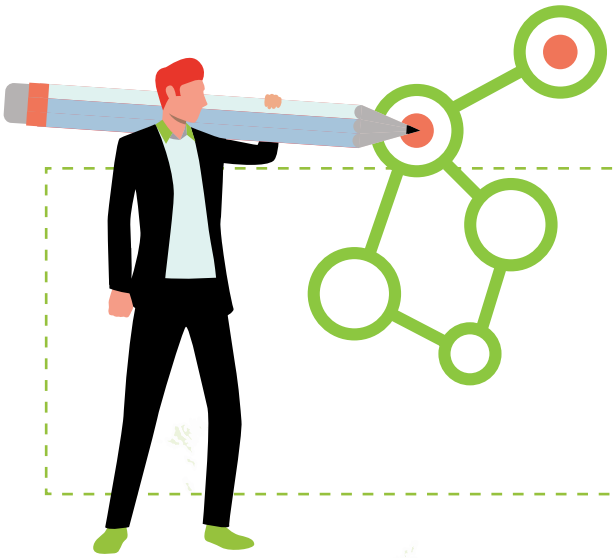

X-tendo

FEATURE 10:
ONE-STOP SHOPS

Implementation guidelines and replicability potential of the innovative features for the next generation EPCs

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 845958.

BPIE

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https://x-tendo.eu/wp-content/uploads/2022/07/x-tendo-Implementation-guidelines-and-replicability-potential_Final.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 845958.

CONTENTS

EXECUTIVE SUMMARY

Energy performance certificate (EPC) schemes have not evolved much since their first introduction in the Member States to meet the mandatory requirements set out under the Energy Performance of Buildings Directive (EPBD). With the recent revision proposal of the *EPBD* it has become more important to focus on EPCs critically and increase their usability for stakeholders. Stakeholders have questioned their reliability but at the same time, they have been useful for the real estate industry. All the Member States have legislation in place and existing infrastructure or systems to run EPC schemes. These schemes must evolve with the changing needs of the built environment and consider elements such as enhanced indoor comfort, reducing air pollution and financing options. This should occur alongside energy consumption analysis giving impetus to renovation rates of Member States towards achieving EU 2050 decarbonisation goals for the building sector set out under the *European Green Deal.* Public authorities view EPCs as potential instruments to improve the performance of existing building stock and deeper renovation. Extending the functionalities of existing EPC systems will create several pathways to update and manage next-generation EPCs.

This report presents the implementation guidelines and replicability potential of ten innovative features proposed within X-tendo: (i) smart readiness, (ii) comfort, (iii) outdoor air pollution, (iv) real energy consumption, (v) district energy, (vi) *EPC databases*, (vii) *building logbook*, (viii) *enhanced recommendations*, (ix) *financing options*, and (x) *one-stop-shops*. The outcome of this report is a critical presentation of the barriers and drivers for each feature's wide uptake, their impact if implemented by Member States and the necessary next steps in order to implement the innovative features in certification schemes around Europe. The developed features were tested in nine countries: Austria (AT), UK-Scotland (UK), Italy (IT), Denmark (DK), Estonia (EE), Romania (RO), Portugal (PT), Poland (PL) and Greece (GR). Then the experts who tested them provided deeper insights, appropriate directions and policy perspectives which provided a realistic estimation for its implementation and replicability across different Member States. The replicability potential is mainly analysed based on qualitative information collected from previous investigations in the project and extensive focus groups within project implementing countries. However, an estimation of the quantitative effects of the implementation of innovative features into the EPC schemes is also performed for X-tendo countries based on the results of the testing activities together with use of a building stock model.

Some general conclusions derived for all features include:

- New or revised EPCs must not be burdened with a lot of new information for the end-user. Information on the first page must be prioritised for the end-user application. Thus, which information is presented on the EPC (on paper) and which on the digital EPC or digital building logbook (DBL) should be considered.

- Automation and simplification of procedures is necessary in overcoming major issues regarding interoperability and data exchange.

- User-friendliness of features is highlighted as one of the most important drivers during tests of all features and more research is needed in this regard, because so far, the features were tested with experts, not with end users.

- EPCs must be coherently linked to other instruments such as DBL and building renovation passports to increase their impact.

- Training is required for some features to upskill and improve the competence of the workforce responsible for delivering EPCs. Some features do not require training at all, while others have either simple or complex methods that require different training needs.

- All the features are compatible for different building typologies. For some features, X-tendo developed two calculation methods, one is more simple and requires low effort, while the other is complex and more reliable. Each method can fit different building typologies (e.g. a detailed SRI is needed for large commercial buildings whereas CARP and CORP can be used for school, office and residential buildings).

X-tendo features were developed from this perspective to empower the end-user with more information and help them take necessary actions for renovation. All the features have been found to have relevance in the test countries with differences in needs and application. The X-tendo project has identified a series of recommendations for policy uptake and formulation that would be beneficial in the implementation of new features:

- Establish simplified procedures at MS level to update the EPC with new features followed by individual and detailed studies at national level.

- Recognise the strengths of existing EPC best practices and provide necessary resources for the transfer of knowledge from front runner countries. Use this process to adapt new features for EPCs.

- Conduct detailed assessments of existing EPC input data and prioritise new features with significant overlap of data input with EPCs. In addition, prioritise outputs relevant to the end-user on the EPC. Information relevant for public authorities can be made available on the attachment or DBL.

- Promote the implementation of new features using market and non-market mechanisms to raise awareness among the public and other relevant stakeholders.

- Conduct cost-benefit analyses at a national level to determine the feasibility of features and their economic impact to build trust in markets.

- Carry out selective implementation and independent pilot studies in national contexts to support MS individual policy goals.

- Set up more ambitious and rigorous quality check mechanisms in EPCs, the EPC database and check consistencies within and between databases.

- Require businesses to work on creating an environment and enabling conditions to support job creation and increase investments in renovation with features such as DBL and OSS.

1 INTRODUCTION

This report brings together the outputs of the evaluation of the test projects (T5.2) alongside the insight from end-users and stakeholders gathered in WP6 (Communication and Dissemination) and from end-users in WP2 (Exploring the principles of next-generation EPCs), and include estimations of:

1. The barriers and drivers for the wide uptake of each of the 10 features.
2. The effects (in quantitative and qualitative terms) of the wider implementation of the developed innovative features of EPCs in Europe.
3. The necessary next steps in order to implement the innovative features in the certification schemes around Europe, in particular assessing staff and training needs.

The replication potential is mainly analysed based on qualitative information collected from previous activities in the project and extensive focus groups within project implementing countries. However, we have also estimated the quantitative effects of the implementation of innovative features into the EPC schemes, based on the results of testing activities in the previous task (T5.1 and T5.2) together with the use of a building stock model. An assessment has been carried out on the potential future number of EPCs with the innovative features developed throughout the course of this project. It forms the basis for the identification of the capacity-building implications for delivery bodies, particularly staff and training needs.

Table 1 provides an overview of the 10 innovative features developed in the project X-tendo and tested by partners with relevant expertise in 9 countries: Austria (AT), UK-Scotland (UK), Italy (IT), Denmark (DK), Estonia (EE), Romania (RO), Portugal (PT), Poland (PL) and Greece (GR).

Based on the methodologies of the developed features, three different test categories were used:

- **In-building testing:** In existing buildings this involved testing the new features in use by assessing the time required and viability to collect new data points as part of, or in addition to, a conventional EPC assessment. This process also involved the systematic collection of qualitative data from EPC assessors and building owners/managers on their view of the new process/indicator.
- **Systems testing:** This involved development work with EPC database operators or public authorities to assess the technical and practical viability of the new features. It considered time and cost implications, integration with existing systems, access to data and data privacy issues.
- **User testing:** Surveys were carried out with specific end users or stakeholder groups to understand the usability of the new features.

Table 1 - Overview of features and implementing partners

Feature number	Innovative feature	Feature lead	Implementing countries
1	Smart readiness	VITO	AT (IB), EE (IB/expert), GR (IB), RO(IB)
2	Comfort	BPIE	AT(IB), GR (IB/expert), PT(IB), RO(IB)
3	Outdoor air pollution	NAPE	PL (IB expert)
4	Real energy consumption	VITO	AT(IB), EE(IB), IT(IB), RO (IB/expert)
5	District energy	E-think	DK (expert), IT(IB), PL(IB), RO(IB)
6	EPC databases	TU Wien	DK (S), GR (S), IT(S), UK (expert)
7	Building logbook	BPIE	EE (U/S) , GR(U/S) , PT (expert)
8	Enhanced recommendations	TU Wien	AT (expert), DK (IB), PL (IB/S), UK (IB)
9	Financing options	ADENE	DK (U/S), PL (expert), PT (U), RO (U/S)
10	One-Stop-Shops	ADENE	DK (U/S), PT(U/S/expert), RO (U) , UK (U)

IB: In-building test; S: System test; U: User test, expert: supporting partner with existing expertise

2

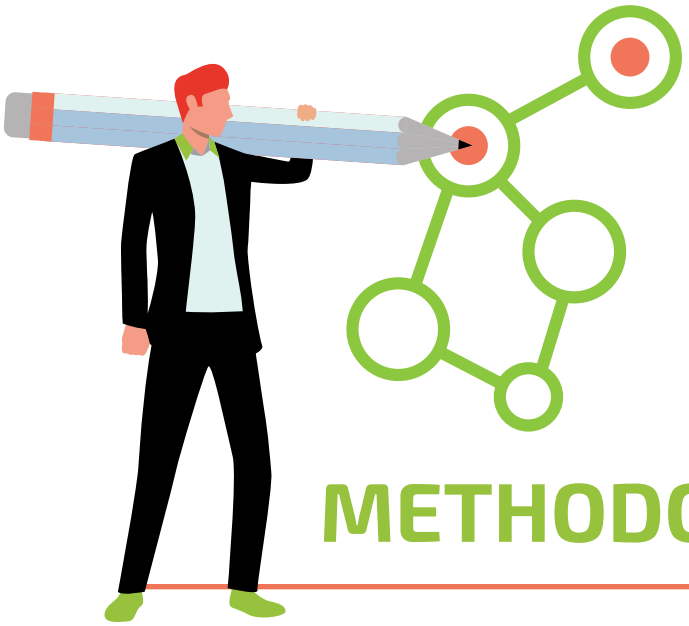
OBJECTIVE OF THE REPORT

This report on the implementation guidelines and replicability potential of the 10 innovative features has been prepared to consolidate useful information to guide public authorities, energy agencies and other relevant stakeholders in the enhancement of EPCs. The report supports the project results' replicability and implementation in different Member States of the EU.

Therefore, the objective of the report is twofold:

1. Provide implementation guidelines for public authorities for the 10 X-tendo features.
2. Estimate the replicability potential in quantitative and qualitative terms.

The implementation guidelines are mainly structured as barriers and drivers for each feature. The identification of the replicability potential is based on qualitative information and quantitative estimations of the potential number of EPCs that will – in future – incorporate the innovative features. Finally, we identify the necessary next steps to implement the innovative features in certification schemes across Europe.



3 METHODOLOGY

Implementation guidelines and replicability potential in this report were prepared through an iterative process of filtering and refining the information and data collected through different project activities. This includes findings from the viewpoints of all relevant stakeholders.

These are briefly described below:

1. **Methodologies and concepts for all features:** Approaches and methods used for the development of the ten features in the X-tendo project [1][2].

2. **End-users needs and perspectives:** A stakeholder survey comprising homeowners, buyers, tenants, sellers and landlords was conducted in 5 European countries (Poland, Portugal, Greece, Romania and Denmark) with 2,563 participants to investigate their needs and identify the relevance of the new features [3]. Interviews and focus groups were also conducted with relevant stakeholder groups for some features to collect their preferences during testing.

3. **Cross-cutting criteria:** The principles used to guide the development and testing of the features for next-generation energy performance certification ensure (i) Quality and reliability, (ii) User-friendliness, (iii) Economic feasibility, and (iv) Consistency with ISO/EN standards [4].

4. **Introductory reports for 10 innovative EPC features:** Brief reports describing the basic concepts, highlight existing cases or best practices, and outline the first steps for implementation [5]–[14].

5. **Evaluation and documentation of test projects:** Monitoring and results reports to assess the practical viability and impact of the ten features. This includes detailed evaluations of the features after testing conducted in nine test countries [15]–[24].

6. **Experience sharing web-calls:** Views gathered from stakeholder representatives within the consortium and from the advisory board.

7. **Workshops and webinars at EU level:** Stakeholder engagements conducted by the test countries with local and national stakeholders to evaluate and receive feedback on the features during their development at EU level.

8. **Online meetings between partners for each feature:** Review of evidence and data collected in the project relevant to each feature with extensive discussion on the replicability potential of each feature.

9. **Estimation of quantitative impact for wider implementation:** Analysis using a building stock model to study the impact on renovation rates of the ten features in Member States. A detailed methodology is described further in this section.

The inputs were analysed to identify drivers and barriers that impact the uptake of each feature. The effects (in quantitative and qualitative terms) of the wider implementation were also analysed for the developed features of EPCs in Europe. Based on these, the necessary next steps were outlined in order to enable their implementation in certification schemes around Europe. To ensure an impartial assessment for replicability, the findings for each feature were triangulated using feedback from testing partners, feature developers and stakeholders.

Methodology for estimation of quantitative impact due to wider implementation

To estimate the quantitative impact of a wider implementation of the 10 features an assessment was conducted for the 10 X-tendo countries using the building stock model. To estimate the impact several trigger points were identified when EPCs can or need to be issued in the X-tendo countries. These trigger points are:

- New building construction
- Major building renovation
- Building sales (if no valid EPC available)
- Renting out (if no valid EPC available)
- Other (e.g. the interest of the building owner in improving the energy performance of the building)

The reference for the above trigger points is drawn from Art 12/1 of the EPBD (2018/844) [25] which states that 'Member States shall ensure that an energy performance certificate is issued for: (a) buildings or building units which are constructed, sold or rented out to a new tenant; and (b) large public buildings'. In Art 17 of the proposed recast EPBD, this is extended to "building units which are constructed, have undergone a major renovation, are sold or rented out to a new tenant or for which a rental contract is renewed".

The different EPC features developed in the X-tendo project will have a different response to the identified trigger points in each Member State. This is due to factors such as public acceptance, real estate needs, market interests, investments, existing state of EPC system etc. The relevance of each trigger point for each feature mentioned above are presented in detail in Table 13 of Annex 1. These trigger points are used to calculate the number of annually issued EPCs until 2030 using historical data of issued EPCs (2014-2019) in the 10 X-tendo countries. The number of EPC end-users potentially interested in a certain feature was determined by estimating the share of interested end-users per trigger point and feature. For the 2030 projection, it was assumed that the number of tenants, real estate transactions and new building constructions follow the same linear trends as in the past 10 years.

More details on calculation method are presented in *Annex 1*.

4

FEATURE 10: ONE-STOP SHOP

4.1 Overview

One-stop shops (OSS) can be defined as advisory tools to facilitate access to financial mechanisms, benefits and support schemes, assist consumers concerning technical and financial issues and to guide them through their building renovation process. Therefore, to provide these functionalities and valuable building information, the data coming from the EPC plays a special role and should be linked to the OSS (among other sources of data). OSS are transparent and integrated advisory tools/venues which will accelerate energy renovations by informing, motivating and assisting building owners throughout the renovation journey, from beginning to end.

The key benefit of setting up an OSS is the possibility to overcome the many and simultaneous barriers related to residential building renovation. The OSS acts as an intermediary that simplifies the fragmented offer of renovation suppliers, for example by aggregating designers, suppliers, installers and financiers into a single package for the homeowners. An OSS also supports the supply side of building renovation by mediating with potential clients, using techniques such as organising offer packages, pooling the projects and managing the project implementation. The OSS is well placed to facilitate the implementation of locally developed projects with strong and trustworthy partnerships between homeowners, local actors and local governments.

OSS can be defined as advisory tools that facilitate access to financial support schemes, assist building owners with technical and financial issues and guide them through their renovation process. To provide these functionalities and valuable building information, the data coming from the EPC plays a special role and could be linked to the OSS (among other sources of data).

This feature links EPC data to OSS and assesses the applicability of the approaches for the different implementing countries, taking account of their corresponding existing EPC data, activities and needs.

The expected outcomes to include in the X-tendo toolbox are guidelines on how to set up or upgrade OSS and link EPC data in order to boost the market. Overall, the guidelines could:

- Explain how to reduce barriers and transaction costs for finding information regarding support schemes, tradespeople and public authorities.
- Describe OSS functionalities that can be adopted partially or completely.
- Provide detailed information to homeowners about their homes and monitor the uptake of improvement measures.
- Facilitate communication between homeowners and experts.

4.2 Key insights from testing

Table 11 - Test projects summary in implementing countries for one-stop-shops

Country	ROMANIA	PORTUGAL	PORTUGAL	Denmark	UK - SCOTLAND
Type of Testing	User Testing	System Testing	User Testing	User Testing	User Testing
Number of testing cases	29 (homeowners), 15 (public authority), 37 (qualified experts), 3 (bankers)	2 functionalities	463 beneficiaries	8 (homeowners)	3 (focus groups)
Tool	Interview questionnaire	CasA+ application	Survey	Interview questionnaire	Interview questionnaire
Testing Period	06/2021 – 12/2021	06/2021 – 12/2021	06/2021 – 12/2021	11/2021 – 12/2021	09/2021 – 01/2022

User testing

The main objective of user testing was to investigate the awareness among stakeholders about the need and usefulness of having OSSs for boosting the renovation rate of buildings. Romania, Portugal, Denmark and the UK conducted user testing with multiple stakeholders. The key results of the user-testing are given below:

- Several stakeholders (owners, assessors, suppliers, companies, financial institutions, utilities and local authorities) are highly interested in OSS.
- Linking of EPC and OSS is essential for the success of the feature.
- Older, inaccurate and poor quality EPCs may pose a challenge to OSS.
- The administration of OSS for renovation must be done by local authorities connecting the local web-portals with local/national databases.

- Setting up of pricing strategy is necessary to ensure optimal marketing and operational plans (e.g. membership for companies).
- Self-service functionalities would be relevant with the options to register and create accounts to directly connect construction and installation companies and end-users.
- User stories and successful cases should be promoted and advertised.
- A database of works subject to verification of compliance and quality would be useful for assessors.
- Strategies for effective public and private collaboration are required between several stakeholders for the success of OSS.
- Multi-channel support (phone, email, online tools etc.) would be useful for personalization of OSS.
- Improved consent process from homeowners is necessary to provide feasible solutions.
- Awareness must be raised about OSS to extend the services and benefits available to homeowners.

System testing

Two new functionalities were tested by Portugal related to OSS on their existing platform for EPCs i.e. casA+. These were (i) automatic proposal for improvement measures, (ii) information on financing and incentives. Some key findings from system testing are given below:

- Both new functionalities are very useful in the context of one-stop-shops and are fundamental for the homeowner.
- The functionalities give the homeowner a better understanding of the possible improvement measures.
- Improvement of the energy performance has been achieved after renovation works supported by casA+ for some homeowners.
- The homeowners are now more aware of the functionality benefits and are interested in using some incentives or support programs.
- Customer led engagement and flexible support to end-users reflecting their interests is necessary.
- Companies are interested in different membership plans offered, however, with more clarity on products and services to homeowners.

4.3 Drivers and barriers for a wide uptake of the feature

4.3.1 Calculation method and quality assurance

This feature explores how to link EPC data to OSS considering existing EPC data, building stock renovation activities and the needs of various countries. Guidelines on how to set up or upgrade OSSs are developed with descriptions of approaches for linking EPC data to OSS. Several barriers and drivers were identified for the one-stop-shop feature:

- The existence of significant differences in providing renovation services between Member States demands a high degree of flexibility when it comes to implementation rules and approaches.
- OSS can be developed around EPC schemes that have common points (recommendations, costs etc.).
- Access to EPC data is one of the major drivers that could enable effective renovation advice to homeowners.
- Financing instruments, renovation works and audits typically are not very linear.
- Centralizing several functionalities in a single place and providing a more effective, efficient service to all stakeholders could benefit greatly from the tool and provide high quality service.
- Protection of the homeowner from fraudulent offers is important.
- Verification methods on OSS are key to establish trust for suppliers and homeowners.
- Public ratings are useful for homeowners to select relevant suppliers.

Denmark outlines that OSS should be simple to use for the end-user. In Portugal, the public authority manages both the EPC database, as well as the OSS, thus the interoperability between platforms makes it easy to implement the OSS services. A company directory was made available for suppliers where they agree on terms and conditions on data usage, which is not used for other purposes. The homeowners have access to suppliers and their offers then further exchange of information takes place outside OSS. In the UK, the focus is on providing impartial advice, which is set aside to support the renovation journey. A list of potential installers and services is available on the existing portal for homeowners; however, the systems are not automated and relies mostly on the end-user to find the relevant suppliers and get offers from them.

4.3.2 Social drivers and barriers (occupants/owners' perspective)

OSS feature provides a better way to analyse data and EPC information, increasing EPC owners' awareness of EPC relevance and needed improvement/implementation actions. OSS can provide a trusted link between end-users and qualified energy experts, financial institutions and companies that have good feedback from clients:

- OSS adds an additional layer of data assessment, especially when linked with building logbook.

- Feedback from clients (end-users) will increase the level of confidence of end-users in the advice/help that they may receive.

- One of the main issues raised concerning processing and sharing of personal data is the GDPR.

- OSS that provide easy access to reduce the burden on end-users by developing platforms with good user experience and communicating in persuasive, non-technical language is more likely to be successful.

The feature focuses on developing guidelines and tools for Denmark, Portugal, Romania and the UK for homeowners to explore the benefits of renovations and of implementing them via OSS, with links to the EPC, focusing on energy and economic savings among others.

4.3.3 Construction sector (upskilling, construction industry, investors, developers etc.)

The existing OSS have very different approaches and types of stakeholders involved, which requires different levels of expertise, skills and training:

- Despite the approach taken, an OSS dedicated to energy renovation can involve aspects throughout the whole customer journey from capturing the attention of the homeowner to access the OSS to the implementation of measures and taking advantage of their benefits. It therefore requires a wide range of skills and considerations.

- OSS are typically digital platforms and require a certain level of IT skills to set up and run. Also, information provided to/by the OSS via other platforms (links with EPCs databases or others) requires a robust level of interoperability.

- Communication expertise, guidance and instructions are also required to target and support the different stakeholders interacting with the OSS: homeowners, energy auditors, suppliers of building components and contractors, financial institutions, real estate market, insurance companies or public authorities.

- Several stakeholders in the construction industry have shown interest in OSS and would like to get involved in national OSS models.

- Increasing trustworthiness by accrediting and quality control of local partners.

All these requirements are influenced by the functionalities of an OSS, which can range from simple marketing, communication and awareness, to providing technical assistance and financial advice, supporting access to products and financial instruments, coordination of works or assurance of performance. In Romania, different priorities were observed for OSS, where public authorities prefer it at municipal level while other actors emphasise the need for physical space. There is a need to provide training for professional advice and provide additional information at no cost. If the services are commercial, then it could entail additional costs. The trust expected in developing OSS could benefit if linked to a public service.

4.3.4 Economic and market drivers and barriers

Different policy and market backgrounds and potentials exist in Member States for considering the future implementation of OSS.

In Romania, there is no OSS and so it needs to be designed from the beginning. In the UK, the current OSS is based on a consultancy approach making the available data accessible online to possibly create better links with funding schemes and installers. The more-developed OSS in Portugal and Denmark still has potential for improvements.

- Definition of the OSS functionalities and a viable business model supporting different stakeholders involved.
- Evaluate existing models already implemented and study the market acceptance.
- A major barrier is the cost that would be required to support OSS and its services, especially if they are provided for free to the homeowners.
- To overcome existing market barriers between service providers and beneficiaries it is important to establish stable partnerships and cheaper solutions.
- Ensuring technical support to manage the OSS.
- Information on green mortgages by collaborating with financial institutions.

Economic feasibility is to be evaluated but OSS may be organised in the energy efficiency departments of public authorities, with well-trained employees, implying no additional costs for end-users. Alternatively, distinct state/private OSS may be financed by the companies involved in construction sectors, with small fees for being on the information platform. Potential financial constraints linked to the business model are the costs of set-up, maintenance, and system interoperability. The OSS business model in the UK (Scotland) is publicly funded. The automation of the data flows between the EPCs and OSS reduces costs when high quality data is imported automatically. In Romania the focus is also on private actors in the market who could benefit from the OSS. Portugal has a mixed model that is funded partly by the public from EPC revenue and funds are from membership plans for companies. Denmark's OSS is market driven, assessors pay to get the training, the services of energy audit are also paid but this has a negative impact on its popularity for renovation advice.

4.3.5 Consistency with existing policies and standards

Accelerating energy renovations faces multiple barriers including social (e.g. lack of awareness, low trust), technical (e.g. inadequate advice, incoherent renovation measures), financial (e.g. high investment costs) and market related (e.g. lack of reliable experts and tradespeople, split-incentive dilemma). To overcome these barriers, the EPBD 2021 recast proposal calls upon Member States to consider transparent advisory tools to inform and assist consumers in energy efficiency renovations and related financial instruments. The concept of OSS has gained traction as a solution to overcome market fragmentation on both the demand and supply side by offering holistic, whole-value-chain renovation solutions.

- The OSS feature and roll-out procedures for future deployment are developed in good consistency with CEN/ISO standards. The determination procedure is developed considering the relevant standards, starting from the EPBD overarching standard EN 52000-1: 2017 and the underlying set of standards for evaluating the performance of buildings and links to EPCs.
- Integration of OSS with building logbooks, building renovation passports, finance options, etc. is important.

- OSS should support and monitor the whole renovation journey with the end-user following all national and regional standards.
- Can implement and monitor policies at national or local level to the building stock.

In the UK (Scotland), it is strategically important to address energy poverty issues. It is about integrating EPC better in the system and how potential measures can be delivered to homeowners. To tackle fuel poverty, it can be used to provide better funding support. Denmark also shows that getting information to homeowners is a priority and it should be easy to access to comply with national instruments. This would make measures and services more accessible to homeowners.

Compatibility with the EPC scheme

In Denmark, the same calculation tool of software is employed to serve their OSS and EPCs which is an extension to the EPC scheme and can be based on an existing EPC for a building. There are a lot of similarities between the two processes. The OSS report can import EPC data and it is also available to the consultant. However, there is room for improvement where the main requirement is to digitally link between EPCs and OSS, in order to make it more flexible, update certain inputs and make it more reliable so it can be used in a longer perspective. In Romania, since there is no OSS, it's mainly the energy auditors who give advice to the beneficiaries regarding renovation and also concerning the costs. Also, due to unavailability of a functional EPC database, it is not possible to process this information and give advice for OSS. In the UK (Scotland), the national OSS is delivered by local advising agencies, whose service was mainly phone-based advice and is now being transformed into online advice. The advisors have access to the EPC database and can give advice to owners using the online tools. Existing EPCs are being used for advice up to 50% of the time but there is scope for much more. There are quality issues that must be overcome as the advisors don't feel confident using the data.

4.4 Estimation of the quantitative replicability potential

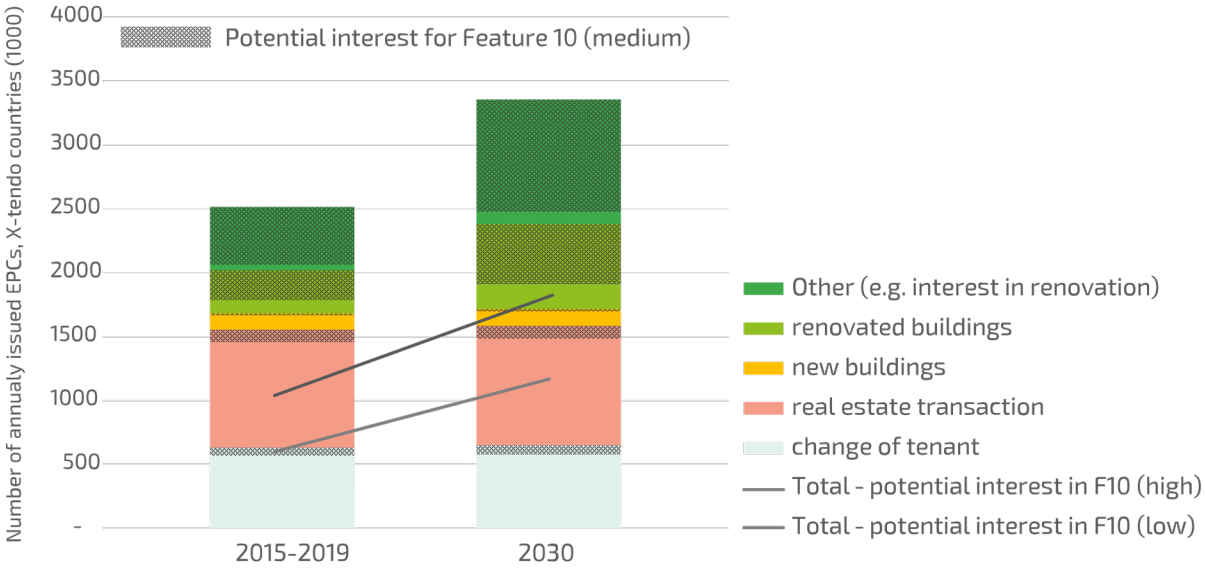
In this chapter, an estimation on the quantitative replicability potential of this feature is provided in the X-tendo countries. This follows the methodology described in section 3. *Figure 11* shows the number of annually issued EPCs, by the different trigger points in the total of X-tendo countries. In the period 2015-2019, about 2.5 million EPCs were issued annually. The largest part resulted from real estate transactions, followed by new building construction, while EPCs due to the change of tenant and building renovation according to our data and the chosen assumptions have lower relevance. In shaded colours, the figure shows the share of EPC-end-users which potentially show special interest in this feature, according to the factors determined in *Table 13* and *Table 14*[11] in *Annex 1*.

[11] The shaded areas (labelled as medium) in Figure 11 were derived as the average of the low/high range depicted in Table 14.

A high relevance is assumed in particular for general interest in the potential improvement of building energy performance, leading to a range of 24%-44% of all EPC end-users showing potential interest in the results of the one stop shop feature. The total number of interested EPC-end-users for all trigger points is estimated to about 0.6 – 1.10 million in the base year which may increase to 1.19 – 1.87 million EPC-end-users in the year 2030, which is indicated by the grey lines. The bandwidth (low-high) results from two factors: (1) The potential interest of EPC-end-users was assigned by categories, each representing a range, for example, 20-40% of EPC-end-users are estimated to be interested. (2) The interest may differ significantly between the buyer and the seller, in particular in case that a building does not perform very well according to a certain indicator. Thus, for the "lower" case a lower value of interest (typically the interest of the seller) is assumed whereas for the "higher" a higher value (typically representing the interest of the buyer) is considered. For Feature 10, it is estimated that no strong difference in the interest in the One stop shop is given for the buyer vs. the seller. Thus, the difference results only from the bandwidth of the estimation.

While the one-stop-shop is very relevant for EPC-end-users planning a renovation, it is not so relevant for most other trigger points.

Figure 11 – Number of annually issued EPCs by trigger points and the estimated share of potentially interested EPC end-users, total of X-tendo countries (Feature 10). Historical data 2015-2019, projection until 2030.



4.5 Next steps for implementation

4.5.1 Calculation method and quality assurance

Denmark outlines that the appetite for OSS depends a lot on the market structure and their link to the EPC database. An attempt must be made to remove barriers and have a single point of information, but it is a costly service and should be made affordable for the future. Another strategy that can be used by the Member States is to provide a free public service so that it becomes affordable. In the UK (Scotland), there are different levels of administration and it is a top-down model, therefore, the first step would be to communicate the benefits across all levels.

As a next step, Portugal sees using an integrated building logbook to improve the information available and after cross-examining they can provide individual measures or packages of measures to homeowners. These are being delivered to the homeowner, which help them to carry out more measures at once achieving deeper renovation. The Danish approach is also to encourage deep renovation which is an initial goal of the OSS. The Danish OSS model needs more specific, digital, connected services.

4.5.2 Capacity building for delivery bodies and training needs for assessors

In general, it would be easier for public authorities to fund the OSS. It is important that an EPC database is connected to this service by the public actors and the subsequent step should be to involve private actors. In the UK (Scotland), the first most important step would be to ensure quality assurance for the EPCs. Another key step would be to link it with the building logbooks. Denmark emphasises that in future OSS should be more flexible and digital. Their current EPC system is well developed and thus meets most of the needs to set up an OSS. They envision making the OSS a unique product that is more digital and tailor-made.

In the UK (Scotland), there is a need to increase the training level, the advisors should compare the data set from the EPC with the one from smart meters and provide different advice to different cases, including behavioural change. Now it is only a list of measures and funding schemes, in the future it should start a more sophisticated discussion with the homeowner. The OSS should also have a different purpose compared to the EPC and focus more on the funding schemes and financing options for homeowners.

4.5.3 Political discourse/ market or end-user awareness

To be able to establish the need for OSS it is essential to identify in Member States what information is needed using detailed market surveys and to establish which stakeholders are interested. For structuring different business models and to increase their effectiveness, it would be important to detail how the improvement measures are evaluated and documented, including what type of data is recorded and integrated in the OSS. End-users can be made aware of OSS using national information campaigns to promote potential benefits to them under the national funding schemes and grants available for renovation. Competition in the market should drive the prices for services down.

4.6 Conclusions

The one-stop-shop feature for existing buildings sets out to facilitate access to financial mechanisms, benefits and support schemes, assist consumers concerning technical and financial issues, and to guide them through their building renovation process. Article 8-10 and 15 on existing buildings in the revised EPBD 2021 proposal [25], outline the need for stronger provisions to overcome the barriers to renovation and mobilisation of financial incentives with one-stop-shops accessible to all building ecosystem stakeholders. A stronger emphasis is seen on deeper renovations supported with higher financial incentives and technical support via one-stop-shops. The one-stop-shop feature is addressing these points very closely and aims to overcome the barriers to residential renovation. There is a high degree of flexibility in this feature to implement in different Member States. This feature enables transparent advisory tools and assistance to homeowners providing integrated renovation services which is very much aligned with the regulations outlined in the revised EPBD. However, awareness regarding one-stop-shops needs to increase so that tailor made information is made available to vulnerable households. It emerges from this research that the social and economic drivers have the capacity to increase the uptake. Meanwhile, there is significant work required to build the capacity of Member States in making provisions for setting up the one-stop-shops. Since the one-stop-shop feature is very relevant for EPC end-users planning a renovation, the impact assessment shows that the total number of interested EPC end-users for all trigger points is estimated to about 595-1,099 thousand in the base year which may increase to 1,190-1,866 thousand EPC end-users in the year 2030 due to implementation of this feature.

Key takeways:

- The one-stop-shop feature is designed to facilitate access to financial mechanisms, benefits and support schemes, assist consumers concerning technical and financial issues, and to guide them through their building renovation process.
- There is a high degree of flexibility in this feature to implement in different Member States.
- Access to a functional EPC database is a major driver to process the information and give advice to homeowners.
- Verification methods on OSS are key to establish trust for suppliers and homeowners.
- One of the main issues concerning processing information and sharing of personal data is the GDPR.
- Several stakeholders in the construction industry have shown interest in OSS and would like to get involved in national OSS models.
- Integration of OSS with building logbooks, building renovation passports, finance options, etc. is important.
- To overcome existing market barriers between service providers and beneficiaries it is important to establish stable partnerships and cheaper solutions.

Key action points:

- Awareness regarding one-stop-shops needs to increase so that tailor made information is made available to vulnerable households.
- There is significant work required to build the capacity of Member States in making provisions for setting up the one-stop-shops.
- Ensure the quality assurance of EPCs so that reliable advice can be provided to beneficiaries (see also feature 6: EPC databases).
- Identify in Member States what information is needed using detailed market surveys and establishing which stakeholders are interested.

5

CONCLUSIONS AND POLICY RECOMMENDATIONS

Overall, the ten features developed and tested in the X-tendo project provide a promising direction to advance the existing EPC schemes. It would not only support taking necessary measures for enhancing the energy performance but extend it beyond that as well. Provision of information to owners and tenants as well as relevant market actors is necessary to give a push to renovation rates and depths across the EU. Each feature aims to enrich the EPCs with such information that enables decision-making by stakeholders. The features developed in the project were tested in X-tendo countries and then the experts who tested them provided deeper insights and appropriate directions, drivers and barriers investigated from social, economic, market and policy perspectives which provided a realistic estimation for its implementation and replicability across the different Member States. Quantitative impact assessments using the trigger points for each feature were conducted to evaluate the impact of feature implementation in terms of increase in share of EPCs. While it is clear that most of the features are directly useful to the end-user, others are meant for quality assurance such as EPC database, tracking progress by public authorities such as district heating, and planning and setting targets for environmental policies using the outdoor air pollution feature.

Each feature is distinct in its application and entails careful planning for its implementation across the Member States. Findings stated thereof in this report from the X-tendo countries are promising and could be replicated in other Member States after careful evaluation in the context of their existing EPC regime. The developed features are provided in the form of a toolbox for public authorities so that it enables effective implementation of more than one feature in the update of the EPC system. All the features build on existing EPC data with additional data inputs that may entail additional training for EPC assessors.

Some key general conclusions derived for all the features are:

- An underlying need for all the features is the establishment of the right conditions and quality assurance of EPC databases at national level giving access to public and other relevant stakeholders.

- New or revised EPCs must not be burdened with a lot of new information for the end-user. Information on the first page must be prioritised for the end-user application. Thus, it should be considered which information is presented on the EPC (on paper) and which on the digital EPC or DBL.

- New features must not overload the assessor's work because it risks the quality, cost and reliability of EPCs.

- Automation and simplification of procedures are necessary for overcoming major issues regarding interoperability and data exchange.

- User-friendliness of features is highlighted as one of the most important drivers during tests of all features and more research is needed in this regard, because so far, most features were tested with experts, not with end users.

- EPCs must be coherently linked with other instruments such as DBL and building renovation passports to increase their impact.

- Training is required for some features to upskill and improve the competence of the workforce responsible for delivering EPCs. Some features do not require training at all, while others have methods, either simple or complex, with different training needs.

- New features must be voluntary in the initial stages of implementation and should be integrated once they showcase acceptance and demand in the building sector.

- All the features are compatible for different building typologies and construction periods. Some features have two calculation methods, one more simple and less reliable, while the other is more complex and reliable. Each method can fit different building typologies (e.g. a detailed SRI is needed for large commercial buildings, CARP and CORP of the comfort tool can be used for school, office and residential buildings).

- Calculation methods were adjusted for individual test countries. However, this presented challenges in different aspects such as missing databases to complete calculations, measurement issues, regional restrictions due to Covid-19, etc.

- All the features have the potential to increase the uptake of renovation if implemented, however, this varies for features that are more directed toward public authorities.

- Stakeholders consider GDPR to be a major barrier for many of the features. Therefore, it requires careful evaluation at Member State level for successful implementation, since it can be shown that the understanding of GDPR issues in the context of EPC data is very different in different EU Member States.

- It is important to establish partnerships and alliances between public and private stakeholders to overcome the market barriers and enable affordable solutions for the implementation of the features.

- Some features demonstrate a marginal increase in cost burden for the end-users of EPC, while some need specific mechanisms to be set up to function (e.g. enhanced recommendations, EPC databases).

Achieving a balance between targets, standards and support measures is necessary to achieve the decarbonisation of the building sector and EPC is a promising policy instrument capable of advancing the EU in this direction. The revised EPBD emphasises that better coverage of the building stock with EPCs is a precondition for its improvement, but at the same time Member States would need to ensure that they are affordable. It also mentions that the EPC should provide additional information to the owner or tenant to foster renovation of the building sector. This would provide a necessary push to unlock private and public funding and subsidies.

X-tendo features were developed from this perspective to empower the end-user with more information and help them take necessary actions for renovation. All the features have been found to have relevance in the test countries with differences in needs and application. Experts found that all the data gathered by the new features is highly relevant for public authorities, but not all outputs are relevant to the end-user. They stressed the importance that the EPC should not lose its main focus and purpose (energy performance) and other outputs can be provided in the DBL.

National policies are framed under the regulations set out in EPBD, thus the X-tendo project has identified a series of recommendations for policy uptake and formulation that would be beneficial in the implementation of new features. These have been compiled below after rigorous development and testing of features in the X-tendo countries.

Next steps for a successful implementation

Plan and prepare mechanisms to link EPCs with new instruments such as Building Renovation Passports, DBL and SRI.

Revise EPC calculation methodologies with a vision to integrate new features developed following the European Standards.

Set up independent control systems to ensure data for EPCs is of high quality.

Ensure that the EPC schemes are in line with more ambitious EU and national goals and targets.

Promote the implementation of new features using market and non-market mechanisms to raise awareness among the public and other relevant stakeholders.

The new features can help to track the progress on policies and support in enforcing mandatory standards by using EPCs for compliance.

Conduct cost-benefit analysis at national level to determine the feasibility of features and their economic impact to build trust in markets.

Selective implementation and independent pilot studies in national contexts would support in meeting MS individual policy goals.

Evaluate national or regional building stock characteristics and estimate the need for new developed features.

Incorporate medium and long-term horizons for the upgradation of the EPC system and on-set of new features.

Advancing comparability and consistency

Promote comparability of features across Member States by following harmonised approaches at EU level.

Consistency with regional policy and standards must be maintained to promote acceptability and reliability of new features.

Set up more ambitious and rigorous quality check mechanisms in EPCs, EPC databases, and check consistencies within and between databases.

Phase-out redundant EPC systems and provide continuous access to interoperable databases, thus increasing transparency and trust.

Adopt standards, methods and tools that promote transparency and accountability in the EPC system.

Market, business models and training needs

Encourage an integrated approach to renovation using the new features and promoting wider benefits such as health and environmental benefits.

Foster collaboration between private and public actors in creating an environment and enabling conditions for supporting job creation and increase investments in renovation with features such as DBL and OSS.

Consider GDPR in data handling of the new features, ensure that data is owned by the homeowner and avoid business models based on trading data.

Promote more collaborative and open-source knowledge systems for EPCs.

Promote the implementation of new features using market and non-market mechanisms to raise awareness among the public and other relevant stakeholders.

Support the implementation of additional features with a more complex methodology including the training and upskilling of EPC assessors.

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ANNEX 1

7.1 Methods and data for estimation of the quantitative impact of implementation of new EPC features

For each country and considered year the following equations were applied to estimate the number of annually issued EPCs (E).

$$E = E_{tenant} + E_{sales} + E_{new} + E_{reno} + E_{other}$$

with

E	Number of annually issued EPCs
E_{tenant}	Number of annually issued EPCs triggered through the change of a tenant
E_{sales}	Number of annually issued EPCs triggered through the sale of a property
E_{renov}	Number of annually issued EPCs triggered through building renovation
E_{other}	Number of annually issued EPCs triggered through other occasions, e.g. the need for advice for renovating the building

In case of rented single family houses or in case that in a certain country an EPC needs to be issued for each apartment of an apartment buildings, E_{tenant_1} applies:

Under the assumption that

$$T_{contract} > T_{EPC}, E_{tenant\_1} = \frac{n_{tenant}}{T_{contract}}$$

Whereas, for apartment buildings in countries where for these buildings only one EPC needs to be issued, E_{tenant_2} applies:

Under the assumption that

$$T_{contract} > T_{EPC}, E_{tenant\_2} = \frac{n_{tenant}}{n_{dwell}(T_{EPC} + \varepsilon)}$$

with

$T_{contract}$	Average duration of Tenancy contracts
T_{EPC}	Validity period of EPCs
n_{tenant}	Total number of rented dwellings and non-residential buildings
n_{dwell}	Average number of dwellings per building
ε	Factor, considering the deviation of changing tenants and the validity of EPCs over time; assumed to be 20% of the validity period of EPCs

For the other trigger points j, the following equation is applied:

$$E_j = \sum_i n_{j,i} \cdot f_{j,i}$$

with

$n_{j,i}$ Number of trigger point (i.e. number of dwellings and non-residential buildings being sold (excluding new buildings, being constructed, being renovated or other) in building category i.

$f_{j,i}$ Correction factor, considering e.g. that some non-residential buildings might not need an EPC, or that for apartment buildings in some countries only one EPC per building needs to be issued.

The number of EPC end users potentially interested in a certain feature k (E_k^*) was determined by estimating the share of interested end-users per trigger point j and feature k ($S_{j,k}$)[12] in certain ranges and partly distinguishing whether the interest refers to the buyer or the seller (or the tenant/landlord) of property. Subsequently, the number of potentially interested EPC end-users is estimated by following equation:

$$E_k^* = \sum E_{j,k} \cdot S_{j,k}$$

As described in *Table 13* and *Table 14*, the factors $S_{j,k}$ were estimated by project partners leading the development of the feature in the project. Thus, there is some subjectivity in the assessment and comparison between features is possible only to a limited extent.

For the 2030 projection, it was assumed that the number of tenants, real estate transactions and new building constructions follows the same linear trend as in the past 10 years, while all the factors specified above remain the same. For the number of renovated buildings, we assumed a doubling of the number from the period 2015-2019. In addition to the renovated buildings, it is assumed that another 50% of building owners is interested in receiving advice for building renovation (i.e. the trigger point "other"). Overall, a strong increase in building renovation activities, moving towards the targets of the fit-for-55 package is assumed.

According to the approach described in *chapter 3*, the number of EPCs issued for each trigger point are estimated. For this purpose, historical data is used on the trigger points, i.e. on the number or real estate transactions, number of rented dwellings and building permits, if available by type of building according to sources in *Table 12*.

[12] See Table 13 and Table 14

Table 12 – Data sources of trigger points

Country	Data sources
Austria	European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.AT._T.N._TR.NTRA.AT2._Z.N._Z*. 22 Feb 2022; Österreichische Nationalbank. *https://www.oenb.at/Publikationen/Volkswirtschaft/immobilien-aktuell.html.* 09 Feb 2022; Statistics Austria. *http://www.statistik.at/web_en/statistics/PeopleSociety/housing/housing_conditions/index.html.* 09 Feb 2022; Statistics Austria. *https://statcube.at/statistik.at/ext/statcube/jsf/tableView/tableView.xhtml.* 09 Feb 2022; Statistics Austria. *https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/wohnen/wohnungs_und_gebaeudeerrichtung/fertigstellungen/026021.html.* 03 March 2022;
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Estonia	European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.EE._T.N._TR.TOOT.EE2._Z.N.RO.* 24 Feb 2022; Republic of Estonia Land Board. *https://www.maaamet.ee/kinnisvara/htraru/Result.aspx.* 03 Feb 2022; Statistics Estonia. *https://andmed.stat.ee/en/stat/majandus__ehitus__ehitus-ja-kasutusload/EH045/table/tableViewLayout2.* 14 Feb 2022; Statistics Estonia. *http://andmebaas.stat.ee/Index.aspx?lang=en&DataSetCode=KVE01#. 24* March 2022; Statistics Estonia. *https://andmed.stat.ee/en/stat/majandus__ehitus__ehitus-ja-kasutusload/EH046/table/tableViewLayout2.* 15 Feb 2022;

Country	Data sources
Greece	European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.GR._T.N._TR.NTRA.GR2._Z.N._Z*; 21 Feb 2022; European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.GR._T.N._TR.NPRO.GR2._Z.N._Z.* 21 Feb 2022; European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=381.SHI.A.GR.TOOT.P.* 21 Feb 2022; European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=381.SHI.A.GR.TRAT.P.* 21 Feb 2022; Hellenic Statistical Authority. *https://www.statistics.gr/en/statistics/-/publication/SOP03/2021-M10.* 17 Feb 2022;
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Country	Data sources
Portugal	Eurostat. *http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do.* 07 March 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008330&contexto=pi&selTab=tab0&xlang=en.* 10 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0007838&contexto=bd&selTab=tab2.* 10 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpagenumber=1&PUBLICACOEStema=55534.* 10 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0009632&contexto=bd&selTab=tab2.* 10 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008329&contexto=bd&selTab=tab2.* 10 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008320&contexto=bd&selTab=tab2.* 17 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008335&contexto=bd&selTab=tab2.* 17 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008334&contexto=bd&selTab=tab2.* 17 Feb 2022; Statistics Portugal. *https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008330&contexto=bd&selTab=tab2&xlang=en.* 17 Feb 2022;
Romania	European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.RO._T.N._TR.NPRO.RO2._Z.N._Z.* 15 Feb 2022; European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=381.SHI.A.RO.TOOT.P.* 15 Feb 2022; European Central Bank - Statistical Data Warehouse. *https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.RO._T.N._TR.TRAT.RO2._Z.N.RO.* 15 Feb 2022; National Institute for Statistics – ROMANIA. *http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table.* 22 Feb 2022; Paul Cosmin Alin ENACHESCU & Genifera Claudia BANICA, 2019. "Analysis Of The Real Estate Market In Romania From The Point Of View Of The Number Of Transactions During 2009-2018," Scientific Bulletin - Economic Sciences, University of Pitesti, vol. 18(3), pages 39-46. *https://ideas.repec.org/a/pts/journl/y2019i3p39-46.html.* 08 Feb 2022;
Scotland	Registers of Scotland. *https://www.ros.gov.uk/data-and-statistics/house-price-statistics.* 07 Feb 2022; Scottish Government. *https://www.gov.scot/publications/housing-statistics-stock-by-tenure/.* 07 Feb 2022; Scottish Government. *https://www.gov.scot/publications/housing-statistics-for-scotland-new-house-building/.* 07 Feb 2022;

For the countries AT, DK, EE, PL, and PT it is considered that in case of apartment buildings, in most cases there is only one EPC issued for the whole building, not for each apartment. For the countries BE, GR, IT, RO and the UK (Scotland) it is considered that EPCs need to be issued for each apartment.

The resulting historical time series for the issued EPCs were then compared to the total number of issued EPCs according to reports [27][28] and selected sources from Table 12. The deviations were calibrated using the approach to the historical and observed data. Subsequently, the relevance of trigger points for each feature is estimated. For this purpose, the share of EPC end-users is estimated, for which the feature might be interesting along the various trigger points. As the tables below indicate, the relevance might differ between the buyer and seller perspectives. This was taken into account by considering both perspectives, where relevant and adding this to the range of results (high/low).

Table 13 – Relevance of trigger points for each feature: Share of EPC end-users for which the feature might be interesting in different trigger points

	New building construction	**Building retrofitting (mandatory or not)**	**Real estate transaction**	**Other (e.g. interest in the improvement of building's energy performance)**
SRI F1	High; insight in impact is relevant for the owner of the new building for the 3 key functionalities; 1) comfort; 2) energy efficiency and operational performance; 3) interaction with the grid.	Medium; insight in impact is relevant for the owner of the building for retrofitting for the 3 key functionalities; 1) comfort; 2) energy efficiency and operational performance; 3) interaction with the grid.	Medium-Low for the seller; unless it shows good results as a selling argument. For the buyer, insight in impact is relevant for the 3 key functionalities; 1) comfort; 2) energy efficiency and operational performance; 3) interaction with the grid.	Medium; SRI scores SRI in 3 key functionalities; 1) comfort; 2) energy efficiency and operational performance; 3) interaction with the grid; not all relate directly to energy performance.
Comfort F2	High; because Comfort (thermal, IAQ, acoustic, visual) has a direct relevance to the end-user especially in the residential sector.	Medium-High; if retrofitting is not mandatory and High if retrofitting is mandatory. Comfort assessment would be preferred by owners.	Medium-High; for buyers, High for sellers and Medium-high for renters. The interest would vary based on the type of transaction.	Low; co-relation of energy performance and comfort not very clear to the end-user.

	New building construction	Building retrofitting (mandatory or not)	Real estate transaction	Other (e.g. interest in the improvement of building's energy performance)
Outdoor air pollution F3	High; in terms of Indoor Air Purity Index, as the quality of internal environment is important for the users. Medium-Low; in terms of Local Air Pollution Contributor Index. The pollutant emissions from the building are less important for the users.	Medium; in terms of Indoor Air Purity Index, as the retrofitting measures might increase the quality (purity) of internal air. Medium; in terms of Local Air Pollution Contributor Index. The index can be used by the users to verify the environmental results of the modernisation.	Medium-Low; in terms of Indoor Air Purity Index, the value of the property can be higher if a better indoor environment is assured. In terms of Local Low, air Pollution Contributor Index. The pollutant emission for the building are not the most important parameters considered in real estate transaction.	High; both indexes can be used in verification of the building modernization results. In this case the Local Air Pollution Contributor Index has a higher value as the goal of the modernisation is to decrease emission.
Real energy consumption F4	Low; similar to EPC, but the indicator will only be available after a one-year operational period. May be implemented for commissioning and as such have indirect influence.	High; indication of actual energy performance forms the best basis for energy retrofitting decisions.	Medium-High for the buyer; is very relevant for indication of actual energy performance and cost. Medium-low for the seller; unless it shows good results as a selling argument.	High; indication of actual energy performance forms the best basis for energy retrofitting decisions.
District energy F5	Low; the main benefit of the feature for building owners / user is to a) compare performance of own system with nearby DH, or b) see if other decentral low-temperature supply options are interesting; both not relevant in case of new construction.	Medium-Low; benefit is as described in column new construction; in case of renovation this can be a bit more relevant; however, potentially other aspects will play a more important role.	Low; for rental will probably not be relevant, for buying most probably other factor more important.	Medium-Low for building owners/user; the feature is more relevant for public dministrations and their urban planning. Thus, the more data is available from issued EPCs, the better.

	New building construction	Building retrofitting (mandatory or not)	Real estate transaction	Other (e.g. interest in the improvement of building's energy performance)
EPC databases F6	Medium-High; the quality of the EPC and trust in the information is important and can influence the decision of buyers of a new building.	Low; the quality of the EPC may be less relevant in the cases where the building is occupied by the owner because they may assess the building's performance more based on their own behaviour.	Medium-High; the quality of the EPC and trust of the information is important and can influence the decision of buyers of existing buildings.	High; In general. many actors have high quality EPCs and trustworthy information on that document.
Logbook F7	Medium; the construction phase is key to collect detailed information about the building, material and embodied carbon levels. Registering this data in a logbook can be linked to various private certifications, which can be valuable to the building owner.	Medium-High; logbooks enable better decision-making throughout the building lifecycle, including for energy renovations. Having all the information in one place is something building owners have been requested and something that can simplify the renovation process.	Medium; the construction phase is key to collect detailed information about the building, material and embodied carbon levels. Registering this data in a logbook can be linked to various private certifications, which can be valuable to the building owner (i.e. increase the financial value of the asset).	Medium-High; logbooks enable better decision-making throughout the building lifecycle, including for energy renovations. Having all the information in one place is something building owners have requested and something that can simplify the renovation process.
Enhanced recommendations F8	Low; the main benefit of the feature for building owners / user is to a) compare performance of own system with nearby DH, or b) see if other decentral low-temperature supply options are interesting; both not relevant in case of new construction.	Medium-Low; benefit is as described in column new construction; in case of renovation this can be a bit more relevant; however, potentially other aspects will play a more important role.	Low; for rental will probably not be relevant, for buying most probably other factor more important.	Medium-Low for building owners/user; the feature is more relevant for public dministrations and their urban planning. Thus, the more data is available from issued EPCs, the better.

	New building construction	Building retrofitting (mandatory or not)	Real estate transaction	Other (e.g. interest in the improvement of building's energy performance)
Financing schemes F9	Low; since usually financing schemes are given for energy efficiency improvement of existing buildings.	High; since usually financing mechanisms are related to the building renovation, namely the improvements related to energy efficiency.	High; EPCs are usually mandatory to be issued during the buy or rental of buildings, and therefore there might be some specific mechanisms that use the EPC as eligibility criteria. This can also be relevant to buyers to advise if there are financing mechanisms available to improve their future house.	High; the interest in improving the building energy performance of a house can be the trigger point for looking for funding.
One Stop Shop F10	Low; since usually one-stop-shops have information about the existing building and provide technical assistance to improve the existing house.	High; since usually one-stop-shops have information about the existing building and provide technical assistance to improve the existing house.	Low; since usually it is necessary to be a homeowner to have access to the information/ technical assistance available in the one-stop-shop. A potential buyer does not have access to the information of the house available in the OSS unless they are the owner.	High; the interest in improving the building energy performance of a house can be the trigger point for using the OSS to search for funding opportunities, technical assistance and get closer to the construction market.

Note

Rating	Percentage range
High	100-80%
Medium-High	80%-60%
Medium	60%-40%
Medium-Low	40%-20%
Low	20%-0%

The qualitative arguments, the rating table and discussion points were transferred into the following table, which was then used for the calculation of the share of EPC end-users for which the feature might be interesting, considering upper and lower boundaries as "high" and "low".

Table 14 – Quantitative summary - Relevance of trigger points for each feature: Share of EPC end-users for which the feature might be interesting in different trigger points

	Change of tenant	Real estate transaction (buyer)	Real estate transaction (seller)	New building construction	Building retrofitting (mandatory or not)	Other, in particular: general interest in the potential improvement of building energy performance
F1	20%-40%	20%-40%	20%-40%	80%-100%	40%-60%	40%-60%
F2	60%-80%	80%-100%	60%-80%	80%-100%	60%-80%	0%-20%
F3 (indoor)	20%-40%	20%-40%	20%-40%	80%-100%	40%-60%	80%-100%
F3 (outdoor)	0%-20%	0%-20%	0%-20%	20%-40%	40%-60%	80%-100%
F4	60%-80%	60%-80%	20%-40%	0%-20%	80%-100%	80%-100%
F5 (low-temp)	0%-20%	60%-80%	0%-20%	80%-100%	60%-80%	60%-80%
F5 (DH-PEF)	0%-20%	40%-60%	0%-20%	60%-80%	20%-40%	20%-40%
F6	60%-80%	60%-80%	60%-80%	60%-80%	0%-20%	20%-40%
F7	40%-60%	60%-80%	20%-40%	40%-60%	60%-80%	60%-80%
F8	0%-20%	80%-100%	0%-20%	0%-20%	60%-80%	80%-100%
F9	0%-20%	80%-100%	0%-20%	0%-20%	60%-80%	80%-100%
F10	0%-20%	0%-20%	0%-20%	0%-20%	60%-80%	80%-100%

With $n_{t,i}$, the number of EPCs issued in year t due to trigger point i, the number of potentially interested EPC end-users in feature j is calculated as $\sum_i n_{t,i} f_{i,j}$, while the values in *Table 14* represent the shares $f_{i,j}$, where the lower and the upper range from *Table 14* is considered as the "low" and "high" result in the quantitative assessment of each feature.

Table 15 – Share of potentially interested EPC end-users by feature and country, 2030

		F1	F2	F3 (indoor)	F3 (outdoor)	F4	F5 (low-temp)	F5 (DH-PEF)	F6	F7	F8	F9	F10
LOW(+)	AUSTRIA	40%	66%	40%	12%	40%	32%	20%	50%	40%	10%	10%	10%
	BELGIUM	34%	46%	44%	30%	51%	33%	14%	39%	42%	31%	31%	31%
	DENMARK	41%	56%	47%	22%	42%	37%	21%	47%	42%	19%	19%	19%
	ESTONIA	38%	41%	53%	38%	49%	42%	18%	36%	44%	38%	38%	38%
	GREECE	28%	46%	38%	26%	64%	24%	8%	41%	46%	29%	29%	29%
	ITALY	34%	39%	48%	39%	60%	39%	14%	32%	47%	43%	43%	43%
	POLAND	46%	63%	49%	16%	24%	39%	26%	54%	35%	10%	10%	10%
	PORTUGAL	24%	61%	24%	2%	33%	6%	4%	59%	29%	1%	1%	1%
	ROMANIA	48%	56%	55%	27%	32%	47%	28%	45%	40%	22%	22%	22%
	SCOTLAND	40%	63%	42%	11%	23%	30%	20%	56%	32%	6%	6%	6%
HIGH (*)	AUSTRIA	60%	89%	60%	32%	66%	62%	47%	70%	67%	43%	43%	30%
	BELGIUM	54%	73%	64%	50%	84%	73%	47%	59%	75%	78%	78%	51%
	DENMARK	61%	80%	67%	42%	69%	68%	48%	67%	69%	53%	53%	39%
	ESTONIA	58%	67%	73%	58%	83%	81%	51%	56%	77%	85%	85%	58%
	GREECE	48%	68%	58%	46%	88%	50%	32%	61%	70%	57%	57%	49%
	ITALY	54%	64%	68%	59%	90%	72%	43%	52%	76%	81%	81%	63%
	POLAND	66%	91%	69%	36%	59%	82%	61%	74%	70%	60%	60%	30%
	PORTUGAL	44%	92%	44%	22%	76%	61%	47%	79%	72%	68%	68%	21%
	ROMANIA	68%	83%	75%	47%	65%	86%	60%	65%	73%	68%	68%	42%
	SCOTLAND	60%	93%	62%	31%	63%	80%	60%	76%	72%	66%	66%	26%

(*) Low and High shares result from the ranges indicated in *Table 14*.

GLOSSARY OF TERMS

AQI	Air Quality Index
BIM	Building Information Modelling
BREEAM	Building Research Establishment Environmental Assessment Method
CARP	Comfort Assessment Rating Procedure
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
CORP	Comfort Operational Rating Procedure
Covid-19	Infectious disease caused by SARS-CoV-2 virus
DBL	Digital Building Logbook
DGNB	Deutsche Gesellschaft für Nachhaltiges Bauen
DH	District Heating
DHW	Domestic Hot Water
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
GDPR	General Data Protection Regulation
GHG	Greenhouse gas
HVAC	Heating, Ventilation and Air-Conditioning
IAPI	Indoor Air Purity Index
IAQ	Indoor Air Quality
IEQ	Indoor Environmental Quality
LAPCI	Local Air Pollution Contributor Index
LEED	Leadership in Energy and Environmental Design
LTRS	Long-term Renovation Strategies
MEPS	Minimum Energy Performance Standards
MFH	Multi-Family House
MS	Member State
MVHR	Mechanical Ventilation and Heat Recovery
nZEB	Nearly Zero-Energy Building
OSS	One-Stop Shop
PA	Public Administration
PEF	Primary Energy Factor
RH	Relative Humidity
ROI	Return On Investment
SFH	Single-Family House
SRI	Smart Readiness Indicator
T	Temperature

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AAECR Asociația Auditorilor Energetici pentru Clădiri din România

ENEA

BPIE

КАПЕ CRES

Danish Energy Agency

adene Agência para a Energia

ENERGIE AGENTUR Steiermark

energy saving trust

ethink ENERGY RESEARCH

NAPE NATIONAL ENERGY CONSERVATION AGENCY

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