BuiltHub

DELIVERABLE D3.4: Platform services development

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Disclaimer

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List of abbreviations

BSO	Building Stock Observatory
CSV	Comma-Separated Values
D	Deliverable
EC	European Commission
EU	European Union
FAIR	findability, accessibility, interoperability, and reusability
GA	Grant Agreement
NUTS	Nomenclature of Territorial Units for Statistics
SPARQL	Protocol and RDF Query Language
T	Task

1. Executive summary

The present deliverable D3.4 of the Horizon 2020 BuiltHub project has two main objectives:

The first is to clarify the basic development idea behind the creation of the BuiltHub platform, describing the main features that will characterize the platform itself. The main features and graphical designs will not be shown through screenshots since they are not yet finalized. A reduced number of them will be however shown through schemes since they are currently under development. **It is worth reminding however that all what is described and shown in this deliverable is just a first draft of what the final BuiltHub platform could include.**

The second major objective of this deliverable is to create the basis for Task 3 (Focus group). Starting from the platform features and functioning described in D3.4, and through the testing of the alpha-version of the BuiltHub platform, this focus group will in fact allow the possibility to the consortium partners to provide a feedback and contributions regarding the platform features and amelioration. Deliverables D3.4 and then D3.3 (Focus group report) are part of a self-amelioration process, which will lead to have an end version of the BuiltHub platform as most as possible in line for fulfilling the stakeholders' requirements.

The Building Stock Observatory (BSO) [1] is the starting point for the development of the BuiltHub platform, as already mentioned in Deliverable D3.1 [2]. However, the BSO presents a number of limitations which need to be ameliorated. The BSO functionalities will be clearly included and restructured in the BuiltHub platform itself, which will then also provide further functionalities in order to offer a higher-level service to the final users and to better meet the requirements of the stakeholders. The functionalities described in this deliverable have been internally discussed with partners and will be ameliorated by the contribution of Task 3.3 and its focus group.

2. Introduction

The main basic functionalities of the BuiltHub platform will be deepened in this deliverable. The aim is to allow readers to have a first idea of how the preliminary version of the BuiltHub platform could look like and what could be the main functionalities and features offered by the platform itself. The creation of these general indications for the development of the BuiltHub platform will allow the consortium to have a solid basis to use for the self-amelioration process carried out in Task 3.3 through the involvement and consultation of a focus group. The focus group will provide ideas for better meeting the needs of the end-users, to increase the efficacy of the platform itself and to provide a better final service to the community. A reduced number of the platform features and graphical designs will be shown through schemes since the majority of these items are currently under development. The BuiltHub platform will use as a starting point for its development the Building Stock Observatory (BSO) [1] platform and its features and functionalities, restructuring them and increasing their efficacy. It will not only provide amelioration for the already implemented features of the BSO but also present further functionalities not implemented in the BSO itself, which could however represent a highly added value.

The deliverable is organized so to describe the main features related to the four main sections in which the BuiltHub platform is going to be divided:

- Database/Data-mapper
- Scenarios section
- SPARQL[1] entry point
- Download/Upload section.

In the aforementioned sections, which will be deepened in the next chapters, a number of the basic functionalities of the BSO platform are included and ameliorated. When possible, the implementation of the ameliorations will be described also through schemes. Among them it is worth mentioning the

(i) indicators description
(ii) metadata provision
(iii) visualization options for the data
(iv) the download possibilities
(v) quality control and statistical indications options
(vi) lower granularity data display
(vii) download and upload possibilities
(viii) future scenarios generation
(ix) the forum discussion function [3].

This process of clarification of the main features and functionalities of BuiltHub is of high importance in order to continue the development of the platform itself meeting the expectations of its main stakeholders. This means developing a product able to satisfy the needs of a multiple type of final users, such as, according to the Grant Agreement:

[1] **SPARQL**: recursive acronym for **SPARQL Protocol and RDF Query Language**), proposed by the World Wide Web Consortium (W3C), is a structured query language that retrieves and manipulates data stored in RDF (Resource Description Framework) format.

(a) researchers
(b) facility managers
(c) real estate developers
(d) utilities/aggregators
(e) policy makers
(f) designers
(g) citizens
(h) local and national authorities, etc.

The results in terms of efficacy of the BuiltHub platform will indeed be related to the meeting of the need of the aforementioned stakeholders, which are central to the BuiltHub Consortium.

3. BuiltHub platform main structure

As already mentioned in chapter 2, the BuiltHub platform is developed so to improve the service provided by the Building Stock Observatory (BSO) data platform [1]. It was decided to keep all useful features, functionalities and services provided by the BSO platform as a starting point for the development of the BuiltHub platform, aiming for a further amelioration of these services and implementing new functionalities for adding value to the new platform itself. The main impacts of the BuiltHub platform are related to the accessibility of the platform and how user friendly it will be. The actual structure of the BSO will be indeed modified and ameliorated. At the moment, the BSO platform mainly presents three separate sections:

- Database
- Data-mapper
- National/Thematic factsheets

A brief definition provided by the BSO itself of the three aforementioned sections is presented next:

- **Database:** The Database is a collection of data/information organized according to the spatial and temporal clustering available. The data are in this case organized according to different thematic areas and represented in tabular form, ready to be consulted or downloaded by the final users. The following Box 1 reports the description of the database provided by the BSO [1].

> "There are 250 indicators feeding into the BSO database. The indicators are organized according to ten thematic areas:
>
> - building stock characteristics
> - building shell performance
> - technical building systems
> - Nearly Zero-Energy Buildings
> - building renovation
> - energy consumption
> - certification
> - financing
> - energy poverty
> - energy market
>
> Every set of data can be viewed per topic, year and country, or the EU as a whole. Once you have selected the indicators, the data is presented in summary tables and graphs, with references to every data source. The sources come from EUROSTAT, the European Commission's Joint Research Centre (JRC), EU funded projects, data from national and official statistics in the EU countries, databases on energy performance certificates and data from market providers, among others."

Box 1: Database definition according to the BSO description [1].

The initial subdivision among the database section and the one of the data-mapper is something that the BuiltHub platform aims to overcome, creating a single section for accessing data in all possible formats available in the platform itself. This aspect will be better explained and illustrated in sub-chapters 3.1 and 3.3.

- **Data-mapper:** The data-mapper is a fundamental tool which allows the final users to visualize the data in a graphical format instead of the tabular one provided by the database. This results in a better comprehension of the analyzed data and allows a better and easier distribution to the final users. The BSO [1] provides a data-mapper, which presents some critical points. The BuiltHub platform aims to solve these critical points implementing an ameliorated data-mapper. The BSO data-mapper is based on a simple map at NUTS0 (Nomenclature of Territorial Units for Statistics) level allowing the selection of the countries in which the end user is interested in. Through a drop-down menu it is possible to select the desired indicator and time period. The only two maps/graphs provided are a colored gradient geographical map at NUTS0 and a simple bar chart. A basic description of the data-mapper provided by the BSO platform itself is reported in Box 2.

> **Data-Mapper according to the BSO description**
>
> "The BSO data-mapper is using maps and graphs to present indicators and allows users to compare the related information and data between EU countries."

Box 2: Data-Mapper definition according to the BSO description [1].

As already mentioned, concerning the BSO database, the data-mapper and the database of the BuiltHub platform will be united in a single section, in which data in all available formats can be reached. Furthermore, some more features and functionalities will be implemented for guaranteeing a better and more complete service to the end-users.

- **National/Thematic factsheets:** National factsheets are specific collections of data provided by the platform, which are elaborated and shown in order to provide to the final users a clearer view both on a specific thematic area and on a specific country. This means that the user will have the possibility to choose among the different indicators or among the different geographic areas represented in the platform itself. The platform will so provide specific graphs, plots, maps and comments about the selected indicators or areas. This is exactly what the BSO provides to its users [1]. A definition of the BSO national factsheets is provided in Box 3. A specific section for national or thematic factsheets will not be integrated in the BuiltHub platform since the new selection structure for the items to visualize already entails a similar function. This will be however more precisely explained and indicated in sub-chapter 3.3.

National factsheets according to the BSO description

"To promote and publish the results from the database, the BSO produces both thematic and country-specific factsheets that address the most relevant issues, present results in charts and tables, and provides customized descriptions of the data.

The factsheets present the most important features, including indicators and recommendations, in relation to implementation of EU buildings legislation. They also present key statistics, analysis, and policy context. The country-specific factsheets also provide a national policy context."

Box 3: National factsheets definition according to the BSO description [1].

National and thematic factsheets will not be relevant anymore given the new indicators selection systems that the BuiltHub platform will implement. Indeed, through the new selection system it will be possible to visualize all indicators available for a certain nation/geographic area or all nations available for a specifically selected indicator. This aspect will be better explained in sub-chapter 3.1.

3.1. Main structure of the BuiltHub platform

The main structure of the BuiltHub platform will be developed and implemented in the most user-friendly way possible. The research for specific indicators will be facilitated through a new "search system", which will also allow to have a clear view which data are available and for which geographic area. This "search system" will be discussed and detailed in sub-chapter 3.3.

The BuiltHub platform will be structured in four main sections, providing different services to the end-user and whom access will be granted through a registration. More details concerning the registration modalities and use are provided in sub-chapter 3.2. The four main sections in which the BuiltHub platform will be subdivided are the following:

- Database/Data-mapper section
- Scenarios section
- SPARQL entry point
- Upload/Download section

The aforementioned sections are shown in a schematic representation in Figure 1. More information concerning the four sections can be found in the following sub-chapters in this document.

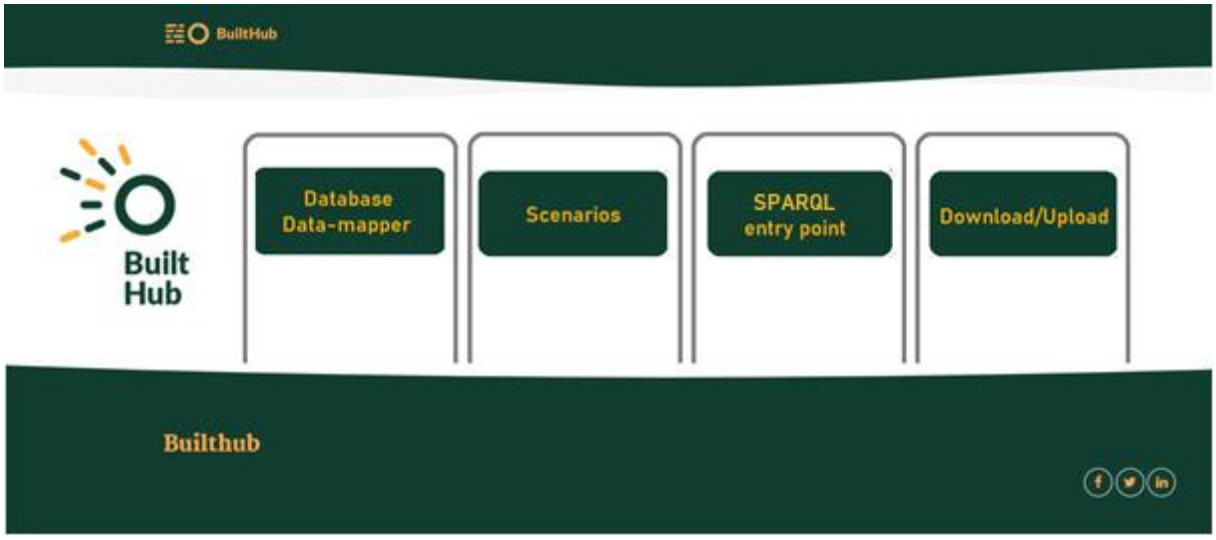

Figure 1: Wireframe of the four main sections accessible by the BuiltHub platform: Database/Data-mapper, scenarios section, SPARQL entry point, and Download/Upload section.

The first section (Database/data-mapper) is open to all end-users. It is the main interface of the platform and is the part of the platform where all data available can be queried. One of the limits of the BSO platform is the division between the database and the data-mapper, which does not allow a smooth navigation through the available data and data representation formats for the end-users. This subdivision is eliminated by the BuiltHub platform, in which a single section for the access to all the data types and formats is present. This section of the platform will be deepened in sub-chapter 3.3.

The second section, related to the generation of future scenarios, will use transparently described models that combine platform data with input settings provided by the end-users and process them to provide the desired outputs to the end-users. The algorithms developed and implemented in the BuiltHub platform itself will allow the end-users to have a clear vision of the possible effect on the future scenarios by modifying the input parameters provided by themselves. More details are provided in sub-chapter 3.4.

The third section, called SPARQL entry point, is indicated for advanced end-users. The platform will give them the possibility to code and launch their own queries. An example of application related to the SPARQL entry point is the possibility to create a search for multiple data types in one go within the BuiltHub platform itself. More information concerning this section is provided in sub-chapter 3.5.

The last section is labeled Upload/Download. Some restrictions related to the users' rights to access its functionalities are envisioned (see sub-chapter 3.2). In this section it will be possible to both download and upload data in raw format. Raw datasets will be ready for the download so to allow users to use and elaborate them. It will also be possible to provide data/datasets to the platform via an upload function and the data will be subjected to a quality check before the actual operation. More information concerning this section can be found in sub-chapter 3.6.

3.2. Access modalities

Given the structure of the platform, different levels of access will be granted to the end-users. It is necessary to distinguish simple data users from those who also provide data and from users with more technical skills capable to access and use the SPARQL entry point. This distinction can be done through an access portal. End-users will need to register to the service and thus will have access to different areas according to their credentials. Figure 2 shows a mock-up of how the access portal of the BuiltHub platform could appear to the end-users.

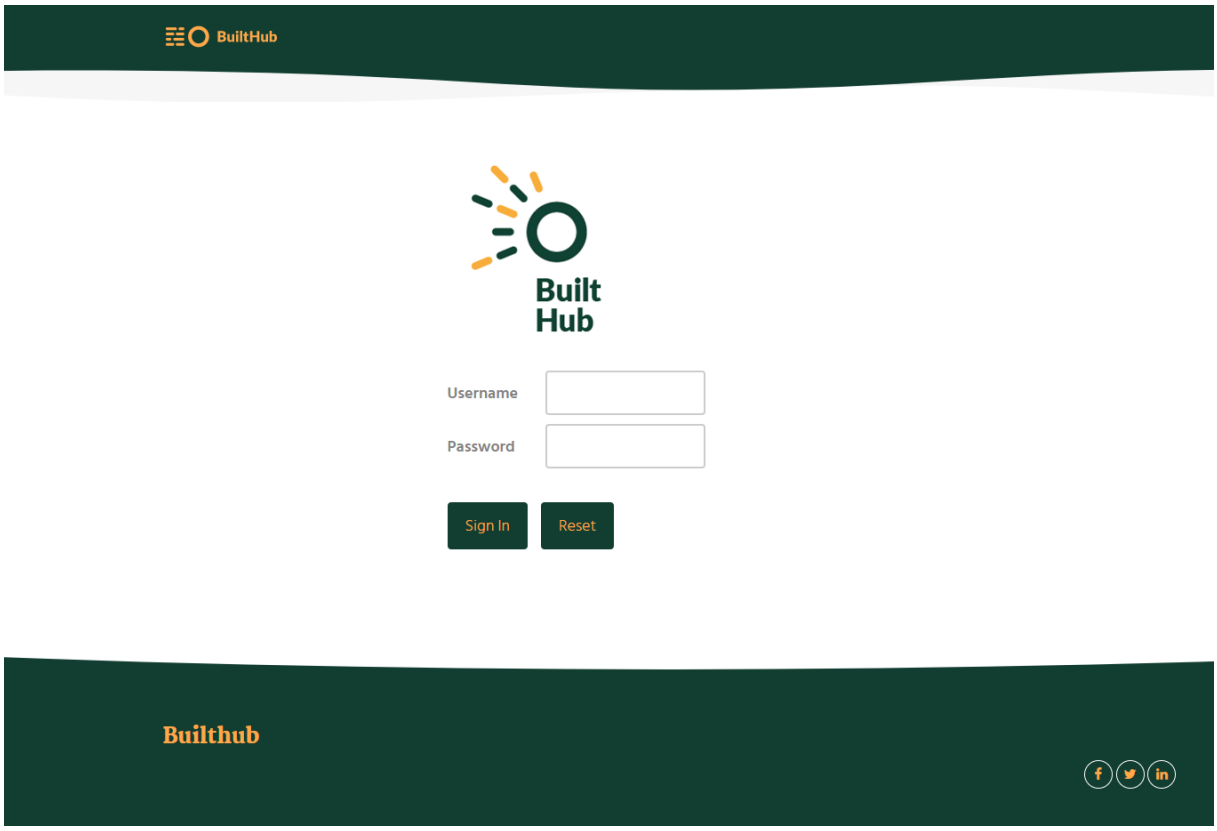

Figure 2: Mock-up and representation of the access portal to the BuiltHub platform.

The use of a registration system will also allow to monitor the use of the platform and understanding which services are most used and appreciated by the end-users, aiming future improvements.

The registration system could also serve for providing added services or functionalities for end-users sharing data and not only downloading/using the data already present in the platform. This could indeed be an incentive for data providers to share their knowledge and upload data/information in the platform, contributing so to the development of the BuiltHub community itself.

3.3. Database/Data-mapper section

In this chapter the most relevant ameliorations and focus points of the database/data-mapper have been reported:

- **Improved smoothness of navigation and user-friendliness**

The BSO presents a clear and well-defined distinction between the database and the data-mapper, not allowing the end-users to smoothly move from one to the other [1]. This distinction represents an obstacle to the user friendliness of the platform and thus it has been decided to remove it by creating a single section. It should always be possible to change data visualization format from tabular to graphical, without changing the section used, as it was for example in the BSO platform (Database). This section will allow the end-users to easily navigate through the available data in the platform choosing which type of data to visualize or download and in which visual representation. This important aspect of the new BuiltHub platform can be resumed in an improved smoothness of navigation and user-friendliness

- **New "search system" for the selection of indicators**
- **Display of only available indicators – no blank pages shown**

This aspect is also sustained by the development of a new search system, allowing the end-users to have a better navigation through the available indicators. This new mechanism is not based as the one of the BSO on the visualization of all indicators/nations but on the selection of a geographic area for which a list of all available indicators will be displayed in such a way that the end-user can only request data effectively available. The same approach can be used the other way round, by letting the end-user selecting an indicator and showing for which nations/geographic area this indicator is available. In this way it will not happen as it was for the BSO to search for an indicator and get a message that no results were found. These aspects can be resumed in the two aforementioned bullet points.

- **New indicators provision with respect to the BSO**
- **Provision of clear definition of the indicators**

The indicators provided by the BSO differ from the ones provided by the BuiltHub platform. They consist indeed of a selection of the most relevant ones provided by the BSO and a set of newly selected by the BuiltHub Consortium according to what was written in the Grant Agreement (GA). In this regard it is worth mentioning the indicators related to smart readiness of buildings, indoor environment comfort and electric mobility. The new main thematic areas available in the BuiltHub platform are energy, building stock, building characteristics, certification, finance, indoor environment, climate, e-mobility, and smart grid readiness. Furthermore, the clearness of the displayed indicators has been improved. The BSO is indeed not providing any information concerning the indicator but the name of the indicator itself. The BuiltHub platform aims to provide to the end-users a clear definition and explanation of the selected indicator. This feature could be developed by letting the definition appear once moved the mouse on top of the name of the indicator. Further technical solutions could be implemented. This means providing the end-users with new and better-defined indicators.

This aspect is also schematized in the following Figure 3.

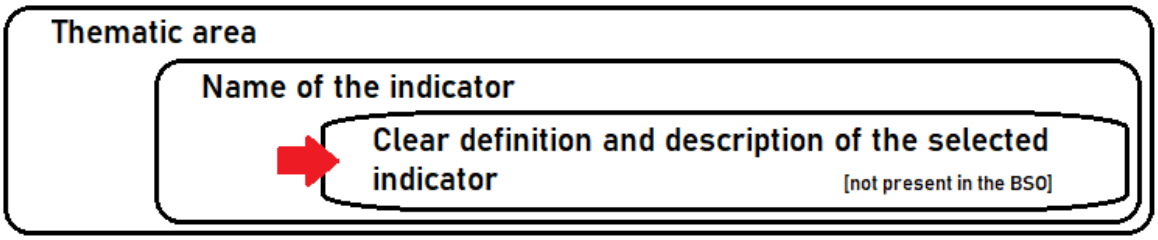

Figure 3: Definition scheme of the available indicators in the BuiltHub platform.

- **Improved metadata provision**

One of the most critical points of the BSO is the poor provision of metadata [1]. Often referred to as data that describes other data, metadata is structured reference data that helps to sort and identify attributes of the information it describes. Metadata are indeed fundamental for guaranteeing a high-quality level service to the end-users. As already explained in both deliverables D3.1 and D3.2 of the BuiltHub project, metadata need to guarantee the FAIRness of the provided data (Findability, Accessibility, Interoperability, and Reusability) [4]. For end-users it is fundamental to have the possibility to clearly trace the displayed data back to their original source. In order to achieve this target, the Schema.org [8] and Data-Cite [7] schemas have been used as a basis for the creation of a list of fundamental metadata to be collected. More specifically, the metadata collected are the following: Name, Content, Author/s, Dataset URL, Reference and publication year, Spatial extension, Granularity, Methodology URL, Methodology description, Accuracy, Completeness, Source, Access, License, Terms of Use, Source type. The visualization possibilities of the metadata are strictly related to the type of visual representation of the data themselves (tabular, plot, map, etc.). Technical solutions for linking the data to the metadata and allowing users to access, download, and show metadata on the BuiltHub platform will be developed along the project. The provision of improved metadata is a relevant added value of the BuiltHub platform.

- **Data for the same indicator coming from multiple sources**

One of the additional services the BuiltHub platform will provide is the possibility to collect data from different sources. This means that for a specific indicator/year/granularity there could be the possibility to have multiple values provided by multiple different sources. The final users will be able to compare and choose among the provided data which one in their opinion is the best for their purposes. BuiltHub will not comment on the provided data quality but will give the possibility to the end-users via the Openmode forum to discuss the provided data [4], see below.

- **Openmode forum access for end-users (Community added value)**

The access to the Openmode forum will be granted to all registered users, allowing them to discuss and provide added value to the community through their comments. The access modalities to the forum are still to be defined. The possibility to have interactions among the different end-users of the BuiltHub platform is a fundamental added value that the platform aims to provide.

- **Improved visualization options (plots, graphs, etc.)**
- **Multiple indicators display and download**

The BuiltHub platform intends to improve the possibilities, also visually, to interconnect different indicators at the same time. One of the main limitations of the BSO database was indeed to allow the visualization of only one indicator per time [1]. This aspect will be improved in the BuiltHub platform, which will give the possibility to the final users to visualize more indicators at the same time through multiple axes graphs or single plots containing multiple indicators. The user friendliness of the platform will allow end-users to visualize and compare different indicators they might need to analyse. This will be possible both in tabular form and in graphical form. The display modalities are strictly connected to the type of visual representation chosen by the end-user (bar chart, pie chart, tabular representation, etc.). Even for single indicators chosen by the end-users it will be possible to choose among a set of pre-set graphical representations and to allow users to visualize the chosen data in the way they prefer. This is an important added value proposed by the BuiltHub platform, since only bar charts and tables are available in the BSO. The possibility of visualizing multiple indicators at one time is clearly reflected also in the download options. The added values are in this case improved visualization and multiple indicator display/download possibilities.

- **Higher granularity than NUTS0 will be available**
- **Updated visual geographical representation (to be explored)**

The data visualization is one of the most important aspects in a platform collecting and distributing data such as the BSO or BuiltHub. The data will be provided in different forms in the database/data-mapper. Multiple types of maps/graphs/plots such as pie charts, bar charts and more will be included. Final users will be allowed to choose the type of graphical representation according to their needs. A further important visual representation option is related to the use of color gradient geographical maps. The geographical maps will allow the users to explore granularities higher than the NUTS0 level guaranteed by the BSO data-mapper. This will be based on the open-street map [5] and its integration with the open-source software Pentaho [6]. A visual representation is given in Figure 4. This graphical implementation will guarantee to have a more modern and effective visualization system, which will allow the final users to navigate the maps more freely and easily. Higher granularity than NUTS0 data will be available, and the visual geographical representation will be updated.

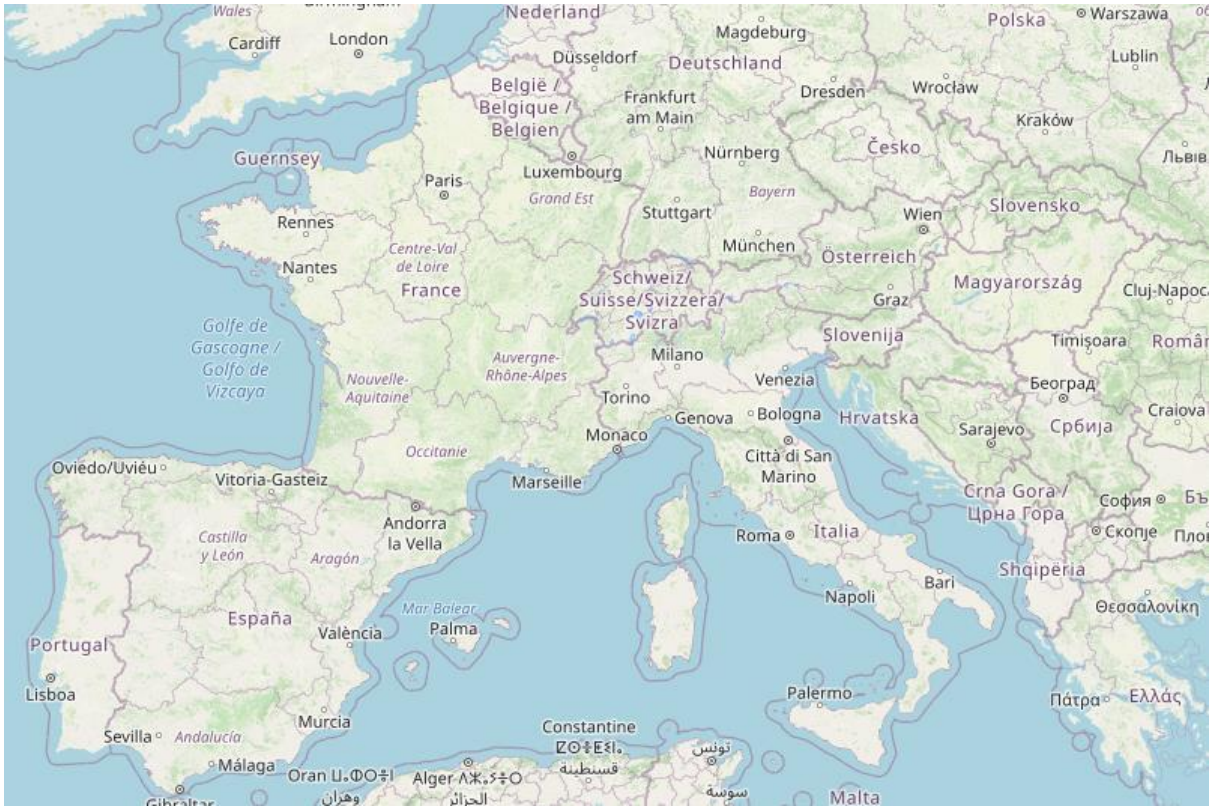

Figure 4: Open-street map - geographical map used in the BuiltHub platform database [5].

- **Integration of statistical parameters related to the selected data**

A further interesting functionality provided by the new BuiltHub platform is the integration of statistical parameters once data of interest is selected. More specifically, data such as the average value, minimum and maximum values and percentiles of the selected data can be provided by the platform (e.g. selecting the data at NUTS0 for the whole EU27 member states energy consumption for heating, the aforementioned statistical data should be provided for the EU27 as a whole considering the single Member States data). According to the type of graphical representation chosen by the end-users, the statistical parameters will be presented in different formats. An example can be the choice of bar charts, in which the aforementioned statistical parameters can be represented through horizontal lines.

- **Enlarged download possibilities**

As for the BSO, data can also be downloaded for offline use or further elaborations. The BSO only allows data to be downloaded in CSV, JPG, PNG, SVG and PDF format (according to the type of visual representation chosen). The BuiltHub platform aims to enhance this service by making available a wider range of download options to the end-users. Furthermore, the platform will also provide the possibility to download raw data form the specific section Upload/Download (see sub-chapter 3.6), which might have some restrictions related to its level of access (registration to the platform required, please see sub-chapter 3.2).

The Table 1 summarizes all the aforementioned added values and functionalities. They cover a wide range of aspects, starting from the smoothness of the platform and its user friendliness to more technical aspects such as download and visualization options. Please always note

that this deliverable only provides general indications and changes to the structure and functionalities of the platform that might be implemented in the future months. Furthermore, this basis will serve as a starting point for Task 3.3 described by the Grant Agreement, in which a focus group will be organized for further enhancing the quality of the platform and of its services.

Table 1: Summary of the main added values and functionalities integrated in the Database/Data-mapper section of the BuiltHub platform.

Added values and functionalities integrated in the BuiltHub platform "Database/Data-mapper" section
Improved smoothness of navigation and user-friendliness
New "search system" for the selection of indicators
Display of only available indicators – no blank pages shown
New indicators provision
Provision of clear definition of the indicators
Improved metadata provision
Multiple sources data available
Openmode forum access for end-users (Community added value)
Improved visualization options (plots, graphs, etc.)
Multiple indicators display and download
Lower granularity than NUTS 0 (Nomenclature of Territorial Units for Statistics) will be available
Updated visual geographical representation (Geographical maps to be explored)
Integration of statistical parameters related to the selected data
Enlarged download possibilities

This section (Database/Data-mapper) will be the first and most utilized interface between the end-users and the platform itself. It entails indeed all collected data, and it represents the most user-friendly and easy search engine for data on the platform itself. It is so important to create a section as much in line with the end-user needs as possible, guaranteeing them the necessary aspects related to usability.

3.4. Scenarios section

The scenarios section is one of the most advanced and innovative parts of the BuiltHub platform. While the BSO platform was limited to the collection and diffusion of data/information, BuiltHub aims to provide to the end-users a service for the elaboration of data. More

specifically, the possibility to assess values for the short-term and mid-term by inserting input data and exploiting the models offered by the platform will be given. The possibility of creating new own scenarios is strictly related to the type of registration to the platform chosen. A business model related to this possibility will be developed by the consortium. This section of the platform will offer a collection of parameterized models. Once chosen by the end-users and provided with the required input data, the models are executed, and outputs shown. This process is shown in Figure 5. A fundamental added value provided by the BuiltHub platform will be the forecasting engine that will be incorporated into the platform.

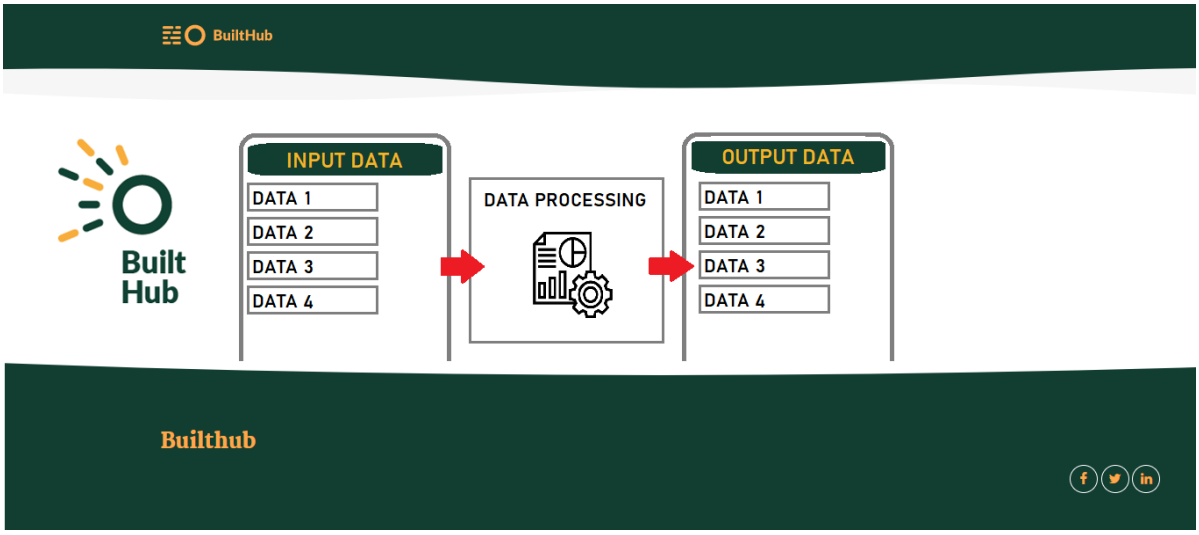

Figure 5: Future scenarios working process scheme.

3.5. SPARQL entry point section

The SPARQL entry point is a section dedicated to technically experienced users, giving them the possibility to code personal queries accessing specific data. This allows automation and saving time and effort for the research of data, which would otherwise be done through the Database/Data-mapper section. Multiple queries can be done by the end users and data can be downloaded in multiple formats, such as CSV and/or JSON. The possibility to download data in different formats represents an important added value provided to the end-users.

3.6. Upload/Download section

This section will be accessible only to partners or to data providers. It gives end users the possibility to access raw data/information. This is something which is not possible to access by all end-users, whom would otherwise be able to only access the elaborated data provided in the Database/Data-mapper. The access to this section will be restricted according to the business model the Consortium will develop. End-users such as BuiltHub partners, data providers, etc. will clearly have some advantages. As for the other section (Database and SPARQL section) multiple options for the download formats will be provided. This section, as already mentioned, will be not only useful for the download of raw data, but also for the data provision. Authorized users will have the possibility to provide their data, which will have to

pass conformity and quality checks and ETL (Extract, Transform, Load) procedures to allow integration into the database and data-mapper in a structured and compatible format.

4. Stakeholders' needs

This chapter entails the results of the stakeholders' dialogues carried out in WP2, relating them to the actual services and functionalities provided by the BuiltHub platform. This qualitative analysis has been carried out dividing the stakeholders in the following categories: i. Policy makers, ii. Researchers, iii. Utilities, iv. Designers, v. Real estate developers, and vi. Civil society. These categories of stakeholders have been analyzed and reported in the following paragraphs:

i. Policy makers (End user):

Policy makers are among the most relevant stakeholders of the BuiltHub platform thus the platform aims to provide them with an excellent service according to their needs, as it will be done for all stakeholders. During the stakeholders' dialogues carried out in WP2, policy makers expressed their need for a user-friendly platform for data collection and analysis. For this reason, the BuiltHub platform aims to provide a wide range of indicators (e.g. smart meters, nearly zero-energy buildings indicators, building renovation related indicators, renovation rates, and financing etc.), organizing them in a clear and comprehensive way. Data will be organized in both tabular and graphical/geographical form, and a variety of download possibilities will be given to end-users. According to the stakeholders' consultations, the platform should further provide functionalities such as calculation models for the renovation sector and insights into buildings characteristics. This type of service is provided by the "future scenarios" section, allowing to produce different possible scenarios for different indicators entailed in the platform itself. Given the expressed desire of stakeholders to have higher spatial granularity data, the BuiltHub platform will provide, if available, not only data at European or national level, but also at lower granularity or even municipality level (NUTS3 and LAU2), both in tabular or graphical form, or through geographical maps. BuiltHub will guaranty the findability, accessibility, interoperability, and reusability (FAIRness) of the data collected in its platform, guaranteeing so a high-quality level data for policy makers by providing data for research and analysis of future pathways and to assess the impact of policies. In this regard, policy makers will be allowed to use the graphical tools provided by the BuiltHub platform for comparing data of different nature within the platform. In order to provide solely reliable data to end-users, a high number and high-quality level of metadata is collected for every information entailed in the data hub. Among these, licenses for the terms of use of the data are reported to ensure that end-users will use the provided data in compliance with the terms of use. By accessing the BuitHub platform, end users will also be able to find useful data related to building stock characteristics, certifications, energy consumption, financing, etc. Policy makers will also be allowed to access data through an interactive geographical map, allowing the data filtering, selection, and display at all available spatial granularity levels.

ii. Researchers (Lead user):

According to the stakeholder's dialogues carried in WP2, researchers expressed a strong interest in community building of data providers and users, in exchange and collection of data

via platform and in developing connections with industry. The BuiltHub platform will be accessible and of interest for several types of stakeholders providing and/or using data in the platform. Within the platform, a forum will be integrated. In this forum all stakeholders will be allowed to exchange opinions and comments related to topics and data shown in the platform. For example, when the platform will provide several data coming from different data sources for the same indicator, end-users will be able to discuss about the quality of the provided data and which dataset in their opinion is better and for which purpose. This forum could so serve also end-users to provide feedback about the collected material. The presence of data coming from different data sources could give to the end users even the possibility to use them for comparison, validation, benchmarking, and cross-referencing operations. The presence of FAIR data and a complete and comprehensive set of metadata for each information/data provided, guarantees to researchers to have reliable data (when available, even links to the methodologies used for reporting the selected data will be provided). Among the most relevant data for researchers there are data related to indoor environmental quality (IEQ), NZEBs, CO_2 emissions, climatic data, real energy consumption, renovation of the building stock, which are all topics allowed for by the BuiltHub platform. The data collected in the platform could serve to researchers even for further analysis or for making future scenarios. More specifically, this last operation is already allowed and implemented in the BuiltHub platform, where it is specifically possible to find a section called “future scenarios”. The restriction of some areas and functionalities of the platform only to data providers could push researchers to decide to share their data on the BuiltHub platform. During the stakeholder’s dialogues carried out in WP2, it emerged the willingness of researchers to share data only when there is visibility for the organisation, privileged access, intellectual property protection/credit is given, and other services are reserved to data providers. According also to researcher’s requests data will be provided, when possible, also at lower granularity than NUTS0 and will be organized in meaningful and interesting infographics, allowing at the same time a high flexibility to the end-users for the download (a variety of different available format will be guaranteed: csv, json, jpg, xlsx, pdf, etc.) and display of the desired data.

iii. Utilities (Lead user):

As required by utilities, the BuiltHub platform will entail a variety of data, which can be displayed/reorganized and downloaded in several formats, guaranteeing to the end-users an easy access to them and the capabilities for analysis. Furthermore, through the open-mode forum available for all end-users it will be possible to interact with other community members. The community created around BuiltHub will likely grow in time, by integrating new end-users using or providing data or information. All uploaded material will be displayable not only in tabular form, but also in interesting and comprehensive infographics. All data will be downloadable in the different available forms (tabular, geographical, graphical, infographics, …) in different formats (csv, jpg, pdf, etc.). Utilities are interested in almost all data available, but the most interesting for them could be data related to socio-economic, environment, as well as health and well-being aspects. The BuiltHub platform entails information about environmental aspects (e.g. CO_2 emissions per sector) but does not have a proper focus on health and well-being related aspects due to a lack of available data.

iv. Designers (End user):

According to the stakeholder´s interviews carried out in WP2, designers ask for a single data platform and at the same time allowing the engagement with the data community. The BuiltHub platform entails in this regard a wide variety of data indicators (e.g. related to energy market statistics, CO_2 emissions, smart technologies, building energy certifications, IEQ, building stock, etc.) at a granularity level when possible lower than NUTS0 (e.g. NUTS3, LAU2, etc.). The presence in the BuiltHub platform of cross-sectoral data and data coming from multiple sources allows data analysis as well as comparison and benchmarking. The data on the platform will be accessible in different forms (e.g. tabular representation, graphical/geographical display etc.) allowing designers to display and download the data in different formats (e.g. csv, jpeg, json, etc.) and freely use them for analysis, development of energy efficiency solutions, life cycle analysis, environmental decision making, benchmarking, and building performance evaluation.

v. Real estate developer (Lead user):

One of the main interests expressed by real estate developers was to have a platform both providing data and allowing the engagement of relationships with other data users or data providers. This is one of the main objectives of the BuiltHub platform. The creation and enlargement of a data community is fundamental for the good development of this project. One of the ways for enforcing the interaction between end-users is the implementation of a forum, where it is given the possibility to comment and discuss about the data/information and services provided by the platform. Functionalities such as visualisation of uploaded datasets would be very useful for real estate developers. The BuiltHub platform aims to provide both guided graphical representation for the main indicators entailed in the platform itself but will leave as well high flexibility to the end-users for creating the graphical representations they feel more comfortable with. According to the stakeholders' dialogues carried out in WP2, real estate developers are mainly interested in data from the buildings and construction industry, EU, national and regional statistics and data from EPC registries; preferable thematic areas where data is needed are NZEBs, building stock characteristics, building envelope, certifications, indoor environmental quality and renovation. The data they could access through the platform would be used mainly for products and services development, benchmarking, decision making and calculation of scenarios. According to the WP2 stakeholders' dialogues, real estate developers would like to share data with provisions such as an agreement, intellectual property protection and in return access to data. Further, they would prefer machine readable and tabular data received through restful API and browser. One of the most interesting services for them provided by the BuiltHub platform is the possibility to access data through the SPARQL entry point, where data can be downloaded as well in json format.

vi. Civil society (End users):

The BuiltHub consortium is developing a platform, which is as user friendly as possible to guarantee an easy access to all types of end-users. More specifically, civil society end users would be interested in the platform to provide and exchange data, community participation and partnerships, data analysis and processing as well as easy to understand outcomes. In this regard the platform guarantees both the provision of the most relevant user-stories, related to comprehensive infographics, but also the provision of a more complex system of data search (SPARQL entry point) where all end-users can create their own queries retrieving in this way specific data or data representations. Furthermore, the other sections of the platform, such as

the scenarios section, allow end-users to easily create/utilise scenarios, goals and plans with enhanced access to data. The data entailed in the BuiltHub platform meet the requirements of the civil society end users, asking specifically for national and municipality level statistics, comparable data from different climate zones, data from EPC registries, energy consumption, smart meters and industry. Further, the civil society is highly interested in data themes such as building stock characteristics, building renovation, energy poverty, IEQ, financing schemes, and certifications. The data they can retrieve on the platform would be used mainly for training and education, research and analysis, impact assessment of policies, and development of energy efficiency solutions. The data provided should be related to reliable sources. More specifically, the BuiltHub platform aims to provide for every entailed data a complete and exhaustive set of metadata (e.g. author, title, link, methodology, publication year, link to the dataset, etc.). The provided data and metadata will be both available for online consultation and for downloading them. More specifically a wide set of different download formats will be provided (e.g. xlsx, csv, json, jpg, etc.)

5. Conclusions

The BuiltHub platform aims to provide a relevant amelioration of both the user-friendliness of the system interface and a more complete and exhaustive service also to more skilled users. For this reason, the structure of the platform, if compared to the BSO, has been completely rethought. A more user-friendly, intuitive, and rapid data search system has been implemented and the graphic display of data has been modernized and updated too. In addition to the graphical and system renovation, further services are provided by the platform. Among them is worth mentioning:

- the possibility to compare and download multiple indicators at the same time;
- the provision of statistical data/information related to the selected data;
- a deeply improved provision of metadata and more.

Concerning the data research and the data download possibilities relevant improvements have been proposed too:

- The possibility to access the database through the SPARQL entry point;
- having the possibility to generate own queries;
- download the selected data in formats such as CSV or JSON.

As already mentioned also in the introduction of this deliverable, it is important to remind the readers that the indications provided are just a preliminary version of the structure, features, and functionalities that the final version of the BuiltHub platform could have. This work will be the basis for the development of Task 3.3, where a focus group will be formed, in order to propose ameliorations and integrations to the basic version of the platform itself.

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