iBRoad2EPC

Integrating Building Renovation Passports
into Energy Performance Certification schemes
for a decarbonised building stock

iBRoad2EPC Assistant software

API v1.0, able to transmit structured building data
API v2.0, fine-tuned, based on the pilot case feedback

BPAC – Blue Planet Academy and Consulting

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www.ibroad2epc.eu

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All of iBRoad2EPC's public reports, analysis and evidence can be accessed from ibroad2epc.eu

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1 INTRODUCTION

Building on the results of the iBRoad project (2017-2020) which developed, tested and delivered a model for the Building Renovation Passport supporting single-family home-owners with personalised advice to facilitate stepwise deep renovation, iBRoad2EPC aims to bridge the Building Renovation Passport with the Energy Performance Certificate (EPC), and expand, improve and broaden their format and joint scope to consider additional features and become applicable also to multi-family and public buildings.

iBRoad2EPC thereby aims to add elements from comprehensive building renovation passports to energy performance certificates in order to enable mass-scale, stepwise and deep renovations and thus the decarbonisation of the existing building stock.

The effort required to issue the iBRoad2EPC should therefore be as low as possible so that it can achieve a high coverage. At the same time, it should provide high added value for building owners with practical, individual information.

After careful analysis about how to best achieve these opposing goals, we reached the conclusion that it was necessary to expand the family of iBRoad tools with a new tool, the iBRoad2EPC Assistant, instead of modifying the existing roadmap tool that was developed in iBRoad.

The concept of the iBRoad2EPC Assistant, including the modular approach, the different proposed modules, the design, the way it adapts to the requirements of different countries, etc., are described in detail in the public report "*iBRoad2EPC in depth - Technical report on the definition of the proposed concept, content and methodology*".

Two important aspects determined the way the practical development of the iBRoad2EPC Assistant was approached:

- The field tests presented an important time constraint, since the iBRoad2EPC Assistant had to be ready for use by auditors by the time the field tests would start.
- The functionality of the iBRoad2EPC Assistant would also need to be made available as an Application Programming Interface (API) that can be used by the EPC software providers available in the implementing countries.

The time constraint presented by the field test would not be met if the full version of the iBRoad2EPC, including API architecture and implementation, was to be developed at once. For this reason, the development was split in two phases:

1. In Phase I, the iBRoad2EPC Assistant was developed in a way that was as efficient as possible for testing with respect to the required development time.
2. In Phase II, a version of the iBRoad2EPC Assistant was developed that includes a full separation between client and API-based back-end. During the development of Phase II, a significant part of the feedback collected during the country testing was already available. The software that was built already took that feedback into account.

2. PHASE I

This section describes the implementations carried out and the relevant architecture of Phase I, the first version of the Assistant, as delivered.

2.1 Phase I Architecture

In the diagram below (Figure 1), a bird's-eye view of the architecture of Phase I of the Assistant is shown.

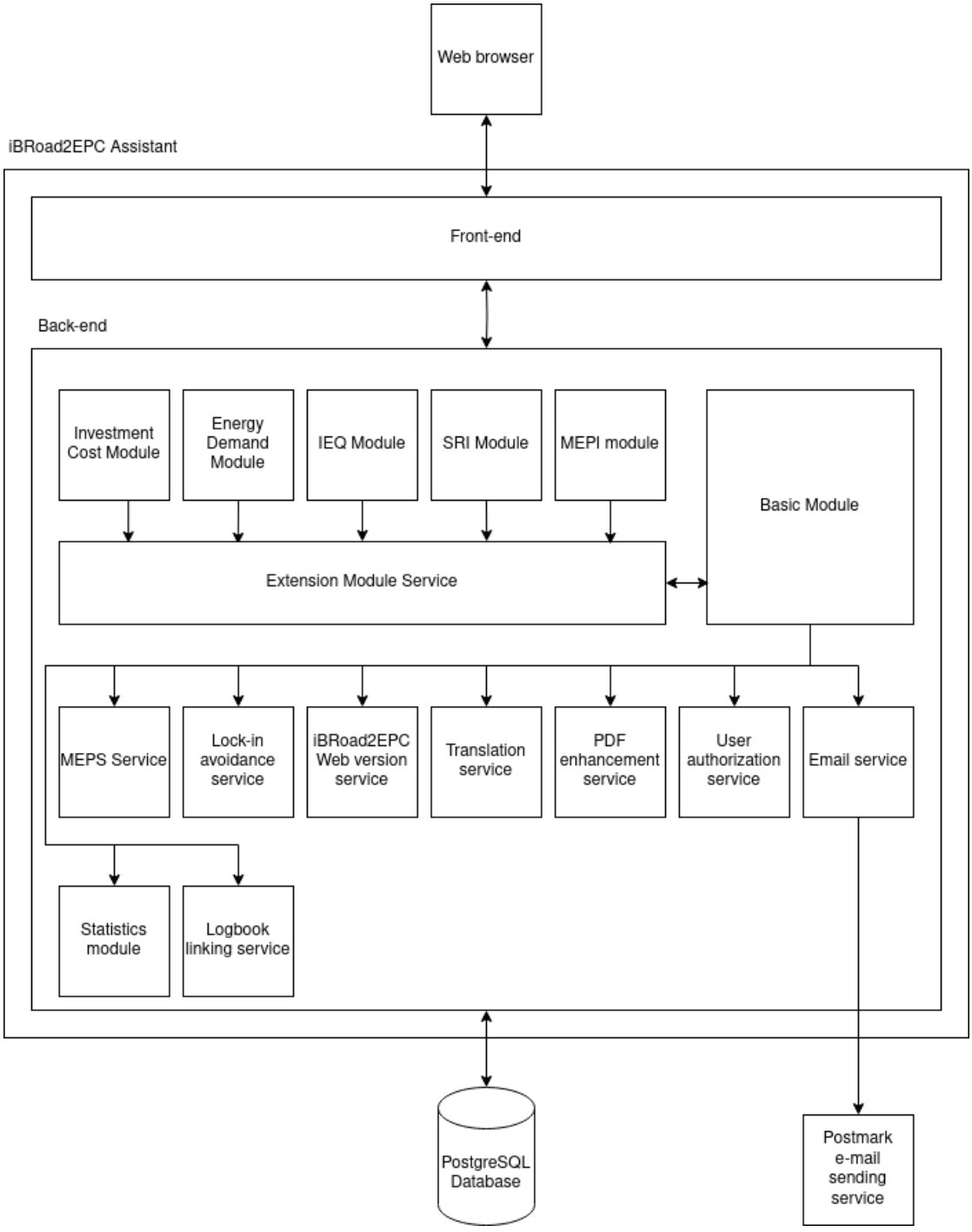

Figure 1. Architecture of Phase I (back-end) of the iBRoad2EPC Assistant.

The common functionality, used by all countries and not depending on having enabled any modules for the country, is called the Basic module. The basic module interacts with the Extension Module Service, which provides the framework that allows the different modules to hook into the application. The five currently implemented modules are shown in Figure 1; these include: Investment Cost module, Energy Demand module, Indoor Environmental Quality module (IEQ), Smart Readiness Indicator module (SRI), Measured Energy Performance Indicator module (MEPI).

The basic module relies on a number of supporting services to provide the overall application's functionality:

- *MEPS Service*: this service makes sure the minimum energy performance standards (MEPS) for the concerned building are correctly reflected in the iBRoad2EPC.
- *Lock-in avoidance service*: this service evaluates the sequence of the different proposed renovation measures, and provides warnings for any lock-in issues that might occur, and that the building owner should be aware of from the start.
- *iBRoad2EPC Web version* service: this service provides the web version of the resulting iBRoad2EPC that is delivered to the building owner, i.e. it provides a number of web pages that present all information contained in the iBRoad2EPC in an attractive and easy to navigate way.
- *Translation service*: this service manages the database of the translations for all texts and snippets used throughout the application, be it parts of the interface or descriptions of specific measures, conflicts, etc.
- *PDF enhancement service*: this service allows the addition of a page that contains a link and a QR code to the PDF of an existing EPC. The look of this page resembles the look of the EPC of each pilot country.
- *User authorisation service*: this (internal) service authorises all actions a user takes (or tries to take) in the application, according to the user's roles.
- *Email service*: this service communicates with an external e-mail sending service (in this case Postmark) to send e-mails.
- Statistics module: this module allows country administrators to consult statistics about the different buildings present for their country in the database.
- Logbook linking service: this service allows an enhanced EPC as created with the iBRoad2EPC Assistant to be easily linked to a logbook in the iBRoad Logbook tool.

All data (except for file uploads) used by the application is stored in a PostgreSQL database. Even though a single database server is used, conceptually we can consider that two different databases exist and are used:

- The “content” database: this database contains all the information related to renovation measures, renovation advice, lock-in avoidance, climate zones, energy classes, etc. that allows the application to function. All of these aspects are specific to each pilot country and, where relevant, they can be modified by country administrators.
- The “building” database: this database contains all information about the projects (i.e. buildings) created by auditors using the iBRoad2EPC Assistant.

2.2 Phase I Implementation / developments

For Phase I, we chose to develop the Assistant using Ruby on Rails, a web framework that allows for very high developer efficiency. Even though the use of supporting technologies like Turbo and Hotwire imply that the application can technically be considered to be mainly an SPA (single page app), virtually all content rendering is done on the server side, which greatly contributed to development velocity. The database used behind the iBRoad2EPC Assistant is PostgreSQL, one of the leading open-source databases.

Details guiding the implementation / development are described in the reports “*iBRoad2EPC in depth - Technical report on the definition of the proposed concept, content and methodology*” mentioned earlier, and *“Specification for the iBRoad2EPC software tools - Report on adaptation requirements for roll-out countries”*.

The main implementations carried out include:

- Catering for various types of buildings

  The iBRoad2EPC Assistant supports single-family, multi-family and various types of public buildings. This means that certain aspects of the user interface change depending on the building type, and that the available renovation measures (and related information) are specific for the chosen building type.

- Adaptation to Member State requirements

  All renovation measures, climate zones, energy classes, colour codes, lock-in avoidance information, etc. is country specific, i.e. specifically adapted to each pilot country. There are also various input fields, features and UI elements that differ from country to country, in order to adapt to specific requirements.

- Modules

  As explained in "*iBRoad2EPC in depth – Technical report on the definition of the proposed concept, content and methodology*", each pilot country can choose which of the available modules it wishes to enable. All modules —Investment Cost module, Energy Demand module, Indoor Environmental Quality module (IEQ), Smart Readiness Indicator module (SRI), Measured Energy Performance Indicator module (MEPI)— have been explained in detail in the iBRoad2EPC report "*Specification for the iBRoad2EPC software tools - Report on adaptation requirements for roll-out countries*". The implementation of the SRI, IEQ and MEPI modules is conceptually similar: the user can download an Excel file (kindly provided by other Horizon 2020 projects), fill it out to calculate the relevant indicator, and upload it again.

- Statistics module

  A statistics module was created that allows country administrators to consult statistics related to the buildings present for their country in the database (Figure 2).

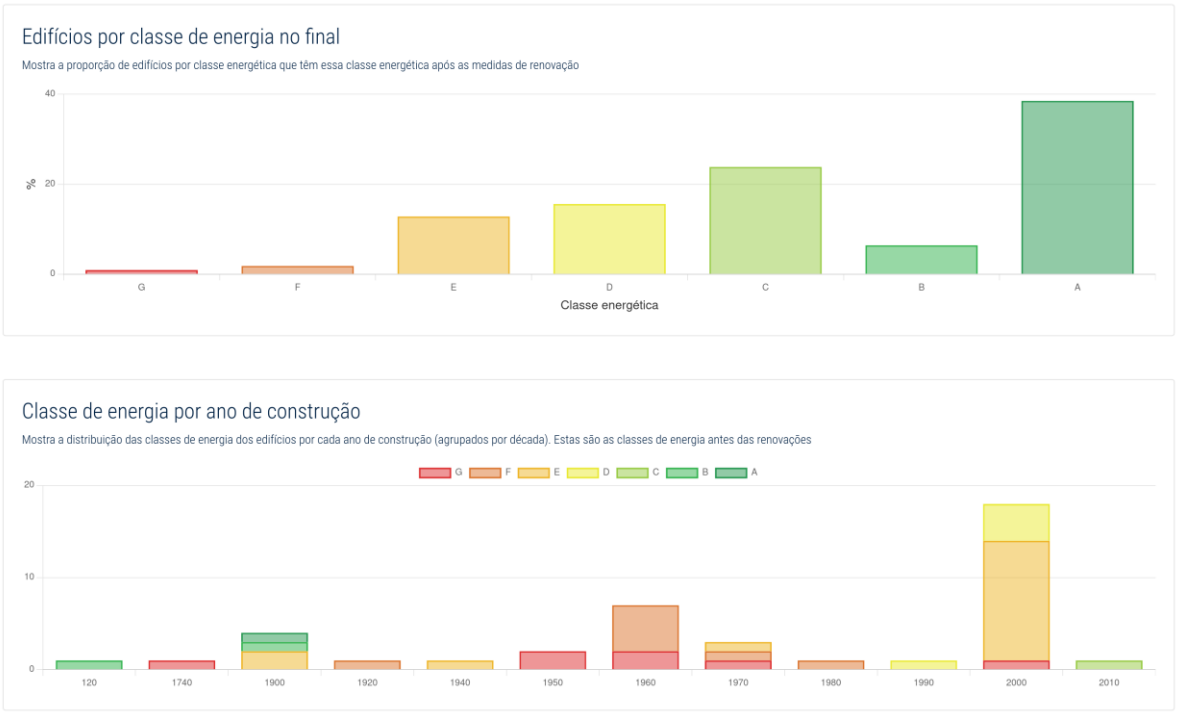

Figure 2. Snapshot from the iBRoad2EPC statistics module.

- Link with the iBRoad Logbook

  The auditor receives a special linking-code that can be used to link the enhanced EPC to an iBRoad Logbook.

- Look and feel

  The layout and design of the application and the resulting enhanced EPC have been discussed in the report *"iBRoad2EPC in depth – Technical report on the definition of the proposed concept, content and methodology"*. The look of the page that the tool adds to the original EPC is styled in the same way as that EPC (this implies that it looks different for each pilot country).

Please see the *"iBRoad2EPC Training toolkit"* for information on accessing and operating the iBRoad2EPC Assistant software.

Access to the iBRoad2EPC Assistant is available upon request.

3. PHASE II

This section describes the implementations carried out and the relevant architecture of Phase II, the version of the Assistant that features a full separation between the API-based back-end, and the client application that consumes the API.

Alongside to the API back-end, it was decided to also develop a browser-based client application that uses the API, and allows users (auditors) to create complete iBRoad2EPC enhanced EPCs. This decision was made for the following reasons:

- The fact that the client application allows the creation of full enhanced EPCs for all rollout countries in the project (and hence also supports all available modules) proves that the API provided by the back-end is both feature complete and fully functional.

  Phrased differently, the client application serves as a proof-of-concept implementation and demonstrates that the full functionality of iBRoad2EPC is available through the API.

- Even though extensive documentation is provided for the API, it is always helpful for developers to be able to see the code of an example application that consumes the API. Hence, the client application also serves as a resource and a source of inspiration for developers of EPC software packages who want to use the iBRoad2EPC API in their own application.

3.1 Phase II Architecture

In the diagram below (Figure 3), a bird's-eye view of the architecture of the API-based client-server system is shown.

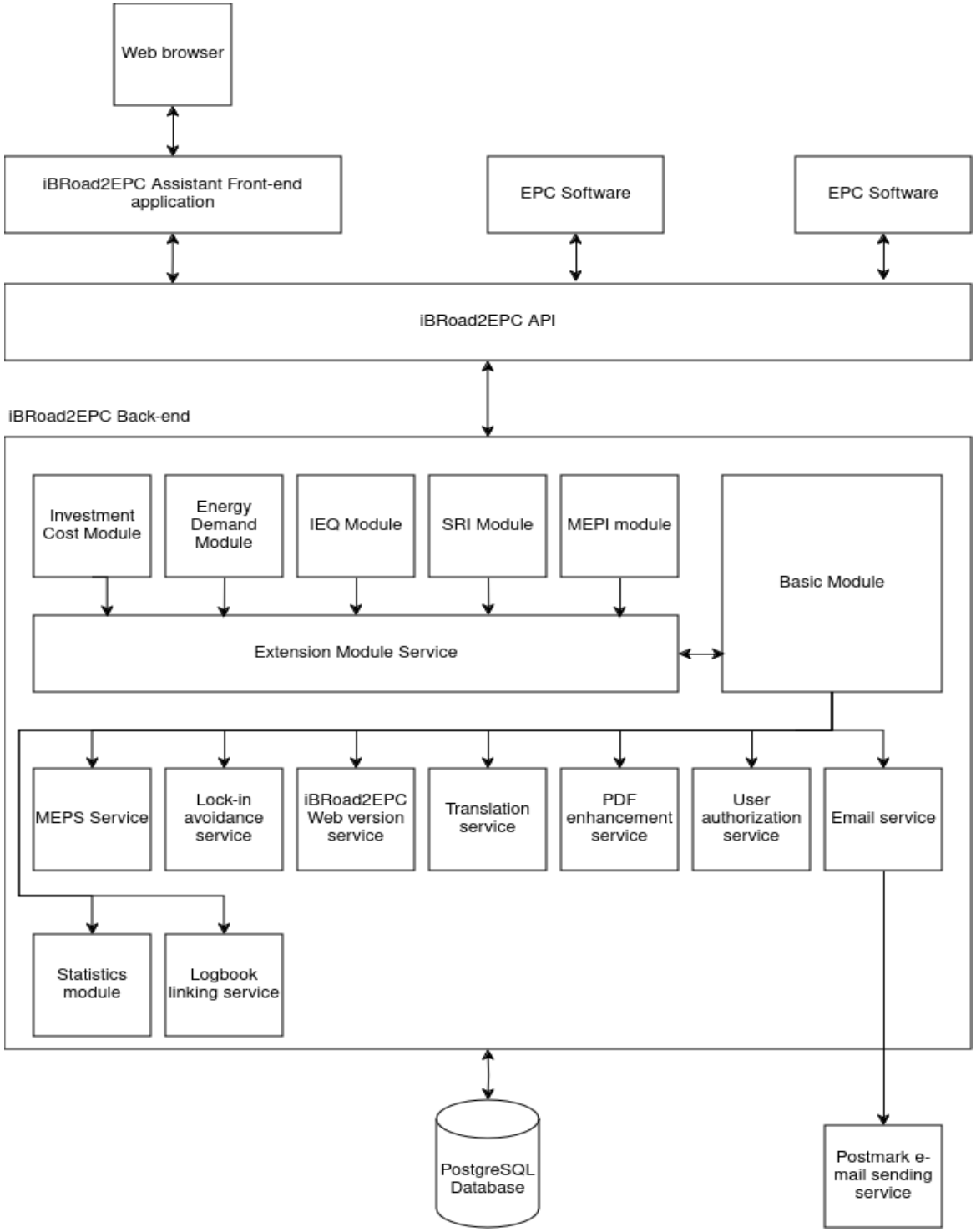

Figure 3. Architecture of iBRoad2EPC API-based client-server system

Compared to the version that was developed in Phase I, we have added an API layer that creates a bridge between client applications (EPC software or the iBRoad2EPC client application) and the common back-end functionality.

It is important to note that virtually all back-end functionality is fully common to both the API and non-API versions of the iBRoad2EPC software, and hence has to be maintained only once.

The database that backs both applications is identical.

3.2 Phase II Implementation / developments

Both the API layer and the iBRoad2EPC back-end have been developed using Ruby on Rails, a web framework that allows for very high developer efficiency.

The browser-based iBRoad2EPC client application has been developed in TypeScript using the React component-based client side framework.

The database used behind the back-end is PostgreSQL, one of the leading open-source databases.

The main implementations carried out in this phase include:

- Development of the API layer. The API comprises 85 endpoints that belong to 21 different subject areas, and cover the full functionality available to auditors in the iBRoad2EPC software.
- Development of the TypeScript/React client side application that consumes the API and serves as a proof of concept implementation.
- Development of the API documentation.

  For APIs, good documentation is essential, and a lot of effort has been put into providing top-notch documentation (Figure 4). The documentation can be consulted at the following URL:

  https://staging.ibroad2epc.blue-planet.be/api/docs

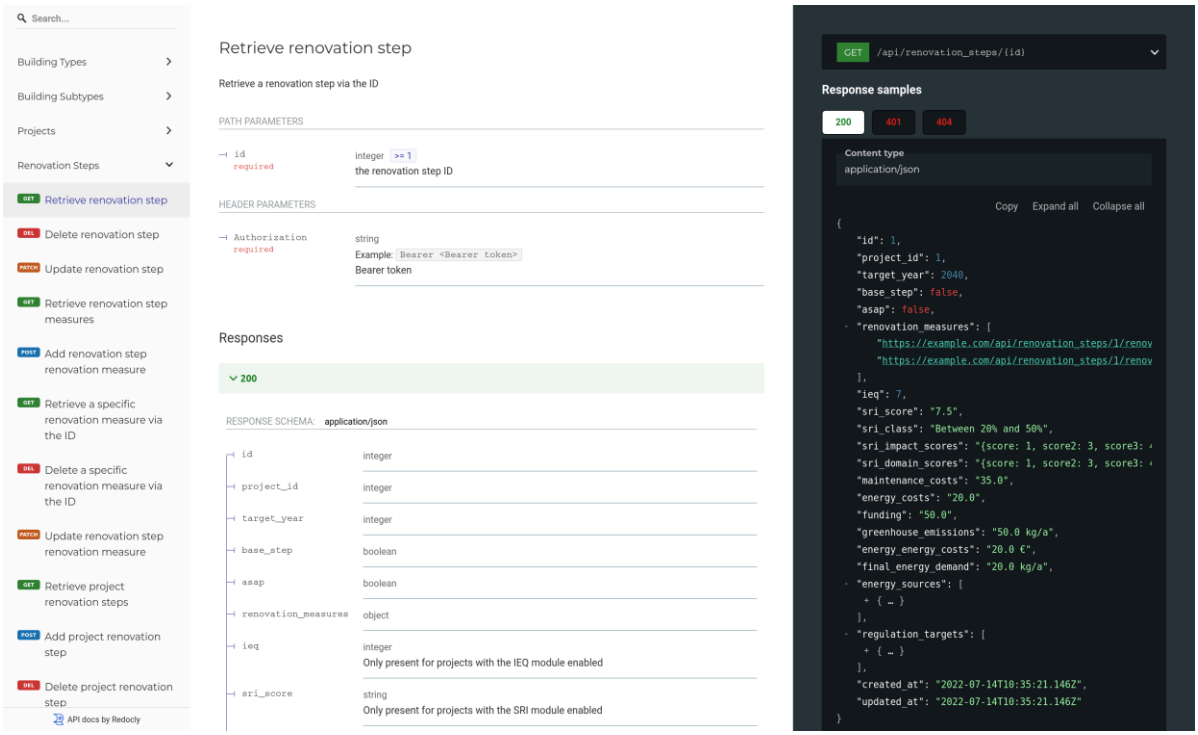

Figure 4. Screenshot of the iBRoad2EPC API documentation.

4. GETTING ACCESS

The tools developed under iBRoad2EPC are aimed at national and regional authorities, research institutions, energy agencies and other key stakeholders. Individuals and organisations interested in the iBRoad2EPC tools can request access by emailing contact@ibroad2epc.eu.

Software developers interested in using the API will need the following:

- An API key
- At least one auditor account (since any project is created under the name of a specific auditor).

Software developers can email contact@ibroad2epc.eu to request access and will receive the above and the related documentation to get started.

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