D2.6 EPC RECAST certification tool/platform

EPC RECAST

ENERGY PERFORMANCE CERTIFICATE RECAST

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3. Executive Summary

The EPC RECAST project has developed software tools to assist assessors and create the next generation of Energy Performance Certificates (EPCs). These tools are integrated into a single platform for efficient intercommunication and user-friendly interface. The integration relies on the KROQI platform, a collaborative web platform designed for the construction sector, supporting document management and third-party applications. The platform enables smooth data exchange and collaboration, and an interface allows assessors to manage EPC RECASTXML files easily, run simulation and generate RoadMap.

The KROQI platform was developed by CSTB in response to French public authorities' demand to help small entities in the construction sector with digital transition. It began in 2016, and by 2018, it had around 15,000 registered users and 4,900 workspaces. KROQI is designed to provide document management, collaborative services, and core services like BIM model checking. It supports a wide range of stakeholders in managing and sharing technical documentation, collaborating on BIM models, and using innovative tools.

Features of KROQI:

- Project Management: Centralized workspace for project collaboration and document management.
- Document Management: Advanced capabilities for uploading, organizing, and version controlling files.
- BIM Collaboration: Support for BIM model collaboration and sharing 3D visualizations.
- Task Management: Tools for creating, assigning tasks, tracking progress, and setting deadlines.
- Communication Tools: Built-in messaging, commenting, and notification features.
- Access Control: User access rights management.
- Mobile App: Allows access to project information on the go.
- Data Security: Emphasis on data security and privacy.
- Integration Capabilities: Options for integrating third-party applications.
- Analytics and Reporting: Features for project performance insights.

In The EPC RECAST Project, the KROQI platform centralizes information from various technological components of the EPC RECAST toolbox, facilitating access to services. It integrates tools with different digital maturity levels via REST API or file-sharing capabilities, using a common data model for EPC information sharing.

Integration and use of Tools:

- BIMEO scan: Manual integration of initial EPC RECAST XML during on-site data collection.
- Assessor Interface and Simulation Tool: Full integration via gateway service, allowing editing and saving of EPC XML files.
- EPC RECAST Calibration Toolbox: Planned full integration for seamless interaction, not fully achieved due to time constraints.
- Operational Rating: Manual processing of output files for computing operational ratings.
- Renovation Roadmap Interface: Full integration for seamless interaction and simulation execution.
- Printing App: Manual processing of output files to print final reports.

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Most components are close to the maturity level required for commercialization. The project developed a demonstrator integrating multiple services tested across Europe. Further automation and service robustness are needed for full deployment. Key points for future deployment should include:

- A common data exchange format for buildings to ensure interoperability.
- A validation process for third-party applications connecting to the software platform.

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4. General principles of the KROQI platform

4.1. Presentation of KROQI platform

As a response to a demand from the French public authorities to provide stakeholders, especially small entities (SMEs, VSEs), with tools allowing them to participate in the digital transition of the construction sector, CSTB has started the development of an easy-to-use collaborative web platform open to everybody in 2017. This development was supported under the French Digital Transition Plan for the Building Sector, in consultation with professional organizations and construction stakeholders.

The project was structured around several key stages:

- June 2016: launch of the public digital collaborative platform project
- March 2017: start of the experimentation of the tool
- November 2017:
  - Launch of the large-scale experimentation phase, in public beta version (at the BATIMAT exhibition in Paris)
  - 1st Call for Expression of Interest aimed at developing high value-added technical solutions and services for VSEs/SMEs
- March 2018: launch of the Digital Building Platform, named KROQI, operational and enhanced with interconnected third-party services, identified as part of the Call for Expression of Interest.

The functional foundation of KROQI, accessible free of charge to all stakeholders, provides document management functionalities, collaborative services, and a set of core services like a BIM model checker (see figure 1 below). This base is associated with an ecosystem of complementary and interconnected business services, which will be enriched over time. The platform, with its integrated services, allows all the actors concerned with a building project to manage and share the technical documentation, collaborate around BIM models, set up validation processes, check BIM models, and use innovative tools such as the production of digital models from scanned 2D drawings. Core services and third-party services are accessible through a web platform using SaaS-technology and ensuring data security to an unlimited number of users. The collaborative suite of the KROQI platform relies on a commercial tool (WIMI), which is hosted on servers rented by the provider of this solution. More technical details on the KROQI platform will be given in the next sections.

At the end of 2018, the platform had around 15,000 registered users (VSE/SMEs, craftsmen, architects, design offices, planners, etc.), including about 4,500 active users. Approximately 4,900 workspaces had been created, of which 800 were used frequently.

In the framework of the EPC RECAST project, the KROQI platform will be used as an open application store. The KROQI platform will allow to centralize the information provided by the different technological components of the toolbox and facilitate the access to the services they provide. As such, the platform will not be a Key Exploitation Result (KER) of the project.

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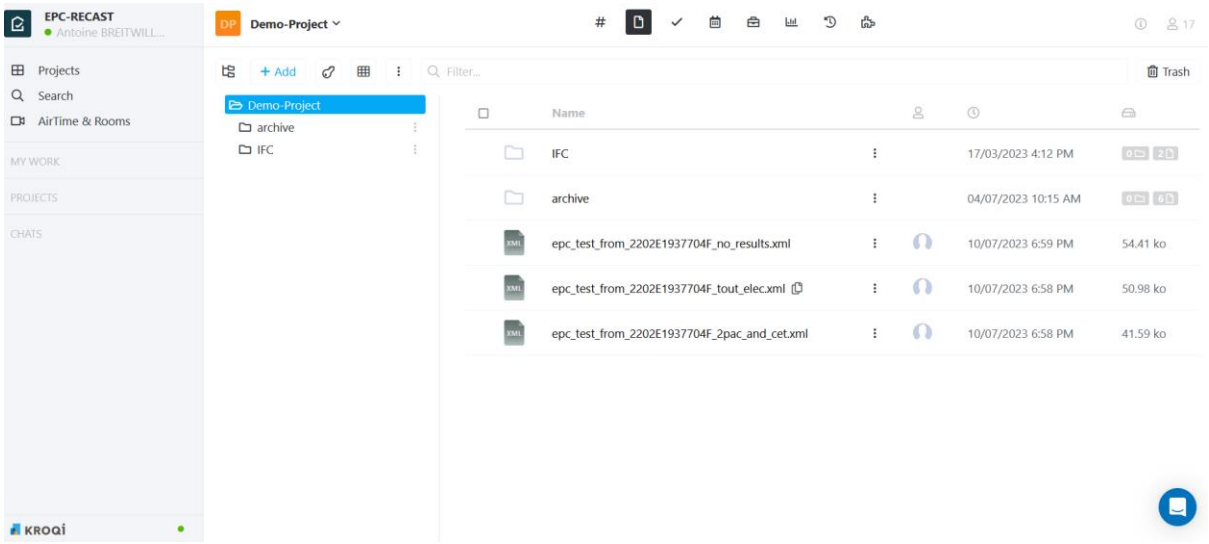

Figure 1 : Interface of the KROQI platform developed for EPC RECAST

4.2. Features of the KROQI Platform

- Project Management: KROQI provides a centralized workspace where project teams can collaborate, store, and manage project-related documents, files, and data. It serves as a hub for all project-related information, making it easily accessible to authorized users.
- Document Management: The platform offers advanced document management capabilities, allowing users to upload, organize, and version control of any file types.
- BIM Collaboration: KROQI supports Building Information Modeling (BIM) collaboration, enabling project teams to work with BIM models and share 3D visualizations.
- Task Management: Users can create and assign tasks, track progress, and set deadlines to ensure smooth project execution and timely completion of deliverables.
- Communication Tools: KROQI facilitates seamless communication among project stakeholders through built-in messaging, commenting, and notification features.
- Access Control: The platform allows administrators to manage user access rights, ensuring that sensitive project information is only accessible to authorized personnel.
- Mobile App: KROQI offers a mobile app, allowing users to stay connected and access project information on the go, enhancing flexibility and productivity.
- Data Security: The platform places a strong emphasis on data security and privacy, implementing measures to protect sensitive project information.
- Integration Capabilities: KROQI provides integration options with various third-party applications and software tools, enhancing interoperability and supporting specific project needs.
- Analytics and Reporting: KROQI offers reporting and analytics features, allowing project managers to gain insights into project performance, identify trends, and make informed decisions.

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4.3. Use of the KROQI Platform for the EPC RECASTtoolbox

Within the EPC RECAST project, the KROQI platform is used to centralize the information provided by the different technological components of the toolbox and facilitate the access to the services they provide. A such, the main functionalities used from the KROQI platform in the project include:

1. Integration Capability: The platform's integration capability enables the smooth integration of EPC RECAST technological components with third-party applications. This facilitates collaborative work and data exchange among different tools used in the project. Very concretely, the platform allows for the configuration and simulation of all the project's housing and buildings, and for creating the roadmaps. The input parameters and results are stored in KROQI, and access to the simulation interface is also through KROQI.
2. Document and Project Management: The document and project management features of KROQI are crucial for the EPC RECAST project. They play a significant role in efficiently organizing, storing, and controlling versions of various documents related to pilot sites. Of particular importance is the management of EPC RECASTXML files, as they serve as the primary project files for each pilot site.

During the project, three training sessions were organized to demonstrate how KROQI works (along with the associated simulation tools). These training sessions showed that the platform is intuitive and easy to use. The file-sharing option between partners was very useful for verifying file configurations. For example, a partner might have doubts about interpreting an input parameter and could share their file with another partner to get help.

A risk associated with this type of platform was identified during the project. If KROQI stops working, all services come to a halt: no access to files, no access to simulation tools. Such a malfunction occurred during the project following an update to KROQI. This highlights the importance of achieving a very high level of availability for this type of service.

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5. Connection and integration of EPC RECAST toolbox into the platform

In this section, we will review the different interactions that technical components have with the platform. The technical components developed in the EPC RECAST project are integrated in the KROQI platform in different ways depending on their levels of digital maturity. The most advanced components will be fully integrated via a REST API, demonstrating the value of integrated digital workflow for EPC, while the less advanced ones will make use of the fill sharing capability of the platform. Independently of the level of digital integration, all the tools make use of the project common data model, demonstrating its value to share EPC related information across tools, and facilitating potential further development/integration after the end of the project.

The following schema illustrate how the main technical components are integrated to the KROQI platform. The next sections will detail how each technical component is integrated.

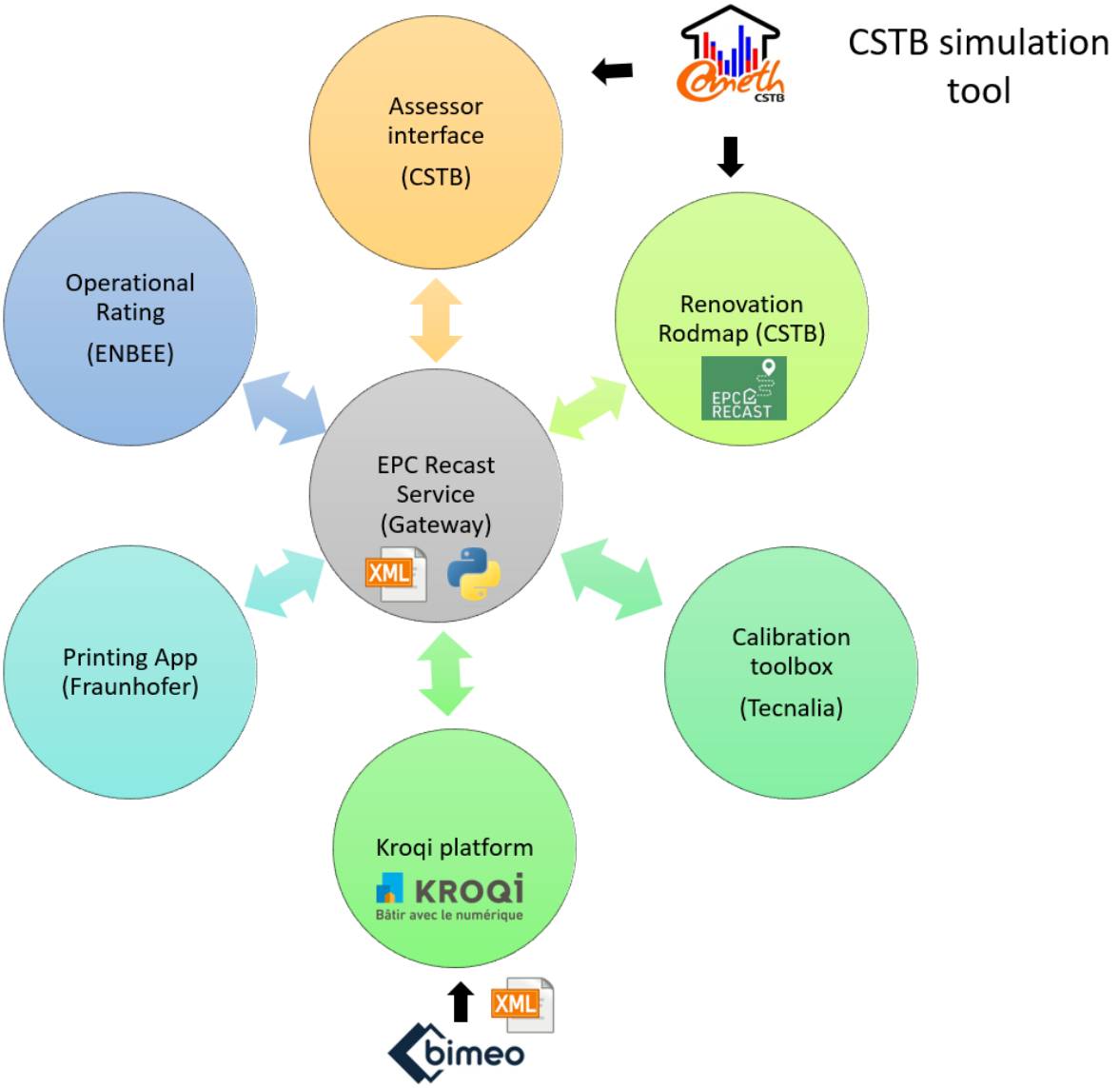

Figure 2: schema of integration of technical components with KROQI through CSTB EPC RECASTSERVICE (GATEWAY)

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The following table presents the list of technical components connected to Kroqi along with their maturity level (or TRL). Specifically, it distinguishes between the maturity level achieved by the EPC RECAST project and the desired level for commercialization or making this type of service available to a wide audience (not planned within the project).

TC name	Technology readiness level reach in the project	TRL gap	Technology readiness level before commercialization
BIMEO scan	Technology demonstrated in relevant environment (TRL6)	2	System complete and qualified (TRL 8)
Assessor interface	System prototype demonstration in operational environment (TRL7)	1	
Simulation tool	System prototype demonstration in operational environment (TRL7)	1	
Operational Rating	System prototype demonstration in operational environment (TRL7)	1	
Renovation Roadmap interface	Technology demonstrated in relevant environment (TRL6)	2	
Printing app	Technology demonstrated in relevant environment (TRL6)	2	

Table 1 : TRL identification of each technical components

It is noted that all components have at least been tested in an operational environment, indicating that they are close to achieving the maturity level necessary for making them available to a wide audience. The following paragraphs describe the ideal level of automation required for the deployment of the technical components, which has not always been achieved within the project.

Figure 4 details the software chain that transforms the characteristics of the housing recorded by the assessor into a consolidated and reliable EPC. This figure shows that the KROQI platform is used at several stages of the software chain: for the collection and consolidation of information and parameters, to access to simulation tools and the roadmap, and also for the recording and sharing of the project's EPCs.

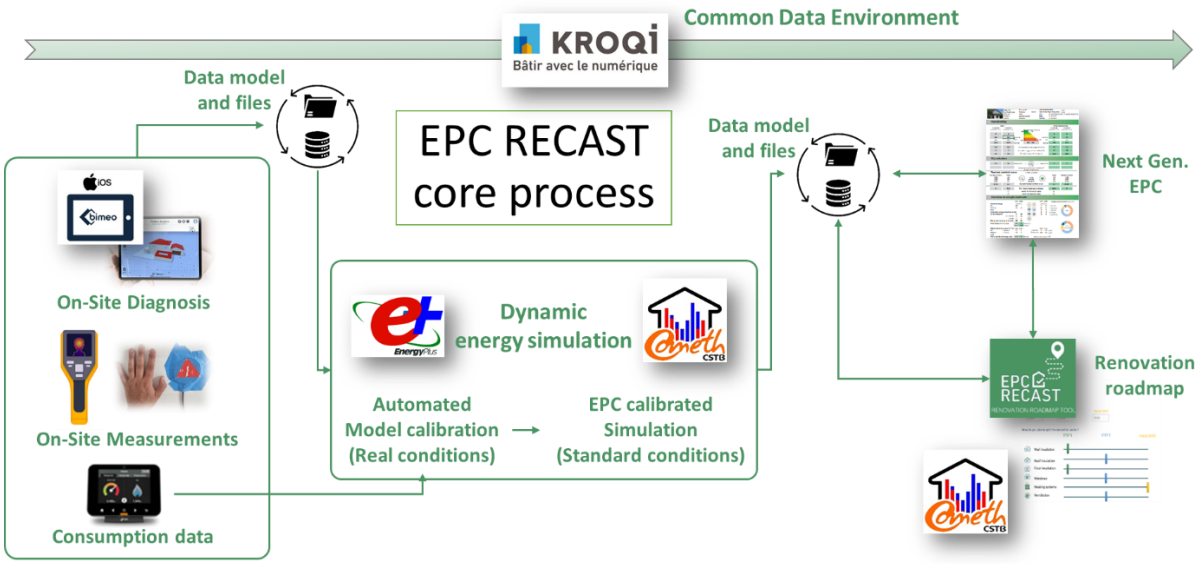

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Figure 3 : Overview of the EPC RECAST Chain, from Input to EPC creation.

5.1.1. BIMEO scan - Manual integration of results

The BIMEO scan technical component (TC n°1) generates the initial EPC RECAST XML during the on-site data collection process. This XML file is subsequently uploaded to the KROQI platform manually. At the completion of the on-site data acquisition, the EPC assessor downloads the XML and uploads it to the KROQI platform. This manual procedure also provides an opportunity for the EPC RECAST assessor to become acquainted with the platform's file management system and effectively organize this/her working environment within it.

5.2. Energy performance (or simulation) layer

The energy performance layer contains the tools developed to obtain more reliable energy performance evaluation for the EPC certificate.

5.2.1. Assessor interface and the simulation tool - Full integration of a third-party service – Triggered by user

The provided interface for the assessor allows direct access from the platform and can be triggered using any valid EPC RECAST XML available on the platform.

When the assessor accesses the interface, the KROQI platform calls the gateway service (CSTB EPC RECAST Service) to redirect the user to the assessor interface. This interface is fully synchronized with KROQI through the gateway service, enabling the assessor to edit the EPC and save the modifications directly on the platform.

Additionally, the assessor interface is connected to the Dynamic Energy Modelling tool (Cometh) for EPC assessors through the same gateway service. The assessor can initiate the simulation when all the required inputs for the EPC are available. After running the simulation, the EPC RECAST XML is updated with the simulation results and can be saved back to the KROQI platform via the gateway service.

5.2.2. EPC RECAST calibration toolbox - Full integration of a third-party service – Full API automation

The EPC calibration toolbox is the integration of three technical components (the IFC-2-IDF that automatically generate an energy model from a BIM model (TC n°7), the EPCA that enable to estimate real occupancy during the period used for calibration (TC n°9), and the BEPS that perform the calibration via an optimization algorithm (TC n°11) and is hosted on TECNALIA's servers. The EPC calibration toolbox should be fully integrated as a third-party service within the KROQI platform, utilizing API automation for seamless interaction. This integration should allow the calibration toolbox to operate without requiring any user interaction on the KROQI platform.

Instead, the calibration toolbox application directly triggers actions within KROQI using KROQI authentication (as described in chapter 9). Through this authentication, the calibrated EPC RECAST XML can be read by the calibration tool and the results can pushed back to the KROQI platform.

The complete integration could not be achieved during the project due to a lack of time. However, this addition is fully compatible with the KROQI service. The integration would be very similar to that of the RoadMap, which is presented right after in the document (section 5.3.1).

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5.2.3. Operational Rating – Manual interaction

ENBEE's operational rating (TC n°15) will use output files provided by the EPC RECAST simulation and calibration process through KROQI platform and will process these outputs manually in the tool to compute the operational rating and the results will be stored on the KROQI platform.

5.3. Output and recommendation layer

The output and recommendation layer contain the tools that enable the delivery of user-friendly results and recommendation of the evaluation process.

5.3.1. Renovation Roadmap interface - Full integration of a third-party service – Triggered by user

The renovation roadmap interface and tool (TC n°17) are integrated in the KROQI platform using the previously mentioned gateway service (CSTB EPC RECAST Service), similarly to the assessor interface. This integration allows the renovation roadmap tool to interact with the KROQI platform seamlessly.

The renovation roadmap tool can write the results of the roadmap to the KROQI platform, enabling easy storage and access to the roadmap information. Additionally, it can utilize the gateway service to call the simulation service, facilitating the execution of simulations related to the roadmap.

5.3.2. Printing app – Manual interaction

Fraunhofer printing app (new TC) uses output files such as the EPC RECAST XML provided by the EPC RECAST simulation and calibration process through KROQI platform and process these outputs manually in the tool to print the final report provided by the printing app.

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6. Work done to connect third-party service to the KROQI platform

As part of the EPC RECAST project, a third-party service called "CSTB EPC RECAST Service" has been developed and integrated into the KROQI platform. This service acts as a gateway connecting the KROQI platform to the assessor interface, facilitating communication and task execution.

The CSTB EPC RECAST Service is a Python application built on the Flask framework. It provides an API with various routes that implement the KROQI API as a wrapper, as well as additional specific routes, such as running simulations.

The current features of the third-party service API are as follows:

- List Project Items: It allows listing all files and folders within a KROQI project.
- List Folder Items: This route lists all files and folders within a specified KROQI folder.
- Read File Information: It retrieves the file metadata of a particular KROQI file.
- Read File Content: This route allows retrieving the content of a specific KROQI file.
- Create File: The API can be used to write a new file onto the KROQI platform.
- Run Simulation: This route enables running a simulation on a designated KROQI file.
- Run and create RoadMap : This route enables running a RoadMap service from a designated KROQI file.

The third-party service API is thoroughly documented in a swagger, providing clear and comprehensive information on how to interact with and utilize its functionalities.

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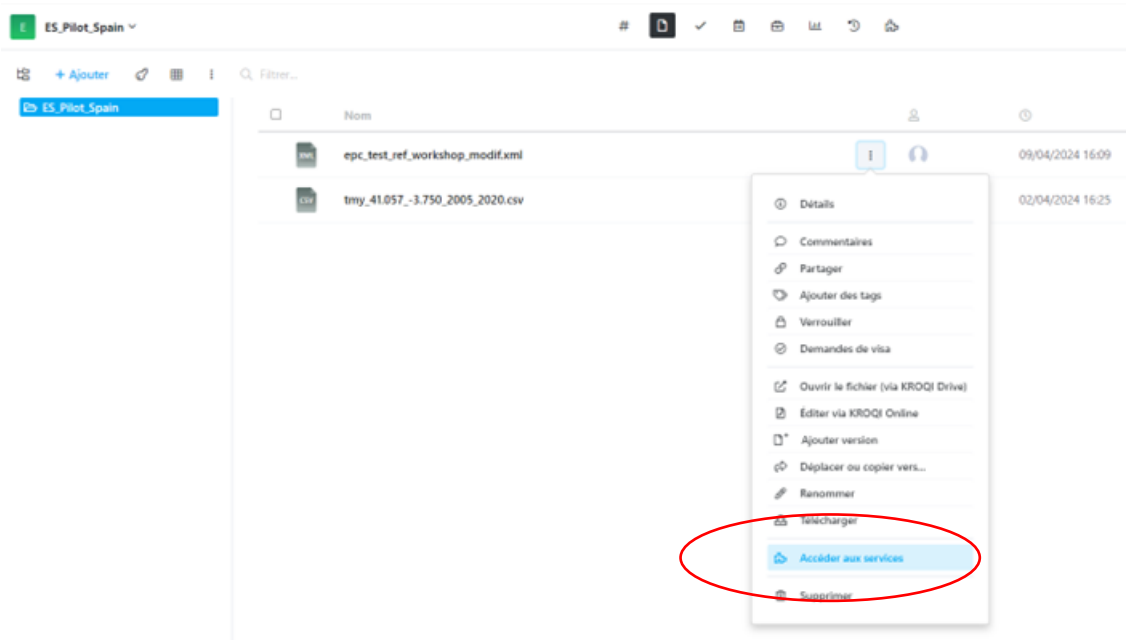
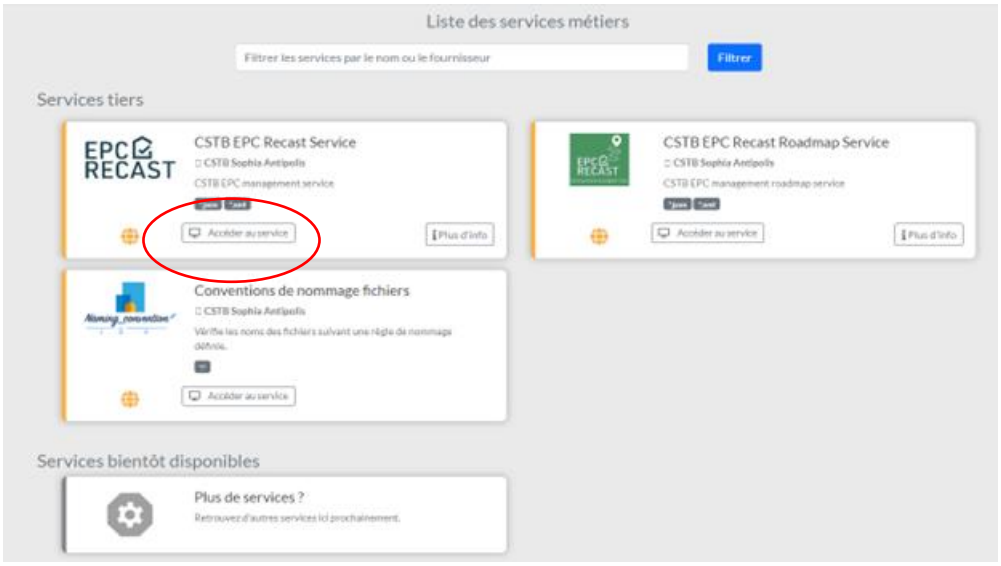
7. Presentation of the current interface with screenshots

To illustrate the interaction between the KROQI application and third-party app we will show the process of editing the EPC, running simulation and saving the EPC with the simulation results from KROQI using the EPC assessor interface developed by CSTB.

From the KROQI platform tailored to the EPC RECAST project, an EPC assessor can choose an XML that they have recovered from the BIMEO tool and upload it to the EPC assessor interface. To do that they launch “access to services” from the XML in KROQI interface.



Then they can select the EPC RECASTSERVICE from CSTB to be redirected to the assessor interface. Similarly, it is possible de run the RoadMap service by clicking “accéder au service “on the right of the panel.



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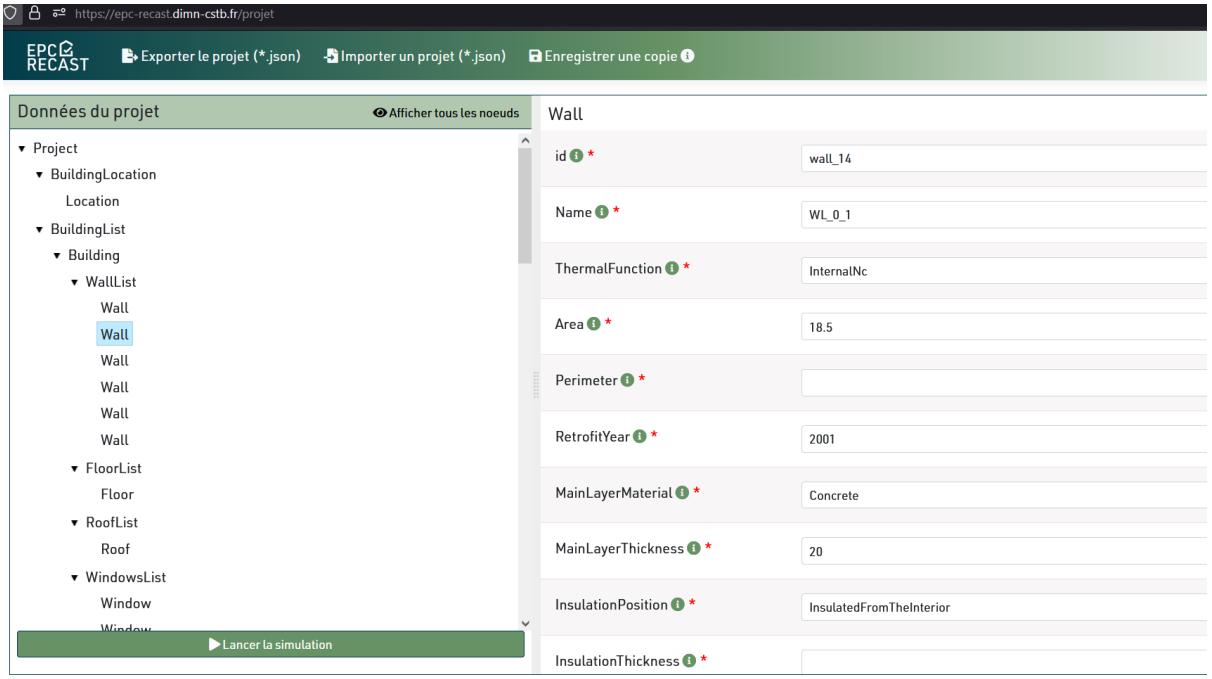
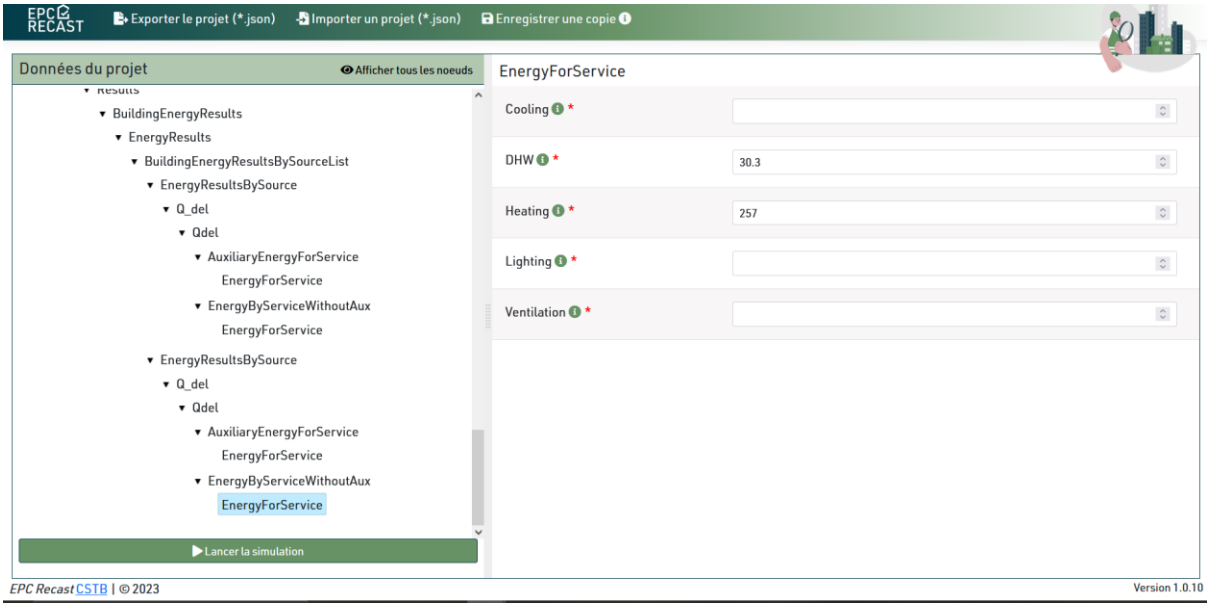
Then they access the data stored in the xml in a user-friendly interface that allows them to edit the properties of the building (in the figure below a wall has been selected and can be edited from the interface).



Once the simulation is complete, the assessor can see the results of the simulation and the energy performance indicators of the building generated by the simulation. On the figure below we can see the results of consumption for heating and domestic hot water in kWh/m²/year for the gas energy carrier.



Once the EPC assessor has ended their work on the CSTB assessor interface they can then save their simulation file with both building characteristics input and simulation output results back to KROQI using the save button.

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The new file with the results and the edit is then saved to KROQI and available to be used for the next steps of the process in the KROQI file management system. For example, this file can be used to create RoadMap with de dedicated service.

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8. Conclusions

Table 1 shows that most of components are close to the maturity level required for commercialization or availability to a wide audience. This could not be achieved within the project due to time constraints, but the project allowed us to develop a complete demonstrator that integrates about ten services, tested on several homes across Europe under near-real conditions. The KROQI platform facilitated integration in this type of project and saved us valuable time. However, if we want to provide diagnosticians with the entire software chain and associated services, further automation and service robustness will be necessary. The ideal scenario would be to allow third-party applications to connect to our software chain in the form of a Marketplace. This raises two central points for deploying this type of service in Europe:

- It is necessary to offer a common data exchange format for buildings to ensure application interoperability. This involves providing a properly structured data format as well as a list of parameters with their precise physical definitions (area, systems, etc.). The EPC RECAST project offers an initial solution to this issue with the XML data exchange used in the KROQI interface. However, this format is probably not robust and versatile enough to support all the uses related to producing EPCs.
- Third-party applications connecting to the software platform should undergo a validation process. Validating simulation or decision-support tools can be complex due to highly variable use cases and specific energy contexts.

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