration phase.

The validation activities reported in this deliverable provide the necessary foundation for the holistic validation and impact assessment to be conducted under Task T5.6. Harmonised validation methodologies, standardised documentation, and structured datasets ensure continuity between component-level verification and system-wide impact evaluation. The data collected enables the derivation of technical, usability, social, and preliminary economic indicators based on real operational evidence.

Cross-pilot coordination and structured exchange of lessons learned supported the identification of common challenges, transferable solutions, and context-specific constraints. These insights confirm the importance of early stakeholder engagement, clear onboarding processes, and adaptable workflows to support replication across different European contexts. Overall, the outcomes of this deliverable demonstrate that the CHRONICLE tools have reached a high level of maturity and market readiness, providing a solid basis for exploitation, replication, and uptake activities under WP6.

1 Introduction

Deliverable D5.2 documents the pre-validation, demonstration, and pilot roll-out activities of the CHRONICLE project carried out between Months 31 and 42 within Work Package 5. Its main objective is to report on the recruitment and engagement of end users, the small-scale verification of CHRONICLE components, and the full-scale pilot demonstrations conducted across the project pilots. The deliverable provides consolidated evidence of the functional performance, usability, and integration maturity of the CHRONICLE ecosystem under real operational conditions.

This deliverable is a direct continuation of Deliverable D5.1, which covered pre-validation and demonstration activities from Months 24 to 30. While D5.1 focused on early validation steps and initial pilot preparation, D5.2 builds upon those results by extending validation to a broader set of users, pilot sites, and longer testing periods. Together, D5.1 and D5.2 provide a coherent and progressive overview of the validation and demonstration process of the CHRONICLE solution throughout WP5.

The document is structured by **validation topics** rather than by individual tasks, reflecting the integrated nature of the activities carried out under Tasks T5.3 to T5.5. This thematic structure supports a holistic presentation of the Common Validation Methodology, small-scale verification, and full-scale demonstrations, enabling clearer traceability of results and a more comprehensive assessment of the CHRONICLE ecosystem across pilots.

1.1 Common Validation Methodology

The **Common Validation Methodology** provides a unified approach for WP5 downstream Tasks T5.4, T5.6 ensuring consistent, traceable validation and holistic impact assessment of the CHRONICLE ecosystem illustrated within Figure 1. It integrates technical verification of system components with the evaluation of their overall impact, enabling comparable results, methodological consistency, and efficient use of project resources. The methodology aims to validate the functional and technical performance of all components under realistic conditions, support both small-scale and full-scale testing, derive technical, social, and economic KPIs from operational data, and ensure a seamless transition from component-level verification (T5.4) to holistic impact assessment (T5.6). The approach is implemented in two validation phases.

The first validation phase, Integration and Functional Validation (T5.4), verifies interoperability, functionality, data integrity, and end-to-end workflows within the Common Data Environment (CDE), confirming the stability and integration of the CHRONICLE architecture. The Small-Scale Validation– Phase I, applies the scenario-driven, UI-first approach of the common validation methodology (T5.2), professional users through ChroViewRen, ChroViewFM, ChroViewPlus, ChroViewOcc and ChroViewDBL. This phase assesses usability, functional completeness, and data consistency while refining the common validation methodology and generating operational datasets for analysis. Engagement with the residential users was limited due to the delays on the integration.

The second validation phase, Full scale demonstration (T5.5), applies a scenario-driven, UI-first approach, engaging residential users through ChroViewOcc and professional users through ChroViewRen, ChroViewFM, ChroViewPlus, and ChroViewDBL. This phase engages a larger number of pilot sites, users (professionals & non-professionals) to a larger testing validation period. All tools are tested thoroughly to their functionality performance. Although some applications could not be tested by the residential users with their own data due to temporary integration issues or temporary sensor failures, this did not affect the overall impact of the project, as these issues were resolved and the applications can be used normally even after the project's closure. The same issues also limited user feedback during the design for the residents, but user feedback can continue to be collected and used for future improvements or proposals.

All validation activities are documented through standardized test cases, validation scenarios, and feedback templates, which are stored in the CHRONICLE repository to ensure reproducibility and support reuse in subsequent tasks. Structured data flows and unique identifiers for projects, buildings, and components provide full traceability, linking component-level tests to system-wide impact assessment. The implementation of this methodology ensures efficient and consistent validation across all components and pilots, reduces duplicated efforts, facilitates the transition from technical verification to holistic impact assessment, and generates reliable, data-driven evidence to support CHRONICLE exploitation and replication under WP6.

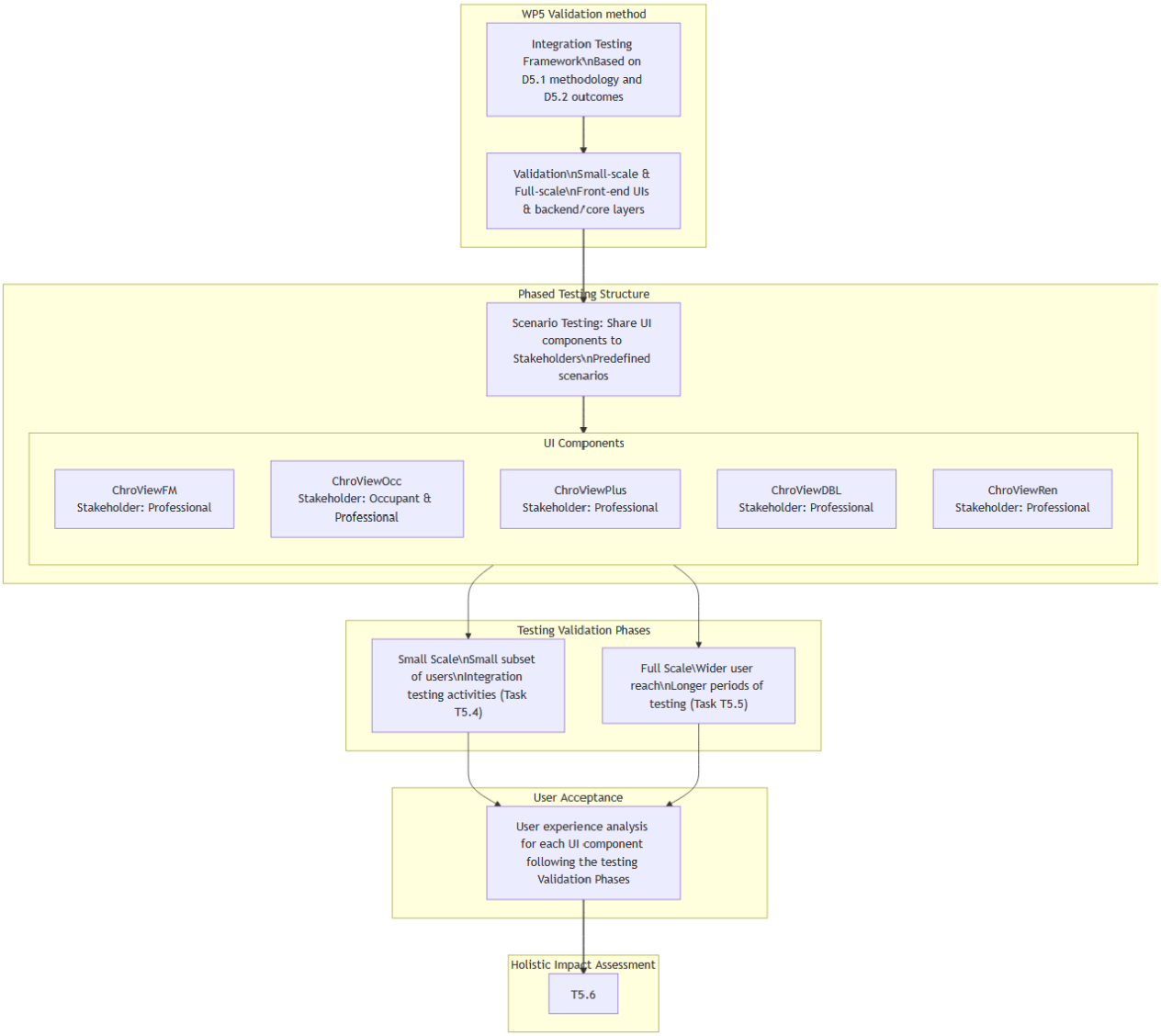

Figure 1 Common validation methodology approach

2 Small scale verification of CHRONICLE components

Task 5.4 – “Pre-validation, Solutions Deployment and Small-scale Demonstration”, encompasses all activities related to the integration testing, functional validation, and small-scale demonstration of the CHRONICLE tools prior to their full-scale roll-out in the pilot sites.

In the initial version of this deliverable (D5.1), an integration testing methodology was defined and applied in close cooperation with WP4, ensuring seamless interoperability among all CHRONICLE components under realistic operational conditions. The present report revisits the adopted methodology and provides a consolidated overview of the integration testing outcomes and the results of the small-scale verification.

2.1 Integration testing methodology

Integration testing was carried out in parallel with the project’s integration activities within WP3 and WP4, where individual components were developed and validated. The methodology presented in this section provides a structured approach that, following component-level functional testing, assesses and ensures secure and uninterrupted data exchange among all components. After completion of the integration testing phase, the end-to-end functionality of the integrated CHRONICLE system is evaluated during the small-scale testing period described in the subsequent section.

The described integration testing methodology steps on the work of T2.1 Stakeholders’ Requirements, CHRONICLE Framework Specifications & Architecture design, which defined the interactions and data exchange between all the system components per UC, and T3.1 CHRONICLE Common Data Model Design & Common Data Environment Development which finalized and analysed all these data exchanges. Four stages are defined and listed below (Figure 2):

1. Definitions of data exchanges between components; This ensures that all project requirements are fulfilled and that the described implementation can be successfully performed.
2. Analysis of all the exchanges towards fully defining their implementation in real life. This analysis includes: the exchange description, the components involved, the data format, the respective endpoints and triggers, the required inputs and all relevant prerequisites.
3. Definition of concrete and standardized integration test cases; Based on the test case template defined (Table 1), these test cases are reported in a comprehensive manner defining all test parameters, expected outcomes and final results.
4. Test case execution; For the final step of the process, the test activities have been performed and documented, their success has been assessed based on the pass criteria set per test case and when these criteria were not met, corrective actions have taken place before rerunning the test case to ensure the correct and seamless integration between two components.

The main idea behind the proposed approach is the definition of standardized test cases per type of data exchange conducted between the system components, which will allow the systematic and structured reporting of the CHRONICLE integration activities.

Figure 2 Integration testing methodology

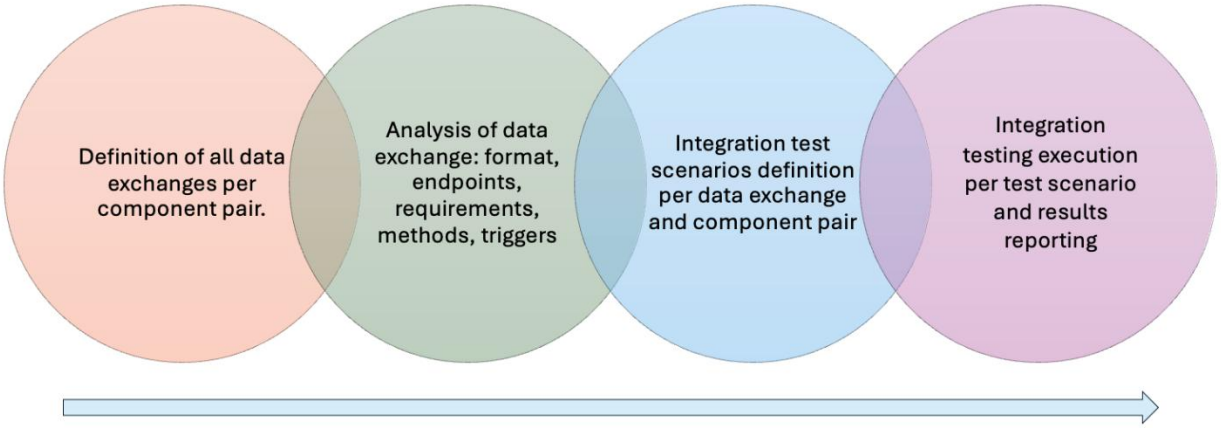

Table 1 Test case template

Test name	Descriptive title of the test scope
Test ID	A unique identifier of the specific test
Components	Components involved in testing
Objective	A short description of the features to be tested
Prerequisites	Any conditions necessary to conduct the test
Test data	Data type and format necessary for the test completion - actual values are not necessary at this point, dummy data can be used.
Test Setup/ component deployment	The specifications of the environment within which the test will be conducted (component version etc)
Test Methodology	Description of the sequential actions to be taken towards the test completion
Pass criteria	An outline of how the system should respond at each test step
Results	Passed/Fail (If failed, describe what actions were taken to successfully complete the test) & results if available (eg. Payloads)

The complete list of test cases is provided in 6.1 offering a full overview of the integration testing activities.

2.2 Integration testing results

Integration testing was performed across all CHRONICLE components within the CDE v1.0 environment, following the procedures and APIs defined in D3.1. The validation actions were conducted using Postman and controlled API calls, confirming successful authentication, communication, and data exchange between the CDE, IoT Platforms, Data-driven Digital Twin (DDDT), Renovation Planner (RP), Digital Building Logbook (DBL), and the Investment Appraiser (IA).

All tests were conducted until returned successful HTTP 200 OK responses and satisfied their respective pass criteria, while any inaccuracy or minor bug detected was finetuned. Data transfers (in IFC4 STEP and JSON formats) were verified for integrity, and storage/retrieval operations were validated against the database entries. Consequently, the end-to-end integration of the CHRONICLE architecture was confirmed to be stable and interoperable.

Table 2: Integration test Summary

Test ID	Test Name	Objective	Result
CDE_01	Projects List Retrieval	Verify that CHRONICLE components can retrieve the available project list from the CDE.	Successful; List retrieved with HTTP 200 OK; data integrity confirmed.
CDE_02	Baseline OpenBIM Data Retrieval	Validate retrieval of the baseline IFC4 STEP model for a specific project from the CDE.	Successful; IFC4 STEP model retrieved, validated, and accessible.
IoT_01	IoT Platform Configuration to the CDE	Verify linking of IoT platform entities to BIM sensing/ metering elements. (Aspra Spitia, Ecce Homo 8, La Sosta, Zaragoza Vivienda)	Successful; Devices assigned with unique UUIDs; CDE acknowledged associations.
CDE_03	IoT Data Retrieval	Verify retrieval of timestamped IoT data for a defined time period. (Aspra Spitia, Ecce Homo 8, La Sosta, Zaragoza Vivienda)	Successful; Time-series data retrieved (JSON); HTTP 200 OK.
DDDT_01	Human-Centric KPIs Storage	Validate storage of human-centric KPIs (comfort, IAQ, well-being) in the CDE.	Successful; KPI batches posted (JSON); acknowledged by CDE.
DDDT_03	Thermal Comfort Profiles Storage	Verify storage of thermal comfort profiles calculated by the Data-driven DT.	Successful; Profiles stored (JSON); HTTP 200 OK.
DDDT_04	Load Profiles Storage	Confirm storage of calculated load profiles per building in the CDE.	Successful; Profiles stored (JSON); integrity check passed.

RP_01	Selected Renovation Scenario OpenBIM Storage	Verify that the Renovation Planner sends and stores the selected scenario IFC in the CDE.	Successful; IFC4 STEP file stored and validated successfully.
RP_02	BRP Storage to CDE	Verify that the Renovation Planner stores the timestamped BRP (JSON) in the CDE.	Successful; BRP stored (JSON); CDE response OK.
RP_03	Renovation Scenario KPIs Storage	Verify that scenario KPIs (WLC, Cost, Comfort/Energy) are stored in the CDE.	Successful; KPIs batch stored (JSON); CDE confirmation received.
RP_04	Post-Renovation Analysis Storage	Verify that the Renovation Planner stores the post-renovation analysis in the CDE.	Successful; Analysis file stored (JSON); CDE confirmation OK.
DBL_01	Post-Renovation Analysis Retrieval	Confirm that the DBL retrieves the post-renovation analysis.	Successful; File retrieved; HTTP 200 OK; integrity check passed.
DBL_02	Renovation Scenario OpenBIM Retrieval	Verify DBL retrieval of the renovation scenario IFC file.	Successful; IFC retrieved; download validated.
DBL_03	BRP Retrieval from CDE	Confirm DBL retrieval of the timestamped BRP (JSON).	Successful; BRP retrieved (JSON); HTTP 200 OK.
IA_00	Send Baseline and Renovation Data to Investment Appraiser	Verify transmission of baseline and scenario data from RP to IA.	Successful; Files sent to IA API; processing initiated.
IA_01	Receive WLC/Cost KPIs and Carbon Assessment from IA	Verify reception of calculated KPIs and carbon metrics by the Renovation Planner.	Successful; JSON response received and parsed correctly.

Most tests were successfully completed during the initial execution cycle, with only a limited number of minor issues identified, primarily related to endpoint parameter handling These were resolved within the same iteration and retested before proceeding to the small-scale pre-validation phase. No critical blocking defects were recorded that would prevent the progression to full pilot deployment.

2.3 Small scale pre-validation and demonstration testing

Following successful system integration, the CHRONICLE tools underwent small-scale validation through a UI-first, scenario-driven approach to exercise all backend workflows (i.e., CDE, IoT, DDDT, RP, DBL, IA). The objective was to identify usability issues, data exchange gaps, and interoperability issues prior to full-scale demonstration.

Small-scale testing was conducted with a subset of households from the Aspra Spitia pilot and the HYP testbed, involving both professional user groups and residentials. The process

focused on real-world interaction, functional completeness, and system stability under normal operating conditions.

End-to-end testing of professional applications (ChroViewRen, ChroViewFM, ChroViewPlus, and ChroViewDBL) was carried out using real pilot and testbed data. Professional users evaluated application workflows under predefined scenarios, with individual steps assessed on a pass/fail basis. Feedback was collected through a unified template to support issue identification and replication. The full set of the testing scenarios and reporting forms are found within 6.2.

Residential beta testing targeted tenants of the Aspra Spitia pilot using the ChroViewOcc application. Participants interacted with the app in real-life conditions and provided structured feedback on usability, navigation, functionality, and responsiveness through standardized questionnaires.

Due to project timeline adjustments, the initially planned focus groups were replaced by mock-up feedback sessions and combined small- and full-scale user training activities. Dedicated validation scenarios were also developed to verify functional completeness, user flow, and expected outputs across all tools.

Reported issues primarily related to wording, chart legends, and navigation paths. These were translated into concrete change requests, implemented in subsequent UI iterations, and verified through follow-up internal testing prior to full deployment.

3 Pilot Roll-out and Full-scale Demonstration (CIRCE)

3.1 Objectives and Scope

The objective is to carry out the pilot roll-out and full-scale demonstration of the CHRONICLE solution under real operational conditions. The scope of the task covers the deployment of all integrated tools across selected pilot sites, the engagement of professional and non-professional users, and the validation of system performance, usability, and interoperability at scale. T5.5 builds on the pre-validation activities completed in earlier tasks to demonstrate the readiness of the CHRONICLE ecosystem for holistic validation and impact assessment.

3.2 Roll-out Planning and Preparation Activities

Roll-out planning focused on coordinating pilot timelines, defining user engagement strategies, and ensuring alignment with technical and organisational requirements at each pilot site. Preparation activities included the selection of demonstration scenarios, confirmation of data availability, user onboarding, and coordination with local stakeholders. These actions ensured that pilot activities could be executed efficiently and consistently across sites, while allowing flexibility to accommodate local conditions.

3.3 Deployment Procedures and Technical Readiness

Deployment procedures were implemented following standardised protocols to ensure consistent configuration, and operation of the CHRONICLE tools within the Common Data Environment. Technical readiness was confirmed through integration checks, data flow verification, and system stability testing prior to full-scale operation. These procedures ensured reliable performance during the pilot roll-out and minimised risks during extended demonstration periods.

3.4 Description of CHRONICLE implementation on Pilot Sites and Local Infrastructures

This section provides a consolidated overview of the implementation of the CHRONICLE solution across the five pilot sites, building on the detailed audits, IoT deployment, and preparatory activities reported in *Deliverable D5.1.* The pilots were selected to represent a diverse range of building typologies, ownership models, climatic conditions, and levels of digital maturity, ensuring broad validation relevance and replication potential.

3.4.1 Zaragoza (Spain)

The Zaragoza pilot (Ecce Homo 8) is a refurbished social housing building managed by Zaragoza Vivienda, hosting a socially vulnerable population. The implementation focused on integrating building-level and apartment-level monitoring through CIRCE's *EnergyBox* gateway, thermostats, CO_2 sensors, and ventilation control interfaces. Emphasis was placed

on tenant engagement, supported by social mediation, and on compensating for the lack of pre-existing BIM models through targeted modelling activities. The pilot provides a representative case for public housing retrofits and social housing contexts.

3.4.2 Mytilineos (Greece)

The Greek pilot at Aspra Spitia consists of single-family dwellings owned and managed by Mytilineos, many of which were already equipped with IoT infrastructure from previous projects. CHRONICLE implementation leveraged Hypertech's IoT gateway and sensors to monitor energy consumption, indoor environmental quality, and occupancy-related parameters. The pilot benefits from strong facility management involvement and provides a controlled environment to validate data continuity, scalability, and long-term monitoring in residential neighbourhoods.

3.4.3 O'Cualann (Ireland)

The Irish pilot includes newly built and refurbished A-rated homes developed by O'Cualann, with high energy performance standards and digitally engaged occupants. The implementation relies on IES's iSCAN platform, smart meters, environmental sensors, and appliance-level monitoring. This pilot supports validation in owner-occupied, high-efficiency residential buildings and enables early testing of system reliability before wider roll-out, contributing valuable insights into user behaviour and performance benchmarking.

3.4.4 AEM (Switzerland)

The Swiss pilot (Fondazione La Sosta) is an assisted-living residential building equipped with advanced metering infrastructure managed by AEM. CHRONICLE implementation integrates smart electricity meters, indoor environmental sensors, and SCADA-based monitoring of heating and domestic hot water systems. Given the elderly user profile, citizen-facing tools were intentionally limited, while building-level optimisation and monitoring were prioritised. This pilot demonstrates CHRONICLE applicability in sensitive user contexts and complex energy infrastructures.

3.4.5 Fallaesbo (Denmark)

The Herning (Fallaesbo) pilot is implemented in a large-scale social housing area connected to district heating, providing a data-rich environment for validating the CHRONICLE solution in a portfolio-level residential context. The pilot relies on extensive IoB monitoring of heat, electricity, and indoor environmental conditions, with all data integrated into the Common Data Environment to support long-term performance analysis and benchmarking. CHRONICLE tools are deployed primarily to support facility and energy managers through structured performance monitoring, KPI visualisation, and scenario-based evaluation of operational and renovation options. The demonstrations focus exclusively on the professional user perspective, validating decision-support capabilities, data reliability, and interoperability with existing management workflows. Overall, the pilot confirms the scalability, robustness, and replication potential of CHRONICLE for professional portfolio management in social housing and district heating contexts.

As shown, the CHRONICLE solution was deployed and operated under real-life conditions in all pilot environments, covering a wide range of building typologies, climatic contexts, ownership models, and user profiles. Detailed roll-out planning and clearly assigned pilot leadership ensured the coordinated execution of demonstrations. When possible, local pilot participants were engaged through training and user testing workshops , enabling end users to become familiar with system functionalities and workflows.

The full-scale demonstrations validated the technical applicability, robustness, and interoperability of the CHRONICLE ecosystem, confirming stable operation of the integrated tools within the Common Data Environment. End users, including occupants and professional stakeholders, were able to interact effectively with the deployed solutions, demonstrating operational readiness and user acceptance. The outcomes of T5.5 provide a consolidated and reliable evidence base that directly feeds into the definition of CHRONICLE Market Maturity Plans and subsequent exploitation and replication activities addressed under WP6.

To sum up, CHRONICLE solution was deployed, operational, and validated at pilot scale, and with end users trained and accustomed to its features and operation.

3.5 User Manuals

To support the effective deployment, validation, and uptake of the CHRONICLE tools during the pilot activities, comprehensive user manuals and training workshops were provided to all relevant stakeholder groups. The user manuals, developed and delivered under previous project deliverables, offer detailed guidance on tool functionalities, workflows, data inputs, and expected outputs for both professional and non-professional users. These documents can serve as the primary reference material throughout the pre-validation and demonstration phases, their goal is to ensure consistent and informed use of the CHRONICLE applications across all pilot sites.

3.6 Timeline and Milestones

The implementation of WP5 activities followed the timeline and milestones defined in the Description of Action, ensuring a coherent progression from tool readiness to full-scale validation. The delivery of the final versions of the energy and life-cycle assessment applications under WP4 (M23) provided the technical baseline required for downstream validation activities. This enabled the timely execution of pilot recruitment, audits, and IoB deployment activities , supported by internal reporting and ex-ante surveys as defined in the milestone means of verification.

As previously mentioned in Sections 3 and 4, the pre-validation and small-scale testing could not be carried out as originally planned. Therefore, a mixed approach was adopted, including prevalidation, smallscale testing, and fullscale testing. Overall, this approach was successfully completed, although some issues were identified, which will be described here as lessons learned. Since these issues did not impact strategic objectives, they will not be reported as deviations. Among these limitations is the reduced ambition of tool testing, caused by a combination of delays in the data integration work and operational constraints related to user-side system interaction, including instances where residents manually

overrode or disconnected monitoring devices, limiting the continuity and reliability of collected data, particularly within social housing environments.

To mitigate these limitations, corrective measures were implemented at both technical and operational levels. On the technical side, data validation and filtering mechanisms were reinforced to identify and exclude inconsistent or incomplete data streams, while alternative aggregation approaches were applied to ensure continuity of performance analysis. On the operational side, coordination with facility managers was strengthened to improve device configuration and reduce unintended manual overrides. In parallel, clearer communication and guidance were provided to occupants regarding the purpose and functioning of the monitoring equipment. These measures improved data stability and allowed the continuation of validation activities with sufficiently reliable datasets for impact assessment purposes.

Table 3: Milestone summary.

No.	Milestone Name	WP	Lead Beneficiary	Description / Means of Verification (DoA-aligned)	Due Month	Status
8	Applications for Energy & LC Assessment	WP4	IES R&D	Final versions of all applications for energy and life-cycle assessment delivered, including appropriate integrations enabling downstream validation activities	M23	Completed
9	Pilot Recruitment, Audits & IoB Deployment	WP5	CIRCE	Internal reports delivered documenting pilot recruitment activities, ex-ante surveys completed, and IoB deployment finalised across pilot sites	M32	Completed
10	Pre-validation & Small-Scale Demonstration	WP5	CIRCE	Pre-validation activities executed and small-scale demonstrations performed to verify functional readiness of CHRONICLE components	M30	Completed, an agile common validation was adopted for small and full-scale validation
11	Full Demonstration, Validation & Impact Assessment	WP5	CIRCE	Pilot roll-out and full-scale demonstration completed; holistic validation and impact assessment delivered	M42	Completed, including missing activities from Milestone 10

3.7 Operational Monitoring and Data Logging

Operational monitoring and data logging were systematically implemented across all pilot sites during both small-scale and full-scale demonstrations. All CHRONICLE tools operated

within the Common Data Environment, enabling continuous tracking of system performance, user interactions, and data integrity. Logged data support the calculation of technical KPIs (system availability, workflow execution success, data consistency), usage KPIs (frequency of use, tool adoption rates), and process KPIs (end-to-end workflow completion). Monitoring was primarily supported by ChroViewDBL and ChroViewFM, ensuring traceability across buildings, components, and user profiles, in line with WP5 DoA requirements.

3.8 Evaluation of Technical Robustness and Functional Stability

The evaluation of technical robustness confirms stable operation of the CHRONICLE ecosystem under real operational conditions across all pilots. Integration and endurance testing demonstrated sustained interoperability between tools, reliable data exchange, and resilience to varying data volumes and user profiles. Performance-related KPIs, including system response time, error rates, and workflow continuity, were assessed through operational logs and user validation scenarios. Key tools contributing to this evaluation include ChroViewRen, ChroViewOcc, and the energy and life-cycle assessment applications developed under WP4, confirming technical maturity and readiness for extended deployment.

3.9 Collection of Preliminary Validation Data for T5.6

The data collected during WP5 constitute the primary empirical input for the holistic validation and impact assessment foreseen under Task T5.6. Harmonised validation protocols ensured methodological continuity between component-level testing and system-wide evaluation. The datasets enable the derivation of technical, usability, social, and preliminary economic KPIs, including user satisfaction, decision-support effectiveness, renovation scenario quality, and operational efficiency. These indicators are grounded in real usage data generated through ChroViewPlus, ChroViewRen, and ChroViewFM, ensuring that impact assessment is based on operational evidence rather than assumptions.

3.10 Cross-pilot Coordination and Exchange of Lessons Learned

Cross-pilot coordination mechanisms enabled structured exchange of experiences, challenges, and best practices among all pilot sites. Regular coordination meetings, shared validation templates, and consolidated feedback reports supported the identification of transferable solutions and context-specific constraints. Replication-related KPIs, such as adaptability to local regulatory frameworks, scalability across building typologies, and stakeholder engagement effectiveness, were qualitatively assessed through cross-pilot analysis. These activities directly support the DoA objectives related to replication potential and European-wide applicability of the CHRONICLE solution.

3.11 Summary and Recommendations for MMPs and Market Readiness

The outcomes of WP5 demonstrate that the CHRONICLE toolset with further information available through the project website (https://www.chronicle-project.eu/tools/) has reached a high level of technical and functional maturity. The integrated tools support decision-making across the renovation lifecycle, from energy and life-cycle assessment to operational monitoring and facility management. Market-readiness KPIs, including usability, interoperability, and deployment feasibility, indicate strong potential for exploitation. Recommendations for Market Maturity Plans (MMPs) include reinforcing long-term support and maintenance strategies, expanding interoperability with external platforms, and extending demonstration periods to capture long-term performance and behavioural impacts, thereby supporting uptake and replication under WP6 as envisaged in the DoA.

4 End-user facing activities

This chapter presents the end-user facing activities conducted in the CHRONICLE project during the last year of implementation as a combined effort of multiple tasks in the work package. They consist of user training and testing of the different end-user facing components of the CHRONICLE solution, and this way contribute to both active stakeholder involvement and tool refinement.

4.1 Methodology

In CHRONICLE, the stakeholder engagement activities circulated mainly around user testing of the CHRONICLE tools during the last period of implementation. User testing is used in digital tool development to systematically collect feedback from intended end user groups on how well a tool fits their needs and work practices, how understandable and usable it is at its current maturity level, and what changes are most important before wider deployment. In CHRONICLE, user testing is approached as an iterative learning activity that supports tool refinement and readiness for demonstration, rather than as a statistically representative evaluation of final product performance.

The CHRONICLE Living Lab plan, available in the first version of the D6.1, the communication and dissemination plan, outlined the user testing strategy. The strategy was built on principles of human centric design and agile development, with an aim to ensure early and continuous involvement of potential and intended end-users into the development of the tools. With the intended end users, it is referred to both professionals working in the building sector, and residents, depending on the type of the tool.

In practice, two separate working streams, or methodological approaches, were introduced, a joint approach for the four “professional tools”, ChroViewFM, ChroViewPlus, ChroViewRen, and ChroViewDBL, and a separate working stream for the “resident tool”, the ChroViewOcc.

This methodology chapter describes the user-facing testing approach and data collection; detailed results from requirements elicitation and internal technical scenario testing are reported elsewhere (D2.1 and Chapter 2 respectively), while results from the user-facing testing are presented later in this chapter.

4.1.1 Professional tools

For the professional tools, a four-phase approach was applied during the project, namely concept testing and user requirement definition at the early phase of development (reported in D2.1), small scale testing to validate the main technical scenarios internally (reported in chapter 2 of this deliverable), user training and feedback collection sessions, and a follow-up survey.

Methodologically, the requirement collection phase was expected to provide information on the user expectations, such as must have features and perceived value, as well as likely use of the tools. Each phase served a different evaluation purpose:

- Requirements / concept testing: capture user expectations, perceived value, and intended use contexts.
- Internal small-scale technical scenario testing: verify core technical scenarios (work / do not work) prior to wider user-facing testing.
- User training & testing sessions: observe how participants interact with the tool, identify usability constraints, and collect improvement needs at the current readiness level.
- Post-session survey: capture structured reflections on perceived usefulness, usability and overall satisfaction.

The main user testing events for the professional tools were the user training and testing focus groups. Online focus groups were selected, as focus groups allow more detailed interaction with the participants, allowing for follow-up and clarifying questions to be asked to better understand potential constraints or challenges the testers might be able to identify. This was deemed as an important step to inform the tool development at their current readiness level. The usefulness and usability questions in the feedback survey further inform likelihood of adoption of such tools in practice.

Each user training and testing session followed a structured format combining (i) a short introduction to the tool, (ii) guided walkthrough of key functionalities, and (iii) facilitated discussion to capture immediate reactions, clarification needs, and improvement suggestions. Data sources for the professional tools therefore consist of facilitator notes and recordings or transcripts from the sessions, complemented by responses to the post-session survey.

While the requirement collection phase targeted professionals working in the building sector in general, candidates from the CHRONICLE pilot site partners and other partner organisations with professionals with relevant background or experience were invited to the user training and testing sessions. The pilot site organisations are mainly companies and organisations that work (also) with building management and development, or energy management related topics, and have staff with suitable end-user profiles. The participants weren't directly involved with the technical development of the specific tools tested in a session.

The Table 4 below lists the user training and testing sessions held by tool and shows the participating pilot sites or organisations.

Table 4: Types of user testing sessions for the professional tools

Tool	Session	Participating sites or organisations
ChroViewFM	3 online sessions	Denmark, Greece, Spain, Ireland
ChroViewPlus	Online workshop	Greece, Ireland, KTU
ChroViewRen	Online workshop	Spain, Switzerland, R2I
ChroViewDBL	Online workshop	Ireland, KTU

The choice to collect structured feedback from the project pilot site organisations, and other project partners with relevant experience, was made based on the still relatively low TRL levels of the tools, in which focusing on the pilot sites, and having structured feedback from them made sense. Recommended future steps include responding to the feedback collected and extending the testing to external actors.

4.1.2 Resident tools

A slightly different testing pathway was followed by the ChroViewOcc residential tool. The ChroViewOcc testing differs from the professional tools because it involved residents using a mobile app in their everyday context.

Equally, user requirements and first impressions were collected at an early phase of the project through a survey applied in four pilot sites (reported in the D2.1), followed by an onsite mock up testing session at the Spanish site, and two rounds of user testing at the Greek pilot site, in which the residents downloaded the app and gave feedback through surveys. The first survey, a small-scale testing survey, was tailored to obtain feedback on the app's functioning in different appliances and to detect potential malfunctioning, while the second round of feedback collection focused more on usability and user satisfaction.

The Table 5 below lists the user testing activities conducted with the residents.

Table 5: User testing sessions, resident app

Tool/ testing type	Type of Session	Pilot site
ChroViewOcc Mock up	Onsite	Spanish pilot site
ChroViewOcc Small-scale	Survey	Greek pilot site
ChroViewOcc Full-scale, usability	Survey	Greek pilot site

4.1.3 Data synthesis and reporting

Given modest participant numbers per activity, workshop/session insights and survey responses are reported together for each tool in the results section. Qualitative inputs from the workshops and the surveys were grouped into recurring themes. Quantitative survey items are presented descriptively where relevant and used to triangulate the qualitative themes rather than as a basis for statistical inference.

4.1.4 Data handling

For all the workshops and surveys, the following research data-handling procedures were followed:

Surveys: all surveys started with explanation of the purpose, and a question for research consent. The pilot sites followed different methodologies for data collection. On most

occasions, online surveys were conducted, in which case, the data collected was anonymous. Sometimes, separate forms sent through e-mail were used to ensure better follow-up on the responses, and in these cases, specific partners handled the information collection, and the responses were anonymized before sending to SIN for analysis.

Workshops: the workshops, both onsite and online, were either recorded or transcribed. The purpose of the workshops was explained to participants, and participants gave their consent for recording. The recordings are classified as containing personal data and are being stored by SIN with restricted access. Personal data was not shared with external parties, and the results were reported in an anonymized manner.

4.1.5 To summarise

Together, these rounds of feedback collection, for both professional and resident tools, cover a range of different aspects relevant for developing technical tools. While the number of participants on any single activity remained modest, the multiple rounds of feedback collected ensured accumulation of understanding on user preferences and satisfaction.

In this deliverable, the technical small-scale testing is reported in chapter 2, small-scale testing, while the results of the user-facing activities, both small-scale and full-scale, are reported in this chapter.

4.2 Outputs of user training and testing sessions

This section presents the outcomes of the user training and testing activities conducted across CHRONICLE tools. It synthesises qualitative and quantitative insights gathered during hands-on testing sessions and post-session user satisfaction surveys. The section focuses on user feedback, tool usability, perceived value, and lessons learned, organised primarily by tool, and concludes with reflections on the testing process itself. It is worth noting that user training and testing session results are not linked back to the initial specifications of tools and so some recommendations were outside of the tool scope. However for ongoing and/or independent development of tools the feedback is relevant.

4.2.1 ChroViewFM

ChroViewFM is a web-based application that supports exploring an IFC building model alongside building performance data. The interface provides a central 3D model view and a model tree for navigating building elements, while dedicated tabs allow users to switch between BIM data, IoT sensor data and KPIs. Depending on data availability, the tool provides information on energy consumption and indoor environmental conditions, CO_2 emissions, and cost. It is intended for building sector professionals, such as facility managers, ESCOs, and architects.

The main user testing events for ChroViewFM were conducted as online user training and testing focus groups at the beginning of July 2025, and another in September 2025. Both sessions were planned to last 90 minutes, were facilitated by Smart Innovation Norway, and the first session was supported by technical developer of the tool, QUE, who provided

a thorough demonstration of the platform for the users. SIN replicated the walk-through in the second session.

The methodology was selected to enable interactive walkthroughs and facilitated discussion, including follow-up questions to clarify constraints and improvement needs at the current tool readiness level. Each session followed a structured format combining (i) a short introduction, (ii) a guided walkthrough of key functionalities, and (iii) facilitated user exercises and discussion. Qualitative inputs were supported by a post-session feedback survey to capture structured reflections on perceived usefulness, usability and overall satisfaction.

Testing exercises were structured around three task scenarios reflecting the core tool areas of 3D model view / BIM, IoT data tab, and KPI tab, enabling participants to explore navigation, interpretability and decision-support potential across the tool's main functionalities.

For ChroViewFM, evidence for this section is drawn from the two online user training and testing sessions, documented through session summaries and supported by meeting transcripts/recordings, a post-session survey (n=6), and an additional written feedback input received from a single participant and treated as one qualitative contribution for reporting purposes. In total, feedback was received from 9 participants.

Participants were recruited via CHRONICLE pilot site organisations and project partners with relevant end-user profiles, rather than tool developers, consistent with the overall professional tools testing approach. Based on the feedback survey, the participants represent different areas in the building sector including facility/housing management, building ownership, MEP engineering and energy service sector. Experience levels were mixed: ranging from 0–2 years of experience, to 10+ years of experience in their related field in a balanced manner. Given the modest sample, these background characteristics are used only descriptively to contextualise the feedback received.

4.2.1.1 Key strengths identified

Across both online sessions, participants reported that the platform was easy to access and navigate, including for users with less technical experience. Survey results aligned with these observations: all respondents rated the platform as "easy" or "very easy" to navigate and reported learning the main features "quickly" or "very quickly".

A practical limitation to note is that admin login credentials were used during the sessions, which may not reveal potential access issues that could emerge in real settings with role-based accounts.

3D model (BIM) tab: The 3D model view was generally perceived as clear in terms of navigation and feature layout, and users were able to select building elements and explore available properties with relative ease. Survey responses also indicate that most users felt the 3D model reflects the building layout and key details well, and that interacting with the 3D visualisation (e.g., rotating, zooming, panning, visibility) was easy or very easy.

IoT data tab: A recurring positive aspect was the ability to view IoT-derived data in different combinations through a relatively intuitive interface, and to use graphs for rapid interpretation of performance conditions. The graph views were explicitly described as clear with well-differentiated colours, and update speed was considered acceptable. The

usefulness of the data was recognised, for example, to detect potential underheating or overheating. Participants also linked the tool's value to maintenance-related use, including the ability to identify problems in the short term and to reduce the need for site visits.

KPI/ reporting tab: The KPI tab was generally perceived as useful for bringing together multiple indicators for overview. In the first session, users highlighted the ability to combine KPIs on the same page (displayed together for comparison), and no navigation issues were raised specific to the KPI tab during that session. In the second session, participants noted that the KPI view could support quick "snapshot reports" tailored to different audiences (e.g., owners vs technicians). Complementing this, one survey respondent explicitly stated that they liked the KPI module and found it useful, while also pointing to future enhancement needs.

4.2.1.2 Main usability challenges identified

Suggestions were made to better tailor the tool to the needs of different professional profiles.

3D viewer: Users noted that when selecting multiple elements, the properties panel did not consistently display clear descriptions, and in some cases the properties box did not respond when clicking between elements. In one workshop, the interface became temporarily unresponsive after repeated multi-element selections, which participants associated with connection conditions or overall system performance. Search functionality was also flagged, as one user reported the search function led to an "unresponsive" message.

In the second session, participants additionally noted that material specifications were not shown in the properties list, limiting the usefulness of the 3D view for some tasks.

IoT tab: While the IoT list was considered easy to browse, the titles/names of sensors were repeatedly described as unclear, which undermined confident interpretation. Improving sensor naming and applying clearer naming conventions for building elements would enhance usability.

A specific usability issue was identified in the second session: toggling a data series via the legend caused the series to disappear entirely and required rebuilding the graph to restore it. In addition, some users reported occasional slowness in loading energy consumption data, and difficulties in understanding what data was available for specific time ranges. This suggests a need for clearer "data availability" cues when selecting time windows.

KPI and reporting tab: A key limitation seemed to be that KPIs were currently predefined and primarily available at whole-building level. Participants expressed interest in custom KPI definition and KPI breakdowns at apartment/zone level. In addition, while pre-decided KPI levels were "fine," the KPI display was not always clear in terms of what drives the proportions shown. Participants noted that threshold and non-exceedance information would benefit from clearer explanation for non-engineering users. Consistently, feedback called for stronger linkage between KPIs and IoT graphs, for example, showing acceptable KPI levels directly on the IoT graph or providing a clear on-screen cue for under/over-performance.

UI related comments: Some comments highlighted that the text size in the navigation tree was too small even on large screens. Participants also suggested analysis-oriented improvements in the 3D view, such as semi-transparency in addition to hide/show, and stronger grouping of elements in the model tree to support inspection, such as separating exterior and interior walls.

4.2.1.3 Perceived usefulness and relevance

Overall, participants considered ChroViewFM relevant for operational work. In the post-session survey, most respondents rated the tool's main features as "relevant" or "highly relevant" and expected it to support more informed operational decisions to a good or very high extent. Usefulness was most often linked to maintenance-oriented work, including preventive maintenance and short-term problem identification that could help avoid site visits when sufficient information can be assessed remotely.

Usefulness appeared to vary by user profile and the extent to which organisations already use comparable digital tools. Participants noted that some information is of primary relevance for certain roles while secondary for others. For facility managers, the strongest value proposition related to operational oversight and rapid problem identification, with survey responses indicating mixed-but-leaning-positive expectations for daily work support. For building management and owners, participants highlighted the reporting angle, including the possibility of using the KPI view to compile snapshot reports for different audiences, for example, owners or technicians, and they requested more zoned/apartment-level comparisons.

The readiness to recommend the tool to others (NPS) was -33.3. Given the small sample, this result is indicative only; however, the distribution suggests that most users saw potential in the tool, while recommendation willingness was affected by the current limitations, especially around integration between the different tabs, and clarity of performance cues. Feedback also suggests that organisations with established 3D viewers and separate monitoring systems have less incentive to switch at this stage, whereas organisations without an equivalent integrated setup may find the current feature set closer to what they need when progressing their digitalisation efforts. As the tool is still at a relatively early maturity level, the NPS may change in future iterations if the reported improvement needs are addressed.

4.2.1.4 High-level recommendations / Implications for tool refinement

Based on the feedback collected across the two training/testing sessions, the post-session survey and the written input, the following high-level improvements are recommended to increase day-to-day usability and strengthen the tool's value for different professional user profiles:

- Strengthen integration between the 3D/BIM view and IoT/KPI information through clearer relationships between spaces/elements, sensors, and indicators.
- Improve sensor and element naming conventions through having clearer titles/labels and consistent metadata to support confident interpretation.
- Fix graph interaction issues and improve data handling clarity, including legend toggling behaviour and clearer indication of available date ranges/data coverage.

- Expand zoning and comparison capabilities to zone/apartment-level filtering and comparisons, especially for multi-unit buildings.
- Enhance KPI and reporting support through clearer KPI meaning/threshold communication, stronger linkage between KPIs and IoT graphs, configurable KPIs where feasible.
- Improve UI readability and analysis-oriented controls, including text scaling in the model tree, and options such as semi-transparency and clearer grouping in the model tree for inspection.

4.2.2 ChroViewRen

ChroViewRen is a web-based professional renovation planning and decision-support tool that integrates the Renovation Planner and the Investment Appraiser into a single interface. It is designed to support building owners, engineers, facility managers, and public housing organisations in developing long-term renovation roadmaps, assessing energy, cost, and carbon impacts, and generating Building Renovation Passports (BRPs). This section reports the key results of the user testing activities conducted during the final phase of the CHRONICLE project, combining findings from a structured user training and testing workshop with qualitative observations and a post-session user feedback survey.

4.2.2.1 Context of testing

ChroViewRen was evaluated within the CHRONICLE project through a structured user training and testing workshop held at the end of October 2025 through Microsoft Teams. The 120-minute session was facilitated by Smart Innovation Norway, and supported by technical developers of the professional tool, PRAGMA and CIRCE, who provided a thorough demonstration of the platform for the users.

The tested version of ChroViewRen included all intended features and specifications, and was connected to a common demonstration building based on Aspra Spitia pilot data. The objective of the session was to assess the tool's usability, clarity, functional completeness, and perceived value and usefulness through a combination of guided explanation and hands-on use.

The testing session combined:

- a guided walkthrough of ChroViewRen's main functionalities,
- scenario-based hands-on tasks covering all major workflow steps (including baseline building overview, selection and application of renovation measures, generation and filtering of renovation plans, and finalisation and export of the Building Renovation Passport), and
- an open discussion followed by a structured post-session user feedback survey.

Although the tool was technically stable, it was acknowledged that the version tested represented an advanced but still evolving stage of development, with certain interaction and usability aspects subject to further refinement.

The post-session survey was completed by seven respondents representing a diverse professional background, including architecture, engineering, energy services,

construction management, facility and housing management, and public building ownership. Experience levels ranged from early-career professionals to participants with over ten years of experience, more specifically, having 3 respondents with less than five years, and 4 with over five years of experience. Although the sample size was limited, it is considered appropriate for formative usability testing and for identifying key strengths, limitations, improvement priorities, and acceptance rather than for statistical generalisation.

4.2.2.2 User testing and feedback

Overall, ChroViewRen was received positively and more confidently than other monitoring tools, with survey results indicating generally high ratings for ease of navigation, clarity of main functions, and overall satisfaction. Most respondents rated the platform as easy or very easy to navigate and use, and all participants were able to complete the core tasks, including applying renovation measures, generating renovation plans, and downloading the Building Renovation Passport.

The qualitative feedback during the workshop complements these results for the most part, showing that users clearly understood the conceptual flow of the tool and recognised its relevance for real renovation projects. At the same time, the testing highlighted several concrete usability and interaction limitations that affect efficiency, transparency, and user confidence, particularly in more complex steps of the workflow.

Main strengths and validated components

Participants recognised ChroViewRen as a professionally relevant and well-structured tool for renovation planning. The overall layout and logical progression from building overview to renovation scenarios, plan comparison, and BRP generation were seen as easy to navigate, and realistically reflecting typical decision-making processes in building renovation projects.

The integration of a 3D building model was highlighted as a major strength, providing valuable spatial context and supporting users in understanding which building elements are affected by specific renovation measures. Users appreciated the ability to visually inspect elements while selecting measures, especially in combination with the structured renovation measure catalogue, and at the same time contributed with suggestions for improvement to eliminate lagging and improve the visual presentation.

The renovation plan generation and KPI-based filtering were generally perceived as intuitive and effective. Survey responses show that most users found it easy to compare renovation scenarios based on performance indicators such as cost, return on investment, and energy performance. The ability to generate and export a Building Renovation Passport was successful for all participants and was considered a particularly valuable output, especially for communication with decision-makers, tenants, or funding bodies.

Additionally, the administrative functionality allowing professionals to edit material data, update prices, and add new products was positively received, especially by public housing and facility management representatives, who emphasised the importance of keeping cost and product data locally relevant and up to date.

Main usability limitations identified

Despite the generally positive feedback, the testing session and survey revealed a cautious attitude or neutrality in terms of data visualisation aspects or the overall relevancy of the platform, as well as several recurring usability challenges. Although these issues did not prevent users from completing tasks on the platform, they did contribute to reduced clarity and efficiency, particularly for first-time users.

A key limitation concerns control limitations during the selection of renovation measures. Users noted the absence of a clear summary view showing all selected measures before generating renovation plans, making it difficult to recall or verify previous choices. Related to this, participants highlighted the lack of an option to deselect or remove individual measures and the loss of previously selected measures when navigating back to earlier steps, which was perceived as confusing and potentially frustrating. These insights are also reflected in survey results, where users showed a tendency towards neutral, or in some cases negative views in terms of the clarity of the forecasted renovation impact.

The interaction between the 3D model and the selection interface also raised questions. While the model was valued for visualisation, users were sometimes unclear about the functional role of selecting elements in the model or from lists. Several participants suggested refinements such as improved zooming and clearer visual feedback to better support detailed inspection of internal elements.

The finalisation step prior to BRP generation was identified as a less intuitive part of the workflow. Users reported uncertainty about what information was required, which fields were optional, and the purpose of certain inputs (such as maintenance dates), indicating a need for clearer guidance, tooltips, or explanatory info boxes.

Minor issues were also noted in relation to responsiveness (e.g. 3D model reload times), layout on smaller screens, and PDF formatting in the BRP output, although these were generally understood as technical refinements rather than conceptual flaws.

Perceived usefulness and relevance

The testing and survey results indicate that ChroViewRen has reached a solid level of functional maturity and usefulness in a professional environment, with only one participant expressing a neutral view. The tool's main features, with its main strengths lying in its integrated workflow, visualisation capabilities, and decision-support outputs, were rated as relevant or highly relevant by most users, while some remained neutral.

Qualitative discussion highlighted particular relevance for engineers, architects, and public housing organisations managing complex renovation decisions across multiple buildings. At the same time, participants noted structural constraints for wider uptake, such as the limited availability of BIM models for existing building repository, which may restrict immediate applicability for some organisations.

Despite the positive reception from the testing session, the Net Promoter Score (NPS) of zero reflects a profile of "passive" users rather than promoters, suggesting that while users see clear value and relevance, further refinement is needed before they would actively recommend the tool to others.

4.2.2.3 Implications for tool refinement

Key implications for further refinement include:

- improving transparency and control over selected renovation measures, including the ability to review, modify, and retain selections across steps,
- clarifying the functional role of the 3D model and enhancing its interaction features,
- strengthening user guidance in complex steps, particularly during finalisation and BRP generation, and
- refining layout, responsiveness, and document formatting to support smoother professional use.

4.2.3 ChroViewDBL

DBL is a cloud-based software for archiving and organising documents and information relevant to building management, with traceability of documents through blockchain-based technology. DBL acts as a destination for information that enables stakeholders to access, share and interpret building records over time, and to verify the integrity of archived files. In the CHRONICLE system, it serves as a repository for information generated by the other tools and components.

User training and testing for ChroViewDBL was conducted as an online training and user testing workshop followed by a survey on user satisfaction in December 2025, involving a small group (n=3) of professional users connected to CHRONICLE implementation activities. Participants reported 10+ years of relevant experience in the building sector, and they interact frequently with building documentation and data (daily/weekly), supporting their ability to assess relevance to professional workflows.

The 60-minute long session was facilitated by SIN, with the support of the tool developer R2I. The session followed the standard professional-tool testing approach for CHRONICLE tools described in this deliverable, including a short introduction, guided walkthrough of key functionalities, hands-on exploration through task scenarios, and facilitated discussion to capture immediate reactions and improvement suggestions. In addition, a follow-up survey on user satisfaction was circulated and filled in by the participants after the session.

The material utilised to inform this section includes facilitator notes and transcript of the user testing session, and the results of the survey.

4.2.3.1 **User feedback**

Key strengths

Although the session did not explicitly focus on identifying “best parts of the tool”, several positive aspects emerged during testing the task scenarios and were further supported by the post-session survey. Participants were able to access the platform with ease, and the core repository and timeline concept were generally perceived as useful for storing and tracing building documentation. Similarly, interaction features, such as tagging, commenting, sharing and liking functions were generally understood and seen as potentially useful.

Main usability challenges

While in general, the participants were able to conduct the task scenarios during the session, some usability challenges were encountered.

Document upload: some friction was encountered when uploading documents, but uploads were eventually completed during the session.

File handling: some documents, such as PDFs, could be previewed in the application, while other file types, such as IFC, required download. Clearer indication whether a preview option is available or not for a specific file type would be useful, and IFC preview function would be even more desirable.

Record classification: the current classification was perceived rather limited for professional building management by some respondents, as it is largely based on the file types commonly provided by the CHRONICLE tools. Use of a recognised classification system was suggested to better support the needs of a wide range of actors in the building sector.

User interface: the interface was described as visually dull and colour coding was suggested to distinguish functions more clearly.

Perceived usefulness and relevance

Overall, mixed feedback was received. On one hand, comments indicated that the tool "does what it is supposed to do", while others questioned differentiation from solutions already available in the market. Better or more direct connectivity with other tools and workflows in building and renovation management was suggested as a way to bring added value.

The readiness to recommend the tool to others (NPS) was 0, indicating a very neutral perception of the tool. Given the very low number of respondents, the score should be considered only indicative, but it can serve as a useful baseline to see how the score evolves after future iterations.

High level recommendations

Based on the feedback, key recommendations for further refinement include:

- Ensure upload stability
- Add file-type indicators and expand preview support, especially for IFC
- Expand record classification, for example, align with an existing standard
- Improve UI clarity/visual structure via colour coding
- Provide brief contextual guidance in the interface explaining the purpose of the main components and how they should be used, to reduce ambiguity during first-time use
- Strengthen integrations/connectivity with external tools to enhance added value

4.2.4 ChroViewPlus

ChroViewPlus is a web-based professional tool designed to support building owners, facility managers, ESCOs, and other building sector professionals in monitoring building energy performance and indoor environmental conditions. The tool integrates data from

building management systems and IoT sensors to provide visual insights and actionable recommendations for optimising building operation and occupant comfort. This section reports the key results of the user testing activities conducted during the final phase of the project, including a structured training and user-testing workshop with professional users, complemented by qualitative feedback collected during scenario-based testing and post-session surveys.

4.2.4.1 Context of testing

ChroViewPlus was tested through a structured user training and testing workshop organised within the CHRONICLE project. The 90-minute session was conducted online in December 2025 and involved participants from the Greek pilot site (METLEN/Protergia) as well as Kaunas University of Technology (KTU), with facilitation by Smart Innovation Norway and tool demonstration support from the IES development team.

The tested version of ChroViewPlus was a late-stage prototype, with live and semi-static data connected from the Greek pilot site, Aspra Spitia, and with some known limitations still under refinement. The primary objective was identifying usability, clarity, and interpretation challenges, as well as perceived usefulness and value of the professional building monitoring tool. The testing was designed to support learning and improvement, rather than summative evaluation, and to inform future refinement of the tool potentially beyond the project lifetime.

The testing session combined:

- a guided tool walkthrough,
- scenario-based hands-on tasks (data exploration, indoor environmental quality review, and actionable intelligence), and
- open discussion, followed by a post-session satisfaction and feedback survey.

The results presented below consolidate observations from the live testing session and qualitative feedback collected during discussion, complemented by survey-based impressions where relevant.

The post-session survey was completed by four respondents representing a range of professional backgrounds, including the energy service sector, data and analytics, and academia or research, with three participants having two years or less of experience and one having over ten years. While the sample size across testing activities was limited, it provided targeted, qualitative insights which are considered sufficient for formative user testing and identifying key usability and user acceptance insights rather than statistically representative conclusions.

4.2.4.2 User testing and feedback

The outputs of the user testing session and satisfaction survey overall indicate a cautious but engaged reception from users where the response and rating across usability, clarity and satisfaction cluster predominantly around neutral values, reflecting that the tool is considered relevant in concept, but needs further refinement in specific aspects. Particularly, this was reflected in the survey results, where all respondents rated the usefulness of the data for understanding building performance and supporting decision-making at a moderate level (3 on a 5-point scale).

Main strengths and validated components

Overall, participants recognised ChroViewPlus as a conceptually relevant professional tool

with promising features for building performance monitoring. The overall structure and appearance of the interface were considered appropriate and aligned with user expectations for building management and ESCO-oriented tools. The integrated data visualisation was seen as a strong asset, enabling users to access energy performance, occupancy, and indoor environmental data within a single interface. In particular, the Actionable Intelligence component providing recommendations was viewed as highly valuable, especially in cases where issues such as temperature or CO_2 exceedances were clearly identified, concrete actions were suggested, and potential savings were indicated. Users also appreciated the graphical presentation of exceedance events over time, as it supported the interpretation of recurring issues and trends. Overall, the combination of monitoring data with decision-support recommendations was regarded as a strength and a differentiating feature of ChroViewPlus.

Main usability limitations identified

Despite positive overall impressions, the testing revealed several recurring usability challenges and needs, however, both the qualitative feedback and the survey results indicate that this is partially on the account that participants interacted with ChroViewPlus for the first time, within a limited timeframe, and with a version that exposed areas still under active development.

From a usability perspective, survey responses show that most users rated ease of navigation and use as neutral rather than easy and reported occasional difficulty accessing the data they expected to see.

During the testing session, concrete examples for challenges that hindered clarity of the platform included unclear terminology, inconsistent use of units and metrics, and several labels and categories not being aligned with professional expectations. These issues were reflected in both workshop discussion and survey responses, where understanding the meaning and usefulness of the presented data was rated as difficult or neutral by all respondents, signalling a clear need for improved interpretability.

Feedback also highlighted that recommendations, while promising, require clearer definitions of thresholds, better differentiation between warnings and faults, and additional contextual information to support confident decision-making.

Overall, the findings suggest that the tool’s current limitations lie less in functionality and more in communication, standardisation, and user guidance.

Perceived usefulness and relevance

Generally, both survey results and workshop discussion suggest that ChroViewPlus is perceived relevant for professional workflows, particularly for facility managers or ESCOs responsible for overseeing multiple apartments or zones within a building. However, the majority of feedback implies neutral or moderate views, with one respondent indicating a higher level of usefulness.

Relevance of the limitations of the testing version to the NPS: The resulting Net Promoter Score was negative, meaning that the testers would be hesitant to recommend the current version to others at this moment. Overall, the score reflects this early-stage positioning and should be interpreted as an indicator of readiness for refinement, rather than rejection

of the tool's underlying approach. The small number of respondents mean that the result is indicative, and should be reassessed during future iterations.

4.2.4.3 Implications for tool refinement

The combined findings from the testing session and survey highlight a set of clear priorities for further refinement of ChroViewPlus, focused primarily on improving clarity, interpretability, and decision support rather than core functionality. Key implications include the need to standardise terminology, units, and KPI definitions; to refine navigation and information architecture, particularly for indoor environmental quality data; and to strengthen the Actionable Intelligence component through clearer definitions and indicators.

4.2.5 Residential tool – ChroViewOcc

ChroViewOcc is a mobile app directed to residents and is designed to visualise data collected through IoT sensors including, but not limited to, electricity consumption and comfort related data in a simple manner. This section reports the results of the user testing activities conducted during the last year of the project, including: an onsite mock-up testing session at the Spanish pilot site, and two rounds of user testing from which feedback was collected through surveys at the Greek pilot site.

4.2.5.1 Site selection

Spanish site was selected for mock-up testing due to interesting user profile, ie. residents in a social housing setting, that is slightly different from a standard expected user group. While some other pilot sites, such as the Danish site, could have fulfilled the selection criteria, timing suited the Spanish site.

The Greek site was selected as the main testing site due to availability of data that allowed the end users to interact meaningfully with the app in their daily lives during the project lifetime. Due to the stakeholders' interest and the availability of relevant data, the Greek pilot site emerged as the most suitable candidate for testing the app. The Swiss site was excluded because residents had lower technology awareness.

4.2.5.2 Early-stage feedback to support app design

A mock-up testing was conducted with the residents at the Spanish pilot site, Ecce Homo building, in March 2025. Around 13 inhabitants took part in the session.

The aim of the session was twofold, first to receive feedback on the different features and layout of the app itself, and second to understand better the technology and energy awareness levels of the potential end users.

Overall, the participants demonstrated interest in the app, and found many of its functionalities, especially the energy monitoring, useful and interesting. Indoor environmental quality indicators, in the case of the mockup temperature, humidity, and CO_2 levels, were rated useful, yet the significance of the humidity and CO_2 levels had to be discussed with the participants to clarify the purpose of them.

The Smart Readiness Indicator, and the Energy Performance Rating were both rated more difficult to understand, though after clarification of the concept, the latter raised more interest in the participants.

Users would benefit from:

- Explanations of the features, including definition or meaning.
- Reference values, what is “good” or “bad”, both for energy consumption and comfort data

In addition to the mockup testing, the technology and energy awareness of the participants were discussed to understand potential use of the app. The workshop discussions and earlier concept testing survey both support the understanding that mobile phones are widely used and a mobile app is the most suited format for providing information on real-time energy consumption. Some residents are already using apps from their utility providers to monitor energy consumption.

The energy awareness levels of the participants were estimated relatively good, with many workshop participants already taking active steps to conserve energy, leading to active sharing of tips for energy savings at home. This is consistent with the results of the concept testing survey, in which the respondents at the Spanish site showed, on average, higher energy awareness levels compared to the average of all pilot sites, including perceived knowledge on relative energy consumption of home appliances and ways to save energy at home. Energy prices and bill savings were frequently mentioned as key drivers for action; other motivations were not explored in depth during the session. Again, the concept testing survey demonstrates that participants at the Spanish site are also socially motivated, and having onsite sessions and exchange of information between the pilot participants is encouraged over more individual approaches.

4.2.5.3 User testing and feedback

Greek site was selected as the main testing site for ChroViewOcc. This pilot site has been part of EU R&I projects before, and some of the pilot site households are seasoned Living Lab members by this date. Indeed, our concept testing survey earlier in the project supported this view, as Greek respondents demonstrated strong interest in improving environmental performance of their homes, high openness towards new technologies and relatively high level of use of technology to follow energy consumption. At the same time, notable attitudes for preferring comfort over energy consumption were reported. These baseline attitudes are consistent with the subsequent user testing feedback, where the app was seen as easy to access and useful for improving understanding on household energy consumption, while respondents also pointed out a trade-off between the simplicity of the app and a desire for additional features.

Two testing rounds were conducted to collect feedback from residents in the Greek pilot site. The small-scale testing conducted in July-August 2025, and the full-scale testing was conducted in December 2025. Both involved the residents downloading the app and giving feedback after familiarising with the functions. The first round focused on ensuring the correct function of the app and detecting potential bugs or issues, while the second round focused on usability, usefulness and user satisfaction.

6 people participated to the small-scale testing, and 10 to the full-scale testing. These are well aligned with industry standards for formative and iterative testing where small numbers of participants and several participation rounds are used to signal usability and user acceptance related issues, instead of aiming for statistical representativeness.

Contextual factors: For half of the respondents this was a first time using an energy monitoring app, and half reported having used similar apps before. 70 % reported having started using the app within the last week or two, and while 40 % stated they have used the app few times per week, the rest reported having used it less frequently. While there is a slight inconsistency given that some participants had tested the app already some months ago, which is not properly reflected in the results, as a rule of thumb, the results should be interpreted as early impressions rather than perceptions on more long-term usage.

Access and ease of use: Most respondents in both rounds confirmed that setting up and accessing the tool felt simple, and the information was easy to access. No errors, crashes or missing information were reported in either feedback rounds.

78 % were satisfied with the visual presentation, with key suggestions for improvement being the colour choice and text size. Equally, 70 % were satisfied with the app in general.

The simplicity of the tool divided the respondents; part of them felt it as a strength as the information was felt simple and easy to understand, while others felt it too simple or limited, and expressed expecting more features to be added in the future. Unfortunately, only few respondents specified these desired features. Separately, suggestions for improvements involved dark mode, time comparisons, and better instructions on what the specific measures mean. In addition, a possibility of downloading the data was suggested.

While the testing process revealed only first impressions, some indication on the potential impact was gathered. Indeed, the tool was felt useful in understanding household energy consumption (90%), and potentially to guide energy conservation measures (60 %), demonstrating a moderate potential for reduced household energy consumption.

Measured by the Net Promoter Score, the app reached an NPS score of 20, which in general is a reasonable score especially for an early-stage app. What is considered a good score varies by context and sector, though.

4.3 Cross tool insights and lessons learnt from the user training and testing process

Going beyond the feedback for each individual tool, this section focuses on horizontal insights and lessons learned that emerged during the testing phase across all the tools in CHRONICLE solution.

4.3.1 Cross tool insights

While several tools showed an initial learning curve, users consistently acknowledged their potential long-term value, particularly where the information presented by the tools supported decision-making, reporting, or actionable insights. However, a recurring factor shaping first impressions was whether users could quickly make sense of the results and visualisations, as well as the extent to which required input data was available and its scope and basis were clearly defined in each context. These patterns indicate a solution-level need for stronger onboarding and built-in interpretation support to enhance usability and coherence.

A common finding is that usability issues were more often related to *clarity and interpretation* than to missing functionality. While users generally recognised the technical relevance of the tools, they frequently reported uncertainty or difficulty around:

- terminology and labels,
- the meaning of KPIs and indicators,
- thresholds and reference values, to help understanding “what is good vs. bad”,
- what the displayed results are based on, including data source, time period, and aggregation.

These limitations were particularly visible during first-time use and reduced user confidence, even when navigation itself was not perceived as difficult.

Across tools, several users commonly expected clearer in-tool guidance, such as information boxes, guiding elements showing the flow of functionality or generally more contextual explanations. Relatedly, users also showed a level of sensitivity to complexity in the platforms. Testers frequently expressed a preference for a step-by-step interaction with progressively revealed details rather than dense, overwhelming information being presented upfront.

The testing also highlighted clear differences between technical and non-technical user profiles. More technical participants tended to focus more on data depth, configurability, and comparisons, while less technical users relied heavily on intuitive cues and explanations to interpret results, and their confidence was more dependent on clear explanations of concepts.

4.3.2 Lessons learned from the user training and testing process

This section summarises key insights and lessons learned from the stakeholder engagement activities that supported solution development, as well as from the feedback gathered during the user training and testing sessions.

4.3.2.1 Timing and iteration of testing

Overall, engagement in tool development is most valuable when it is planned as a series of feedback cycles rather than as a late-stage, one-off activity. In practice, this means involving representative end-users already during early prototypes, repeating lightweight validation at key development milestones, and reserving sufficient time between rounds to implement changes and verify whether they address the issues identified. Such iterative engagement supports usability improvements and trust-building, as users can see how their feedback is reflected in subsequent versions and progressively develop familiarity with the tools. While multiple rounds of feedback collection were conducted throughout the project lifecycle, conducting focused user testing on key themes at an even earlier stage could have created more time to integrate feedback into tool development.

The results also confirm the importance of early training and testing. Earlier exposure would have helped users better understand concepts and workflows, supporting a gradual build-up of understanding over time and reducing cognitive load during later, more advanced testing sessions.

In addition, sessions were most effective when preparation began early. This allowed sufficient time to align objectives, validation needs, and the overall testing scope between tool developers and facilitators. It also ensured that facilitators were well prepared with a tailored methodology, necessary testing materials, and timely distribution of invitations, licenses, and credentials to participants.

4.3.2.2 Structure of the testing sessions

Regarding the chosen testing approach, scenario-based task framing helped users understand intended workflows and enabled more focused and comparable feedback than fully open exploration, particularly for first-time users. This approach helped guide attention towards relevant functionalities and tool logic in a way that supported the validation needs of tool developers, especially for more complex or multi-step platforms.

It is also useful to reflect on passive interaction with the platforms, which in the CHRONICLE activities was supported through demonstrations by tool developers. While detailed walkthroughs were valuable in clarifying purpose and functionality, balancing explanation time with hands-on interaction emerged as a key lesson. In most cases, the most actionable feedback was generated during active use rather than passive demonstration. At the same time, participants responded positively to structured tool introductions, indicating that an effective format typically combines concise explanations with guided practice.

Given the limited time availability of professional users, testing formats and tool onboarding benefit from prioritising short, high-value tasks and quick interpretation support rather than expecting extended exploration. Where feasible, it is also beneficial to test under conditions that resemble real use, including typical access roles, devices, and setup steps, as these factors can influence first-time experience.

4.3.2.3 Differences observed across pilot contexts

Within the timeline of the CHRONICLE user training and testing sessions, contextual differences across pilot sites remained an ongoing challenge for both tool developers and facilitators. One key success factor was the availability of pilot-site data. Testing is generally more intuitive when participants can explore tools using their own building context and data. In several sessions, users could not yet interact with complete datasets from their own sites. While it is not proposed to postpone user feedback collection until all data becomes available, future activities could, where feasible, include an additional feedback round once full datasets are in place.

Beyond data availability, pilot contexts also differed in digital maturity, prior exposure to similar tools, and user expectations. These factors influenced perceived usefulness and should therefore be considered when interpreting results and planning future roll-out or replication. More broadly, the level of building stock digitalisation and interoperability also affects readiness for adoption. In some pilot contexts, initially digital building models such as BIM were not available, but they were completed during the course of the project for project specific requirements. Where models existed, interoperability limitations could constrain integration with parts of the CHRONICLE solution. These local conditions are therefore relevant when assessing real-life adoption potential.

Overall, these observations underline that local starting conditions vary, and that both the testing approach and future roll-out should remain flexible to accommodate these differences.

5 Conclusions and next steps

Deliverable D5.2 reports on the pre-validation, demonstration, and pilot roll-out activities implemented between Months 31 and 42, in line with the objectives and scope defined for Work Package 5 in the Description of Action (DoA). As foreseen, the deliverable documents (i) the recruitment and active participation of end users, (ii) the small-scale verification of all CHRONICLE components, and (iii) the pilot roll-out and full-scale demonstration of the CHRONICLE solution across multiple real-life contexts.

Building upon the results presented in Deliverable D5.1, D5.2 confirms the successful scaling-up of validation activities from early demonstrations to extended, multi-site deployments involving both professional and non-professional users. The integration and functional verification of all tools within the Common Data Environment validates the technical maturity, interoperability, and stability of the CHRONICLE ecosystem, as required by Tasks T5.3 to T5.5. The execution of coordinated demonstrations in five pilot sites (Spain, Greece, Ireland, Switzerland, and Denmark) demonstrates the adaptability of the solution to different regulatory, climatic, and organisational contexts, directly supporting the DoA objective of replicability across Europe.

User training, co-creation sessions, and continuous feedback mechanisms ensured effective engagement and contributed to iterative refinement of system functionalities, in line with the DoA emphasis on user-centred validation. Operational monitoring and data logging were systematically implemented, enabling the generation of high-quality datasets for subsequent technical and impact analysis.

The outcomes of D5.2 provide a solid and traceable foundation for the holistic validation and impact assessment activities foreseen under Task T5.6. The Common Validation Methodology applied across WP5 ensures continuity between component-level verification and system-wide assessment, as explicitly required in the DoA. The datasets collected during small-scale and full-scale demonstrations support the derivation of technical, usability, social, and preliminary economic KPIs based on real operational evidence.

By standardising validation procedures, documentation templates, and data structures, the project ensures that results generated in WP5 can be directly exploited within T5.6 without methodological discontinuities. This structured transition enables a comprehensive assessment of the CHRONICLE solution’s effectiveness, user acceptance, and added value, fully aligned with the DoA objective of demonstrating measurable impact under realistic conditions.

The pilot roll-out activities highlight several recommendations relevant for future demonstrations and large-scale replication, in line with the DoA exploitation and scalability objectives. Early involvement and sustained engagement of end users proved essential to ensure adoption, meaningful feedback, and validation of usability across different stakeholder groups. Future deployments should therefore allocate sufficient time and resources for onboarding, training, and iterative user interaction.

From a technical perspective, the use of a unified validation framework and a centralised data environment is confirmed as a key enabler for consistency, comparability, and scalability across pilots. Extending monitoring periods in future demonstrations would further strengthen impact assessment by capturing long-term performance and behavioural effects.

Finally, the structured collection of lessons learned, and cross-pilot coordination mechanisms developed in WP5 constitute a transferable reference framework that can directly support replication, market uptake, and exploitation activities under WP6, as envisaged in the DoA.

6 Appendices

6.1 ANNEX I: Integration test cases

6.1.1 CDE

Authentication & Authorisation to access data available in CDE

Test name	Authorisation & Authentication between the CDE and other CHRONICLE components
Test ID	CDE_OAUTH
Components	CDE – IoT Platforms CDE – Renovation Planner CDE – Data driven Digital Twin CDE – Physics based Digital Twin CDE – Performance Evaluator CDE – ChroViewOcc CDE – Oracle
Objective	CHRONICLE components and IoT platforms request and are granted permission to access the CDE
Prerequisites	Credentials for each CHRONICLE component and IoT platform have been provided
Test data	Username: xxx Password: xxx
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 • Operating System: Linux • Java Version: 21 LTS • Python Version: 3.12 *Component Versions and IoT Platforms in detail in D5.2
Test Methodology	The Component enters with their credentials. A request for access is send to the CDE to which responds with an OK (200) status and provides an access token to the authorized component.
Pass criteria	Access Token generated
Results	* To be provided per component in D5.2.

Projects List Retrieval

Test name	Get the available project list
Test ID	CDE_01
Components	CDE – Renovation Planner CDE – IoT Platforms CDE – Data driven Digital Twin CDE – Physics based Digital Twin CDE – Performance Evaluator CDE – ChroViewOcc CDE – Oracle
Objective	CHRONICLE components and IoT platforms request and receive the available project list from the CDE.
Prerequisites	Test ID CDE_OAUTH must be successful For each project (pilot), a valid, baseline openBIM model in IFC4 STEP format, that has passed the data completeness, correctness and consistency checks, must be available in the CDE. Projects that have not passed the checks will not be included in the response.
Test data	HYP's testbed .ifc file
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 *Component Versions and IoT Platforms in detail in D5.2
Test Methodology	The component or platform with the generated authorization token requests the list of available projects from the CDE, to which it responds with an OK (200) status and a list of projects the authorized component has access to.
Pass criteria	Successfully retrieve the projects list the authorized component has access to.
Results	* To be provided per component in D5.2.

Baseline OpenBIM Data Retrieval

Test name	Retrieve the (baseline) .ifc from the CDE
Test ID	CDE_02
Components	CDE – Renovation Planner CDE – IoT Platforms CDE – Data driven Digital Twin CDE – Physics based Digital Twin CDE – Performance Evaluator CDE – Oracle
Objective	CHRONICLE components request and receive the baseline BIM model in IFC4 STEP format for a specific project from the CDE.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful For a specific project (pilot), a valid, baseline openBIM model in IFC4 STEP format, that has passed the data completeness, correctness and consistency checks, must be available in the CDE.
Test data	HYP's testbed .ifc file
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 *Component Versions and IoT Platforms in detail in D5.2
Test Methodology	The component requests the baseline openBIM model in IFC4 STEP format for a specific project. If the component is authorized to access such data for the specific project, the CDE responds with an OK (200) status and the file's location (URL) for download.
Pass criteria	The baseline openBIM model in IFC4 STEP format for a specific project is successfully downloaded using the file's location (URL) provided by CDE.
Results	* To be provided per component in D5.2.

IoT Devices – Connecting IoT Platform entities to BIM sensing and metering elements

Test name	IoT platform configuration to the CDE
Test ID	IoT_01
Components	CDE – IoT Platforms
Objective	Upload the BIM model (.ifc baseline) of the Pilot demo site to the CDE, to configure the IoT devices.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_02 must be successful The CDE data model population with static data (including geometric representations of IoT devices and their containment in spaces) must be successful
Test data	HYP's testbed .ifc file and IoT platform
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0: 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Hyp's IoT platform: 1. Operating System: Linux 2. Java Version: 17 LTS * IoT Platforms in more detail in D5.2
Test Methodology	1) The IoT platform requests the baseline static data in json format for a specific project. If the platform is authorized to access such data for the specific project, the CDE responds with an OK (200) status and the static data json. 2) The IoT platform admin assigns each IoT device from the platform to a unique IoT element listed in the provided json.
Pass criteria	Pilot demo site's devices assigned with unique UUIs in the CDE.
Results	* To be provided per IoT platform in D5.2.

IoT Data Retrieval

Test name	IoT data retrieval from the CDE
Test ID	CDE_03
Components	CDE – Renovation Planner CDE – IoT Platforms CDE – Data driven Digital Twin CDE – Physics based Digital Twin CDE – Performance Evaluator CDE – ChroViewOcc
Objective	A CHRONICLE component requests and receives timestamped data of an IoT device for a specific time period.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test IoT_01 must be successful IoT data available for the specific time period
Test data	HYP's testbed - .ifc file and IoT data
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Hyp's IoT platform: 1. Operating System: Linux 2. Java Version: 17 LTS *Component version and IoT Platform's in more detail in D5.2
Test Methodology	A component or a platform, requests timestamped data of an IoT device over a specified time period from the CDE. The CDE response with an OK (200) request and the timestamped IoT data (timeseries) in json file format.
Pass criteria	IoT Data for a predefined period successfully retrieved from the CDE
Results	To be provided per component in D5.2.

6.1.2 Data-driven DT

Human-centric KPIs storage in CDE

Test name	Human-centric KPIs storage in CDE
Test ID	DDDT_01
Components	CDE – Data driven DT
Objective	The Data driven DT must send batches of calculated human-centric KPIs to be stored in the CDE.
Prerequisites	Test ID_OAUTH must be successful Test ID_01 must be successful Test ID_03 must be successful IoT data availability BIM availability
Test data	A batch of dummy Human-centric KPIs calculated on data from Hypertech's testbed. *The Human-centric KPIs are separated in three groups: Comfort, Indoor Air Quality, Well-being/Social
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Data Driven Digital Twin V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12
Test Methodology	The Data-driven DT posts the batch of Human-centric KPIs to the CDE in json format. The CDE successfully receives the KPIs by responding with an OK (200).
Pass criteria	The group of KPIs in json format succesfully stored in the CDE
Results	To be provided in D5.2

Thermal comfort profile storage in CDE

Test name	Thermal comfort profile storage in CDE
Test ID	DDDT_03
Components	CDE – Data driven DT
Objective	The Data driven DT must send the calculated thermal comfort profiles per building to be stored in the CDE.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_03 must be successful Test ID IoT_01 must be successful Occupancy profiles must be successfully calculated
Test data	A dummy thermal comfort profile calculated based on occupancy for a specified time period in HYP's testbed.
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Data Driven Digital Twin V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12
Test Methodology	The Data-driven DT posts the thermal comfort profiles of a building to the CDE in json format. The CDE successfully receives them by responding with an OK (200).
Pass criteria	Thermal comfort profiles in json format succesfully stored in the CDE.
Results	To be provided in D5.2

Load profile storage in CDE

Test name	Load profile storage in CDE
Test ID	DDDT_04
Components	CDE – Data driven DT
Objective	The Data driven DT must send the calculated load profiles per building to be stored in the CDE.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_03 must be successful Point UUID (unique per device in the CDE) must be known
Test data	A dummy load profile calculated based on electric load (HVAC/DHW) power consumption extracted from Hypertech's testbed.
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Data Driven Digital Twin V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12
Test Methodology	The Data-driven DT posts the load profiles of the submetering devices on a building to the CDE in json format. The CDE successfully receives them by responding with an OK (200).
Pass criteria	Load profiles in json format successfully stored in the CDE.
Results	To be provided in D5.2

6.1.3 Renovation Planner

Selected Renovation Scenario **OpenBIM Data** Storage

Test name	POST the selected renovation scenario .ifc
Test ID	RP_01
Components	Renovation Planner - CDE
Objective	The Renovation Planner sends the openBIM model in IFC4 STEP format for the selected renovation scenario to CDE.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_02 must be successful The end-user has selected their preferred renovation scenario. The selected renovation scenario .ifc file is available in the Renovation Planner.
Test data	The selected renovation scenario .ifc file from HYP's Testbed
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Renovation Planner V1.0 1. Operating System: Linux 2. Angular Version: 15.2 3. Python Version: 3.11 4. Node.js Version: 18.10 5. MongoDB: 8.0
Test Methodology	The Renovation Planner sends the.ifc openBIM model in IFC4 STEP format for the selected renovation scenario to the CDE. The CDE successfully receives it by responding with an OK (200).
Pass criteria	The selected renovation scenario openBIM model in IFC4 STEP format for a specific project is successfully stored in the CDE.
Results	To be provided in D5.2

Selected Renovation Scenario Timestamped BRP storage

Test name	Building Renovation Passport (BRP) of the renovation scenario storage to the CDE
Test ID	RP_02
Components	Renovation Planner - CDE
Objective	The Renovation Planner sends the BRP for the selected renovation scenario in json format to be stored in the CDE.
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_02 must be successful A BRP in json format has been generated in the Renovation Planner.
Test data	A timestamped BRP in json format for HYP's testbed
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Renovation Planner V1.0 1. Operating System: Linux 2. Angular Version: 15.2 3. Python Version: 3.11 4. Node.js Version: 18.10 5. MongoDB: 8.0
Test Methodology	The Renovation Planner sends the timestamped BRP for the selected renovation scenario in json format to the CDE. The CDE successfully receives it by responding with an OK (200).
Pass criteria	The timestamped BRP for the renovation scenario in json format successfully stored in the CDE.
Results	To be provided in D5.2

Renovation scenario's KPIs storage in the CDE

Test name	Renovation scenario's KPIs storage in the CDE
Test ID	RP_03
Components	Renovation Planner - CDE
Objective	A batch of KPIs for the selected renovation scenario send and stored in the CDE
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_02 must be successful Test ID RP_01 must be successful (The selected renovation scenario KPIs were successfully generated by the Investment Appraiser and the DT framework and received by the Renovation Planner.)
Test data	A batch of KPIs calculated for the selected renovation scenario based on data from Hypertech's testbed, in json format. **The KPIs are:* WLC, Cost, Comfort/Energy
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Renovation Planner V1.0 1. Operating System: Linux 2. Angular Version: 15.2 3. Python Version: 3.11 4. Node.js Version: 18.10 5. MongoDB: 8.0
Test Methodology	The Renovation Planner sends the KPIs for the selected renovation scenario in json format to the CDE. The CDE successfully receives it by responding with an OK (200).
Pass criteria	The group of KPIs in json format succesfully stored in the CDE
Results	To be provided in D5.2

Post renovation analysis storage

Test name	POST the renovation analysis
Test ID	RP_04
Components	Renovation Planner - CDE
Objective	The post renovation analysis for the selected renovation scenario in json format to be stored in the CDE
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID CDE_02 must be successful Test ID RP_02 must be successful (The simulated/calculated post-renovation KPIs are available to the Renovation Planner via the DT framework and the Investment Appraiser.) The real post-renovation KPIs are calculated and compared against the abovementioned KPIs.)
Test data	The Post-renovation analysis calculated based on HYP's Testbed
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Renovation Planner V1.0 1. Operating System: Linux 2. Angular Version: 15.2 3. Python Version: 3.11 4. Node.js Version: 18.10 5. MongoDB: 8.0
Test Methodology	The Renovation Planner sends the post renovation analysis in json format to the CDE. The CDE successfully receives it by responding with an OK (200).
Pass criteria	The post renovation analysis in json format successfully stored in the CDE.
Results	To be provided in D5.2

6.1.4 Digital Building Logbook

For the integration between the DBL and the CDE, including the Test IDs previously described - CDE_OAUTH, CDE_01, CDE_02 – as well as for the remaining DBL integration tests as presented below, the Oracle component will act as an intermediary between the CDE and the DBL.

Post renovation analysis retrieval from CDE

Test name	Get the Post renovation analysis file from the CDE
Test ID	DBL_01
Components	CDE – (Oracle) - DBL
Objective	The DBL must request and receive the post renovation analysis for the selected renovation scenario in json format from the CDE (through the oracle component)
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID RP_04 must be successful
Test data	The post-renovation analysis calculated based on HYP's Testbed
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Oracle V1.0 1. Operating System: Linux 2. Java Version: 21 LTS DBL MVP Version 2 1. Operating System: Linux 2. Python Version: 3.10
Test Methodology	The DBL requests the post renovation analysis for the selected renovation scenario for a specific project.If the component is authorized to access such data for the specific project, the CDE responds with an OK (200) status and the file's location (URL) for download.
Pass criteria	The EPC for a specific project is successfully downloaded using the file's location (URL) provided by CDE.
Results	To be provided in D5.2

Selected Renovation Scenario **OpenBIM** retrieval from the CDE

Test name	Get the (renovation scenario) .ifc file from the CDE
Test ID	DBL_02
Components	CDE – (Oracle) - DBL
Objective	The DBL component requests and receives the renovation scenario BIM model in IFC4 STEP format for a specific project from the CDE. (through the oracle component)
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID RP_01 must be successful
Test data	Selected renovation .ifc file from HYP's Testbed
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Oracle V1.0 1. Operating System: Linux 2. Java Version: 21 LTS DBL MVP Version 2 1. Operating System: Linux 2. Python Version: 3.10
Test Methodology	The DBL requests the renovation scenario openBIM model in IFC4 STEP format for a specific project. If the component is authorized to access such data for the specific project, the CDE responds with an OK (200) status and the file's location (URL) for download.
Pass criteria	The renovation scenario openBIM model in IFC4 STEP format for a specific project is successfully downloaded using the file's location (URL) provided by CDE.
Results	To be provided in D5.2

Selected Renovation Scenario Timestamped BRP retrieval from the CDE

Test name	Get the BRP file from the CDE
Test ID	DBL_03
Components	CDE – (Oracle) - DBL
Objective	The DBL must request and receives the BRP for the selected renovation scenario in json format from the CDE. (through the oracle component)
Prerequisites	Test ID CDE_OAUTH must be successful Test ID CDE_01 must be successful Test ID RP_02 must be successful
Test data	A timestamped BRP in json format for HYP's testbed
Test Setup	Integration testing can be validated in Postman by testing API calls exposed by the CDE (see D3.1). CDE V1.0 1. Operating System: Linux 2. Java Version: 21 LTS 3. Python Version: 3.12 Oracle V1.0 1. Operating System: Linux 2. Java Version: 21 LTS DBL MVP Version 2 1. Operating System: Linux 2. Python Version: 3.10
Test Methodology	The DBL requests the timestamped BRP for the selected renovation scenario in json format. If the component is authorized to access such data for the specific project, the CDE responds with an OK (200) status and the file's location (URL) for download.
Pass criteria	The timestamped BRP for the renovation scenario in json format is successfully downloaded using the file's location (URL) provided by CDE.
Results	To be provided in D5.2

6.1.5 Renovation Planner

Forward the Baseline and Renovation scenario data to the Investment Appraiser

Test name	Send the baseline and renovation scenario data to the Investment Appraiser.
Test ID	IA_00
Components	Renovation Planner – Investment Appraiser
Objective	The Renovation Planner must send successfully the baseline .ifc file, the generated renovation scenarios along with their energy indicators to the Investment Appraiser.
Prerequisites	Any conditions necessary to conduct the test Test ID CDE_02 must be successful Renovation scenarios are generated and available within the Renovation Planner. The energy indicators for the generated renovation scenarios and for the baseline are available to the Renovation Planner.
Test data	Data type and format necessary for the test completion - actual values are not necessary at this point, dummy data can be used. HYP's testbed .ifc file Renovation scenarios for the HYP's testbed (Changesets) in json format Energy indicators for the HYP's testbed and the renovation scenarios in json format
Test Setup	POST endpoint provided by the Investment Appraiser's API The endpoint is not finalized yet, but it should look like this: https://chronicle-ia.com/api/results Renovation Planner V1.0 1. Operating System: Linux 2. Angular Version: 15.2 3. Python Version: 3.11 4. Node.js Version: 18.10 5. MongoDB Version: 8.0 Investment Appraiser V1.0

	1. Operating System: Windows 11 2. Python Version: 3.18 3. MongoDB Version: 8.0
Test Methodology	1. The Renovation Planner sends the the .ifc openBIM model in IFC4 STEP format for the baseline scenario, the generated renovation scenarios .in json format and the energy indicators for the generated renovation scenarios and the baseline to the Investment Appraiser via an API. 2. The Investment Appraiser has successfully retrieved the files and begins calculating/simulating WLC and Cost KPIs.
Pass criteria	The .ifc openBIM model in IFC4 STEP format for the baseline scenario, the generated renovation scenarios in json format and the energy indicators for the baseline and the generated scenarios files are available to the Investment Appraiser.
Results	* To be provided per component in D4.4 & D5.2.

Receive the WLC/Cost KPIs, the Carbon Bill and the Carbon Benchmark Balance Assessment from the Investment Appraiser

Test name	Receive the calculated/simulated data from the Investment Appraiser.
Test ID	IA_01
Components	Investment Appraiser – Renovation Planner
Objective	The Renovation Planner must successfully receive the calculated/simulated WLC/Cost KPIs, the Carbon Bill and the Carbon Benchmark Balance Assessment
Prerequisites	Test ID IA_00 must be successful
Test data	Calculated WLC/Cost KPIs based on HYP's Testbed in json format.
Test Setup	POST endpoint provided by the Investment Appraiser's API Renovation Planner V1.0 1. Operating System: Linux 2. Angular Version: 15.2 3. Python Version: 3.11 4. Node.js Version: 18.10 5. MongoDB: 8.0 Investment Appraiser V1.0 1. Operating System: Windows 11 2. Python Version: 3.18 3. MongoDB Version: 8.0
Test Methodology	Upon calculating the WLC/Cost KPIs, the Carbon Bill and the Carbon Benchmark Balance Assessment, the Investment Appraiser responds to the Renovation Planer with these calculations in a json format.
Pass criteria	The calculated/simulated WLC/Cost KPIs, the Carbon Bill and the Carbon Benchmark Balance Assessment are available to the Renovation Planner.
Results	* To be provided per component in D4.4 & D5.2.

6.2 Annex II – Validation Scenarios and Test Reporting Forms

6.2.1 ChroViewRen

Scenario 1: Renovation Measures Creation.

- **Objective:** Ensure that the Renovation Planner can generate a renovation plan by allowing users to select different building elements and apply desired renovation measures.
- **Steps:**
  - Load an existing building model into the Renovation Planner.
  - Select specific building elements for renovation, including:
    - Adding insulation to the floor.
    - Adding insulation to the walls.
    - Adding a frame to windows and changing the glass.
    - Replacing the available radiators.
  - Confirm that the system allows selection of multiple renovation measures.
  - Verify that the renovation scenario updates dynamically based on user selections.
  - Check that estimated energy performance improvements, cost calculations, and comfort impact are displayed
- **Expected Outcome:**
  - The Renovation Planner successfully generates a renovation plan incorporating selected measures.
  - Users can modify building elements and apply multiple renovation strategies.
  - The system provides accurate estimations of energy savings, costs, and indoor comfort improvements.

Scenario 2: Renovation Scenario Selection & Building Renovation Passport (BRP) Generation

- **Objective:** Ensure that users can review, adjust, and select a renovation scenario based on predefined KPIs and generate a Building Renovation Passport (BRP) with all necessary details.
- **Steps:**
  - Display all generated renovation scenarios and verify that each KPI has an upper and lower bound that can be adjusted.
  - Verify that adjusting KPIs updates the renovation scenarios list, exluding scenarios that out of bounds
  - Select a renovation scenario from the available options and verify that the scenario details include All renovation measures applied in the selected scenario and proposed dates for each measure.
  - Display key performance indicators (KPIs) for each scenario and verify that each KPI has an upper and lower bound, allowing for adjustments.
  - Modify the maintenance timeline by adjusting the proposed dates and ensure the system allows manual updates to scheduling.

  - Verify that users can add extra details to the BRP (including Required permits and approvals, Assigned contractor Available public/private renovation grants.)
  - Confirm that the Building Renovation Passport (BRP) is generated with all details and ensure that the BRP can be downloaded as a PDF for documentation.
- **Expected Outcome:**
  - Renovation scenarios can be compared by adjusting KPI constraints.
  - The selected scenario displays all renovation measures with editable maintenance dates.
  - The BRP is correctly generated and exported as a PDF, containing all necessary details.

Scenario 3: Renovation Measure & Product Management (Admin View)

- **Objective:** Ensure that administrators can manage renovation measures by selecting measure types, choosing specific renovation products, and modifying product details.
- **Steps:**
  - Access the Admin View of the Renovation Planner.
  - Select a renovation measure type (e.g., installation or replacement of a boiler, adding or increasing insulation on walls, floors, or roofs).
  - Verify that selecting a measure type displays a list of available renovation measures.
  - Choose a specific renovation measure and verify that a list of available products (including names and manufacturers) is displayed.
  - Select a product and confirm that it contains multiple tabs with detailed information about the product, and that it can be edited.
  - Add a new product to the product list and verify that the fields can be completed/ are editable.
  - Modify an existing product's details and confirm that changes are saved correctly.
  - Delete a product and ensure that it is removed from the available product list.
- **Expected Outcome:**
  - Administrators can select and manage renovation measures effectively.
  - Renovation measure displays a **list of corresponding products** with detailed information.
  - The system allows adding, modifying, and deleting products in the renovation planner.

Scenario 4: Tenants' informative report review (Tenants' screen)

- **Objective:** Ensure the tenant can review all the information regarding their building's renovation process.
- Steps:
  - The tenant gains access to the Tenants' screen by inputting their credentials in the Log-In screen.

- The tenant may select the Baseline KPIs tab to access the relevant information.
- The tenant may select the Post-Renovation KPIs tab to access the relevant information.
- The tenant may select the Building Renovation Passport tab to access the relevant information.

Expected Outcome:

The tenant can review the information included in all three tabs and stay informed regarding the planned renovation scheduled for their building along with the gains, in terms of KPIs, that the renovation will bring to them.

Scenario Reports of ChroViewRen

Scenario 1: Renovation Measures Creation.

- **Objective:** Ensure that the Renovation Planner can generate a renovation plan by allowing users to select different building elements and apply desired renovation measures.
- **Tester: HYPERTECH**
- **Date: 25/06/2025**
- **Environment:** (macOS Sequoia V15.4.1, Safari)

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Load existing building overview	Inspect and click on the existing renovation project “Aspra Spitia”.	The selected project’s building overview data are loaded and presented successfully.	√	Clicked on “Aspra Spitia” Apartments Renovation	
Select and load specific building element groups and elements	Click on the building element groups and then, on the loaded building elements of the selected group	Selected building element groups and elements are loaded successfully and are visible in the model viewer.	√	In “Renovation Scenarios” Tab, clicked on 1. Basic Roof: Roof01_30cm:63449 2. Floor01_31,3 cm:613869	

				3. Wall: Basic Wall:Wall02 20 cm List 4. Window-Sliding-Double:Window 240x140 List 5. Radiators Kaldo:350 List	
Select (multiple) renovation measures/products for the building elements	Select a renovation measure to be applied to the building element and then select: 1. Insulation product(s) to be applied on floor(s) 2. Insulation product(s) to be applied on wall(s) 3. Frame product(s) to be installed on windows and glass product(s) to be added. 4. Radiator product(s) to replace the	The renovation measures and materials/products selected were successfully added.	√	1. Floors a) Extruded Polysterene (XPS) Insulation, XPS insulation boards b) Mineral Wool Insulation, Stone wool (mineral wool) insulation without facing c) Rigid Foam HFC Insulation, non-gas-permeable coating (PUR or PIR), swissporPIR Alu 2. Walls a) Mineral Wool Insulation, Stone wool (mineral wool) insulation without facing b) Rigid Foam HFC Insulation (PUR or PIR), PUR insulation board, unfaced 3. WIndows PVC (two cavities) Frame, PVC frame window, 76 mm, 1.23x1.48 m, MD Xtrem 4. Space Heaters	

	existing the already existing ones.			a) Electric radiant infrared panel, Radiant heating and cooling ceiling panel, ItuAlu b) Electric convector radiator, Electric radiator M145112	
Finalize renovation measures selection	Click on the “Generate Renovation Plan” button and inspect the generated estimations (in terms of KPIs) of energy savings, costs and indoor comfort improvements per renovation plan.	The user is transferred to the Renovation Plans screen and the KPI estimations per renovation plan are calculated and loaded successfully.	√	Clicked on the “Generate Renovation Plan”, then on “PROCEED TO NEXT SECTION” button and inspected the KPI estimations for the **four Scenarios** that have been generated	

Scenario 2: Renovation Scenario Selection & Building Renovation Passport (BRP) Generation

- **Objective:** Ensure that users can review, adjust, and select a renovation scenario based on predefined KPIs and generate a Building Renovation Passport (BRP) with all necessary details.
- **Tester: HYPERTECH**
- **Date: 25/06/2025**
- Environment: (macOS Sequoia V15.4.1, Safari)

Step	Action	Result	Pass/Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Inspect generated renovation plans	Inspect the generated renovation plans along with their details by clicking on their “KPIs” and “Measures” buttons and verify that the KPIs presented in slider format have lower and upper bound and can be adjusted.	Pop-up boxes appear successfully when clicking the buttons mentioned with the expected information presented and the sliders of the KPIs are loaded successfully as described.	√	Clicked on the “KPI” and “Measures” Button for all the scenarios. All four slide bar KPIs slide properly filtering out and in different scenarios	
Filter the generated renovation plans by adjusting	Filter the renovation plans by adjusting KPIs’ sliders and verify that the renovation scenarios list updates to exclude	The renovation plans list successfully filters and updates based on the KPIs	√	slide bar KPIs filter in and out different scenarios	

the KPIs' sliders	renovation plans that are out of bounds.	slider selections the user makes.			
Finalize renovation plan selection	Click on the preferred renovation plan to select it and then click on the "Finalize" button.	The user gets successfully transferred to the Finalization and BRP screen, where the Building Renovation Passport is generated for the selected renovation plan.	√	Check "Scenario-3" to finalize	
Inspect and customize the BRP	Modify the maintenance timeline by adjusting the proposed dates and add extra details in the text boxes.	The maintenance dates are updated based on the user's input along with the additional information they have provided in the text boxes.	√	Modified the dates on these measures: "Adding or increasing insulation (Wall)", "Installation/Replacement of electric radiators" and "Installation of window frame" to Jan 1, 2030 , Jan 1, 2052 and Jan 1, 2040 respectively. Added information on the Additional information boxes "Approvals" and "Contractors"	
Finalize the generated BRP.	Click on the "Finalize and download BRP" button and download the BRP in PDF format. Inspect the downloaded BRP and verify that it contains all relevant information and details.	The BRP is successfully downloaded in the user's device, and it presents all relevant, to the selected renovation scenario, details.	√	BRP downloaded, information is EHn consistent with the above changes	

Scenario 3: Renovation Measure & Product Management (Admin View)

- **Objective:** Ensure that administrators can manage renovation measures by selecting measure types, choosing specific renovation products, and modifying products. details.
- **Tester: HYPERTECH**
- **Date: 25/06/2025**
- **Environment:** (macOS Sequoia V15.4.1, Safari)

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Log-in to the Admin View	Provide admin credentials to log-in to the Admin View.	The user is successfully logged in as an Admin and the Admin View appears.	√	Loged in with provided credentials	
Inspect the available renovation measures	Select a renovation measure and verify that all related renovation products are loaded.	The renovation materials/products related to the selected renovation measure are loaded successfully.	√	Inspect Renovation "Mineral (glass and stone) wool insulation rolls, single side black glass fiber facing" : **Renovation materials loaded:** a) Mineral (glass and stone) wool insulation rolls, single side black glass fiber facing b) stone wool (mineral wool) insulation without facing	
Inspect a renovation product	Click on the *eye* button next to a renovation product to inspect all its available details.	A pop-up box appears containing all the available information on the renovation product.	√	Inspect Renovation "Mineral (glass and stone) wool insulation rolls, single side black glass fiber facing" :	

				Basic info tab, environmental properties tab and lifecycle tab, prices tab and system properties tab were OK	
Modify a renovation product	Click on the *pencil* button next to a renovation product to modify some of its information and save the changes by clicking on the “Update” button.	A pop-up box appears with all the available information on the renovation product in editable form and after the user modifies some of them and clicks on “Update”, the changes are saved successfully.	√	In the Mineral (glass and stone) wool insulation rolls, single side black glass fiber facing product added “Test” in its description	
Add a new renovation product	Click on the “Create Product” button and fill-out the details asked of the product to be added in the database. Save the new product by clicking on the “Save” button.	A pop-up box appears asking details about the new product to be added and when the user clicks on “Save”, the new product is saved successfully, and it appears in the available products list.	√	Create a test product named test in the **Mineral Wool Insulation** renovation category.	
Delete a renovation product	Click on the *Trash Bin* button next to an already available renovation product from the list.	The deleted renovation product was deleted successfully and no longer appears in the available products list.	√	Delete the test named product successfully.	

Scenario 4: Tenants' informative report review (Tenants' screen)

- **Objective:** Ensure the tenant can review all the information regarding their building's renovation process.
- **Tester: HYPERTECH**
- **Date: 25/06/2025**
- **Environment:** (macOS Sequoia V15.4.1, Safari)

Step	Action	Result	Pass/Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Log-in to the Tenants' View	Provide tenants credentials to log-in to the Tenants' View.	The user is successfully logged in as a Tenant and the Tenant View appears.	√	Logged in with provided credentials	
Inspect the Baseline KPIs	Click on the *Baseline KPIs* tab and inspect the relevant information.	The information related to the tenant's building's Baseline KPIs are loaded successfully.	√	Baseline KPIs tab is the default tab. All KPIs have values and units	
Inspect the Post-Renovation KPIs	Click on the *Post-Renovation KPIs* tab and inspect the relevant information.	The information related to the tenant's building's Post-Renovation KPIs	√	Clicked on the post renovation tab. All KPIs have values and units	

		are loaded successfully.			
Inspect the Building Renovation Passport	Click on the *Building Renovation Passport* tab and inspect the relevant information.	The Building Renovation Passport associated to the tenant's building's is loaded successfully.	√	Clicked on the Building renovation Passport tab. All KPIs have values and units	

6.2.2 ChroViewFM

- **Scenario 1**: Model Import/ create (Project)
  - **Objective**: Ensure that BIM models are imported correctly in ChroViewFM.
  - Steps:
    - Upload IFC models (small, medium and large – for stress test).
    - Verify that all elements (walls, floors, assets) are Imported correctly.
    - Upload an IFC with known errors
    - Verify that the Validation report flags that error
  - **Expected Outcome:** Models are loaded without errors, rendering is accurate, and navigation is smooth.

- **Scenario 2**: Model Visualisation (BIM)
  - **Objective**: Validate that the model (elements) renders correctly and information (properties, attributes) can be retrieved from the model.
  - Steps:
    - Check responsiveness when rotating, zooming, and panning.
    - Click on various model elements, with the focus button toggled.
    - Verify that the correct metadata (e.g., type, material) are displayed.
    - Test searching/filtering assets by type or attribute.
    - Test the toggle visibility button.
  - **Expected Outcome**: Correct information is displayed for each asset, and different available buttons work as expected.

- **Scenario 3**: Information Retrieval/ IoT
  - Objective: Confirm ChroViewFM can display IoT data (e.g., IoT sensors, HVAC etc).
  - Steps:
    - Select a device, then a metric in ChroViewFM to display IoT data (e.g., temperature, energy consumption).
    - Validate the correctness of the data retrieval stored in the CDE (values, units).

        - Verify historical data visualization.
        - Combine different metrics to display (stress test)
    - **Expected Outcome**: External data is correctly integrated, displayed, and stored for analysis.

- **Scenario 4:** Information Retrieval/ KPIs
    - **Objective**: Confirm ChroViewFM can display KPIs (static & timeseries)
    - Steps:
        - Select a KPI category and then a KPI in ChroViewFM to display its value.
        - Validate the correctness of the values.
        - Combine different KPIs to display (stress test)
    - **Expected Outcome**: KPIs are correctly integrated, displayed, and stored.

Scenario Reports of ChroViewFM

Scenario 1: Model Import/ create (Project)

- **Objective:** Ensure that BIM models are imported correctly in ChroViewFM.
- **Tester: PRAGMA**
- **Date: 26.06.2025**
- **Environment:** (e.g. Chrome, Windows 11)

Table 6: Small Scale Scenario 1 report

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Upload small IFC model	Upload HYP's Testbed IFC file	Model loaded successfully	√	Upload "HYP Testbed_V2"	
Verify elements	Click on an external wall element	Element visible and placed correctly	√	Click on the wall 1352538	
	Click on an Internal wall element	Element visible and placed correctly	√	Click on the wall 185737	
	Click on an asset (i.e. Air condition unit)	Element visible and placed correctly	√	Click on the AC_Livingroom	
	Click on a floor element	Element visible and placed correctly	√	Click on the slab 6782536	
	Click on a window element	Element visible and placed correctly	√	Click on the window 1695870	
Upload an IFC with a mistake	Upload an IFC file with known errors	Validation report flags the issue	√	1. Upload 'HYP Testbed Mistake' 2. Download the Validation report	

Scenario 2: Model Visualization (BIM)

- **Objective:** Validate that the model (elements) renders correctly, and information (properties, attributes) can be retrieved from the model.
- **Tester: Prodromos Polychroniadis (PRAGMA)**
- **Date: 26/06/2025**
- **Environment:** Mozilla Firefox – Windows 11

Table 7: Scenario 2 Small Scale

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Rotate Model	Rotate the 3D model	Responsive & smooth rendering	√	Model rotates smoothly without any rendering issues.	
Zoom Model	Zoom the 3D model.	Responsive & smooth rendering	√	Model zooms in/out smoothly without any rendering issues.	
Pan Model	Pan the 3D model.	Responsive & smooth rendering	√	Panning the model successfully without any rendering issues.	
Focus button	Toggle on the focus button. Click on a wall.	Camera focuses on the wall element	√	1. Click on the focus button. 2. Click on the wall 611411.	
	Toggle on the focus button. Click on a window.	Camera focuses on the window element	√	1. Click on the focus button 2. Click on the window 632569.	

	Toggle on the focus button. Click on a sensor.	Camera focuses on the sensor element	√	1. Click on the focus button. 2. Click on the sensor 676034.	
Properties button	Toggle properties button, click on wall.	Wall properties are displayed correctly	√	1. Click on the properties button. 2. Click on the wall 617849	
	Toggle properties button, click on window.	Window properties are displayed correctly	√	1. Click on the properties button. 2. Click on the window 632747.	
	Toggle properties button, click on sensor.	Sensor properties are displayed correctly	√	1. Click on the properties button. 2. Click on the sensor 676034.	
Focus & properties button	Toggle focus and properties button, click on slab.	Camera focuses and properties window appears	√	1. Click on focus and properties buttons. 2. Click on slab 620388.	
Search	Use search to find IoT device and select it	Selected element is highlighted	√	1. Click on the search button. 2. Search by typing ‘IoT’. 3. Click on the result ‘OnePhase_monitoringdeviceIoT_sample:ACGRR31_TotalConsumption:678596'.	
	Use search to find wall and select it.	Selected element is highlighted	√	1. Click on the search button. 2. Search by typing ‘Wall’. 3. Click on the result ‘BasicWall:Wall02_20 cm: 561604’.	

Focus button & search	Toggle focus button, search for walls, select 'wall'.	All walls are focused and highlighted	√	1. Click on the search button. 2. Search by typing ‘Wall’. 3. Click on the result ‘Wall’.	
Reset view button	Zoom in, then toggle reset view button.	Camera resets to default position	√	1. Zoom in. 2. Click on the reset view button.	
	Zoom out, then toggle reset view button.	Camera resets to default position	√	1. Zoom out. 2. Click on the reset view button.	
Orientation box	Click a side of orientation box.	Model aligns to selected side view	√	Click on the front side of the orientation box.	
Visibility button	Toggle visibility off for whole model	All model elements are hidden	√	Click off the visibility icon next to ‘Aspra Spitia’ on the top of the model tree.	
	From model tree, toggle a single space	Only the selected space is visible	√	1. Click off the visibility icon next to ‘Aspra Spitia’ on the top of the model tree. 2. Click on the visibility icon next to Space 95.	
	From the model tree, toggle on the walls	Only the walls are visible	√	1. Click off the visibility icon next to ‘Aspra Spitia’ on the top of the model tree. 2. Click on the visibility icon next ‘Wall’.	

Scenario 3: Information Retrieval/ IoT

- **Objective:** Confirm ChroViewFM can display IoT data (e.g., IoT sensors, HVAC etc).
- **Tester: Prodromos Polychroniadis (PRAGMA)**
- **Date: 26/06/2025**
- **Environment:** Mozilla Firefox – Windows 11

Step	Action	Result	Pass/Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Display IoT Metric	Select a device and a metric in the IoT tab (e.g., temperature, energy)	Graph shown correctly (Axes, units, time intervals)	√	Click on the device's (Aeotec_ElectricalFixtures_Multisensor 6:ACGRR35_MultiSensor_Bedroom1:682659) temperature, illuminance, humidity and motion metrics.	
Hover in the graph	Hover the mouse over the graph.	Y axis value, and specific time step should be visible	√	Hover over the graph and inspect the Y axis value and specific time steps.	
Combine Metrics	Select 2 metrics from the same device to be plotted in the graph	Graph shown correctly (Axes, units, time intervals)	√	Click on the device's (Aeotec_ElectricalFixtures_Multisensor 6:ACGRR35_MultiSensor_Bedroom1:682659) temperature and illuminance metrics simultaneously.	

Combine metrics from different devices	Select 2 metrics from different devices with different units to be plotted in the graph	Graph shown correctly (Axes, units, time intervals)	√	Click on the device's (Aeotec_ElectricalFixtures_Multisensor 6:ACGRR35_MultiSensor_Bedroom1:6 82659) temperature and illuminance metrics and on the second device's (Aeotec_ElectricalFixtures_Multisensor 6:ACGRR35_MultiSensor_OtherRoom: 682574) motion and humidity metrics.	
	Select 2 metrics from different devices with same units to be plotted in the graph	Graph shown correctly (Axes, units, time intervals) and the Y axis is common for the same unit	√	Click on the device's (Aeotec_ElectricalFixtures_Multisensor 6:ACGRR35_MultiSensor_Bedroom1:6 82659) temperature and illuminance metrics and on the second device's (Aeotec_ElectricalFixtures_Multisensor 6:ACGRR35_MultiSensor_OtherRoom: 682574) illuminance and temperature metrics.	
Historical view	Select a historic period, start date and end date to retrieve data	Graph shown correctly (Axes, units, time intervals)	√	1. Click on the device's (Aeotec_ElectricalFixtures_Multisensor6:ACGRR35_MultiSensor_Bedroom1:682659) temperature metric and select 01/06/25 as a Start Date and 11/06/25 as an End Date. 2. Click on the Update Chart button.	

- **Objective:** Confirm ChroViewFM can display KPIs (static & timeseries)
- **Tester: Prodromos Polychroniadis (PRAGMA)**
- **Date: 26/06/2025**
- **Environment:** Mozilla Firefox – Windows 11

Step	Action	Result	Pass /Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Select KPI category	Select a KPI category from the KPI Tab (i.e Energy)	KPIs are displayed	√	Click on the Energy KPIs category.	
KPI description	Hover the mouse over a KPI	KPIs description is displayed	√	Hover over the Total Power/Area KPI.	
Select a KPI	Select a KPI from the list	Value and unit displayed correctly	√	Click on the Total Power/Area KPI.	
Combine 2-4 KPIs	Select two KPIs	All values and units shown correctly	√	Click on the Total Power/Area and Heating Consumption/ Area KPIs.	
	Select three KPIs	All values and units shown correctly	√	Click on the Total Power/Area, Heating Consumption/ Area and Cooling Consumption/ Area KPIs.	
	Select four KPIs	All values and units shown correctly	√	Click on the Total Power/Area, Heating Consumption/ Area, Cooling Consumption/ Area and Domestic Hot Water Consumption/Area KPIs.	
Combine timeseries KPIs	Add timeseries KPI to be displayed	Value and time graph shown correctly	√	Click on the Total Power/Area, Heating Consumption/ Area, Cooling Consumption/ Area, Domestic Hot Water Consumption/Area and Electric Energy Consumption Over Time KPIs.	

6.2.3 ChroViewOcc

Scenario 1: Data (Environmental Conditions & Electricity Consumption)

- **Objective:** Ensure that environmental conditions and electricity consumption data update correctly and display accurately.
- **Steps:**
  - Display environmental sensor data (temperature, humidity, etc)
  - Verify that the displayed values on the Home Screen are updated (when new measurements are available.)
  - Click on "Day," "Week," and "Month" buttons to switch views and
  - Display household electricity consumption for different time periods (day, week, month).
  - Verify that the graph updates correctly and the selected period is highlighted in yellow.
- **Expected Outcome:**
  - Environmental conditions always reflect the latest available measurements from the CDE.
  - Electricity consumption data is displayed accurately, and time-period selection functions correctly.

Scenario 2: Smart Readiness & Energy Performance

- **Objective:** Validate that ChroViewOcc correctly displays Smart Readiness and Energy Performance scores.
- **Steps:**
  - Verify that the Smart Readiness score is visible [according to the BIM-to-SRI methodology.]
  - Verify that the energy performance score is visible
  - Select a previous month from the Performance Rating Screen.
  - Verify that the SRI and energy performance scores update correctly to reflect past behavior.
  - Tap on the standing Energy Performance value for a specific month.
  - Confirm that the breakdown of energy consumption per load (heating, cooling, DHW) appears correctly.
- **Expected Outcome:**
  - The system correctly displays the Smart Readiness and Energy Performance scores.
  - Historical performance ratings are displayed accurately, and energy consumption details are available.

Scenario Reports of ChroViewOcc

- **Objective:** Ensure that environmental conditions and electricity consumption data update correctly and display accurately.
- **Tester: QUE Technologies, Konstantinos Mamis**
- **Date: 26.06.2025**
- **Environment:** (Android 15.0)

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Display Environmental data	Verify that environmental data (temperature, humidity, air quality) are displayed on the Home Screen.	Humidity, Air Quality and Temperature values displayed where available	Pass	Logged in with provided credentials. Default tab is showing values and units for temperature, humidity, air quality	
	Validate that the measurements are updated	Humidity, Air Quality and Temperature values updated where available	Pass	Logged out and logged in about four hours later, temperature and humidity values had changed.	
Day Consumption	In the home screen validate the daily energy consumption graph is visible	Graph shown correctly (Axes, units, time intervals)	Pass	Energy consumption is displayed, “Y” axis in kWh and ‘X’ axes in hours	
	Hover in the graph	Date and value are visible	Pass	When hovered in the graph values in kWh are displayed with timestamp	

Week Consumption	In the home screen validate the weekly energy consumption graph is visible	Graph shown correctly (Axes, units, time intervals)	Pass	Energy consumption is displayed, “Y” axis in kWh and ‘X’ axes in days	
	Hover in the graph	Date and value are visible	Pass	When hovered in the graph values in kWh are displayed with timestamp	
Month Consumption	In the home screen validate the monthly energy consumption graph is visible	Graph shown correctly (Axes, units, time intervals)	Pass	Energy consumption is displayed, “Y” axis in kWh and ‘X’ axes in days	
	Hover in the graph	Date and value are visible	Pass	When hovered in the graph values in kWh are displayed with timestamp	

- **Objective:** : Validate that ChroViewOcc correctly displays Smart Readiness and Energy Performance scores.
- **Tester: QUE Technologies, Konstantinos Mamis**
- **Date: 26.06.2025**
- **Environment:** (e.g. Chrome, Windows 11)

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
SRI score	Navigate to the Energy Performance screen	Smart Readiness score is displayed with an indicator	Pass	Moved to Energy Performance Tab, Smart readiness score is being displayed	
	Select a previous month	SRI score updates accordingly	Pass	By selecting a previous Month “December 2024” SRI score changed	
Energy performance score	Validate on current month	Energy performance score visible and correctly labelled	Pass	Energy performance score is being displayed	
	Select past month	Score updates accordingly	Pass	By selecting a previous Month “December 2024” SRI score changed	
Energy performance breakdown	Click on the energy performance score	Energy breakdown popup appears correctly with detailed data	Pass	Clicked on the Energy performance score pops up an Energy breakdown	

6.2.4 ChroViewDBL

Scenario 1: Data Storage & Integrity Verification

- **Objective:** Ensure that building data (e.g., .ifc files, property deeds) is securely stored, organized, and verified for integrity.
- **Steps:**
  - Upload different types of building-related documents (e.g., .ifc files, etc).
  - Verify that metadata (e.g., comments, author, date, type, description) can be added and edited.
  - *Check that blockchain-based integrity verification confirms authenticity and prevents tampering.*
  - Attempt to retrieve uploaded documents and confirm they remain unchanged.
- **Expected Outcome:**
  - The system securely stores documents and associated metadata.
  - Integrity verification ensures that files remain unaltered and trusted.
  - Documents are retrievable with full traceability.

Scenario 2: Timeline-Based Building History Visualization

- **Objective:** Validate that the DBL correctly organizes and displays building history through a timeline.
- **Steps:**
  - Upload multiple versions of a building's .ifc file, representing different renovation stages.
  - Navigate the timeline to view past modifications and building evolution.
  - Verify that previous versions remain accessible and unchanged.
  - Check that users can add comments, tags, and metadata to historical records.
- **Expected Outcome:**
  - The timeline correctly displays the sequence of building modifications.
  - Users can interact with and annotate past records.
  - The building's historical data remains accessible and trusted for decision-making.

Scenario 3: Fetching IFC file from the CDE

- **Objective:** Validate that the DBL correctly fetches and stores a building's IFC file from the Common Data Environment (CDE), linking it to a new record in the system.
- **Steps:**
  - Ensure that the IFC file for a specific building is already available and stored in the connected CDE.
  - Navigate to the dedicated building page within the DBL platform.

- Click on the **“Fetch IFC File”** button to initiate retrieval.
- Confirm that the IFC file is downloaded from the CDE and automatically attached to a newly created record in the DBL.
- Verify that the new record includes appropriate metadata such as filename, associated building, and upload date.

- **Expected Outcome:**
  - The DBL successfully retrieves the IFC file from the CDE.
  - A new record is created in the DBL system with the retrieved IFC file attached.
  - All associated metadata is correctly stored, and the file is traceable and accessible through the platform.

Scenario Reports of ChroViewDBL

Scenario 1: Data Storage & Integrity Verification

- **Objective:** Ensure that building data (e.g., .ifc files, property deeds) is securely stored, organized, and verified for integrity.
- **Tester: R2M**
- **Date: 26.06.2025**
- **Environment:** (e.g. Chrome, Windows 11)

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Upload Record to the DBL	Open “Add Record” page	“Upload Record” page showing	✓	Click on add record	
	Add Record essential metadata (related building)	Record associated to a building and saved in the DBL	✓	Record added	
Upload building related documents	Attach building related documents to the previously created record	Building documents correctly saved in the DBL	✓	Carbon bill excel file uploaded	
Edit/View Record metadata	Edit/View Record metadata (Issued Date, Activity, Comments etc..)	The record is enriched with metadata	✓	Expiration date for the carbon bill excel added	

Check that blockchain-based integrity verification confirms authenticity	View attached file integrity status clicking on the “Validate files in the Blockchain” button in the record page	Retrieve authenticity verification details from the blockchain.	✓	Automatic message “validate files in the blockchain” Viewed	
Retrieve building related Records	Access previously uploaded Records	View previously uploaded building Records	✓	Accessed and validated the presence of the carbon bill record	

Scenario 2: Timeline-Based Building History Visualization

- **Objective:** Validate that the DBL correctly organizes and displays building history through a timeline.
- **Tester:**
- **Date:**
- **Environment:** (e.g. Chrome, Windows 11)

Step	Action	Result	Pass/ Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Visualize Records in the Timeline	In the DBL landing page, visualize Records organized in the timeline	Records are displayed in the timeline, ordered by upload date by default	✓	Records visualized correctly as expected	
Modify the timeline sorting criteria	From the dropdown menu, select the 'Issued Date' option to sort the records by that metadata field.	Records are displayed in order of Issued Date	✓	Record modified and validated	
Access Records from the timeline	Navigate through the timeline and click on a record name to open it	Access the desired record and edit/view its details	✓	Clicked on the timeline to reach the record >> reached.	

Scenario 3: Fetch IFC file from the CDE

- **Objective:** Validate that the DBL correctly fetches and stores a building's IFC file from the Common Data Environment (CDE), linking it to a new record in the system.
- **Tester:**
- **Date:**
- **Environment:** (e.g. Chrome, Windows 11)

Step	Action	Result	Pass/Fail	Action report/ Please report the actions	In case of a failure/ bug/ incorrect value insert instructions to replicate
Access the single building details page	From the landing page, click on the building name in the portfolio section	The single building details page will be displayed	✓	Clicked from the landing page to the correspondent building	
Fetch IFC File from CDE	Click the "Fetch IFC File" button	A new record is created with the HYP test bed IFC file from the CDE attached	✓	Clicked to fetch IFC File	
Access the newly created record	Update the page and access the newly created record	Access the new record and verify that metadata are created and the IFC from the CDE is being attached to it	✓	Opened the record uploaded from the fetch feature and verified that the file is correctly attached	

6.3 ANNEX III: KPI´s and UCs

UC1.1

Validation Scenario	Use Case	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency
Thermal comfort improvement per (HVAC focused) renovated household	UC1.1	This validation scenario refers to the households (h) which underwent renovations through the Renovation Planner focusing on the HVAC systems on site.	Swiss, Danish, Greek	(Thermal) Comfort related	Thermal degree percentage hours reduction	$TDP_{h,n}\ reduction = \frac{TDP_{Baseline,h,n} - TDP_{Renovated,h,n}}{TDP_{Baseline,h,n}} \times 100\%$	Monthly (n)
					Relative humidity percentage reduction	$RH_{h,n}\ reduction = \frac{RH_{Baseline,h,n} - RH_{Renovated,h,n}}{RH_{Baseline,h,n}} \times 100\%$	Monthly (n)
				Energy related	Total energy consumption reduction	Energy consumption reduction = E100% × n,enilesaB,noc E n,detavoner,noc E − n,enilesaB,noc	Monthly (n)
				Sustainability	Carbon emission reduction	$\text{Carbon reduction} = \sum \text{Energy consumption reduction}_n \times CO2\ conversion\ Factor_{country}$	Monthly or annually?
				Financial	Energy Efficiency Cost Savings when accounting Carbon Footprint	Cost per ton avoided= CO2 Emissions Reduction (tons) Total Investment in Reduction Measures	
				Acceptance/Engagement	A composite index on perceived usefulness	The following statements incorporated in user-testing survey help to validate the renovation planner: "The renovation planner helps me to identify the most suitable renovation option for me" "The renovation planner provided insights I would not have considered before" "The renovation scenarios I received based on my preferences are valid" "I am likely to use the renovation planner for future renovation planning" Calculation: a weighted index	Once with the same audience, but for several pilot sites or separate LL user testing sessions
				Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, usually measured through surveys	Once, at the end of the project
					Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project
					On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project

UC2.1

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Dynamically updated energy performance reports based on total energy consumption	This validation scenario refers to the usage of the ChroViewOcc from households where no individual loads are monitored within CHRONICLE. In such cases, the operational performance of the household is rated based only on its total electricity consumption.	Spanish, Irish	Energy related	Total energy consumption reduction	$\text{Energy consumption reduction}_n = \frac{E_{con,Baseline,n} - E_{con,measured,n}}{E_{con,Baseline,n}} \times 100\%$	Monthly (n)	If there are no season-depended loads included in the energy measuments on site (e.g. electric heating, cooling, DHW), no weather correction is necessary.
			Sustainability	Carbon emission reduction	$\text{Carbon reduction}_n = (E_{con,Baseline} - E_{con,measured})_n \times CO2\ Conversion\ Factor_{country}$	Monthly (n) or annually	To be adjusted if this indicator is calculated on an annual basis. Sum of all months
			Financial /Business	Cost savings due to energy reduction per household	$\text{Cost savings due to energy reduction}_n = (E_{con,Baseline} - E_{con,measured})_n \times \text{Cost per kWh}$	Monthly (n) or annually	To be adjusted if this indicator is calculated on an annual basis. Sum of all months
				Payback period per building (?)	Payback period per buidling = Initial investment / Annual energy savings per building	Once	
				Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
			Acceptance/Engagement	Perceived usefulness	The following statements to be incorporated in user-testing survey: "The app helps me to understand the energy consumption of my home" "The insights provided by the application help me take actions to improve energy efficiency or comfort of my home" "I have taken action to reduce energy consumption of my home based of the information provided y the app"	Once	Question inserted to the user-testing questionnaire, or alternatively a question in user testing focus groups
						Once	Question inserted to the user-testing questionnaire, or alternatively a question in user testing focus groups
			Energy related	Total energy consumption reduction	$\text{Energy consumption reduction}_n = \frac{\sum[(E_{con,Baseline,load,i} - E_{con,measured,load,i}) \times primary\ energy\ factor_i]}{\sum(E_{con,Baseline,load,i} \times primary\ energy\ factor_i)} \times 100\%$	Monthly (n)	Here we should consider that other major loads measured migh be seasonal - e.g. Heating, Cooling
Dynamically updated energy performance reports based on major loads submetering	This validation scenario refers to the usage of the ChroViewOcc from households where major, loads are monitored within CHRONICLE, i.e. Heating energy, Cooling energy, DHW energy. In such cases, the operational performance of the household is rated based on its total electricity consumption accounting also for the contribution of other measured loads.	Greek, Danish	Sustainability	Carbon emission reduction	$\text{Carbon reduction}_n = \sum[(E_{con,Baseline,load,i} - E_{con,measured,load,i}) \times CO2\ conversion\ Factor_{i,country}]$	Monthly (n) or annually	To be adjusted if this indicator is calculated on an annual basis. Sum of all months
			Financial /Business	Cost savings due to energy reduction per household	$\text{Cost savings due to energy reduction}_n = \sum[(E_{con,Baseline,load,i} - E_{con,measured,load,i}) \times Cost\ per\ kWh_i]$	Monthly (n) or annually	To be adjusted if this indicator is calculated on an annual basis. Sum of all months
				Payback period per building	Payback period per buidling = Initial investment / Annual energy savings per building	Once	
				Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
			Acceptance/Engagement	Frequency of use		Once	
				Energy savings action implemented		Once	

UC2.2

Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
The goal of this validation scenario is to verify whether the functionalities described in the ChroViewPlus application meet the requirements for ESCOs, building owners, and investors SCENARIO1: To ensure that the ChroViewPlus accurately tracks and displays both energy performance and indoor air quality in a commercial building. The goal is to verify that the system provides up-to-date data for decision-making purposes	Swiss (AEM), Spanish (Zaragoza) and Greek (depending on scale)	Energy related	Total energy consumption (and breakdown per source) [kWh] Energy Usage Intensity	*Total Energy Consumption=Σ(Energy Consumption per Source)* *Total Energy Consumption (kWh) / Building Area (m^2) / year*	15min	
		Sustainability	Operational CO2 emissions, temperature and humidity		15min	
		Financial	Opertional cost		15min	
		Acceptance/Engagement	Perceived usefulness	The following statements incorporated in user-testing survey help to validate the scenario: "I trust the accuracy and reliability of the data provided by ChroViewPlus" "The data and insight provided by the ChroViewPlus tool are easy to understand and interpret" "The insight provided help me to take timely and effective actions to optimize the building (energy) performance"	Once, during piloting	
		Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
			Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project	
			On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	
The goal of this validation scenario is to verify whether the functionalities described in the ChroViewPlus application meet the requirements for ESCOs, building owners, and investors SCENARIO2: To ensure that the ChroViewPlus application accurately analyses the building performance data and provides actionable recommendations to reduce energy consumption, costs, and carbon emissions	Swiss (AEM), Spanish (Zaragoza) and Greek (depending on scale)	Energy related	Energy savings	*(BaselineEnergyConsumption- Post implementationEnergyConsumption) [kWh / year]*	Daily / weekly	
		Sustainability	Carbon Emissions Reduction	*(BaselineCO2 Emissions - Post implementationCO2) [tCO_2 / year]*	Daily / weekly	
		Financial	Cost-saving recommendations	€/year	Daily / weekly	
		Acceptance/Engagement	Usability of the tool	The following statements incorporated in user-testing survey help to validate the scenario: "The recommendations the ChroViewPlus tool provides are realistic for the type of building in question" "I have taken action on the recommendations provided" "The actions I have taken based on the tools recommendations have had a positive impact on the building performance"	Once, during piloting	
		Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
			Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project	
			On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	

UC 3.1a

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Improvement of the renovated building's energy-efficiency and carbon-neutrality based on total energy consumption	This validation scenario refers to the households which underwent renovations through the Renovation Planner and where no individual loads are monitored.	Swiss, Spanish	Energy related	Total energy consumption reduction	□Energy consumption reduction□□ =□n□E100% × □□n,enilesaB,noc□E□□□n,detavonер,noc□E□ −□n,enilesaB,noc□E	Monthly (n)	
			Sustainability	Carbon emission reduction	$\text{Carbon reduction} = \sum (E_{con,Baseline} - E_{con,renovated})_n \times CO2\ Conversion\ Factor_{country}$	Monthly or annually?	
			Financial	Energy Efficiency Cost Savings when accounting Carbon Footprint	Cost Savings=Baseline Carbon Cost−Post-Renovation Carbon Cost		
			Acceptance/Engagement	Paired with UC1.1			
			Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
				Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project	
				On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	
Improvement of the renovated building's energy-efficiency and carbon-neutrality based on major loads submetering	This validation scenario refers to the households which underwent renovations through the Renovation Planner and where major, season-related loads are monitored.	Greek	Energy related	Total energy consumption reduction	$\text{Energy consumption reduction}_n = \frac{\sum[(E_{con,Baseline,load,n} - E_{con,renovated,load,n}) \times primary\ energy\ factor_i]}{\sum(E_{con,Baseline,load,n} \times primary\ energy\ factor_i)} \times 100\%$	Monthly (n)	
				Energy consumption reduction per load	$\text{Energy consumption reduction}_{load\ type,n} = \frac{E_{con,Baseline,load,n} - E_{con,renovated,load,n}}{E_{con,Baseline,load,n}} \times 100\%$	Monthly (n)	
			Sustainability	Carbon emission reduction	$\text{Carbon reduction} = \sum \text{Energy consumption reduction}_n \times CO2\ conversion\ Factor_{country}$	Monthly or annually?	
			Financial	Energy Efficiency Cost Savings when accounting Carbon Footprint			
			Acceptance/Engagement	Paired with UC1.1			
			Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
				Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project	
				On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	

UC3.1 b

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Post Renovation Performance Analysis		Irish, Danish	Energy related				
			Sustainability				
			Financial				
			Acceptance/Engagement	Composite index, perceived usefulness	The following statements in end-user testing questionnaries provide information for this scenario: "I find the post renovation analysis useful" "I am likely to use a post renovation analysis in future renovation planning and impelementation"	Once in the project life-time. Information collected from the pilot sites and possibly from separate LL sessions	
			Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
				Customer Satisfaction Score	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project	
				On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	
				EPC (energy performance certificate) rating	EPC (energy performance certificate) rating: The increase of EPC rating after renovation actions	Yearly	

UC3.2

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Carbon Bill CO2 Calculation Evaluation	**Assessment of WLC and Carbon Bill for baseline & renovation scenarios** These indicators allows to measure how accurate the tool is in calculating the carbon footprint of a building compared to measured data or industry standards. This is essential to validate whether the calculation is reliable and can be used in life cycle environmental assessments.	All	Energy related				
			Sustainability	Carbon Bill CO2 Accuracy	Calculation Formula: Accuracy = (1 − | Measured CO2 − Calculated CO2 | Measured CO2) × 100 %		
			Financial				
			Acceptance/Engagement	n/a			
			Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, usually measured through surveys (applicable to all UCs)	Once, at the end of the project	
				Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency (applicable to all UCs)	Once, at the end of the project	
				On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	
Carbon Bill CO2 Cost Calculation Evaluation	**Validation of cost saving through renovations,** This indicator helps measure the financial impact of energy efficiency renovations by showing the carbon cost savings compared to the baseline scenario. It can be useful to economically justify renovations This indicator shows how much it costs to avoid each ton of CO2 emitted thanks to carbon reduction measures, making it possible to evaluate the cost-efficiency of mitigation strategies in terms of money per ton of CO2.	All	Energy related				
			Sustainability	Cost of Avoided Carbon	Cost per ton avoided= CO2 Emissions Reduction (tons) Total Investment in Reduction Measures		
			Financial	Energy Efficiency Cost Savings when accounting Carbon Footprint	Cost Savings=Baseline Carbon Cost−Post-Renovation Carbon Cost		
			Acceptance/Engagement				
			Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, usually measured through surveys	Once, at the end of the project	
Energy Performance Improvement Validation	Validation of energy efficiency improvements through renovations	All	Energy related				
			Sustainability				
			Financial				
			Acceptance/Engagement				
			Business	Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, usually measured through surveys	Once, at the end of the project	

UC 4.1

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Monitoring of building performance for FMs	This scenarion will validate that the FM can accurately retrieve and visualize IoT data & KPIs for a selected building and time period.	ALL	Modeling Accuracy	% accuracy of data retrival	Accuracy = (No. of accurate data points retrieved / Total No. of data points retrieved) * 100	Once per demonstrating Pilot	
			Acceptance/Engagement	Perceived usefulness	"The ChroViewFM provides and accurate visual representation of my building and its equipment" "The ChroViewFM is easy to use"	Once, during piloting period	
			Business & Financial				
				Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
				Cycle Time	Cycle Time: the total time from the beginning to the end of the project, indicating efficiency	Once, at the end of the project	
				On-Time Project Completion	On-Time Project Completion: Percentage of projects completed on schedule.	Once, at the end of the project	
FM ifc import/export	Ensure that the FM can manually import files into ChroViewFM and export a specific set of information successfully.	ALL	Modeling Accuracy	file import and export operations with a high success rate	File Import/Export Success Rate = (Number of successful import/export operations / Total number of attempted import/export operations) * 100	Once	Import and export a No of .ifc seamless
							Import a No of .ifc some of which do not pass the IDS check. The challenge is to "flag" all of the non valid .ifc
	Ensure that the ChroViewFM can "flag" ifc files imported and do not match the desired requirements.		Business & Financial	RINA-C/(EGC & SIN can also support) please provide some inputs **Note it may makes sense to use the same B&F KPI for these validation scenarios - Use the same Business KPIs above for this validation scenario			

UC4.2

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Predictive maintenance	The system scans past operational data of the HVAC system to detect anomalies that might indicate system malfunctions or decay	Greek, Swiss	Modelling Accuracy	Number of flagged situations detected per pilot	$\sum_i Incident_i$	Once	
				Social: perceived usefulness and action taken	The following statements incorporated in user-testing survey help to validate the scenario: "The notifications provided by the ChorViewFM tool have been accurate in detecting possible system malfunctions" "I have taken action based on the notifications provided" "The actions I have taken based on the tools recommendations have had a positive impact on the building performance"	Once, during piloting	
			Business/Financial				
Preventive maintenance	The system notifies the user when scheduled maintenance activities are upcoming for the installed HVAC system	Greek, Swiss	Modelling Accuracy	Number of notifications sent in the project duration per pilot	$\sum_i Notifications_i$	Once	
				Social: perceived usefulness and action taken	The following statements incorporated in user-testing survey help to validate the scenario: "I find a notification option about scheduled maintenance activities of the HVAC system useful" "I have received notifications from ChroViewFM about scheduled maintenance activities for the HVAC system" "I have taken action based on the notifications provided" "The actions I have taken based on the tools recommendations have had a positive impact on the building performance"	Once, during piloting	
				Customer Satisfaction Score	Customer Satisfaction Score: a metric that measures how satisfied customers are with a company's products or services, us	Once, at the end of the project	
			Business/Financial				

UC5.1

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Digital Building Logbook for Secure and Trusted Documental archive	This validation scenario will involve providing access to a group of users, allowing them to explore and visualize the existing data stored within the DBL. The primary objective is to assess how easily users can navigate through the DBL to locate and view building-related information, such as EPCs, facility management reports, and baseline IFC files. Feedback will be collected on the effectiveness of data presentation and the overall user experience in accessing and understanding the data available within the DBL. Prerequisites: The user has an account in the DBL. The user has access to at least one building's data within the platform.	Any or all	Energy related	N/A			
			Sustainability	N/A			
			Financial	N/A			
			Acceptance/Engagement	System Usability Scale	Common questionnaire based SUS calculation methods (eg: https://usabilitygeek.com/how-to-use-the-system-usa	Probably once	This scenario focuses on evaluating practically the usability of the
			Business	NA (See comments)			If needed we could create a SUS like questionnaire with questiones related to bussiness development and market potential of DBL, and ask to 5-10 business developers and exploitation experts. A kind of MPS (Market Potential Score) or something similar

UC5.2a

Validation Scenario	Description	Pilot	KPI category	KPI	Calculation Formula	Calculation frequency	Comments
Data upload into the DBL by the building owner	This scenario aims to verify the accuracy and consistency of data uploaded by building owners. Building owners will be asked to upload building-related documents and information into the DBL. The validation process will check if the uploaded data matches the expected structure and format, ensuring that the information adheres to the standards set by the DBL framework. Prerequisites: Building owners have DBL accounts and access to their respective buildings. Owners have the necessary documents (e.g., EPC, building permits) in a digital format for upload.	Any or all	Energy related	NA			
			Sustainability	NA			
			Financial	NA			
			Acceptance/Engagement	System Usability Scale	Common questionnaire based SUS calculation methods (eg: https://usabilitygeek.com/how-to-use-the-system-usability-scale-sus-to-evaluate-the-usability-of-your-website/)	Probably once	This scenario focuses on evaluating practically the usability of the DBL User Interface and functionalities
			Business	NA (See comments)			If needed we could create a SUS like questionnaire with questiones related to bussiness development and market potential of DBL, and ask to 5-10 business developers and exploitation experts. A kind of MPS (Market Potential Score) or something similar

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