crossCert

Next-generation of Energy Performance Assessment and Certification

D4.2. Analysis of the current integration of EPC data

EREN (Spain)

Task 4.1 Integration of EPCs in the Administration databases

WP4 Increasing the value of EPCs

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EXECUTIVE SUMMARY

This document completes the proposed structure in D 4.1, and it carries out a full analysis of the gathered data. The objective of this document is to analyse the integration of EPCs in the Administration databases, helping the Consortium to identify the general current status of the existing databases and the barriers and challenges still to overcome to achieve fully interoperable and useful EPC databases.

The interim report D 4.1 showed the general composition of the assessed registers based on the energy and buildings parameters disclosed and available among crossCert countries' EPC databases. After having completed that quantitative analysis, further assessments needed to be made. In that sense, D 4.2 has been planned to focus and expand the information on the potential uses for EPC databases. Moreover, and basing the conclusions on partner's feedback and the extracted best practices, different guidelines have been proposed as a common road map to achieve harmonisation and potential value for the existing databases.

One of the prior clarifications that need to be made has been the establishment of a distinction around the concept of EPC database. Through D 4.2 and aiming to assess EPC integration in the Administration databases, it has been methodologically paramount to differ the subsequent tools that appear around the EPCs lifecycle:

- EPC – document.
- EPC repository – document storage.
- EPC database – dataset processing.
- EPC platform – interactive and interoperative dataset.

Presently, the EPC database has been understood as a global entity where every aspect of the EPCs is treated, but that reality is far from the actual situation. Therefore, the concepts of EPC storage, processing, interaction, and interoperability are readily understood. In addition, dividing concepts and tools allows the generation of tailor-made guidelines for each stage of the EPC life cycle.

As an added value for the EPC databases integration assessment, an EPC based estimation tool for building stock envelope renovation has been developed to exemplify the possible outreaches of EPC databases capabilities of interoperability. The objective of the aforementioned tool development has been the encouragement of the stakeholders, within the countries constituting the European Commission, to proceed with needed changes/adaptations in EPC databases to leverage finally from every undergone effort on those tools development.

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1. Introduction

In this task, the crossCert consortium is analysing how the current and next-generation EPCs can be integrated into relevant regional or national databases.

The Deliverable 4.2 is an extension of D 4.1, therefore it includes the subsequent analysis based on the criteria established in Task 4.1. This deliverable refines the desk research conducted in D 4.1, where the status of the existing EPC databases was determined by the gathered information through the survey responses from the project partners, which is included as an annex. When necessary, national and regional certification institutions are interviewed on the possibilities to integrate EPCs in the existing databases.

Findings from this work are paramount to determine the possibilities of digitising and integrating EPCs in the national/regional databases as well as detect barriers and challenges preventing the integration. Within this task the possibility of enabling user interactivity has been assessed, as well as the potential to use EPC databases in relation to other databases/applications/decision making processes (e.g. to map energy demands, paving the way for future heat/energy maps of the cities; elaboration of local renovation roadmaps, SEAPs and SECAPs, enhancement of policy-makers decisions or research by academic institutions) in order to provide technical/harmonisation guidelines to boost the interoperability of the existing EPC datasets with other administration tools.

To better define the barriers preventing different stakeholders to use EPC databases, the following stakeholder groups are analysed: public authorities, homeowners and citizens, ESCOs and researchers. The main objective is to determine the added value of the upgraded databases after understanding the existing challenges for each group.

After gathering the necessary information, potential improvements are proposed, followed by the analysis of their impact and the requirements for the Administrations databases. Furthermore, according to the general methodology of crossCert, provided analysis results with technical guidelines and harmonisation recommendations, consistent with an overview of the current best practices of the countries involved in crossCert.

As foreseen in the crossCert work programme, D4.2 completes the proposed structure in D 4.1, and it carries out a full analysis of the gathered data.

2. EPC databases general status

In this section, the basis for understanding how EPC databases are implemented among the consortium partners has been set. As a first step, the current EPC databases performance has been studied, before figuring the process of integration of EPCs into Administration databases.

This difference between EPC databases and Administration databases might lead to misunderstandings, with the need to clarify the different concepts related to EPC current data storage and management. The existing tools are EPC repositories/registers for storing data, EPC databases that use those repositories to manage data for specific purposes, and Administration databases that have been understood as broader data managers to achieve fixed objectives by linking different databases. The methodology has been defined to analyse the actual treatment of the EPCs among partner's country to assess the interactivity of EPC platforms, if existing.

Once the EPC file processing method has been established, it is possible to designate the EPC implementation in other databases or tools. This concept would be analysed by the EPCs interoperability rate, to be developed subsequently.

After explaining the methodology, the crossCert partners' EPC databases websites are presented.

Table 1 - EPC databases websites among crossCert countries.

Partner	Country	Database URL
EREN	Spain	https://servicios3.jcyl.es/cefe/
KAPE	Poland	https://rejestrcheb.mrit.gov.pl/rejestr-budynkow
IRI UL	Slovenia	https://www.energetika-portal.si/podrocja/energetika/energetske-izkaznice-stavb/register-energetskih-izkaznic/
ENEFFECT	Bulgaria	https://portal.seea.government.bg/en/IndustrialSystemsReport
CRES	Greece	https://www.buildingcert.gr
REGEA	Croatia	https://eenergetskicertifikat.mgipu.hr/login.html
AEA	Austria	https://www.energieausweise.net/
HWU	United Kingdom	https://www.gov.uk/find-energy-certificate
MIEMA	Malta	https://bca.org.mt/epcs/
ECNET	Denmark	https://sparenergi.dk/

Before examining potential issues concerning the integration of EPCs in the Administration databases, data collection has been conducted using the method outlined in the project deliverable *D2.4 EPC cross-testing procedure*. To update and ascertain the mentioned report data, information from the circulated survey among crossCert partners have been extracted.

According to the methodology, the succeeding table represents the prior parameters that need to be studied for the EPC databases. In that sense, the scale of the ECP registers is shown, together with the end-user access permission mode, the xml file registration possibility, and the general availability of building elements dataset.

Table 2 - EPC databases scale, access, registration file format and general available dataset.

Country	Scale	Access	xml	Available dataset	
				Envelope	Systems
Spain	Regional/National	Public	Yes	No	No
Poland	National	Partially public	Yes	No	No
Slovenia	National	Public	Yes	No	No
Bulgaria	National	Public	Yes	No	No
Greece	National	Restricted	Yes	Yes	Yes
Croatia	National	Public	Yes	No	No
Austria	Regional	Restricted	Yes	No	Yes
United Kingdom	Regional	Public	Yes	Yes	Yes
Malta	National	Restricted	Yes	No	No
Denmark	National	Public	Yes	Yes	Yes

The resulting information from this first approach to EPC registers user-experience lead to conclusion that most of the assessed countries have national EPCs registers. Besides, approximately the 70% of the assessed databases have public access to the EPC dataset platform, which seems a good sign prior to further analysis. Also, every assessed country uses xml files to process EPCs into databases, which is foreseen as a possible common element to achieve harmonisation.

The last two columns of the previous table disclose the first challenges. Every country possesses an EPC database (except Malta that runs a currently unavailable EPC repository), and a high percentage of partners have made public the general information of the EPCs, but the rest of the EPC information is not displayed. It seems clear that the **EPC databases have generally become repositories used as storage tools rather than managed user-friendly platforms. Pending further analysis, this is found as the first barrier**.

To conclude this initial assessment of the current status of EPC databases and visualization platforms, it is important to determine whether the consortium countries have fully digitised EPC databases rather than pdf non-interactive digital repositories.

The digitisation level among all participant countries has been assessed. Generally, all partners have a high level of digitalisation, but some of them need a significant improvement. The following graph shows that only Poland and Spain have completely digitalised their EPC databases.

Remedying this situation is the key to overcome many of the current barriers and challenges to the EPC integration into Administration databases. Furthermore, achieving a full digitisation level would be a major added value for all stakeholders interested in the EPC data and to achieve full interoperability with other Administration tools.

Nevertheless, with an average of 3.16 digitalisation rate over 5, it can be concluded that a significant number of the databases are digitised tools. This leads to conclusion that the percentage of integration of databases within the administration or organizations managing the EPCs is important, but not enough. For instance, only 30% of participants have rated the digitisation level of their country databases 4 or higher.

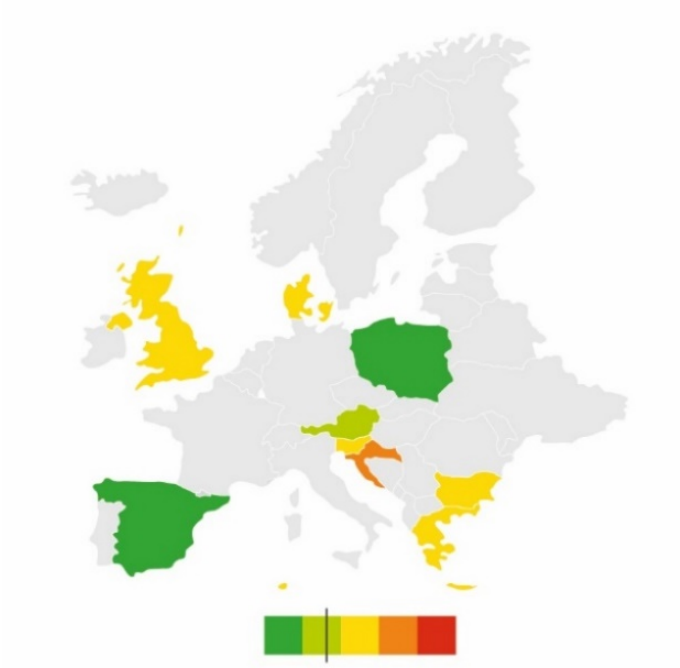


Figure 1 - Digitisation level among crossCert countries.

3. Quality assessment of EPC databases

In this section, after having checked the general parameters of the consortium databases, further analysis needs to be conducted to assess the quality of these EPC databases. The EPC platforms are usually accessible, but interactivity is the key to find the practical purpose regarding any end-user.

The methodology of the assessment is divided between:

- A questionnaire circulated among crossCert's partners, included in Annex 2 "Developed questionnaire to assess the current EPC databases", since access limitations and language barriers have occurred.

- The exploration of the EPC databases visualization platforms to experience the interaction. This second analysis enables to prove the availability of information, the easiness of understanding and platform use, as well as the direct barriers for a non-familiarised user.

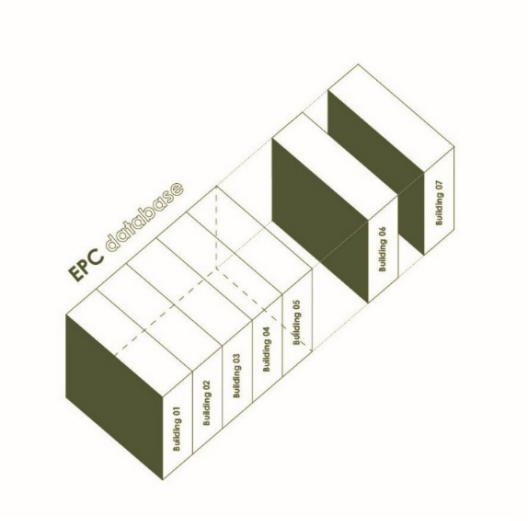


Figure 2 - EPC databases conceptual outline.

All the data gathered from the partners' contribution has been processed. Considering the different aspects that EPCs focus on, this assessment has been divided into following sections:

- EPC registration process
- General data broadcasting
- Buildings elements disclosure
- Energy performance indicators disclosure
- Energy efficiency recommendations disclosure
- Data accessibility and user interactivity

3.1. EPC registration process

One of the parameters to determine the registration process is defining who undertakes such task. All partners have been questioned whether this process is carried out by the building owners, the energy certifiers, both owners and certifiers or, otherwise the registration is performed by another stakeholder. The results are summarised in the following figure.

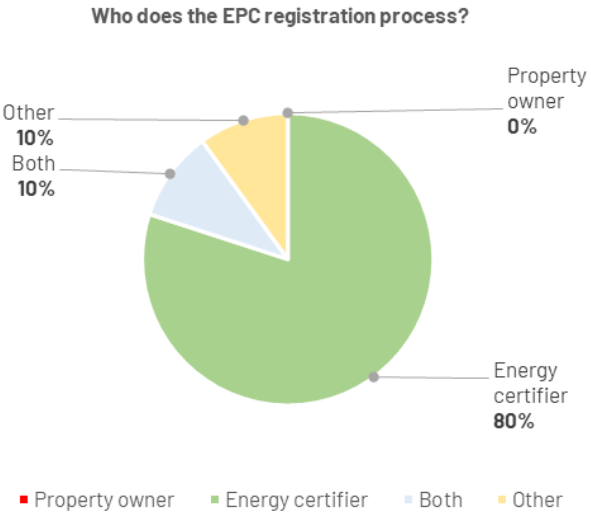


Figure 3 - EPC registration process analysis.

As the figure reveals, most countries rely on energy assessors to submit all the information required by the databases.

Besides, Bulgaria registers EPCs through a Sustainable Energy Development Agency, and in the United Kingdom their certifiers issue to the Accreditation Scheme who issues to the Government EPC register.

Likewise, the type of documents required in the submission process have been analysed. This assessment reveals that most of the countries register the xml and pdf files extracted from their EPC software. However, most databases do not request the registration of EPC software files.

Aside from this usually required documentation, Poland allows the issuers who have manually calculated the EPC values to enter them one by one into the register.

It is important to highlight that Bulgaria's assessors need to enter a considerably larger amount of documentation compared to other countries: energy audit report in pdf, scanned EPC signed and stamped, summary of the Energy audit in Microsoft Excel®.

3.2. General data broadcasting

Some metrics have been proposed to evaluate the general information each database shows when having registered an EPC. In this case, almost all countries display the same general information for the buildings. The next graph shows the statistical summary of the type of information displayed.

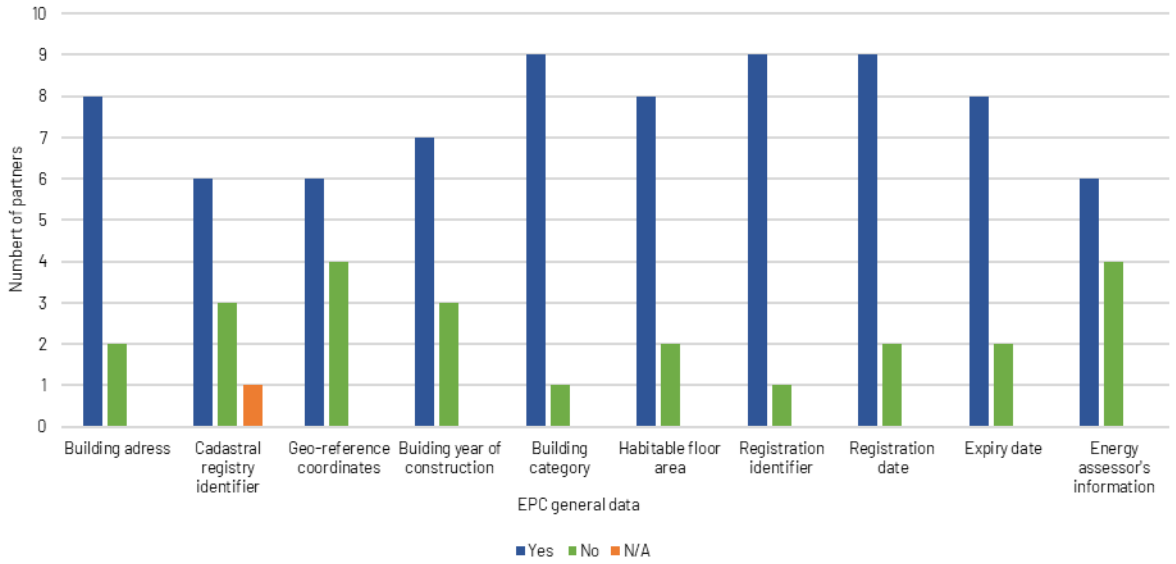


Figure 4 - EPC general data displayed in crossCert's registers.

Although it may seem that some parameters analysed are not related to EPC issues, such as geo-reference coordinates or cadastral identifiers, there is a reason for their inclusion, as these general parameters embody an option for EPCs interoperability with other Administration databases.

Consequently, countries that allow the disclosure of these non-energy related parameters would benefit from a wider dataset available to stakeholders, and the process of improvement of the usability of their databases would be easier.

As a conclusion, it is understandable to state that even though all countries are using xml files to manage the registration processes to build up EPC databases, and most of the registration agents are professional energy assessors, **wide differences on data disclosure occur**. This is producing a non-harmonized EPC databases environment among the assessed member states, expecting for this issue to be a reality among the rest of the EU countries.

3.3. Building elements disclosure

In this section of the quality assessment, it is determined if the EPC databases are disclosing the building elements. Displaying this data is fundamental for the databases to amplify the scope for any stakeholder interested. Besides, partners sharing information on thermal envelopes and technical systems are potentially keen to enable other administration to use those data.

The proposed evaluation has included the determination of whether databases show building envelope and technical systems features, e.g. their thermal performance, or the conservation status.

The analysis concludes with the following graph, where certifiers have rated (from 1, very bad, to 5, very good) the information on building elements shown in their EPC registers.

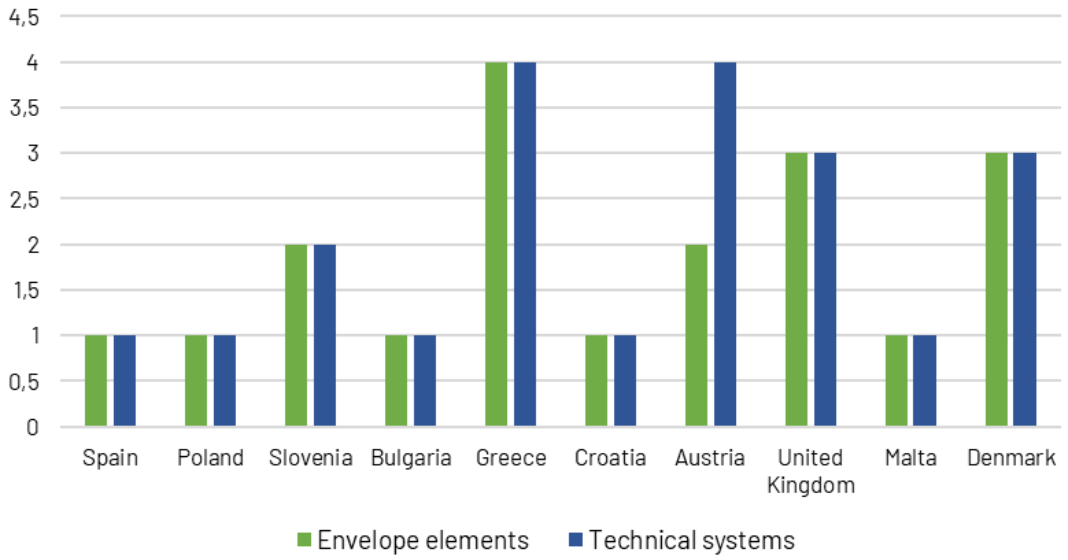


Figure 5 - Building elements parameters definition disclosed among crossCert's EPC databases.

It has been determined that most databases do not display these parameters. In particular, 30% of registers do not disclose any envelope elements, as this are only displayed in United Kingdom, Greece, and Denmark databases. Also, when disclosed, they are not fully described. Specifically, the conservation status of the building constructive elements is not presented by any EPC register except for Denmark's database. This reality presents a lack of available data to all stakeholders, generating a barrier that diminishes the added value of all data submitted to the registries.

The status of the technical systems is usually more available to database users compared with envelope elements. Nevertheless, even though 50% of registers are displaying information on existing technical systems of the assessed building, none is describing their conservation status.

For this reason, the description of building elements with focus on their conservation status should be included for dissemination in all EPC databases. Having access to that information would add great value to EPC databases by helping investors in making more informative investment decisions, or policymakers to design policies for building stock renovation.

3.4. Energy performance indicators disclosure

The next step of the analysis methodology is to focus on EPC results availability. In this case, the number of energy performance indicators that each registry allows access to have been evaluated. After defining the available indicators, the added value of the database for different stakeholders can be determined.

The next graph summarises the energy performance indicators available from the databases, at the same time defining the potentials for improvement.

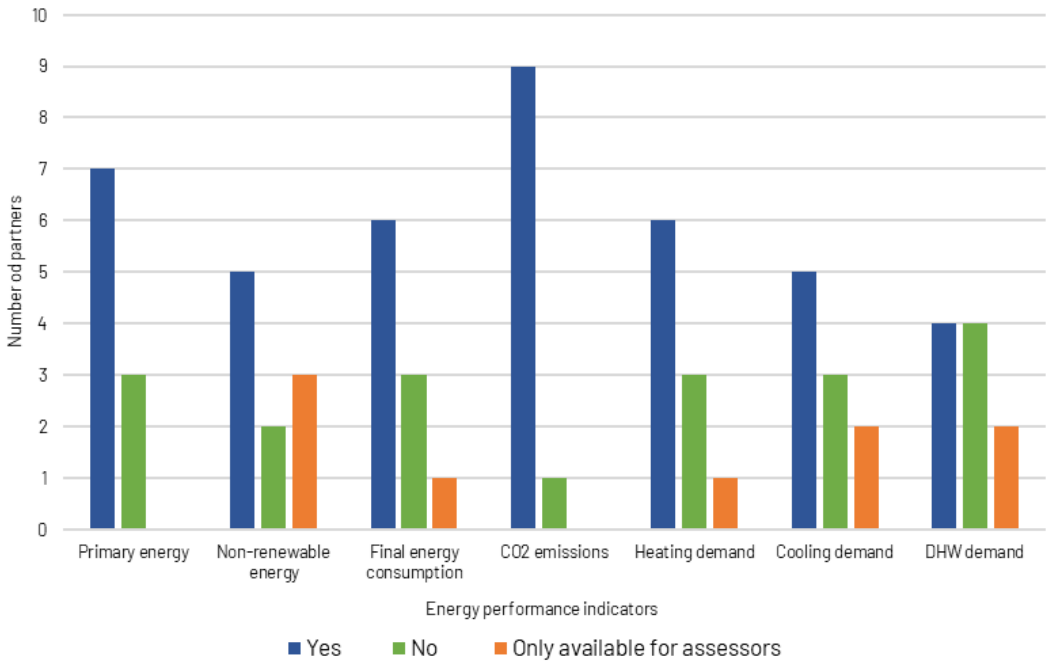


Figure 6 - Energy performance indicators disclosed on crossCert's EPC databases.

As expected, the results of the energy performance of the building assessment are widely disclosed. Nonetheless, it can be concluded that there is a lack of harmonisation among the consortium because the countries are using different indicators. CO_2 emissions appear in every assessed database, while energy demands are the least disclosed results (heating and cooling have higher appearance than DHW demands)

Although some disparity among partners has appeared in the presented table, it can be concluded that the energy indicators listed in the table above are broadly disclosed on the assessed registers, with an average of 74% availability between indicators and partners.

Poland, Spain, and Bulgaria are the countries that most need to improve their energy performance indicators disclosure.

As a recommendation, the countries which are not showing all energy indicators results should include them. In this case, Slovenia and Austria are ahead of the consortium being the only countries presenting all EPC indicators.

It is reasonable to state that not only total energy consumption or CO_2 emissions are important for the stakeholders. **When energy demands are not available, the database user is not able to have prior information on the possible building pathologies of the building elements, eventually producing a lack of investment decisions.**

3.5. Energy efficiency recommendations disclosure

Considering the recommendation measures within the databases, it has been concluded that only Bulgaria, Greece, Denmark, and the United Kingdom display the improvements recommended by issuers.

This is a barrier for countries that have not yet displayed such data in their registers. **When energy efficiency recommendations are shown, they allow stakeholders to know which investment should be made on buildings to improve their energy efficiency, in accordance with feasible renovations regarding the investment payback period.**

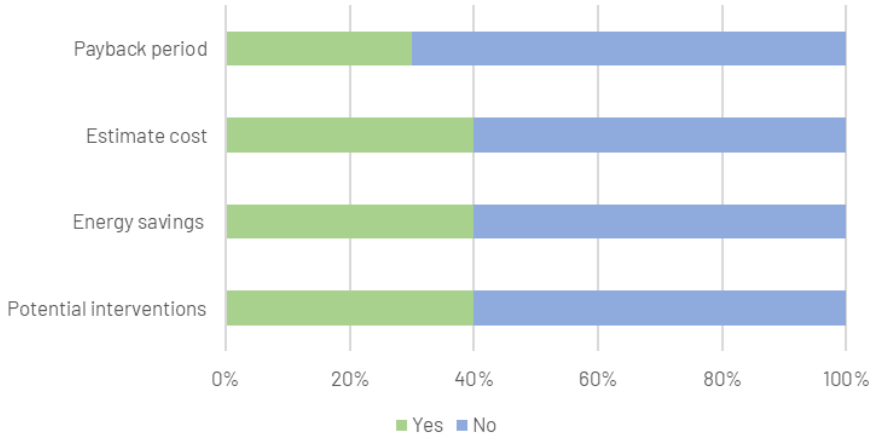


Figure 7 - Disclosure of energy efficiency recommendation parameters among the assessed EPC databases.

3.6. Data accessibility and user interactivity

In this section, data accessibility and user interactivity are assessed. Both parameters characterise databases as examples of good practices where stakeholders can use the available information. In this regard, the most accessible and interactive databases will be proposed as benchmarks for other country teams.

First, it is important to clarify the assessed conditions. The characteristic of accessibility has been analysed under two different assumptions.

On one hand, crossCert partners have elaborated on the type of access to the EPC databases. However, when analysing the **accessible data** of each platform it could be found that full public access may not lead to full access to the data contained in the database.

The next table shows both concepts and proposes an accessibility rate if the EPC databases allows to extract information and the access to the register is in public domain. It is needed to be highlighted that permitting data extraction does not mean that the information the end-user receives is complete (e.g., the Spanish database allows to extract information but only provides primary energy, CO_2 emissions and heating/cooling demands regarding EP aspects).

Table 3 - Data accessibility and user interactivity analysis.

Countries	Who can access registry data?	Does the database allow to extract information?	Accessibility rate
Spain	Public information.	Yes	**100%**
Poland	The only public data is information on persons authorized to draw up EPCs and information on public.	No	**25%**
Slovenia	Public with limited information and certifiers - every EPC with all information available in it.	Yes	**75%**
Bulgaria	Public information.	Yes	**100%**
Greece	Only available for energy assessors and registry administrators.	No	**25%**
Croatia	Energy certifiers can access to all data, while general public only have access to non-editable set of data.	Yes	**75%**
Austria	The EPC issuer and the building owner have only access to their certified uploaded building.	Yes	**50%**

United Kingdom	Public information.	No	**50%**
Malta	Registry data is only available to BCA. Assessors can only view their own EPCs.	No	**0%**
Denmark	Public information.	Yes	**100%**

It is direct to notice that the existing EPC databases have some barriers concerning data availability when around 70% of the consortium has public access to the information, and 60% has the possibility of extracting any information from the registers. However, it is simple to achieve a 100% accessibility rate by retrofitting some features of the database. The major issue presented by multiple partners preventing full access to EPC information is the data protection ruling in their countries. But, from a technical point of view, it would be feasible to harmonize the access to EPC datasets considering that every register is processing xml files.

On the other hand, regarding the user interactivity features available in each country, only 40% of the participants have answered that their databases allow the interaction with the dataset.

The analysis based on consortium feedback via collected questionnaires (included in Annex 2) was followed by evaluation of the level of user interactivity in practice, testing each EPC database website via links provided by partners (an empirical experience of the public EPC database platforms). The non-public registers have not been assessed for user interactivity. They have been considered as null interactive databases the non-public or with restricted access platforms, no matter how user-friendly the existing platform is.

After assessing the digital platform of each partner, different typologies can be determined of front-end for the EPC data disclosure:

- **Data sheet format**: the website, after filtering the needed parameters, deploys a set of different columns revealing several data from the EPC xml file. Some of these databases allow the user to extract the information in xsl or csv format. This dissemination structure does not make distinctions regarding different users.

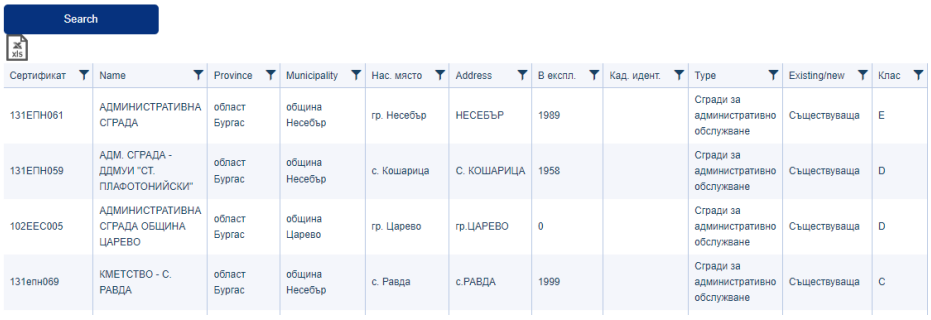
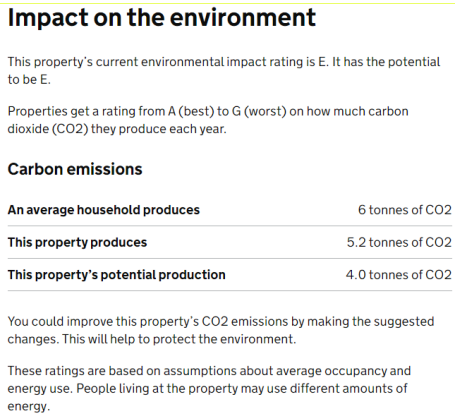


Figure 8 - Bulgarian EPC database front-end.

- **Text format**: the platform, after selecting a specific building, shows all the EPC information by generating a text. This dissemination structure appears to be helpful for stakeholders like building owners or tenants because the text usually clarifies some concepts.



Impact on the environment

This property's current environmental impact rating is E. It has the potential to be E.

Properties get a rating from A (best) to G (worst) on how much carbon dioxide (CO2) they produce each year.

Carbon emissions

An average household produces	6 tonnes of CO2
This property produces	5.2 tonnes of CO2
This property's potential production	4.0 tonnes of CO2

You could improve this property's CO2 emissions by making the suggested changes. This will help to protect the environment.

These ratings are based on assumptions about average occupancy and energy use. People living at the property may use different amounts of energy.

Figure 9 - United Kingdom EPC database front-end.

- **Map format**: the information appears on the screen over a cadastral or google maps template. Usually, this dissemination format shows the specific ratings (in a written pop up) of a building when selecting the property. Besides, other map format platforms pop up the building information in a different window after selecting the property.

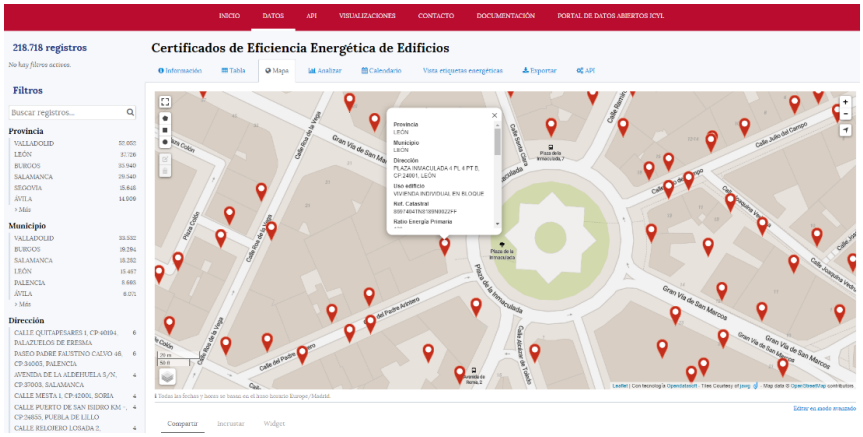


Figure 10 - Castilla y Leon EPC database front-end.

Each different visualization format has advantages and disadvantages. However, combining different dissemination structures might be the best technical guideline in achieving full user interactivity of any EPC database. Data sheet format is a useful tool for energy assessors or other technical agents because they are already familiar with the concepts. Nevertheless, the text or map formats seem closer to the citizens and decision makers.

The results for both metrics: accessibility and interaction, suggest that most partner countries should propose to enhance the conversion of the existing registries into user-friendly tools. Allowing interested stakeholders freely access to the information they need, significant value to the databases will be added.

3.7. Quality assessment conclusions

To sum up, the conclusions are going to be presented regarding EPC databases quality. This summary aims to provide a joint vision on the consortium fortes, but also the most troubling disadvantages. For that reason, the next infographics will represent this status by applying a colour scale (red to green), widely understandable:

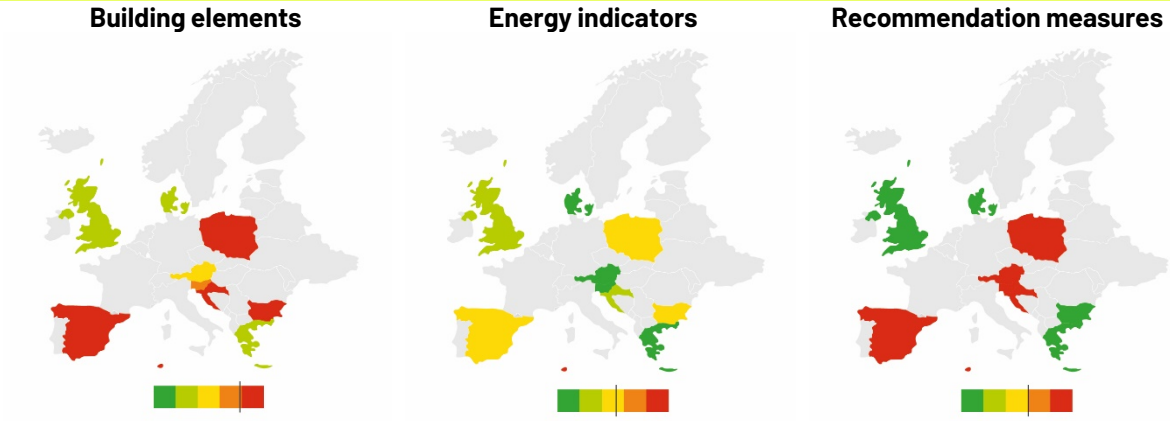


Figure 11 - Graphic outline of EPC databases parameters disclosure among crossCert partners.

As represented in the infographics, the consortium average on EPC displayed data in the existing databases is not very representative for good practices. Even though, some of the countries are in more advanced development situations. In this sense, the best practices regarding information dissemination for database users will be pointed out, which will help in harmonisation among EU countries.

- The databases should implement a full disclosure of EPC elements, directly extracted from the registered xml files. The assessed countries need to include, in general, further accessible information. More attention should be paid to building envelope elements (with focus on their conservation status), due to their importance in the European Union objectives for renovation.
- Although energy indicators are widely disclosed, they are focused on CO_2 emissions. This indicator is obviously the key for decarbonising purposes, but other parameters as final energy or any energy demand must not be left aside. Building owners are a little bit more familiar with the terms final energy demand or/and energy demand for space heating or warm water and make a connection to energy efficiency. CO2 emissions or primary energy demand is a too abstract and complex indicator for end users/building owners. Databases should display the following parameters throughout all EPC databases: CO_2 emissions, Primary Energy (renewable or non-renewable), Final Energy, and Energy demands (heating, cooling and DHW). Also, as a recommendation, the energy indicators that all countries should use on their databases should be normalised, helping to achieve a common language. Besides, these parameters are already inside the xml coding, therefore it should not be a complex issue to include them in any database.
- Other added value for enhancing the EPC databases quality is to include recommendation measures in the platforms. Less than 50% of crossCert partners have highlighted that their countries' registers are not sharing this kind of information. Most stakeholders would directly benefit from this dataset if available.
- Cadastral identifiers and georeferenced coordinates should also be included as part of the EPC databases accessible information. This will improve the EPC databases and facilitate interoperability with other Administration databases.
- A very important issue already expressed in this report is the need for achieving full digitalisation level. As a recommendation, financial incentives should be implemented to get a full digitalised EPC databases all over the European Union.
- Providing full access to any user interested in EPC data is paramount. Nowadays 4 out of 10 partners provide full access to EPC data, the other 60% of the consortium communicates different conditions or aforementioned restrictions.

4. Barriers for the integration of EPC into databases

In this section, the barriers and challenges will be identified for the existing EPC databases to achieve the highest quality level and to reach the needs for any stakeholder. Also, it is important to note that the integration of EPC in the Administration databases appears to be significantly accomplished, though not implemented for other Administration databases as reference data. This is a paramount observation to understand that the barriers to be assessed are related to the EPC databases themselves. Nonetheless, the interoperability issues have been analysed, which will provide some answers for the integration of EPC in other Administration databases. However, linking with other Administration tools will be assessed in different crossCert reports.

Some digitalisation and dissemination issues among some members notwithstanding, the main issue is not integration, but the added value of existing databases.

One of the biggest challenges is that not all databases are available to the public. This situation makes sense according to *"D2.2 Report on EPC best practices"* from the QualDeEPC project, which states that EPCs databases are facing a great lack of awareness, interest, and acceptance from the homeowners.

This assessment has been planned to focus on the stakeholders that have been considered potential end-users of EPC databases. Therefore, the study groups for the barriers will be: Public authorities, Energy Service Companies (ESCOs), Homeowners and citizens, and Researchers.

The following subsections show where crossCert partners find different types of barriers and challenges for the several stakeholders.

4.1. Digitization

Digitization refers to the process of converting physical information into digital formats, while digitalization is understood as the use of digital technologies to improve the operations and create value for the user.

After processing all partners' answers to the questionnaire, it is concluded that in general terms there are no problems with respect to this barrier. The countries that in the previous section showed the lowest digitization level are the ones that embody the greatest difficulties for stakeholders. Therefore, countries with a low digitization level of their EPC databases should begin working towards a full digitalisation. Aside, most of EPC databases among the consortium has digitalization issues which need to be overcome. This second concept causes a barrier preventing to use EPCs for other purposes and complicates to add value to the registered available dataset.

4.2. Interactivity

The next barrier is database interactivity, which is vital to provide added value for every stakeholder. Interaction is the ability to produce communication or reaction between EPC dataset and the user.

Contrary to digitisation, interactivity with the databases need to be improved for most of the partner countries for the databases to be useful for their users. Although some of the evaluated databases react to filters, only few of them actually provide a service to the user other than data extraction. For instance, an interactive database could have implemented an EPC analyser to issue reports on neighbourhood's energy performance.

Improving the database interactivity has become a major challenge for most countries. The interactive relation with an actual digital tool is an important step to enhance user friendliness.

4.3. Availability of information

Another barrier for almost all partner registries would be the information availability.

As most of the responses received have shown, the data recorded are not readily available to stakeholders. As a result, the use of the data is not being promoted and the databases risk becoming large information containers that nobody uses. Improving this database feature is one of the potential upgrades challenging the value addition expected to be achieved by all registries.

4.4. Understanding the available dataset

The last barrier to be analysed is the understanding of the EPC indicators displayed in the registers.

Even with a full EPC data disclosure, the concepts represented by these energy indicators may not be fully understood by the stakeholders. If this is the case, EPC databases would no longer have a value in terms of usability and would be reduced to large databases that citizens cannot use.

It has been concluded that for half of the countries in the consortium, 75% of the stakeholders who would use the information do not understand it. Bulgaria, Greece, and Croatia state that there is no barrier in this respect. Furthermore, the Austrian case shows a lack of understanding of the information on the part of authorities and owners, whereas companies and researchers do understand the data in their register. These results show an important barrier in the understanding of the available dataset. This barrier needs to be addressed in order to achieve usable databases that provide value to users.

4.5. Summary of barriers among partner databases

The presented graph displays the barriers assessed among the selected stakeholders. The graph represents the percentage of countries encountering the barriers for each group, so the closer to 100% the more barriers exist.

We can summarise that the most significant barriers currently facing the databases are the absence of certain key information and the difficulties for the interaction with the registered dataset. Additionally, promoting the dissemination of the concepts related to energy efficiency parameters is an important aspect for the increase of the usefulness of these databases to interested stakeholders.

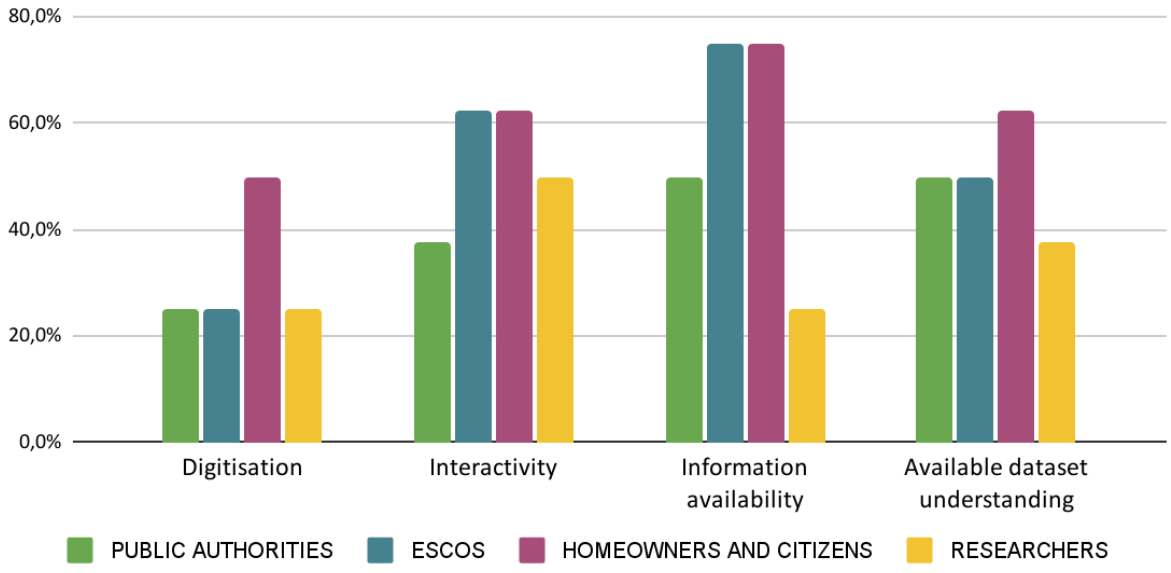


Figure 12 – Conclusions on stakeholders' identified barriers related to EPC databases interaction and use.

5. Technical guidelines and harmonisation

In this section a set of technical guidelines is proposed that would increase the value of the EPC integration in the Administration databases.

As part of the technical guidelines for the EPC databases, it is the key regarding the new EPBD proposal. The next lines provide very concrete objectives that need to be achieved for all EPC databases:

> *"Article 19. Databases for energy performance of buildings*
>
> *1. Each Member State shall set up a national database for energy performance of buildings which allows data to be gathered on the energy performance of individual buildings and on the overall energy performance of the national building stock.* ***The database shall be interoperable with other relevant online platforms and public services*** *and shall allow data to be gathered from all relevant sources related to energy performance certificates, inspections, the building renovation passport, the smart readiness indicator, energy building benchmarks and the calculated or metered energy consumption of the buildings covered. (…)*
>
> *2. The aggregated and anonymised* ***data of building stock shall be made publicly available****, in compliance with Union and national data protection rules. (…)*
>
> *6. For the purpose of ensuring coherence and consistency of information, Member States shall ensure that the national* ***database for energy performance of buildings is interoperable and integrated with other administrative databases*** *containing information on buildings, such as the national building cadastre and digital building logbooks."*

As a prior state for technical guidelines for EPC databases to add value, crossCert partners have expressed their input for potential improvements that could be implemented in each EPC database.

Table 4 - Potential improvements proposed by crossCert partners for their EPC databases.

Country	Potential improvements
Spain	To include more accessible data.
Poland	Ability to view data for other than public buildings, information on heat sources, statistics on average primary/final energy values, number of EPCs.
Slovenia	Public availability and database systematics for all stakeholders.
Bulgaria	Data to be added about the energy consumption and specific consumption by building systems. Data to be added for the potential savings from different energy saving measures. A national building register to be developed and both reciters to be connected. To develop new national software generating all data required for the register as an output.
Greece	Enhanced interoperability with other public authorities' IT applications. More publicly available data. Better data quality control.
Croatia	The dataset available to general public has only one purpose - to see how many buildings energy performance certificate has published from 1st October 2017. The dataset opens in one online document, and you cannot sort buildings per category/location/energy class. Registered energy certifiers are the only stakeholders who can approach to complete dataset and use it for sorting/extracting.
Austria	A major element would be the realisation of the access of research institutes and the general public. In Salzburg, the database can be connected to the smart meters of buildings to monitor electricity and heating costs and to be better able to monitor a building and make decisions concerning renovation measures. The responsible person can also grant someone else access to the data - e.g., the HVAC engineer or energy advisor. That is a good element.
United Kingdom	Key recommendations for improvements needed to make EPCs a valuable tool, described by the Elmhurst Almanac summary of the EPC industry in the UK.

Malta	It would be really useful if non-confidential/aggregated data is made available to the different stakeholder to help them in their decision-making when it comes to energy in buildings. The fact that all EPCs must be issued directly to the national system is an advantage since all the data is already available in digital format and therefore only the design and implementation of the public registry would be required.
Denmark	More options in relation to statistical analysis and use of data from other registers (this is in progress). Statistics on increase in property values when implementing EE measures would also be useful.

As crossCert partners have described, and along the same lines as the barriers already described in previous section, the proposals for the improvement of the databases refer to the following points:

- **Increasing availability of information**, especially referring to the need to expand the level of available information.
- **Enhancing user interactivity** with the existing visualisation platforms (EPC databases front-end) in order to be able to manage the data according to the objectives of any stakeholder.
- **Improving the interoperability** of EPC databases with other databases, ensuring the possibility of linking EPC data with other Administration databases.

5.1. Harmonisation

In order to achieve greater harmonisation among EU countries, a set of energy performance parameters has been proposed below to be included in all databases. This will ensure that all participating countries disseminate similar information, allowing stakeholders from other countries to also benefit from these databases.

The proposed set of information should be extracted from registered EPC xml files, which every assessed country is currently using and guarding.

Table 5 - Dataset disclosure proposal for European Union's EPC databases.

Register Status		
Country:	*---*	
Scale of the register:	*National, regional or both*	
Beginning of the register:	*--/--/---*	
Database access:	*Public or only certifiers*	
Information extractable by the user:	*xml, pdf, excel…*	
Building data		
Building identification	*Address*	
Building year of construction:	*----*	
Construction code used:	*---*	
Climatic zone	*Each country's designation*	
Habitable area	m^2	
Net heated area	m^2	
Building use	*Residential*	
		Single family house
		Terraced house
		Multi-apartment building
	Tertiary sector	
		Educational
		Office
		Sports hall
		Healthcare buildings
		Public entertainment buildings
		Community/Public assembly buildings

		Social housing
		Retail buildings
		Buildings for religious activities
		Public security buildings
		Others
	Industrial sector	
		Industrial buildings
		Warehouses
Energy Performance data		
Is the building nZEB?		*Yes or No*
Final energy consumption		*kWh/m²year*
Non-renewable primary energy		*kWh/m²year*
Non-renewable primary energy rating		*A, B, C, D, E, F, G*
CO2 emissions		*kgCO2/m²year*
CO2 emissions rating		*A, B, C, D, E, F, G*
Heating demand		*kWh/m²year*
Heating demand rating		*A, B, C, D, E, F, G*
Cooling demand		*kWh/m²year*
Cooling demand rating		*A, B, C, D, E, F, G*
Other		
Renewable energy contributions		
Heating renewable energy percentage		%
Cooling renewable energy percentage		%
DHW renewable energy percentage		%
Energy generator type		---
Other		
Potential energy efficiency interventions		
Envelope		*Specify*
Technical systems		*Specify*
Energy efficiency savings		%
Investment estimate cost		€
Payback period		*years*

Aside the proposed harmonized xml, it is important to mention the EPBD recast Annex V, which refers to the European Commission's template for Energy Performance Certificates. The EPC data disclosure on the databases is based on the EPBD recast standards. However, the next points from the Annex V could be added for the harmonisation xml process:

> *(ib) expected remaining economic lifetime of the space and water heating and/or cooling systems and appliances.*
>
> *(ic) a clear mention indicating whether or not the current building or dwelling can flexibly use energy.*

5.2. Renovation tools

Resultant from crossCert consortium recommendations and the proposed harmonised xml file, a set of guidelines to develop the next generation EPC databases has been created. The infographic shows three different parameters: tools, guidelines, and achievements.

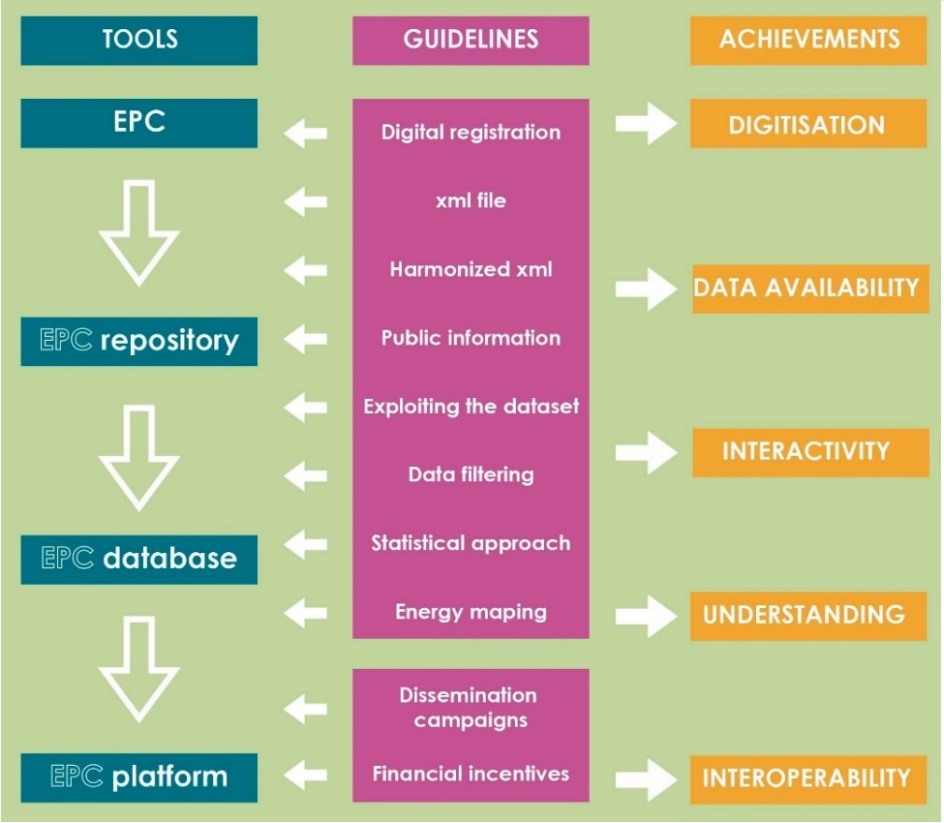


Figure 13 - Proposed guidelines for EPC renovation tools.

5.3. EPC repository

Following the proposed scheme, the procedure including the steps that the Energy Performance Certificate must follow to reach the stakeholders needs has been first set out. In this way, a first phase of data storage has been established, which currently all crossCert members comply with (EPC repository). At this point, the first technical guidelines that needs to be proposed which would be the development of fully digitised registers based on xml files processing. According to the EPBD recast proposal, article 16, the EPCs shall be available in a machine-readable format, and the xml files has been selected as a common vehicle for defined technical guidelines. Once the first phase has been completed, the complete digitisation as the first benefit, would have been achieved.

5.4. EPC database

The second phase, which refers to the generation of EPC databases, has been proposed. This is where the processing of the collected information comes into play. The harmonised xml file should be introduced as a model to guide all European Union countries to have a common working base.

This processing of the initially registered xml file is also intended to solve the problem that some crossCert partners have expressed in relation to data protection. The xml processing should remove confidential data, but once this information has been cleansed, the rest of the EPC data can be disseminated. As a technical guideline it has been proposed that the complete exploitation of the data should be enhanced, since it is currently identified as a weakness of existing databases.

The proposed harmonised xml has not focused on the EPC components for energy performance, rather on the EPC results. However, it has to be stated that, as an added value, the building information has to be processed as well to enable EPC databases to disclose the data. The aforementioned EPC components

consist of thermal envelope elements, technical systems, and operational conditions. These components need to be displayed in the database in order to achieve the benefit of the data availability, for any stakeholder's needs.

5.5. EPC platform

The following step would be to bring EPC closer to the end users, since processed information would have already been obtained. This would correspond to the next tool presented in the infographic, the EPC platform. The concept of the online platform has been separated from that of the database in order to attribute to it the functions of front-end dataset development. However, the EPC platform simply refers to the visualisation of the data processed by the database.

Following the crossCert partners' statements, the next technical guideline to be proposed would be related to **dataset processing**. It consists of **filtering systems, statistical generation systems and energy map creation systems**. One of the examples of this procedure would be the database of EPCs in Spain, which allows the end user to select different parameters in order to obtain a precise selection and not a vast compendium of data. Regarding the statistical system, cossCert's Denmark partner pointed out that they are already developing this system in their country. The energy mapping is further developed in posterior section.

The development of the EPC platform should be based on combination of the best practices among the crossCert partners. As explored in section 3.6, crossCert consortium provides a wide range of possibilities for EPC platforms. Nevertheless, the technical guideline would be **to implement in the existing databases the data sheet format, the text format, and the map format**. The proposed EPC platform would achieve **full interactivity for the end-users**.

The final step of the proposal for the technical guidelines for the integration of EPCs in the Administration databases is to **boost dissemination campaigns of the EPCs processed information**. Through the increase of information and transparency along the EPC registration processes, the general public could finally be closer to achieve full understanding of the EPC dataset, currently lacking. In addition, financial incentives are recommended for development of the described tools.

Once the current EPC databases have been renovated, and supported by the mentioned incentives, each country could work to develop the links between EPCs and other information/tools from different Administrations. By encouraging this renovation, interoperability between databases would be reached, which would serve to achieve the added values of the EPC databases developed in the next section.

6. Potential value for the EPC databases

This section describes the potential value of EPC databases, and the importance of achieving a fully digitized user-friendly database. When implemented, this platform will not only serve the Administrations but also the end-users such as homeowners, researchers or ESCOs.

Before assessing the potential value, it should be clarified what is an EPC. Following the Article 2 of the EPBD recast proposal, an Energy Performance Certificate is a certificate recognised by a Member State or by a legal person designated by it, which indicates the energy and climate performance of a building or building unit.

Following that definition, it could be predicted that certifying the building stock by the EPBD calculation standards will directly generate a database on the approximate energy performance of the stock of buildings. Nevertheless, would this set of data be useful to support other tools or to achieve EU 2050 objectives?

As other Administrations has acquired, developing an EPC database would create an "energy cadastre". EPCs might not be considered as tools not even close to energy audits but, using them for statistical pursuits if accompanied with other data filters, will give very useful tools for the Administration and other stakeholders.

As already known, the EPCs provide specific energy parameters no matter the country focusing on. For that reason, if hypothetically access is provided to a fully digitised and interactive database, such platform could return to the end-user the following information:

- Thermal envelopes disclosed according to their year of construction.
- Percentage of any building fabric among the building stock with hazardous U-values.
- Percentage of different building envelopes that build the stock of buildings.
- Summation of windows non-airtight and its link with thermal discomfort.
- Summation of the different fuels serving the buildings technical systems.
- Average efficiency of the technical systems according to the fuel used.
- Approximate year of installation of the building systems.
- Summation of heating, cooling and DHW demands.

The list of possible combinations of available and manageable information proceeding from EPC databases would be very vast. As an example of EPC data usability, some curated information extracted from EREN's EPC database is shown in the table below.

Table 6 - Curated dataset extracted from EREN's EPC database.

Location	León, Spain		
Building typology	Individual flat in a multiapartment building		
Fuel	Natural gas		
Construction year	**Average useful area [m^2]**	**Number of heating systems [n]**	**Heating demand average [kWh/m^2year]**
1900-1929	83,97	85	180,60
1930-1949	78,48	241	1.896,39
1950-1959	77,24	145	175,58
1960-1969	78,71	1.157	975,48
1970-1979	89,67	1.337	837,08
1980-1989	86,60	638	1.103,50
1990-1999	85,03	872	586,97
2000-2009	84,42	282	1.277,98
2010-2020	74,72	287	15.560,55
TOTAL	**82,09**	**5.044**	**22.594,13**

Although the file the user would receive is a csv format, it is simple to extract the EPC data of interest. In that sense, integrating full EPC dataset into Administration will increase the interest of stakeholders on building status, even enabling a new set of investments rounds. Obviously, the more interactive and complete information there is, the easier the risk assessment for renovation investments would be for the stakeholders. The table presented before represents just a token of the full scope of these databases.

Database value can be described in terms of the six factors presented in Deliverable *D2.2 Report on EPC best practices"* from the QualDeEPC project, which can serve as a benchmark of good practices for the integration of EPCs in the Administration databases and for the enhancement of the value of EPCs registers:

1. The databases and the process of integrating the EPCs data should be based on transparency, involving citizens in public administration's work that will enhance public trust and acceptance of the databases.
2. Cost-effectiveness around the generation of the databases balancing the resources used and the results achieved.
3. Reliability in terms of data quality and identification of verifiable indicators on the certificates themselves ensuring that the registries will provide quality information to all the stakeholders.
4. Comparability of the displayed information so that the databases become a useful tool.
5. Functionality, generating a high level of accessibility for convenient, fast and accurate service.
6. Neutrality, leading to equal conditions for all actors involved through the implementation of EPCs in the Administration.

In the next subsections, possible new applications of the EPC dataset that would greatly enhance the database value are analysed.

6.1. Energy indicators map

One of the potential uses of EPC databases relates to energy mapping. When establishing fixed criteria to the EPC information integration, such as deciding the parameters displayed or the interaction between the database and the final user, a full scope on the actual energy efficiency occurring in cities could be provided.

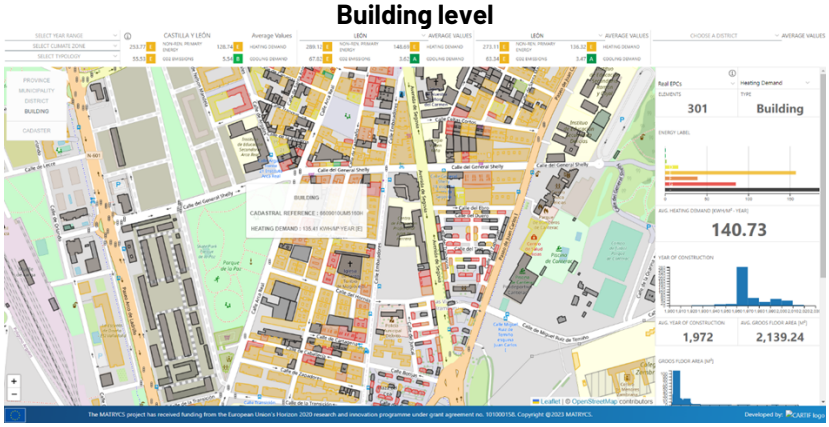
This kind of tool could be potentially helpful for many types of final users, which has been discussed in previous chapters.

To set an example of EPC databases platforms to map energy demand, the MATRYCS European project proposal for EPCs visualisation, building status repository and EPC data disclosure are shown.

The viewer has been developed in the pilot LSP9: Energy performance certificates to exploit EPCs with the deployment of big data. MATRYCS solutions have been deployed to support harmonisation and data sharing of EPCs, facilitate their compliance and checking procedures and finally contribute to de-risking investments in the energy efficiency sector, by analysing the refurbishment options contained in Energy Performance Certificates. An accurate calculation system of the actual energy savings obtained with building's refurbishments has been developed, based on the assessment of the final energy consumption in the EPCs and the real consumption data from the smart meters.

EPC and Estimated Demand Viewer

Building level



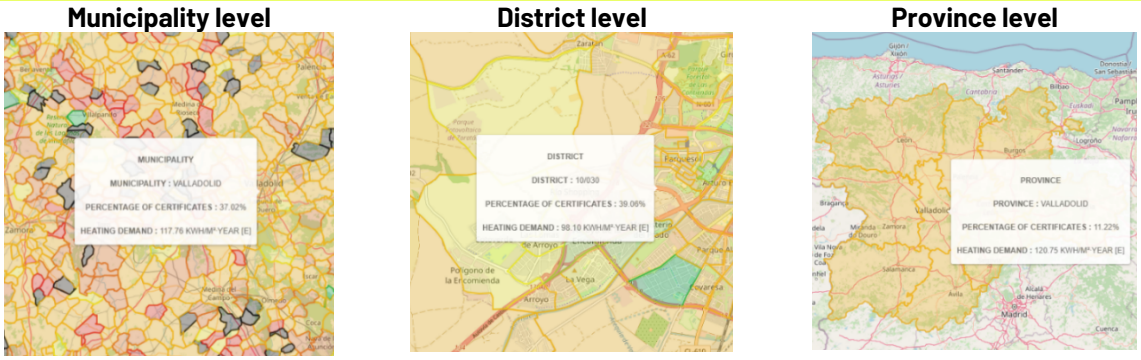


Figure 14 – MATRYCS' energy demand viewer tool. Available visualisation levels.

Also, MATRYCS project has developed other tools corelated to the energy map. They have made a link between EPC databases and cadastral bases to enable the calculation of the envelopes embodying the stock of buildings. As presented in the next picture, the online tool allows the end user to extract information after applying different filters.

Castilla y León Cadastre: building status repository

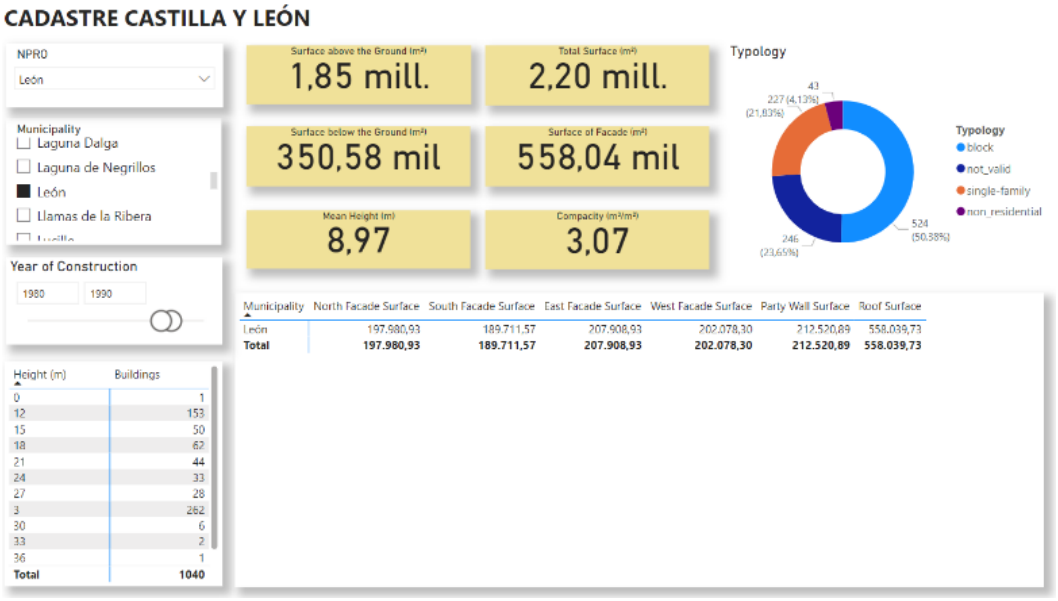


Figure 15 - MATRYCS' cadastre-based building stock status and typology distribution viewer tool.

This platform would add value to any interested investor on energy renovation. As an example, the MATRYCS cadastre viewer developed by CARTIF has been used to roughly extract some available data to calculate the façade surface seemingly needed to be renovated in a municipality.

Table 7 - Dataset of the Leon's municipality extracted from MATRYCS ' cadastre-based building stock viewer.

Location	Municipality of León, Spain					
Data	Data extracted from MATRYCS Toolbox					
Construction year	**Typology**	**Number of Buildings**	**Façade surface**		**Roof surface**	**Party Wall surface**
1930-1939	Residential block	77	N	12.731,44 m^2	19.920,00 m^2	16.994,27 m^2
			S	11.594,24 m^2		
			E	13.095,35 m^2		
			W	11.853,84 m^2		
1940-1949	Residential block	176	N	25.883,50 m^2	41.709,19 m^2	45.111,19 m^2
			S	26.874,29 m^2		

			E	28.150,76 m^2		
			W	30.735,56 m^2		
1950-1959	Residential block	273	N	44.213,82 m^2	75.126,89 m^2	65.200,37 m^2
			S	44.373,66 m^2		
			E	41.313,79 m^2		
			W	44.773,41 m^2		
1960-1969	Residential block	840	N	168.686,76 m^2	299.130,06 m^2	232.629,81 m^2
			S	173.635,29 m^2		
			E	154.145,47 m^2		
			W	158.489,86 m^2		
1970-1979	Residential block	705	N	186.885,53 m^2	328.647,43 m^2	353.993,33 m^2
			S	190.780,68 m^2		
			E	201.159,89 m^2		
			W	190.824,61 m^2		
1980-1989	Residential block	458	N	136.259,39 m^2	165.233,48 m^2	261.820,10 m^2
			S	126.520,19 m^2		
			E	139.372,08 m^2		
			W	134.129,88 m^2		
1990-1999	Residential block	563	N	195.718,65 m^2	349.262,43 m^2	138.106,61 m^2
			S	196.913,67 m^2		
			E	188.841,21 m^2		
			W	193.031,56 m^2		

Moreover, MATRYCS tool has created an EPC viewer to add value to the existing data available. In this case, the viewer has been conceived to facilitate the understanding and knowledge on the buildings stock by uniting EPC data to return the energy indicator values.

Energy Performance Certificates in Castilla y León: data disclosure

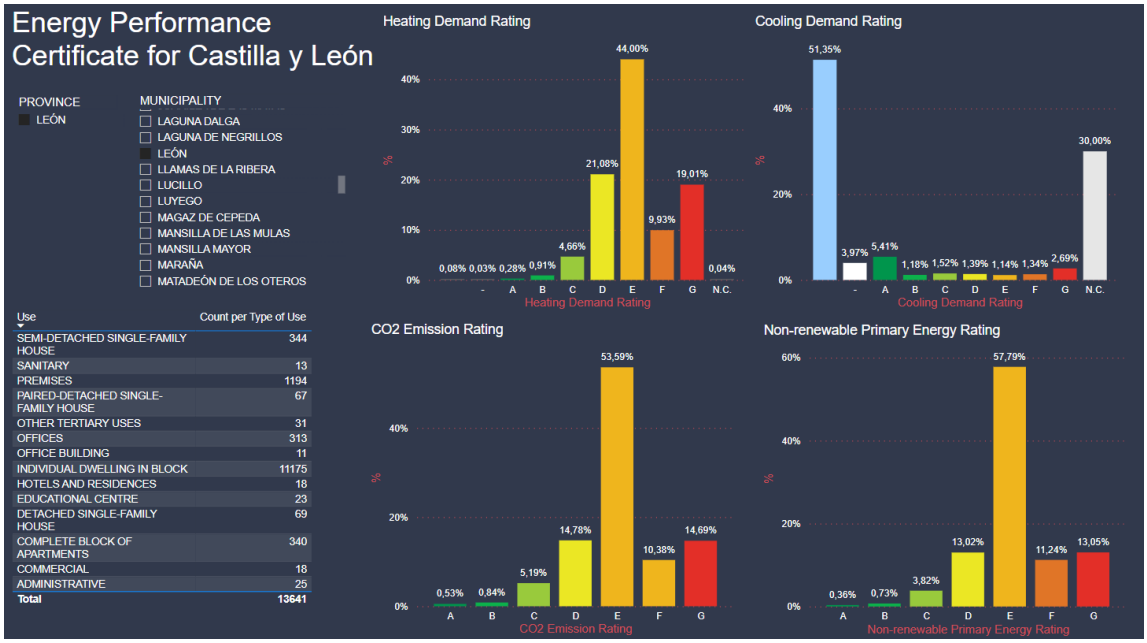


Figure 16 - MATRYCS' registered EPC viewer.

A different example of energy mapping is the Spanish MITECO geoportal, where any stakeholder is able to check the building stock energy status. Moreover, even if there is no EPC registered in a building, they would create an estimation for the properties.

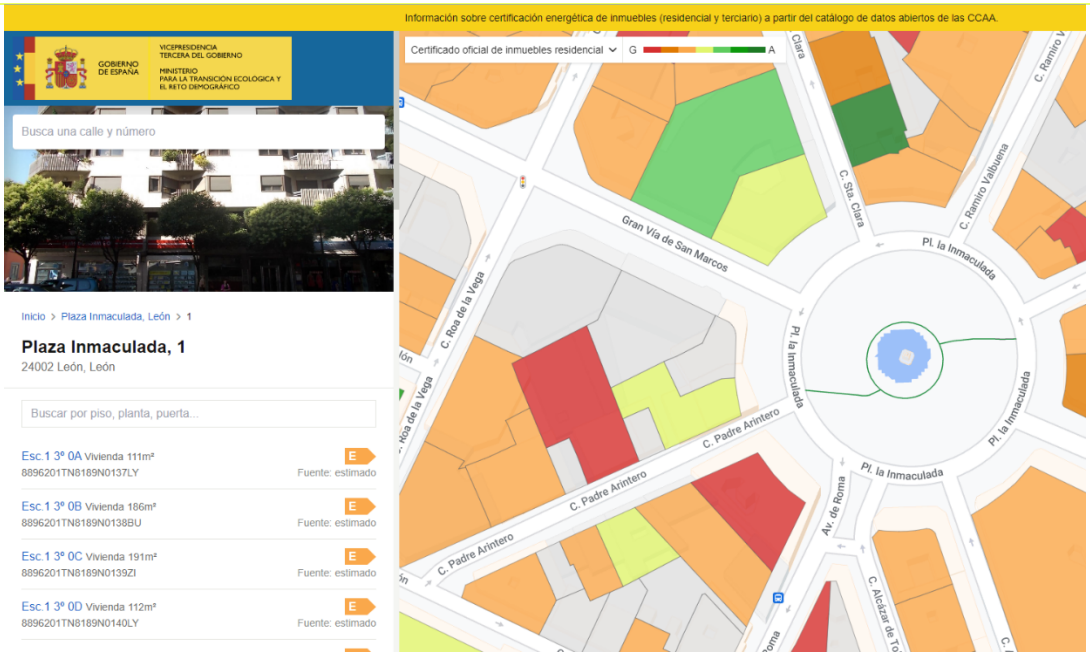


Figure 17 - MITECO's Spanish registered and estimated EPCs geoportal.

6.2. Local renovation roadmaps

The local renovation roadmaps (LRR) are a useful tool to enhance the transformation of the building stock. These planning actions can be supported by the energy demand maps, thus simplifying the process of elaborating a fully planned set of renovation agendas.

However, currently there is neither a deep understanding of EPC data nor enough interactivity with the registers to develop such actions. One of the greatest beneficiaries would be public authorities that could also link this tool with energy maps.

Despite Public authorities would be directly benefited from the EPC data integration, other stakeholders will also receive advantages. For instance, owners and tenants would take advantage from a reliable local renovation roadmap because they would have their buildings improved, which might rise the value of the properties or boost the inner comfort characteristics. Besides, if a LRR is created, it may attract several investors to the proposed area to be renovated.

6.3. Local building logbooks

The European Commission has mandated the use of digital building logbooks to encourage deep energy renovations. The logbooks will cover the entire life cycle of buildings and provide a more comprehensive evaluation of buildings, through providing a passport rating in three domains: energy performance, sustainability, and smartness. The digital building logbook data structure has been defined within the context of the EUB SuperHub project, which involved an extensive review of relevant literature, including existing logbooks data structures developed in previous EU projects (iBRoad, ALDREN, BIM4EEB, X-tendo), recommendations from the "Study on the Development of an EU Framework for Buildings' Digital Logbook".

A digital building logbook will respond to the requirement of forming the database that covers the entire building life cycle, from the design phase through the construction, operation, performance, maintenance, and deterioration, containing all relevant building-related data over the whole life cycle of a building, providing different types of stakeholders with different information for different purposes at the right time.

The concept of a digital building logbook was first introduced recently, through EU legislation with the European strategy "Renovation Wave", published by the European Commission in 2020. To break some of the key barriers in building renovations and foster deep energy renovations by creating better conditions for renovation, the European Commission has been obliged to introduce digital building logbooks that integrate all building-related data. In the proposal for the third revision of the Energy Performance of Buildings Directive (EPBD), published in December 2021, a digital building logbook is defined as a "common repository for all relevant building data, including data related to energy performance such as energy performance certificates, renovation passports and smart readiness indicators, which facilitates informed decision making and information sharing within the construction sector, among building owners and occupants, financial institutions and public authorities". Article 19 of this EPBD proposal refers to a database for energy performance of buildings. The last paragraph of this article states that "Member States shall ensure that the national database for energy performance of buildings is interoperable and integrated with other administrative databases containing information on buildings, such as the national building cadastres and digital building logbooks". This sentence within article 19 paves the way for mandatory linking of the national EPC databases to digital building logbooks.

A digital building logbook, serving as a repository for a building's information throughout its life cycle, is crucial not only for the construction sector but also for the real estate sector. Building-related information plays a vital role in investment and financial decision making, as well as in adequate risk assessment.

In May 2021, the ePANACEA project published a report to incentivise energy renovations and stimulate cost-effective deep building renovation in Europe. They conducted two surveys to collect information on the current state of energy performance certificates (EPCs) and to identify stakeholders' needs and expectations regarding a possible link between EPCs and the digital building logbook. The authors concluded that EPCs could be an important data source for a digital building logbook, and that building descriptions, characteristics, and technical building systems are important data to include, without providing the exact logbook data structure. The authors emphasised that the EPC should automatically feed the digital building logbook.

6.4. Smart Readiness Indicators

The Smart Readiness Indicator (SRI) was introduced by the European Union in 2018 while amending the Energy Performance of Buildings Directive (EPBD) (European Parliament, 2018) and its subsequent regulations (Delegated Regulation 2020/2155 (European Commission, 2020a) and Implementing Regulation 2020/2156 (European Commission, 2020b)), triggering an optional implementation phase by the EU countries. Therefore, the EU countries might decide to implement the SRI on their territory for all buildings or only for certain categories of buildings.

It is important to underline that under the amended EPBD, the European Commission was mandated to develop a common framework for the SRI. Following this, a series of studies were carried out to develop the concept of the SRI and create a methodology for its calculation. At the moment the SRI is optional and a voluntary EU scheme that will be used to assess the technological readiness of buildings to interact with their occupants, to interact with connected energy grids and to operate more efficiently.

Based on the analysis performed in the framework of TIMEPAC project, SRI (Smart Readiness Indicator) and an EPC (Energy Performance Certificate) can be easily integrated, as a significant portion of the data collected during an energy audit can be utilized for the SRI's calculation. In a way, the SRI and EPC complement each other, with the EPC defining the quality of the building and its technical systems, while the SRI focuses on the quality of the control systems. This integration allows for a comprehensive evaluation of the building's energy efficiency and smart readiness. By deriving possible energy-efficiency measures from both the EPC and SRI assessments, a cohesive improvement scenario can be developed. The emphasis is placed on all aspects, including efficiency, flexibility, and comfort, to create a holistic and well-rounded process.

Based on the analysis performed in the framework of Aldren project, the smart readiness score means the score obtained by a building or building unit as part of the process for rating smart readiness. The process

of scoring starts with the assessment at domain level, per impact criterion by evaluating the impact scores (absolute values). Once all these individual services impact scores are known, an aggregated impact score is calculated for each technical domain. The domain impact score is calculated as the ratio (expressed as a percentage) between individual scores of the domains' services and theoretical maximum individual score.

For each impact criterion, a total impact score is then calculated as a weighted sum of the domain impact scores. The weight of a given domain will depend on its relative importance for the considered impact. The weighting factors for the technical domains are derived from the importance of the domain in the overall energy balance of the building. For example, the heating domain will gain importance in northern areas of Europe, whereas the relative importance of the cooling domain would increase in southern areas of Europe. For domains where no direct link with an energy balance can be made (e.g. monitoring & control), a weighting factor can be defined based on the estimated impact. The proposed methodology provides default weighting factors which are differentiated by building type and climate zone. Therefore, the EPC database could provide enough information for determination of default weighting factors in different countries.

6.5. One-stop-shops

The establishment of technical assistance facilities for energy efficiency in buildings has been proposed by the European Commission to target all actors around building renovation. Member States will have to include diverse stakeholders such as homeowners, financial actors or microenterprises as beneficiaries of the aforementioned technical assistance facilities, ensuring the establishment of one one-stop-shop per region and in any event per 45000 inhabitants.

The aim of these facilities is to provide free of charge and tailor made assistance on technical, administrative and financial procedures for local renovation projects. The establishment of one-stop-shops is based on activities such as:

- Legal assistance
- Connecting potential projects with market actors
- Providing access to affordable energy offers
- Training programmes and education
- Collecting and submitting typology aggregated data to the Commission from energy efficiency projects
- Supporting awareness-raising activities
- Providing and developing holistic support to all households
- Providing information on alternatives to fossil heating and cooling in buildings
- Evaluation of the impact of minimum energy performance standards on housing affordability and quality

The EPBD recast also emphasises the importance of the cooperation with local and regional authorities and the development of a harmonised approach for one-stop-shops development.

This new assistance structure might be easily supported by EPC databases. The facility is meant to be supported by technical experts to offer different knowledge on energy efficiency renovation, therefore EPC databases fit to be used as a starting point for generating the criteria around renovation. However, EPC databases and platforms need to be developed as proposed in the previous section. A fully digitised EPC database which provides the available data captured by the repositories, if interactive for the one-stop-shops personnel at least, will facilitate the understanding needed for these interventions. Moreover, if EPC databases are interoperable with other Administration databases will enable those technicians to add more value to their services, for instance being able to compare several data of a district and combining the data with population and financial information of the area.

In essence, EPC databases are able to be used as common language between the technical teams and the stakeholders for the one-stop-shops, but also might enrich the technical procedures.

6.6. SECAPs elaboration

The next scale step would be the development of a Sustainable Energy and Climate Action Plans (SECAPs) which should be based on a profound knowledge of the regional energy environment of each country.

This is the final usage that would link every aspect of EPC databases. If authorities can avail themselves of a reliable and user-friendly source of information, the policy making that any SECAP entails would significantly gain in accuracy.

7. Example of EPC databases potential use

After having explored the possibilities of the potentials for EPC databases, we have developed a simple tool based on Castilla y León regional EPC database to generate a Local façades Renovation Plan. We have picked the municipality of León to develop the tool.

As a principle, we have linked different databases and Spanish reference documents to estimate the investment the municipality of León would have to make to achieve high-performing opaque façade elements in the building blocks constructed from 1970 to 1999. We have established this period because it represents the most worst performing façades due to their construction and conservation.

Our proposed methodology uses the regional EPC database and links registered energy indicators with the performance gap existing on EPC energy indicators studied by crossCert (D3.2 Performance gap causation), cadastral data processed by MATRYCS toolbox viewer, outcomes of the report on the segmentation of the residential housing stock of Spain into typological clusters included into the Spanish building sector long term renovation strategy (ERESEE2020) developed by the Ministry of Development, population data from National Statistics Institute of Spain data (INE), orientated thermal transmittance values and operational conditions described in the technical building code of Spain (DB-HE), the new system of Energy Savings Certificate (CAE) developed by the Spanish Ministry for Ecological Transition and Demographic Challenge (MITECO) to plan a periodic economic grant to diminish the estimated payback period, and the new Energy Efficiency Directive to plan the investments and the energy savings through the interventions.

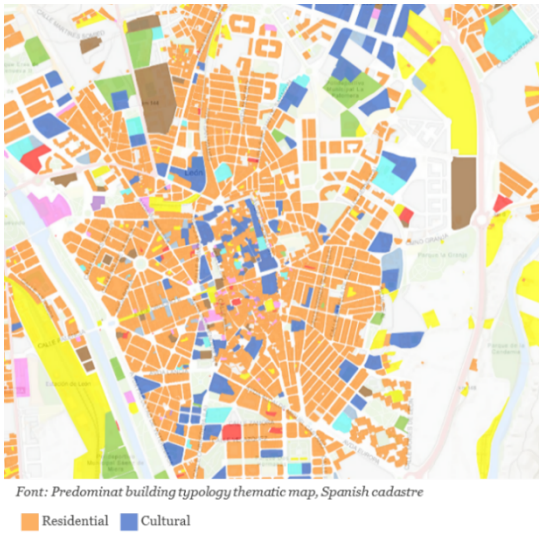


Figure 18 - Building typology map. Municipality of León. Spanish cadastre information (left). Construction year map. Municipality of León. Spanish cadastre information (right).

METHODOLOGY PROPOSED

The first step is to obtain the general energy and geometric information of the assessed group of the building stock. For that reason, we have extracted the useful area and heating demands from the regional EPC database (data attached on Annexe 3). As only a percentage of buildings has been certified yet, we have used the MATRYCS cadastre viewer where we have the option to filter the construction year of the stock of buildings. From this tool we have obtained the façade surfaces built per year, and from that data we have estimated the useful area of the complete building stock of the municipality.

Sequentially, we have applied the ratios published in the report on the segmentation of the residential housing stock of Spain into typological clusters to obtain the different approach for the number of dwellings and an estimation on all building thermal envelopes. The next picture represents the typologies used for the building stock study group. The information has been extracted from the volumetric matrix definition of the housing block clusters.

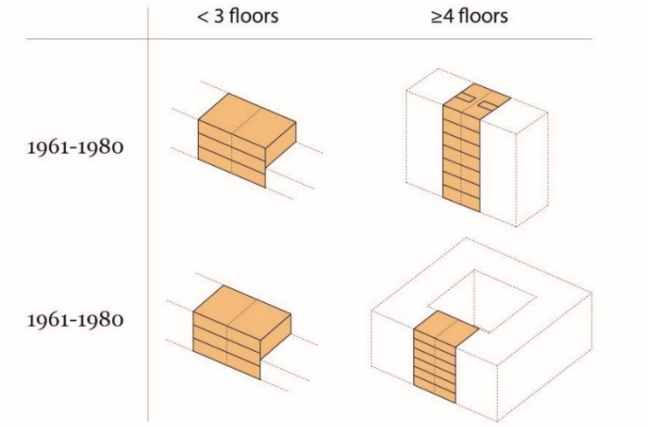


Figure 19 - Chosen typologies for the building stock estimation. Extracted from the report on the segmentation of the residential housing stock of Spain into typological clusters. ERESEE 2020.

Furthermore, the average values presented in the aforementioned report on which our estimations are based are the following:

Bb 61-80				
Average useful area of the dwelling (m²)	93,66	Superficies de envolvente	Per dwelling	Per 100 m²
Number of building floors	7	m² façade	86,47	92,33
Number of dwellings per floor	4	m² façade OPAQUE	47,74	50,98
Front/depth (Building type)	1,16	m² façade WINDOWS	12,64	13,50
Front/depth (Dwelling type)	1,16	m² party wall	26,09	27,85
Front (Building type) (m)	20,82	m² roof	13,38	14,29
% party walls in contact with exterior air	-	m² floor	13,38	14,29
Bb 81-07				
Average useful area of the dwelling (m²)	99,50	Superficies de envolvente	Per dwelling	Per 100 m²
Number of building floors	6	m² façade	84,06	83,03
Number of dwellings per floor	2	m² façade OPAQUE	33,95	33,77
Front/depth (Building type)	1,32	m² façade WINDOWS	13,91	13,50
Front/depth (Dwelling type)	0,66	m² party wall	36,20	35,76
Front (Building type) (m)	13,22	m² roof	17,17	16,67
% party walls in contact with exterior air	-	m² floor	17,17	16,67

Figure 20 - Bb 61-80 and Bb 81-07 envelope values selected for the estimation. ERESEE 2020.

Based on the typological studies and averages, it has been possible to calculate the number of dwellings that were constructed from 1970 to 1999 in the assessed municipality. In this case, Figure *21* represents the

yearly distribution of individual apartments that configure the complete housing blocks that are part of this analysis.

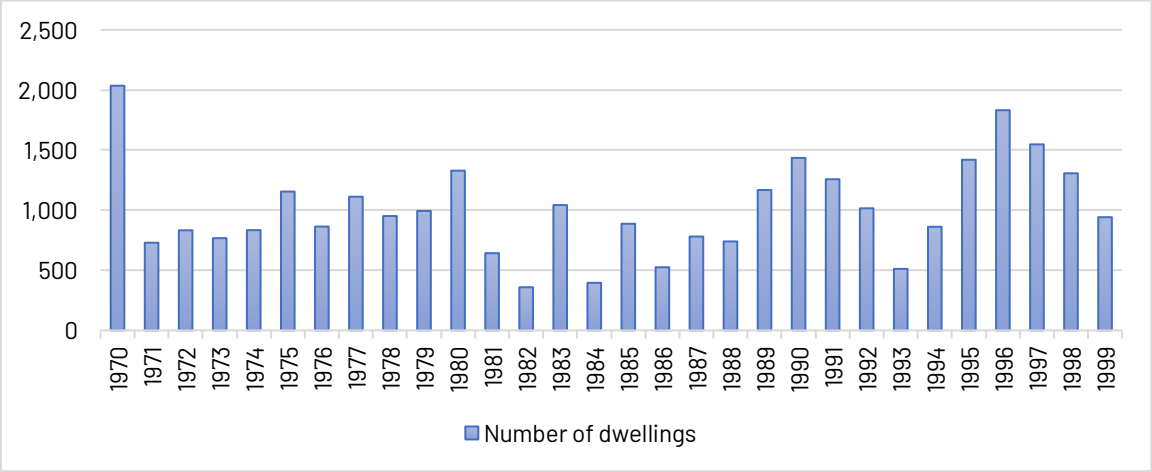


Figure 21 - Estimation of constructed dwellings per year.

The results obtained from the estimations based on ERESEE 2020 are presented in the next table.

Table 8 - Complete building envelope surfaces estimation for the municipality of León estimated by ERESEE 2020 building typology report.

Construction year	Estimations based on ERESEE 2020								
	Number of dwellings	Useful area	Adiabatic party wall surfaces	Roof surfaces	Ground floor element surfaces	Opaque façade surfaces	Window surfaces	Total envelope surface	Percentage of façade
year	n	m^2	m^2	m^2	m^2	m^2	m^2	m^2	%
1970	**2.035**	200.447	102.188	28.644	28.644	**102.188**	13.795	275.459	**37,10**
1971	**729**	71.805	19.998	10.261	10.261	**36.606**	4.942	82.068	**44,60**
1972	**832**	81.962	22.827	11.712	11.712	**41.784**	5.641	93.677	**44,60**
1973	**767**	75.565	21.045	10.798	10.798	**38.523**	5.201	86.364	**44,60**
1974	**834**	82.121	22.871	11.735	11.735	**41.865**	5.652	93.858	**44,60**
1975	**1.155**	113.737	31.676	16.253	16.253	**57.983**	7.828	129.992	**44,60**
1976	**863**	85.045	23.685	12.153	12.153	**43.356**	5.853	97.200	**44,60**
1977	**1.112**	109.518	30.501	15.650	15.650	**55.832**	7.537	125.171	**44,60**
1978	**951**	93.660	26.084	13.384	13.384	**47.748**	6.446	107.046	**44,60**
1979	**994**	97.890	27.262	13.988	13.988	**49.904**	6.737	111.881	**44,60**
1980	**1.329**	130.871	36.448	18.702	18.702	**66.718**	9.007	149.576	**44,60**
1981	**642**	64.537	23.078	10.758	10.758	**21.794**	2.942	69.331	**31,43**
1982	**358**	36.022	12.882	6.005	6.005	**12.165**	1.642	38.698	**31,43**
1983	**1.042**	104.756	37.461	17.463	17.463	**35.376**	4.776	112.539	**31,43**
1984	**395**	39.734	14.209	6.624	6.624	**13.418**	1.811	42.686	**31,43**
1985	**887**	89.114	31.867	14.855	14.855	**30.094**	4.063	95.734	**31,43**
1986	**525**	52.736	18.858	8.791	8.791	**17.809**	2.404	56.654	**31,43**
1987	**780**	78.439	28.050	13.076	13.076	**26.489**	3.576	84.266	**31,43**
1988	**740**	74.332	26.581	12.391	12.391	**25.102**	3.389	79.854	**31,43**
1989	**1.167**	117.331	41.957	19.559	19.559	**39.623**	5.349	126.047	**31,43**
1990	**1.435**	144.177	51.558	24.034	24.034	**48.689**	6.573	154.888	**31,43**
1991	**1.257**	126.342	45.180	21.061	21.061	**42.666**	5.760	135.728	**31,43**
1992	**1.015**	102.023	36.483	17.007	17.007	**34.453**	4.651	109.602	**31,43**

1993	**511**	51.382	18.374	8.565	8.565	**17.352**	2.342	55.199	**31,43**
1994	**862**	86.587	30.964	14.434	14.434	**29.241**	3.947	93.020	**31,43**
1995	**1.419**	142.630	51.005	23.776	23.776	**48.166**	6.502	153.226	**31,43**
1996	**1.831**	184.057	65.819	30.682	30.682	**62.156**	8.391	197.730	**31,43**
1997	**1.547**	155.501	55.607	25.922	25.922	**52.513**	7.089	167.053	**31,43**
1998	**1.307**	131.317	46.959	21.891	21.891	**44.346**	5.987	141.072	**31,43**
1999	**942**	94.622	33.837	15.774	15.774	**31.954**	4.314	101.652	**31,43**
30 years buildings	**30.263**	3.018.260	1.035.312	475.950	475.950	**1.215.912**	164.148	3.367.271	**36,01**

The next graph shows the distribution of built thermal envelopes. These results reinforce the decision on planning the renovation of façade elements.

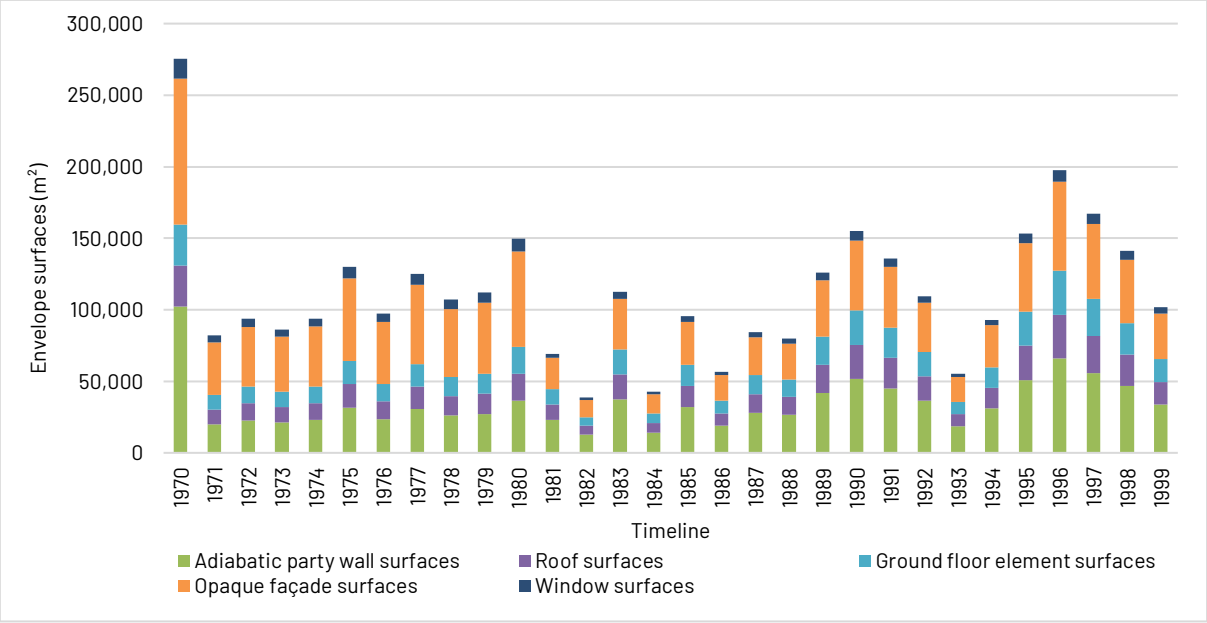


Figure 22 - Distribution of built thermal envelopes estimation.

At this moment, the chosen elements for renovation represent an important share of the thermal exchange surfaces of the stock. Therefore, the next step is to estimate the heat losses distribution of each element to calculate the impact on the heating demands. For this purpose, it has been decided to create a criterion around the affection of the envelopes on the heating demands for the Spanish E1 climate zone. The distribution of heat losses is divided between opaque envelope surfaces, thermal bridges, ventilation, and windows.

The parameters of the thermal envelopes and heat losses calculated for all the stock are showed in the following images. As a first conclusion, it can be determined that the proposed intervention will diminish approximately the 36% of the heat losses caused by opaque elements, and it will reduce most thermal bridges of the building. It can be stated that most thermal bridges will be eliminated because, if we focus on housing blocks typology, thermal bridges are produces by integrated pillars in the façades, façade joints with the slab (floor slab or floor horizontal structure slab), and joints between the façade and the roof elements. Therefore, an intervention on façade renovation will eventually reduce heating demands up to 70%. The next infographics sum up the conclusions on building envelope and heat losses distribution.

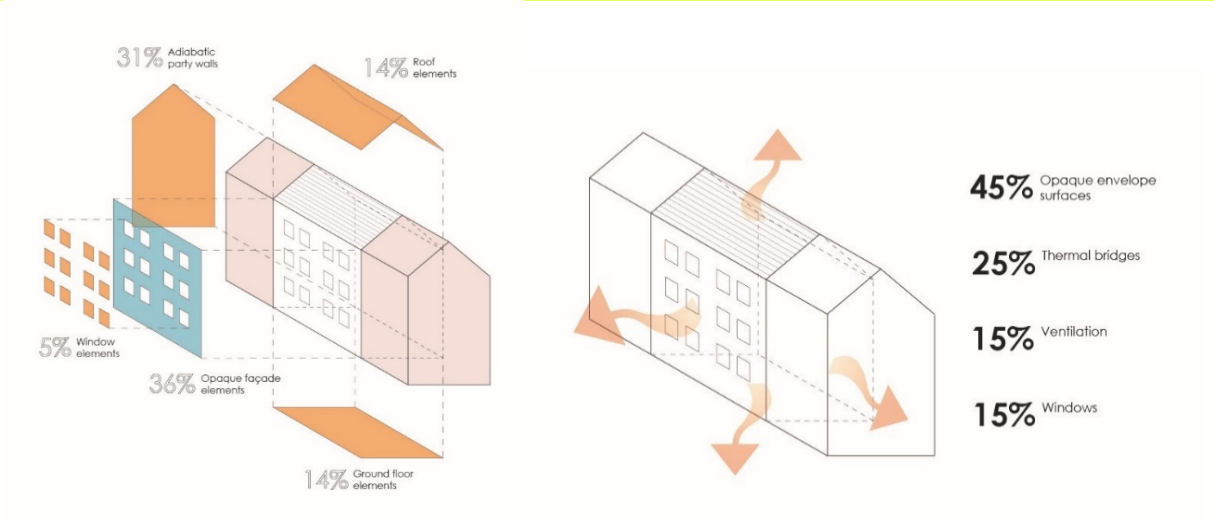


Figure 23 - Thermal envelopes percentual distribution (left). Proposed assumptions on heat losses distribution (right).

Even though it has already been determined the diminishment of heating demands, more precise calculations are needing. At this point, we have the information of the heating demands average rations for each assessed year but is well known that EPC usually over calculate energy consumptions. For that reason, and after latest crossCert findings on EPC performance gaps, it has been decided to apply a reduction factor to the calculated demands. This estimation helps to adjust the energy demands obtained from the databases and bring them closer to the real demands of the stock analysed.

The next graph represents the total heat losses distribution of the stock under study adjusted by crossCert performance gap.

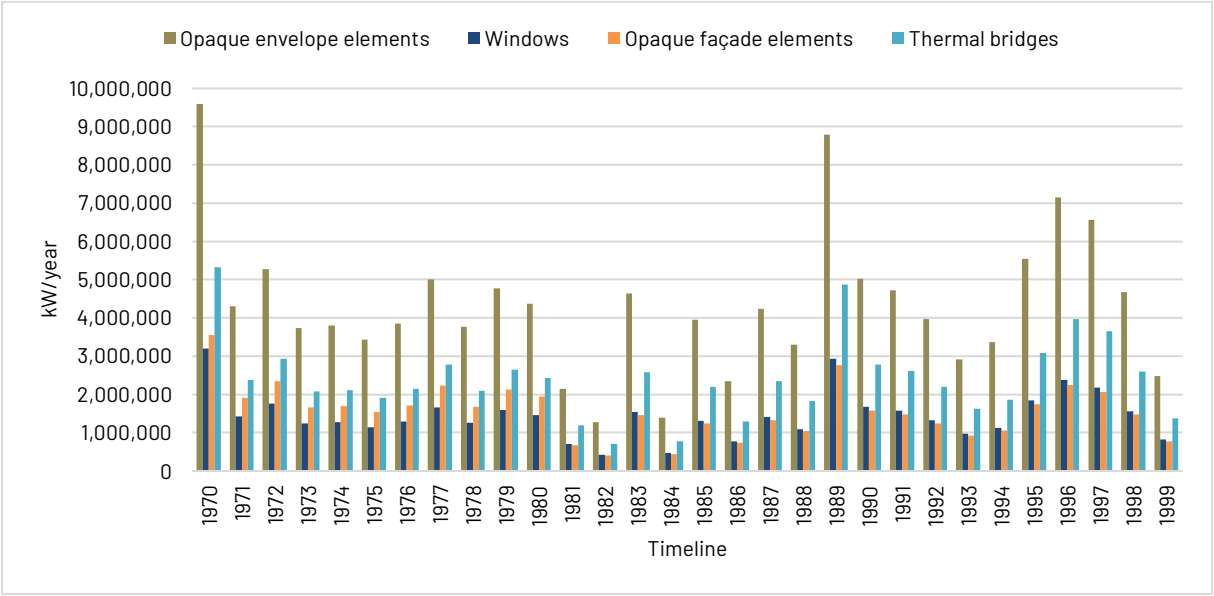


Figure 24 - Building stock envelopes heat losses distribution.

Table 9 - EPC heating demands extracted from EREN's database corrected by crossCert performance gap estimation for building blocks, and estimation of heat losses by envelope elements.

Construction year	Heating demand		CrossCert Performance gap	Estimated heat losses for heating regime			
	EPC database		Corrected heating demands	Opaque envelope elements	Windows	Opaque façade elements	Thermal bridges
year	kWh/m²year	kWh/year	kWh/year	kWh/year	kWh/year	kWh/year	kWh/year
1970	**177**	35.528.841	**21.317.305**	9.592.787	3.197.596	3.558.668	5.329.326
1971	**222**	15.917.797	**9.550.678**	4.297.805	1.432.602	1.917.033	2.387.670
1972	**238**	19.521.732	**11.713.039**	5.270.868	1.756.956	2.351.067	2.928.260
1973	**183**	13.852.206	**8.311.324**	3.740.096	1.246.699	1.668.267	2.077.831
1974	**172**	14.085.894	**8.451.537**	3.803.191	1.267.730	1.696.411	2.112.884
1975	**112**	12.748.382	**7.649.029**	3.442.063	1.147.354	1.535.330	1.912.257
1976	**168**	14.275.636	**8.565.382**	3.854.422	1.284.807	1.719.262	2.141.345
1977	**169**	18.541.778	**11.125.067**	5.006.280	1.668.760	2.233.048	2.781.267
1978	**149**	13.987.723	**8.392.634**	3.776.685	1.258.895	1.684.588	2.098.158
1979	**181**	17.707.528	**10.624.517**	4.781.033	1.593.678	2.132.576	2.656.129
1980	**124**	16.190.368	**9.714.221**	4.371.399	1.457.133	1.949.860	2.428.555
1981	**123**	7.934.793	**4.760.876**	2.142.394	714.131	673.456	1.190.219
1982	**131**	4.721.870	**2.833.122**	1.274.905	424.968	400.763	708.280
1983	**164**	17.208.439	**10.325.064**	4.646.279	1.548.760	1.460.545	2.581.266
1984	**131**	5.187.559	**3.112.535**	1.400.641	466.880	440.288	778.134
1985	**164**	14.638.822	**8.783.293**	3.952.482	1.317.494	1.242.452	2.195.823
1986	**164**	8.662.974	**5.197.784**	2.339.003	779.668	735.259	1.299.446
1987	**200**	15.692.121	**9.415.273**	4.236.873	1.412.291	1.331.850	2.353.818
1988	**164**	12.210.509	**7.326.306**	3.296.838	1.098.946	1.036.352	1.831.576
1989	**277**	32.532.249	**19.519.349**	8.783.707	2.927.902	2.761.135	4.879.837
1990	**129**	18.594.565	**11.156.739**	5.020.532	1.673.511	1.578.191	2.789.185
1991	**138**	17.486.598	**10.491.959**	4.721.381	1.573.794	1.484.154	2.622.990
1992	**144**	14.677.147	**8.806.288**	3.962.830	1.320.943	1.245.705	2.201.572
1993	**210**	10.803.311	**6.481.987**	2.916.894	972.298	916.918	1.620.497
1994	**144**	12.456.577	**7.473.946**	3.363.276	1.121.092	1.057.237	1.868.487
1995	**144**	20.519.005	**12.311.403**	5.540.131	1.846.710	1.741.525	3.077.851
1996	**144**	26.478.691	**15.887.215**	7.149.247	2.383.082	2.247.346	3.971.804
1997	**156**	24.303.180	**14.581.908**	6.561.859	2.187.286	2.062.703	3.645.477
1998	**132**	17.335.146	**10.401.088**	4.680.490	1.560.163	1.471.299	2.600.272
1999	**97**	9.200.845	**5.520.507**	2.484.228	828.076	780.910	1.380.127
30 years buildings	**160**	483.002.286	**289.801.371**	130.410.617	43.470.206	47.114.194	72.450.343

The real status of the building stock of the municipality has already been calculated, hence the estimations need to derive to energy savings.

The planned intervention is based on the addition of external wall insulation. This type of material has been calculated to meet the current Spanish construction regulations for climate zone E1. Besides, the U-values of the existing elements has been estimated with the reference documents, thus it is possible to evaluate de savings when increasing U-values with external insulation. The results of this step are presented in the next graph.

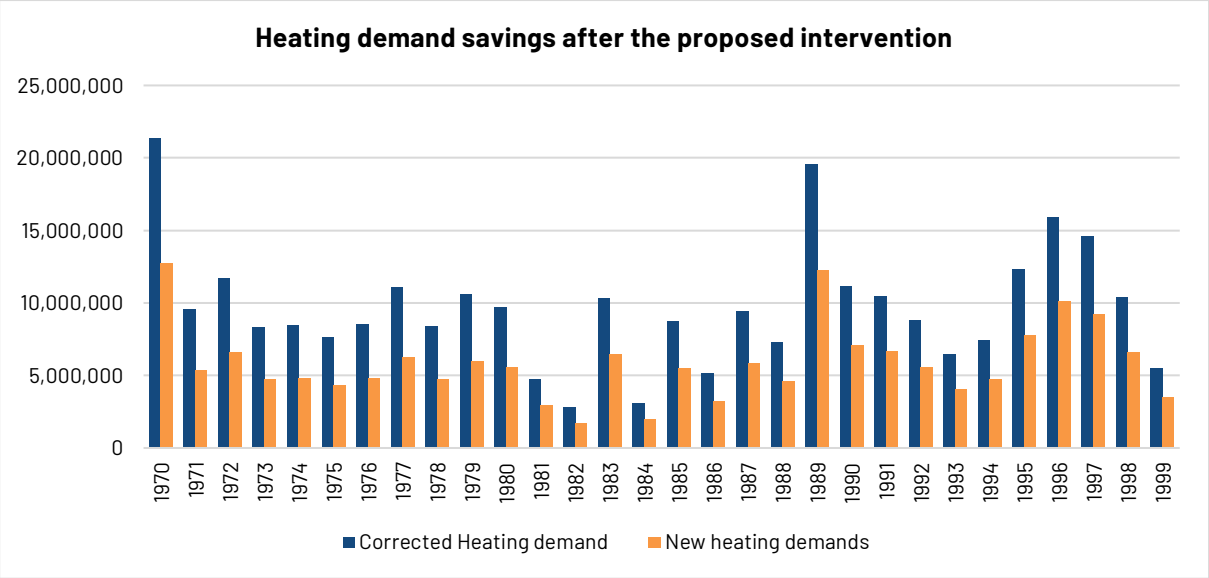


Figure 25 - Heating demand savings after the proposed intervention.

Table 10 - Heat energy demand savings after applying a recommendation of thermal transmittance U-value increase. Proposed measure based on 12cm of EPS for external wall insulation.

Construction year	Proposed intervention						
	Ui	Uf	Façade elements improvements	New heating demands	Heating demand savings		
year	W/m²k	W/m²k	%	kWh/year	kWh/year	kWh/m²year	%
1970	2,38	0,22	90,76%	12.758.264	8.559.041	63,6	40,15%
1971	2,38	0,22	90,76%	5.423.180	4.127.498	75,5	43,22%
1972	2,38	0,22	90,76%	6.651.038	5.062.001	81,1	43,22%
1973	2,38	0,22	90,76%	4.719.435	3.591.888	62,5	43,22%
1974	2,38	0,22	90,76%	4.799.053	3.652.484	58,4	43,22%
1975	2,38	0,22	90,76%	4.343.363	3.305.666	38,2	43,22%
1976	2,38	0,22	90,76%	4.863.697	3.701.684	57,2	43,22%
1977	2,38	0,22	90,76%	6.317.169	4.807.898	57,7	43,22%
1978	2,38	0,22	90,76%	4.765.606	3.627.028	50,9	43,22%
1979	2,38	0,22	90,76%	6.032.940	4.591.577	61,6	43,22%
1980	1,69	0,22	86,98%	5.589.634	4.124.587	42,7	42,46%
1981	1,69	0,22	86,98%	2.984.870	1.776.006	46,3	37,30%
1982	1,69	0,22	86,98%	1.776.249	1.056.873	49,3	37,30%
1983	1,69	0,22	86,98%	6.473.383	3.851.681	61,8	37,30%
1984	1,69	0,22	86,98%	1.951.429	1.161.106	49,1	37,30%
1985	1,69	0,22	86,98%	5.506.757	3.276.536	61,8	37,30%
1986	1,69	0,22	86,98%	3.258.793	1.938.991	61,8	37,30%
1987	1,69	0,22	86,98%	5.902.982	3.512.291	75,3	37,30%
1988	1,69	0,22	86,98%	4.593.287	2.733.019	61,8	37,30%
1989	1,69	0,22	86,98%	12.237.815	7.281.534	104,3	37,30%
1990	1,15	0,22	80,87%	7.091.278	4.065.461	49,2	36,44%

1991	1,15	0,22	80,87%	6.668.741	3.823.218	52,8	36,44%
1992	1,15	0,22	80,87%	5.597.320	3.208.968	54,9	36,44%
1993	1,15	0,22	80,87%	4.119.983	2.362.004	80,2	36,44%
1994	1,15	0,22	80,87%	4.750.477	2.723.469	54,9	36,44%
1995	1,15	0,22	80,87%	7.825.188	4.486.215	54,9	36,44%
1996	1,15	0,22	80,87%	10.097.992	5.789.223	54,9	36,44%
1997	1,15	0,22	80,87%	9.268.332	5.313.576	59,6	36,44%
1998	1,15	0,22	80,87%	6.610.983	3.790.105	50,3	36,44%
1999	1,15	0,22	80,87%	3.508.861	2.011.646	37,1	36,44%
30 years buildings	**-**	**-**	**86,20%**	**176.488.098**	**113.313.273**	**58,5**	**39,10%**

Table 3 results show that the heating demands savings will be reduced approximately from 43-36 % of the total value. Besides, the external insulation will increase the energy performance of the façade elements about 86%, which represent a very important finding. Also, we need to consider that expected life of the intervention is up to 50 years.

It is important to highlight that this tool has been developed to obtain "big numbers" to clarify how difficult would be to achieve high-performing envelopes in a municipality. Aside, it is obvious that it has not been included into the equation that some buildings would have historical value and should not be externally intervened. In parallel with this argument, all EU members should think of how this kind of external solutions will modify the urban vision. It is also possible that internal solutions must be considered to protect architectural and urbanistic values.

Returning to the explanation of the proposed Local Renovation Plan estimator tool, the next step was to calculate the investment required to carry out the proposed intervention.

In addition, following the approval of the new Spanish government instrument Energy Saving Certificate (CAE), an estimate of the possible subsidy that would be obtained to cover the improvement intervention if the local council of the municipality acted as CAE delegate agent has been proposed.

Table *11* shows quite encouraging results with regard to the EU's 2050 targets. The total investment required for a total of 30,263 dwellings amounts to 115 million of euros. This figure does not seem to be so high that we need to rethink the targets set, but rather to drive the renovation wave.

Table 11 - Estimated investment for the proposed intervention, economic possible grant from CAEs tool, and final calculation of energy/economic savings and the payback period for the proposed intervention.

Construction year	**Investment**	**CAE - Energy Savings Certificates**			**Savings and Paybacks**			
		Energy Savings	**Economic grant**	**Investment savings**	**Energy savings**	**Economic savings**	**Payback period**	**Payback period after CAE**
year	**€**	**MWh/year**	**€**	**%**	**kWh/year**	**€**	**years**	**years**
1970	9.707.867	16.334	1.960.049	20,19%	13.415.425	1.073.234	9,0	7,2
1971	3.477.588	5.851	702.136	20,19%	6.469.432	517.555	6,7	5,4
1972	3.969.520	6.679	801.459	20,19%	7.934.171	634.734	6,3	5,0
1973	3.659.665	6.157	738.898	20,19%	5.629.919	450.394	8,1	6,5
1974	3.977.197	6.692	803.009	20,19%	5.724.896	457.992	8,7	6,9
1975	5.508.387	9.268	1.112.161	20,19%	5.181.294	414.504	13,3	10,6
1976	4.118.809	6.930	831.601	20,19%	5.802.013	464.161	8,9	7,1

1977	5.304.067	8.924	1.070.908	20,19%	7.535.891	602.871	8,8	7,0
1978	4.536.033	7.632	915.839	20,19%	5.684.997	454.800	10,0	8,0
1979	4.740.909	7.977	957.204	20,19%	7.196.828	575.746	8,2	6,6
1980	6.338.229	7.258	870.913	13,74%	6.464.870	517.190	12,3	10,6
1981	2.070.436	2.371	284.491	13,74%	2.783.708	222.697	9,3	8,0
1982	1.155.651	1.323	158.794	13,74%	1.554.225	124.338	9,3	8,0
1983	3.360.745	3.848	461.788	13,74%	5.664.237	453.139	7,4	6,4
1984	1.274.738	1.460	175.157	13,74%	1.707.509	136.601	9,3	8,0
1985	2.858.908	3.274	392.832	13,74%	4.818.435	385.475	7,4	6,4
1986	1.691.847	1.937	232.470	13,74%	2.851.457	228.117	7,4	6,4
1987	2.516.434	2.881	345.774	13,74%	5.165.134	413.211	6,1	5,3
1988	2.384.667	2.731	327.668	13,74%	4.019.145	321.532	7,4	6,4
1989	3.764.141	4.310	517.217	13,74%	10.708.139	856.651	4,4	3,8
1990	4.625.429	3.351	402.091	8,69%	5.978.619	478.289	9,7	8,8
1991	4.053.244	2.936	352.351	8,69%	4.839.517	387.161	10,5	9,6
1992	3.273.044	2.371	284.527	8,69%	4.061.985	324.959	10,1	9,2
1993	1.648.413	1.194	143.297	8,69%	2.989.879	239.190	6,9	6,3
1994	2.777.850	2.012	241.480	8,69%	3.447.429	275.794	10,1	9,2
1995	4.575.794	3.315	397.776	8,69%	5.678.753	454.300	10,1	9,2
1996	5.904.820	4.278	513.309	8,69%	7.328.130	586.250	10,1	9,2
1997	4.988.691	3.614	433.670	8,69%	6.726.045	538.084	9,3	8,5
1998	4.212.844	3.052	366.225	8,69%	4.797.602	383.808	11,0	10,0
1999	3.035.629	2.199	263.889	8,69%	2.546.387	203.711	14,9	13,6
30 years buildings	**115.511.593**	142.158	17.058.981	14,77%	164.706.070	13.176.486	9,0	7,8

In this way, we have managed to make an approximation of the intervention to improve the opaque elements of the municipality's façades. It is important to emphasise the economic estimation of the proposal since the economic values are the primary factors which allow the elaboration of the renovation strategies. Therefore, it was decided to make an approach to the new EPBD in order to evaluate the impact of this intervention on the energy saving objectives for the region. Table 12 represents a calculation of the necessary savings to be achieved in Castilla y León.

Table 12 - New Energy Efficiency Directive objectives transposed to Castilla y León region.

New Energy Efficiency Directive 2023											
										120	**2030**
									120	120	**2029**
								120	120	120	**2028**
							95	95	95	95	**2027**
						95	95	95	95	95	**2026**
					82	82	82	82	82	82	**2025**
				82	82	82	82	82	82	82	**2024**
			50	50	50	50	50	50	50	50	**2023**
		50	50	50	50	50	50	50	50	50	**2022**
	50	50	50	50	50	50	50	50	50	50	**2021**
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	
	0,80%	*0,80%*	*0,80%*	*1,30%*	*1,30%*	*1,50%*	*1,50%*	*1,90%*	*1,90%*	*1,90%*	*1,37%*
ktoe	**50**	**101**	**151**	**233**	**315**	**410**	**504**	**624**	**743**	**863**	**3.994**

Table 12 presents a development of energy savings in a scenario from 2021 to 2030. In order to be in line with this strategy, it has been decided to follow its savings schedule, starting in 2024 and completing the investment rounds in 2030.

Establishing this timeframe allows us to set out the local renovation plan, which is the goal of the development of this tool.

A percentage distribution of the total calculated investment and its energy savings can be found in Table 13. It should be noted that the calculation of energy savings has been calculated under the assumption of gas boilers with different performances depending on their estimated year of installation. These types of hypotheses make this tool an estimator to obtain approximate figures to promote the development of municipal renovation plans, but at no time should it be used as a detailed study of a building stock, as it has not been designed for such use.

Table 13 - Distribution of total investment and energy savings produced by the renovation.

Action plan for the renovation of the façades of the municipality assessed							
Investment timeline	**Investment**		**Accumulated**	**Energy savings**	**Accumulated**	**Energy savings**	**Accumulated**
year	**€**	**%**	**€**	**GWh**	**GWh**	**ktoe**	**ktoe**
2024	12706275	11%	12.706.275,23 €	18,12	18,12	1,56	1,56
2025	12706275	11%	25.412.550,45 €	18,12	36,24	1,56	3,12
2026	16171623	14%	41.584.173,47 €	23,06	59,29	1,98	5,10
2027	16171623	14%	57.755.796,48 €	23,06	82,35	1,98	7,08
2028	18481855	16%	76.237.651,36 €	26,35	108,71	2,27	9,35
2029	19636971	17%	95.874.622,16 €	28,00	136,71	2,41	11,75
2030	19636971	17%	115.511.592,96 €	28,00	164,71	2,41	14,16
7 years	**115511593**	**100%**		**164,71**		**14,16**	

As a final approach, the proposed action has been extrapolated, using a population factor, to all provincial capitals. In this way, it is possible to estimate how it would affect the EPBD objectives of the region. The results are presented in Table 14.

Table 14 - Estimation of the intervention's impact on the regional energy savings objective.

Action plan for the renovation of the façades of the Region of Castilla y León				
Investment timeline	**CyL energy savings goals**	**Accumulated**	**Leon's percentage on CyL goals**	**Unitary intervetion***
year	**ktoe**	**ktoe**	**%**	**%**
2024	82	82	1,900%	15,764%
2025	82	164	1,900%	15,764%
2026	95	259	2,087%	17,317%
2027	95	354	2,087%	17,317%
2028	120	474	1,888%	15,668%
2029	120	594	2,006%	16,647%
2030	120	714	2,006%	16,647%
7 years	**714**			
*Energy savings percentage for a unitary intervention on all the façades between 1970-99 of Castilla y León province capitals.				

8. Conclusions

After having developed the sections forming the analysis of the integration of EPCs in the Administration databases, it seems reasonable to divide the conclusions in the same general assessments and assumptions that have been conducted during the production of the present document.

As a relevant quality assessment conclusion, it can be stated that the general status of the existing EPC databases is maintained with equivalent quality characteristics. The report has shown that most registration processes are held by the same actors among EU's assessed countries but also, focusing on dataset broadcasting it can be affirmed that the majority of crossCert partners have developed an EPC database/repository structure that storages similar general information. Therefore, the participant countries except minor adjustments, such as including further data, have been able to generate and run EPC repositories.

Nevertheless, the disclosure of building elements and energy indicators has resulted disaggregated. Therefore, the first lack of harmonisation has been found. CO_2 emissions stands as the common indicator spread among all EPC platforms, however that indicator can be misleading for different stakeholders like homeowners. As a result, a common treatment of the EPC xml files has been proposed as a harmonizing tool to achieve the common language needed for the EPC databases.

As the .xml is the common tool used to register EPC data in every country assessed, an agreed similar processing procedure should be conducted generally. The sections recommended to be widely disclosed by EPC databases are:

- **General information** (identification data, cadastral data…) – to boost interoperability with other databases.
- **Building dataset** (envelopes, technical systems, conservation status…) – to increase availability of information and usability of existing data.
- **Energy performance results** (expressed by the whole set of indicators available) – to maintain a common vocabulary among EU countries, increasing interactivity for different EU stakeholders.
- **Renewable energy contributions** – to complete EP results, providing data for EU objectives and enhancing EPC real estate market permeability by creating awareness.
- **Potential energy efficiency interventions** (individually explained the proposal, the intervention costs, the energy savings, and payback periods) – to complete EP results, providing data for EU objectives and enhancing EPC real estate market permeability by creating awareness.

At this stage, if completed the recommendations, every Member State would be able to achieve fully harmonised available information while having standardised the EPC files treatment. Once applied the recommendations, a common EPC database can be developed, therefore having prepared the dataset processing sets the prior conditions to interoperable EPC platforms, not only for national/regional Administration databases but for international data interaction.

Besides, some barriers for the integration of EPCs into databases have been found. However, it has been stated that the lack of available information supposes a real challenge still. The barriers have been assessed through a group of stakeholders to include as many agents as possible. The analysis has resulted that, among the assessed stakeholders, ESCOs and homeowners endure more difficulties to interact with the EPC databases. It should not be forgotten that EPC platforms have to be interactive but, even if achieved the ideal EPC platform structure, informative actions need to be carried out concertedly to enhance the understanding of the available dataset.

The document has formulated several technical guidelines to improve and add value to the existing EPC databases structures. Those guidelines, resulting from the renovation of the current EPC treatment and management tools, can be concentrated in:

- **Increasing availability of information** – to boost usability of EPC databases information.
- **Enhancing user interactivity** – to support different stakeholders needs supported with EPC data.

- **Improving interoperability** – to add value to the existing repositories and EPC tools.
- **Harmonising the .xml treatment** – to achieve a common language among EU countries, increasing interoperability.

As a final section of the present deliverable, the potential values for the EPC databases have been explored. Many different tools have been found as a matchable option for including EPC dataset as a support or even driving force. The following have been assessed as direct compatible options:

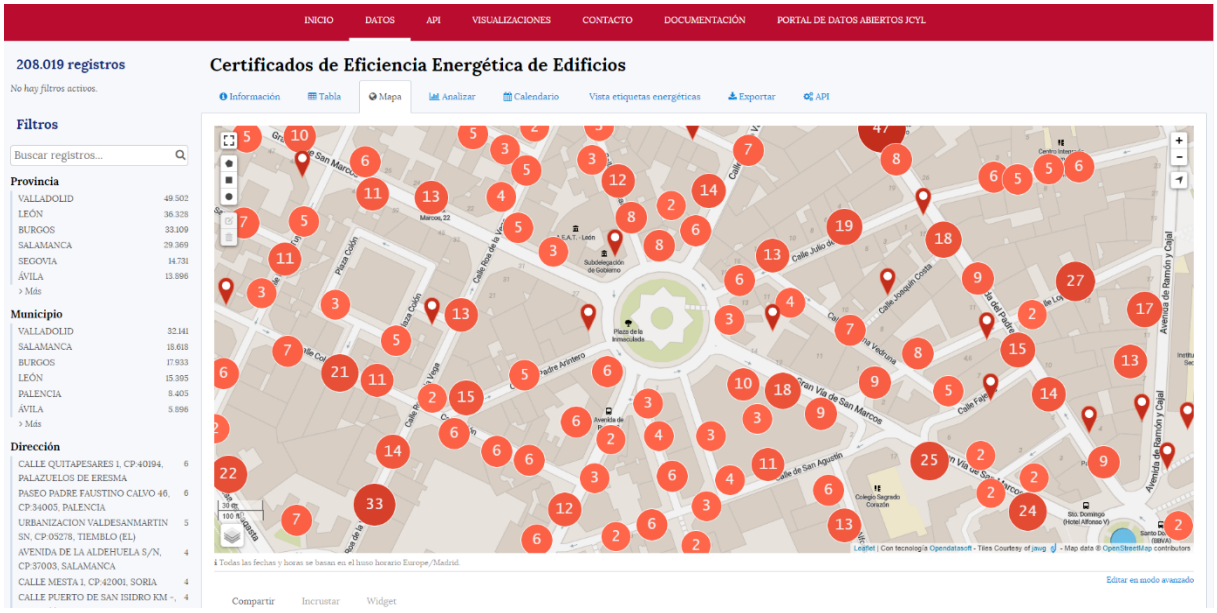
- **Energy indicators map** – enabling EPC data to become a visual platform to inform on the current status of the assessed stock.
- **Local renovation roadmaps** – using EPC data for informed decisions.
- **Local building logbooks** – EPCs used as information sources.
- **Smart Readiness Indicators** – using EPCs as vehicle to include new indicators.
- **One-stop-shops** - assistance structures by EPC databases.
- **SECAPs elaboration** – using EPC data for informed decisions and data sources.

Annex 1: Example of the integration of EPCs in Administration databases

This part of the report shows an example of integration of EPCs in the Administration databases.

The study case is *Castilla y León* region (Spain), where the regional administration has created a public and interactive register where the final user can obtain a very complete set of data and parameters from the EPCs.

Starting with a full scope over all the territory covered by the database, the total number of registered certificates and its distribution over the whole region can be viewed.



When the user starts to zoom in, geolocated EPCs are discovered as they interact with the map.

Finally, the building they need to consult can be selected, and a pop-up panel will reveal all the EPC data.

Furthermore, they could filter the address and extract the information in the form of a table. This option allows to discriminate by address to export the information in several formats.

Annex 2: Questionnaire developed to assess the current EPC databases

In this annex, the survey answered by the partners is presented. It specifies all aspects related with the EPC registries of their respective countries. This tool has allowed us to assess the current databases' status.

Country	----					
Registry/database URL	*Fill in the gap*					
Registry process						
Who does the EPC registration process?	Building owner	--	Energy certifier	--		
	Both	--	Other	--		
Digitalisation level assessment	*(Rate 1-5: 1- very poor, 2- poor, 3- average, 4- good, 5- very good)*					
	1	2	3	4	5	
Needed documents to EPC registration	*Xml*	--	*Pdf*	--		
	EPC software files	--	*Other*	--		
Displayed data on the Registry **A. BUILDING INFORMATION**						
information	*(Mark Yes or No)*					
	Address	*Yes*	*No*			
	Cadastral registry identifier	*Yes*	*No*			
	Geo-reference coordinates	*Yes*	*No*			
	Year of construction	*Yes*	*No*			
	Building use/category	*Yes*	*No*			
	Habitable floor area	*Yes*	*No*			
	Registration identifier	*Yes*	*No*			
	Registration date	*Yes*	*No*			
	Expiry date	*Yes*	*No*			
	Energy assessor/certifier information	*Yes*	*No*			
Breakdown of building's Energy Performance features	*(Rate 1-5: 1- very poor, 2- poor, 3- average, 4- good, 5- very good)*					
Envelopes	Does the dataset display the thermal envelope system features? (Walls, windows, floors, roofs…)					
		Yes	*No*			
	Are the envelope components described by their thermal performance? (Thermal resistance, transmittance…)					
		Yes	*No*			
	Is the envelope system described by its conservation status?					
		Yes	*No*			
	Rate the envelope system definition displayed on the database					
	1	2	3	4	5	
Technical Systems	Are the technical systems displayed on the database? (Heating, cooling, DHW, lighting)					
		Yes	*No*			
	Are the technical systems described by their performance features? (COP, EER, power…)					
		Yes	*No*			
	Are the technical systems described by their state of preservation or maintenance undertaken? (Very poor, poor, average, good, very good)					
		Yes	*No*			
	Rate the technical system definition displayed on the database					
	1	2	3	4	5	

B. ENERGY PERFORMANCE RESULTS			
Energy Performance Assessments	*(Mark Yes, No or Only available for energy assessors/certifiers)*		
Does the registry display the energetic parameters rated and their score?			
	Primary energy	*Yes*	*No*
		Only available for energy assessors/certifiers	
	Non-renewable primary energy	*Yes*	*No*
		Only available for energy assessors/certifiers	
	Final energy consumption	*Yes*	*No*
		Only available for energy assessors/certifiers	
	CO2 emissions	*Yes*	*No*
		Only available for energy assessors/certifiers	
	Heating demand	*Yes*	*No*
		Only available for energy assessors/certifiers	
	Cooling demand	*Yes*	*No*
		Only available for energy assessors/certifiers	
	DHW demand	*Yes*	*No*
		Only available for energy assessors/certifiers	
	Describe other indicators exhibited on your database	*Fill in the gap*	
Energy Efficiency Improvements	*(Mark the suitable option)*		
Does the registry show potential energy efficiency interventions for the building?			
	Yes, only envelope improvements		
	Yes, only technical systems improvements		
	Yes, both envelope and technical systems improvements		
	No		
Does the registry show the benefits of recommended interventions?			
		Yes	*No*
Does the registry provide information on energy savings achieved by recommended interventions?			
		Yes	*No*
Does the databases show recommended interventions investment estimate cost?			
		Yes	*No*
Does the registry show the payback period of recommended interventions?			
		Yes	*No*
C. ADDITIONAL ENERGY EFFICIENCY INFORMATION			
Energy Efficiency Information	*(Mark Yes or No)*		
	Does your database show the average energy rating in the town?	*Yes*	*No*
	Does your database show the average energy rating in the region?	*Yes*	*No*
	Does your database show the average energy rating in the country?	*Yes*	*No*
	Does your dataset display secondary energy indicators rating? (Heat demand, cooling demand…)	*Yes*	*No*
	Does the dataset include a year's energy cost forecast?	*Yes*	*No*
Describe other parameters shown on your database	*Fill in the gap*		

User experience: assessment of digitisation and interactivity							
Who can access to registry data							
		Public	X		Energy certifiers	X	
					Others	X	
Information options		*(Mark Yes or No)*					
	Does the database allow you to interact with registered dataset?				*Yes*	*No*	
	Does the database allow you to export information?				*Yes*	*No*	
	Does the database display the percentage of EPCs registered of the regional/national building stock?				*Yes*	*No*	
	Does the database display registered EPCs percentage characterised by building use type?				*Yes*	*No*	
	Does the database allow to estimate averages on registered EPC indicators by regions/areas? (Average heat demand, average CO2 emissions…)				*Yes*	*No*	
	If your database allows to generate average estimations on registered EPCs, please describe which indicators stakeholders are able to analyse				*Fill in the gap*		
Easiness to access dataset by stakeholders		*(Rate 1-5: 1- very poor, 2- poor, 3- average, 4- good, 5- very good)*					
	Public authorities	1	2	3	4	5	
	ESCOs	1	2	3	4	5	
	Homeowners	1	2	3	4	5	
	Researchers	1	2	3	4	5	
Integration of EPCs in the Administration databases added value analysis							
Dataset usefulness		*(Rate 1-5: 1- very useless, 2- useless, 3- average, 4- useful, 5- very useful)*					
	Public authorities	Does the database information help this actor developing local renovation roadmaps, SECAPs implementation or enhancing policy making?					
		1	2	3	4	5	
	ESCOs or other companies	Does the database information help this actor when investing in building renovations or knowing the current status of buildings?					
		1	2	3	4	5	
	Homeowners or other citizens	Does the dataset help this actor while deciding over potential investments for energy efficiency improvements?					
		1	2	3	4	5	
		Does the dataset help this actor before renting/buying a new property?					
		1	2	3	4	5	
	Researchers	Does the dataset help this actor to implement research projects related to Building Energy Efficiency?					
		1	2	3	4	5	
Describe other potential stakeholders who could benefit from EPC integration data in the Administration databases					*Fill in the gap*		
Describe the added value/benefit of integrating EPCs in the Administration databases for each stakeholder described in previous question					*Fill in the gap*		
Barriers and Challenges							
Mark the barriers and challenges (Yes or No) that the different actors and explain why.							
	Public authorities	X	*Digitalisation*		*Fill in the gap*		
		X	*Interactivity*		*Fill in the gap*		
		X	*Information availability*		*Fill in the gap*		
		X	*Available dataset understanding*		*Fill in the gap*		

	ESCOs or other companies	X	*Digitalisation*	*Fill in the gap*
		X	*Interactivity*	*Fill in the gap*
		X	*Information availability*	*Fill in the gap*
		X	*Available dataset understanding*	*Fill in the gap*
	Homeowners or other citizens	X	*Digitalisation*	*Fill in the gap*
		X	*Interactivity*	*Fill in the gap*
		X	*Information availability*	*Fill in the gap*
		X	*Available dataset understanding*	*Fill in the gap*
	Researchers	X	*Digitisation*	*Fill in the gap*
		X	*Interactivity*	*Fill in the gap*
		X	*Information availability*	*Fill in the gap*
		X	*Available dataset understanding*	*Fill in the gap*

Potential improvements proposals

Please describe the potential improvements that you deemed could be implemented in your country's dataset.

Annex 3: EREN's regional EPC database information to calculate the heating demand ratios of the assessed building periods.

EPC Database				Calculated		MATRYCs Toolbox	Calculated
Construction year	Building use	Useful area	Heating demand	Heating demand		Façade surfaces	Useful area
	Typology	m^2	kWh/m^2year	kWh/year	kWh/m^2year	m^2	m^2
1970	BLOQUE DE VIVIENDAS COMPLETO	641,35	221,10	141.802,49	**177,2**	**185.059,63**	**200.447,38**
	BLOQUE DE VIVIENDAS COMPLETO	6.601,00	138,27	912.720,27			
	BLOQUE DE VIVIENDAS COMPLETO	814,36	246,84	201.016,62			
	BLOQUE DE VIVIENDAS COMPLETO	2.650,00	156,70	415.255,00			
	BLOQUE DE VIVIENDAS COMPLETO	3.278,00	168,31	551.720,18			
	BLOQUE DE VIVIENDAS COMPLETO	488,00	175,06	85.429,28			
	BLOQUE DE VIVIENDAS COMPLETO	730,10	161,24	117.721,32			
	BLOQUE DE VIVIENDAS COMPLETO	130,00	299,58	38.945,40			
	BLOQUE DE VIVIENDAS COMPLETO	195,00	249,94	48.738,30			
	BLOQUE DE VIVIENDAS COMPLETO	890,00	176,10	156.729,00			
	BLOQUE DE VIVIENDAS COMPLETO	851,00	267,65	227.770,15			
	BLOQUE DE VIVIENDAS COMPLETO	1.288,00	237,64	306.080,32			
	BLOQUE DE VIVIENDAS COMPLETO	1.610,00	270,04	434.764,40			
	BLOQUE DE VIVIENDAS COMPLETO	1.880,66	143,85	270.532,94			
	BLOQUE DE VIVIENDAS COMPLETO	176,00	169,51	29.833,76			
1971	BLOQUE DE VIVIENDAS COMPLETO	6.055,00	242,21	1.466.581,55	**221,7**	**66.292,74**	**71.805,00**
	BLOQUE DE VIVIENDAS COMPLETO	575,00	152,47	87.670,25			
	BLOQUE DE VIVIENDAS COMPLETO	4.939,00	197,70	976.440,30			

	BLOQUE DE VIVIENDAS COMPLETO	950,30	257,39	244.597,72			
1972	BLOQUE DE VIVIENDAS COMPLETO	913,48	200,34	183.006,58	**238,2**	**75.670,38**	**81.962,39**
	BLOQUE DE VIVIENDAS COMPLETO	1.493,00	125,01	186.639,93			
	BLOQUE DE VIVIENDAS COMPLETO	4.157,05	378,67	1.574.150,12			
	BLOQUE DE VIVIENDAS COMPLETO	1.950,00	75,01	146.269,50			
	BLOQUE DE VIVIENDAS COMPLETO	391,76	79,10	30.988,22			
1973	BLOQUE DE VIVIENDAS COMPLETO	1.383,00	67,22	92.965,26	**183,3**	**69.763,65**	**75.564,51**
	BLOQUE DE VIVIENDAS COMPLETO	3.365,80	231,02	777.567,12			
1974	BLOQUE DE VIVIENDAS COMPLETO	1.936,12	57,31	110.959,04	**171,5**	**75.816,72**	**82.120,90**
	BLOQUE DE VIVIENDAS COMPLETO	2.075,25	272,20	564.883,05			
	BLOQUE DE VIVIENDAS COMPLETO	623,97	191,10	119.240,67			
1975	BLOQUE DE VIVIENDAS COMPLETO	1.969,90	164,42	323.890,96	**112,1**	**105.005,56**	**113.736,80**
	BLOQUE DE VIVIENDAS COMPLETO	1.340,00	176,09	235.960,60			
	BLOQUE DE VIVIENDAS COMPLETO	2.417,00	55,19	133.394,23			
	BLOQUE DE VIVIENDAS COMPLETO	3.881,00	102,26	396.871,06			
	BLOQUE DE VIVIENDAS COMPLETO	687,20	152,86	105.045,39			
	BLOQUE DE VIVIENDAS COMPLETO	819,67	61,80	50.655,61			
1976	BLOQUE DE VIVIENDAS COMPLETO	2.277,00	167,86	382.217,22	**167,9**	**78.516,25**	**85.044,89**
1977	BLOQUE DE VIVIENDAS COMPLETO	1.038,00	167,71	174.082,98	**169,3**	**101.110,64**	**109.518,01**
	BLOQUE DE VIVIENDAS COMPLETO	4.536,00	182,4	827.366,40			
	BLOQUE DE VIVIENDAS COMPLETO	3.042,84	183,56	558.543,71			
	BLOQUE DE VIVIENDAS COMPLETO	2.968,00	145,01	430.389,68			
	BLOQUE DE VIVIENDAS COMPLETO	1.069,00	177,98	190.260,62			

	BLOQUE DE VIVIENDAS COMPLETO	4.706,09	148,67	699.654,40			
	BLOQUE DE VIVIENDAS COMPLETO	1.120,00	185,92	208.230,40			
	BLOQUE DE VIVIENDAS COMPLETO	1.731,00	192,52	333.252,12			
1978	BLOQUE DE VIVIENDAS COMPLETO	1.986,00	146,64	291.227,04	**149,3**	**86.469,72**	**93.659,70**
	BLOQUE DE VIVIENDAS COMPLETO	3.462,30	102,78	355.855,19			
	BLOQUE DE VIVIENDAS COMPLETO	3.425,37	198,72	680.689,53			
	BLOQUE DE VIVIENDAS COMPLETO	101	124,37	12.561,37			
1979	BLOQUE DE VIVIENDAS COMPLETO	1.947,00	145,76	283.794,72	**180,9**	**90.375,24**	**97.889,96**
	BLOQUE DE VIVIENDAS COMPLETO	1.253,00	166,45	208.561,85			
	BLOQUE DE VIVIENDAS COMPLETO	1.854,00	157,89	292.728,06			
	BLOQUE DE VIVIENDAS COMPLETO	3.200,00	150,66	482.112,00			
	BLOQUE DE VIVIENDAS COMPLETO	1.476,00	180,36	266.211,36			
	BLOQUE DE VIVIENDAS COMPLETO	5.500,00	190,48	1.047.640,00			
	BLOQUE DE VIVIENDAS COMPLETO	6.162,00	209,12	1.288.597,44			
1980	BLOQUE DE VIVIENDAS COMPLETO	755	241,21	182.113,55	**123,7**	**120824,72**	**130.871,32**
	BLOQUE DE VIVIENDAS COMPLETO	4.257,00	117,07	498.366,99			
	BLOQUE DE VIVIENDAS COMPLETO	1.155,00	153,85	177.696,75			
	BLOQUE DE VIVIENDAS COMPLETO	7.700,00	109,25	841.225,00			
	BLOQUE DE VIVIENDAS COMPLETO	261	185,45	48.402,45			
1981	BLOQUE DE VIVIENDAS COMPLETO	16.420,00	122,95	2.018.839,00	**123,0**	**54522,2**	**64.536,75**
1982	BLOQUE DE VIVIENDAS COMPLETO	1.526,00	162,01	247.227,26	**131,1**	**30432,56**	**36.022,36**
	BLOQUE DE VIVIENDAS COMPLETO	1.062,00	163,01	173.116,62			
	BLOQUE DE VIVIENDAS COMPLETO	4.909,00	114,56	562.375,04			
1983	0	0	0	0	**0,0**	**88500,79**	**104.756,47**

1984	BLOQUE DE VIVIENDAS COMPLETO	375,45	147,12	55.236,20	**130,6**	**33568,54**	**39.734,35**
	BLOQUE DE VIVIENDAS COMPLETO	1.190,00	125,33	149.142,70			
1985	0	0	0	0	**0,0**	**75285,58**	**89.113,91**
1986	0	0	0	0	**0,0**	**44552,56**	**52.735,90**
1987	BLOQUE DE VIVIENDAS COMPLETO	3.775,56	216,23	816.389,34	**200,1**	**66266,97**	**78.438,78**
	BLOQUE DE VIVIENDAS COMPLETO	3.338,52	218,62	729.867,24			
	BLOQUE DE VIVIENDAS COMPLETO	3.396,81	194,91	662.072,24			
	BLOQUE DE VIVIENDAS COMPLETO	3.468,50	223,59	775.521,92			
	BLOQUE DE VIVIENDAS COMPLETO	3.349,03	208,83	699.377,93			
	BLOQUE DE VIVIENDAS COMPLETO	3.368,81	111,45	375.453,87			
	BLOQUE DE VIVIENDAS COMPLETO	3.343,64	211,79	708.149,52			
	BLOQUE DE VIVIENDAS COMPLETO	3.848,04	206,09	793.042,56			
	BLOQUE DE VIVIENDAS COMPLETO	3.739,43	201,83	754.729,16			
	BLOQUE DE VIVIENDAS COMPLETO	5.068,57	201,6	1.021.823,71			
	BLOQUE DE VIVIENDAS COMPLETO	4.666,09	191,72	894.582,77			
	BLOQUE DE VIVIENDAS COMPLETO	3.358,91	208,18	699.257,88			
	BLOQUE DE VIVIENDAS COMPLETO	2.939,17	205,63	604.381,53			
	BLOQUE DE VIVIENDAS COMPLETO	3.409,35	200,12	682.279,12			
1988	0	0	0	0,00	**0,0**	**62797,08**	**74.331,54**
1989	BLOQUE DE VIVIENDAS COMPLETO	184,98	277,27	51.289,40	**277,3**	**99123,7**	**117.330,58**
1990	BLOQUE DE VIVIENDAS COMPLETO	1.416,00	128,97	182.621,52	**129,0**	**121804,58**	**144.177,44**
1991	BLOQUE DE VIVIENDAS COMPLETO	6.896,90	136,22	939.495,72	**138,4**	**106736,84**	**126.342,08**
	BLOQUE DE VIVIENDAS COMPLETO	648,87	161,65	104.889,84			
1992	0	0	0	0,00	**0,0**	**86191,3**	**102.022,77**
1993	BLOQUE DE VIVIENDAS COMPLETO	29.275,13	211,7	6.197.545,02	**210,3**	**43408,78**	**51.382,03**

	BLOQUE DE VIVIENDAS COMPLETO	63,49	163,86	10.403,47			
	BLOQUE DE VIVIENDAS COMPLETO	575	141,79	81.529,25			
1994	0	0,00	0	0	**0,0**	**73151,04**	**86.587,30**
1995	0	0	0	0	**0,0**	**120497,51**	**142.630,29**
1996	0	0	0	0	**0,0**	**155495,67**	**184.056,85**
1997	BLOQUE DE VIVIENDAS COMPLETO	250	156,29	39.072,50	**156,3**	**131370,61**	**155.500,54**
1998	BLOQUE DE VIVIENDAS COMPLETO	671,34	132,01	88.623,59	**132,0**	**110939,7**	**131.316,92**
1999	BLOQUE DE VIVIENDAS COMPLETO	1.750,00	49,44	86.520,00	**97,2**	**79939,31**	**94.622,43**
	BLOQUE DE VIVIENDAS COMPLETO	927	187,47	173.784,69			