

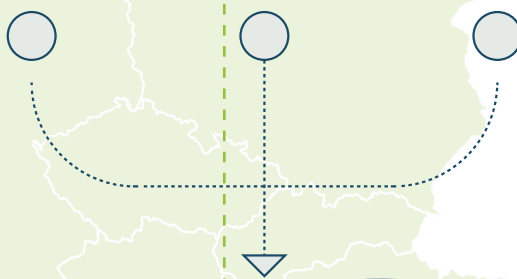
X-tendo



FEATURE 9:

FINANCING OPTIONS

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



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Please note these chapters are extracted from the full report, available at this link:

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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



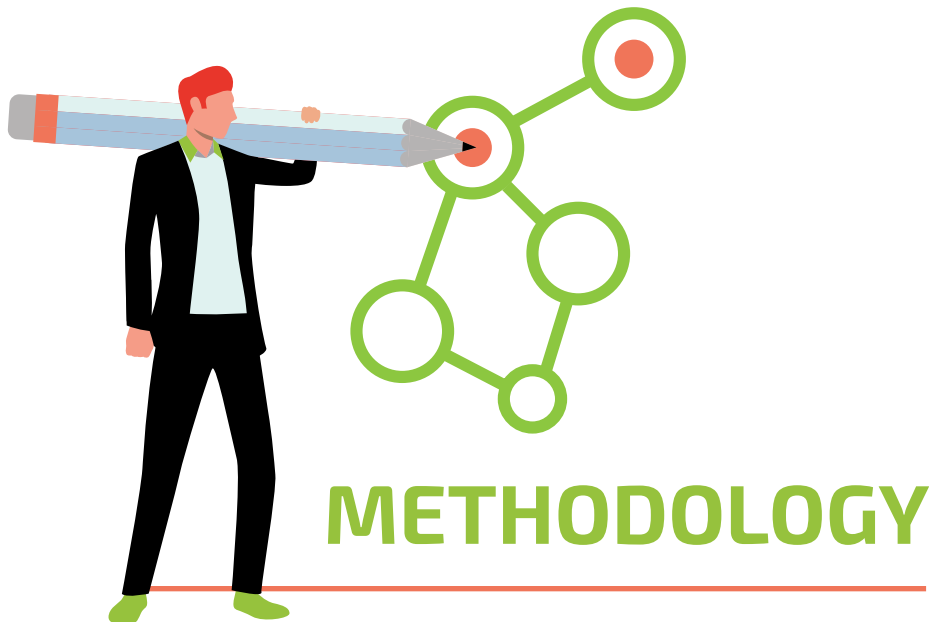
OBJECTIVE OF THE REPORT

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.



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:

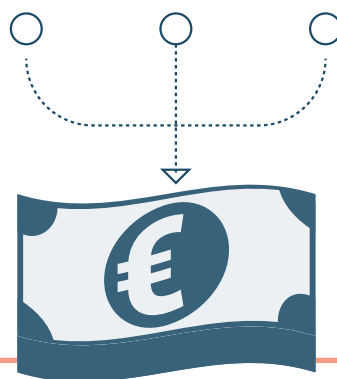
- New building construction
- Major building renovation
- Building sales (if no valid EPC available)
- Renting out (if no valid EPC available)
- Other (e.g. the interest of the building owner in improving the energy performance of the building)

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](#).

FEATURE 9: FINANCING OPTIONS



4.1 Overview

Integrating information on financial support in the EPC and its specific recommendations can help to persuade building owners to undertake an energy renovation and steer investments toward deep renovations. There is a need to unlock further public and private financing for energy renovations of buildings to achieve the long-term climate and energy objectives of the EU. The EPC provides renovation recommendations to the end-user making it a logical entry point to increased awareness of various financial options, including the availability of subsidies, low-interest loans, as well as innovative financial solutions (e.g. energy performance contracting, on-bill financing).

EPCs can provide a market benchmark and clear eligibility criteria for public authorities, as well as guide policymaking and the introduction of new financial support schemes. Furthermore, integrating financial support alongside the EPC recommendations can help to persuade building users to undertake an energy renovation. This feature is exploring how the integration of financing options can boost the perceived usefulness of the EPC, increase its impact on renovation decisions and help public authorities to develop more effective financial support schemes.

The current feature identifies and assesses which financial sources can be linked and integrated with the EPC. This includes the identification of available financing options, linking EPC data with the underwriting of finance, as well as effective communication with building owners/users.

4.2 Key insights from testing

Table 10 - Test projects summary in implementing countries for financing options

Country	ROMANIA	PORTUGAL	DENMARK
Type of Testing	User Testing	User and System Testing	User Testing
Number of testing cases	29 (homeowners), 15 (public authority), 37 (qualified experts), 3 (bankers)	133 (qualified experts), 1 (interview), 56 (workshop participants)	8 (homeowners)
Tool	Interview questionnaire	Interview questionnaire	Interview questionnaire
Testing Period	06/2021 – 12/2021	06/2021 – 12/2021	11/2021 – 12/2021

The user-testing was conducted with different stakeholders in Romania, Portugal and Denmark mainly using interview questionnaires as a study method. The aim was to assess the individual country context regarding the types of financing schemes and role of EPC as a facilitator for financing. Also, how owners finance their energy renovation should be identified. Some key findings regarding the financing option feature are given below:

- A clear communication strategy is required for financing options and an interconnection to communicate the existing benefits available at national and regional level, namely through digital platforms linked to EPCs (e.g. OSS).
- EPCs should be used to access financing for energy renovation with clear indication of detailed eligibility criteria. A connection is required between the level of energy performance improvement, including emission reduction and the promised financing amount.
- Instruments with special focus on families, loan offers, low interest rates on funding, and better return on investment (ROI) analysis should be looked at to encourage homeowners for energy renovation.
- Prioritisation of worst performing building stock is necessary for subsidies and incentives.
- Discounts should be made possible to the owner when updating the EPC and financing advice should be made available without a fee (e.g. on OSS).
- Amendments in national legislation are important regarding the financing of energy renovation.
- Banks are interested in providing financing solutions and guidance to the public sector.
- Experts are interested in accessing the financing options' data for providing consultancy services to the beneficiaries.

4.3 Drivers and barriers for a wide uptake of the feature

4.3.1 Calculation method and quality assurance

The financing options methodology intends to identify information sources on public financial schemes that can be provided alongside the EPCs and explore how financing schemes can be more closely integrated with these, providing guidelines on approaches and mechanisms to achieve this goal. The outcome dedicated to public authorities will be guidance on how to link EPC schemes with financial instruments, which could be easily applied by the countries involved. To achieve the expected output the following tasks were developed:

- Evaluate the types of mechanisms and available financing, including descriptions and classification of financing schemes.
- Assess the focus of these mechanisms and their target audience.
- Evaluate financing conditions and the type of data used to underwrite and monitor the financing mechanisms.
- Map the needs and barriers faced by financial institutions.
- Analyse the compatibility of existing financing schemes based on EPCs.
- Identify existing best practices in the use of financing related to EPCs.

Renovation of buildings and its financing tend to have many similarities among Member States; however, it is necessary to adapt the feature to the local conditions, needs, socio-economic and market conditions. The tool supports overall good quality EPCs and regular quality assessment procedures. The use of transparent methods, data and results improves the relevance and acceptance of EPCs and assures access to adequate data. Expert assessors must prepare the EPC so it can be used to apply for specific financing mechanisms and comply with their requirements, leaving the beneficiary the freedom to choose among the existing options. Assessors must be aware of available financing options that could be applied for the building typology and/or improvement measure under evaluation. Financing schemes could be adapted to different building typologies and tailored around the EPC.

Currently, there are several barriers to estimating prices and the percentage covered by grants/subsidies/funding for each EPC recommendation. The eligibility criteria are different for each measure and they depend on the socio-economic situation of the dwellers. Thus, experts from Romania and Denmark find these estimations difficult to calculate during the EPC certification, however, they could be possible during the energy audit. Another option would be an online platform such as digital building logbook (DBL) or digital one-stop-shop (OSS) which allow simulations of different scenarios. Specific guidance must be developed for different building types.

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

Experts consider the maturity of the developed feature for system testing low but for user testing high. The users are willing to find information on financing, however, experts do not find the EPC to be the right policy tool. Providing information about financing and incentives would need a platform where all the financial suppliers are present including public and private institutions. This platform should be updated, and allow simulations. Specifying the validity of information is necessary and a link to the platform is easier to administrate at the national level.

Testing showed that worst performing buildings must be prioritised, which is in line with the introduction of minimum energy performance standards (MEPS) by the EPBD recast. Member States offer subsidies and funding which are tailored for low-income households to encourage renovation instead of subsidising energy bills. In Poland, some grants for low-income groups cover most of the expenses to change the heating system if it is highly polluting. However, the issue is often not in lack of funding, but in the cost of the fuel after replacing the heating system, since the fuel price for coal is lower than for gas or electricity.

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

Early involvement of all stakeholders is necessary for the successful implementation of the instrument. Setting up an effective financing mechanism is challenging, requiring multi-stakeholder engagement, including building owners, experts and financing institutions. In a first step to set up this new financing option, other stakeholders from the construction value chain and public authorities ought to be involved.

The implementation of a financing option involves several different actors and sectors, which demands a certain level of skill and expertise, supported with training and communication activities. Good advice and technical assistance from an EPC assessor, who can evaluate building performance and identify the best measures to implement, is needed to convince the building owner. Currently, most assessors lack any deeper knowledge about the available and applicable financing options, including where and how they could be attained. For this feature, an intermediate level of expertise would be enough for the EPC assessor, which could be supported by digital instruments. Specific training sessions for experts would enable them to provide more attractive advice to building owners. To encourage deep, staged renovation instead of single measures, homeowners must be provided with continuous support to guarantee success during the whole process.

4.3.4 Economic drivers and barriers

Financing institutions traditionally view energy renovations as a rather risky investment due to a lack of knowledge and follow-up, and because many renovations are based on questionable advice. Increased confidence in the EPC data and related experts would help decrease the perceived risk and could facilitate better financing conditions for the end user. Private Banks are particularly interested in the link to the EPC and interoperability between the EPC database and their systems considering the new regulatory framework (the EU Taxonomy). In Portugal, families are indebted and have low incomes which has an impact on the rate of green loans. Commercial banks or ESCOs could take the risk of these investments and offer affordable interest rates. In Denmark, the EPCs are crucial for financing since most financial institutes want to evaluate the recommendations from the EPCs before providing loan opportunities. Other important factors are the payback time and debt factor. Sometimes it is not possible to pay back the investment for buildings in rural areas due to the house valuation. It is important to evaluate and inform about the state of the building to visualise the potential for the building and convince financial institutes to engage in the renovation.

4.3.5 Consistency with existing policies and standards

Current development and implementation of the Renovation Wave and LTRS, along with recovery and resilience plans which provide considerable public and private funding make this feature very timely and convenient. Various business models already exist for energy audits and in Romania, where OSS are not yet in place, intermediaries provide support in applying for financing.

In Portugal the current mechanism (IFFRU) is a good example of a financial mechanism which enables the energy rehabilitation of the entire building. The model used by IFFRU, namely regarding the link to EPCs and the technical advisory support were very important for the success of this mechanism and have potential of replication to other Member States.

Member States implement various concepts of the DBL, OSS which include EPC certifications or energy advice, thus at this stage it can generate confusion in the market. At this stage, it is important to provide EU guidelines regarding concepts and lessons learned from front runners. The current feature was developed in consistency with CEN/ ISO standards. The determination procedure is developed taking into account the relevant standards, starting from the EPBD overarching standard EN 52000-1: 2017 and the underlying set of standards, along with other standards related to finance or similar, e.g. those provided by the Energy Efficiency Financial Institutions Group (EEFIG) and its toolkit.

The following aspects in the implementation of the LTRS must be considered:

- The role that real state evaluation can have in changing the paradigm of energy renovations contributing to the achievement of the ambitious renovation rates proposed.
- The opportunity the LTRS brings to define the initiatives that will support the policies and actions.
- Which entities will negotiate with the financial entities regarding the mechanisms of operationalisation.

Compatibility with the EPC scheme



Linking this feature to the existing EPC frameworks will help to overcome some of the main barriers to renovations. It can achieve this by engaging various stakeholders including financing institutions and by reducing the risk of investments. The existing paper EPC should be linked to online services and where homeowners receive the EPC recommendations, they should receive an offer from the online platform for financing. The energy audits often include information on financing however, these are rather costly compared to the EPCs. Thus, additional digital tools and services should be provided. It is important to make EPCs more dynamic for integrating financing information with the inclusion of digital formats such as QR codes linking EPC to a platform where information is updated periodically. It is crucial to initiate a partnership with financial and other private actors in the setup of online services of the DBL, building renovation passport or the OSS and the update of the information. Adding detailed financing options within the EPC scheme would considerably increase the cost of it. Another barrier is the detail of the information regarding requirements to access various products for different socio-economic profiles. The online platform, on the other hand, offers the possibility of simulations of scenarios and a continuous update of the information. The EPC recommendations could provide generic information such as whether funding or incentives are available and a link to the online platform.

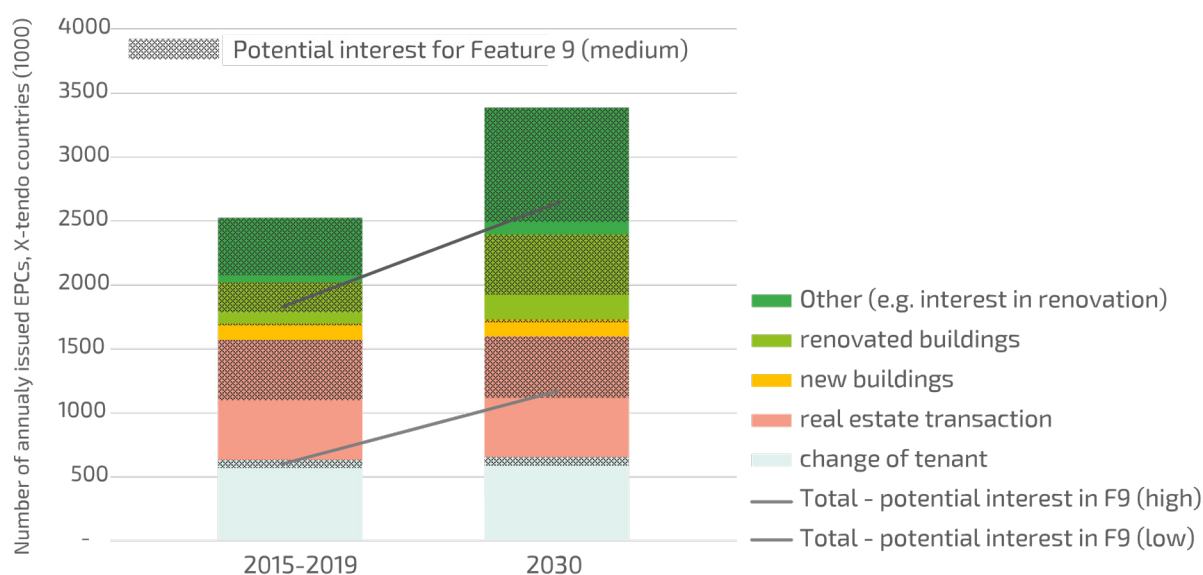
4.4 Estimation of the quantitative replicability potential

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 10](#) shows the number of annually issued EPCs, by the different trigger points in the total of X-tendo countries. In the historical 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](#)⁹ in [Annex 1](#). A high relevance is assumed in particular for real estate transactions (interest of the buyer) and general interest in the potential improvement of building energy performance, leading to a range of 24%-73% of all EPC-end-users showing potential interest in the results of the financing schemes feature. The total number of interested EPC end-users for all trigger points is estimated to about 0.6 – 1.83 million in the base year which may increase to 1.19 – 2.62 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” case a higher value (typically representing the interest of the buyer) is considered.

For Feature 9 it is assumed that the interest of EPC end-users in receiving more reliable information on financing strongly differs for the buyer vs. the seller. Thus, the difference results from the bandwidth of the estimation plus the difference of the perspective (seller-perspective for the lower boundary, buyer perspective for the higher boundary).

It can be observed that there is a high bandwidth between the lower and the upper boundary, resulting mainly from the perspective (seller-perspective for the lower boundary, buyer perspective for the higher boundary), since for the seller the financing of possibly required renovation measures is not relevant, whereas for the buyer this is of high interest.

Figure 10 – Number of annually issued EPCs by trigger points and the estimated share of potentially interested EPC end-users, total of X-tendo countries (Feature 9). Historical data 2015-2019, projection until 2030.



⁹ The shaded areas (labelled as medium) in [Figure 11](#) were derived as the average of the low/high range depicted in [Table 14](#).

4.5 Next steps for implementation

4.5.1 Calculation method and quality assurance

Similar to other features, the implementation of this tool depends on the maturity level of the EPC databases and the level of interoperability between data sources in various Member States. First of all, it is necessary to identify what information is available from EPCs and which are necessary to support the financial instruments. However, the mapping of existing financial instruments and their requirements in the implementing countries may also be replicated for other building types such as public, commercial and office buildings along with residential.

4.5.2 Capacity building for delivery bodies and training needs for assessors

The success of the implementation of the current feature relies on the ability to engage public and private stakeholders. Thus, communication and training campaigns for stakeholders and experts may include training on financing, technical and IT skills. Experts involved in the energy audit may require minimum training because they already perform cost/benefit and payback calculations. Currently, energy auditors in Romania are familiar with eligibility criteria for funding schemes and incentives and provide financial advice. However, the OSS in Denmark which offers integrated financial solutions resulted mainly in shallow renovation. For encouraging deep, staged renovation, the energy audit must be complemented with online services and sustained financial advice.

4.5.3 Political discourse/market or end-user awareness

Based on the testing some recommendations for the design of future financing mechanisms for were highlighted:

- Prioritize the worst-performing buildings, reinforced by the introduction of the MEPS in the EPBD recast proposal.
- Define the entities that will negotiate with the financing sector.
- Have a clear communication strategy for the energy renovation financing initiatives.
- Design instruments with a special focus on the low-income support: the low-interest rates financing mechanism.
- Non-refundable support should be avoided or limited for resource efficiency and the risk assessment analysis should be reconsidered because of the return on investment.
- Important to articulate the subsidies/incentives for financing the energy renovation.
- Link different entities, promoting the skills and knowledge of stakeholders towards a common goal.
- Improvement of evaluation criteria of economic activities (taxonomy).

4.6 Conclusions

The current feature is highly relevant in the view of the Renovation Wave, LTRS, Recovery and Resilience plans and thus, available public and private funding. Besides the EPC scheme, various online tools such as DBL, building passport or digital OSS can provide additional advice on financing. A clear communication strategy is required for financing options and an interconnection to communicate the existing benefits available at national and regional level, namely through digital platforms linked to EPCs (e.g. OSS). For successful implementation of the feature, various public and private stakeholders must be involved in setting up and updating the information. The available funding should also be tailored to target low-income families and worst-performing buildings that must be prioritised. The introduction of MEPS by the EPBD 2021 recast proposal, as well as policies to tackle fuel poverty are in line with prioritising funding for renovating worst-performing buildings. However, homeowners may be reluctant to replace the heating system if the electricity prices are higher than gas and coal. To encourage deep, staged renovation instead of single measures, homeowners must be provided with continuous support to guarantee success during the whole process. It is essential to link different entities and promote the skills and knowledge of stakeholders towards a common goal. The total number of interested EPC end-users for all trigger points evaluated for OSS feature is estimated to about 0.6 – 1.83 million in the base year which may increase to 1.19 – 2.62 million EPC end-users in the year 2030.

Key takeaways:



- OSS feature is highly relevant in the view of the Renovation Wave, LTRS, Recovery and Resilience plans and thus, available public and private funding.
- Experts must be aware of available financing options that could be applied for the building typology and/or improvement measure under evaluation.
- Existing paper EPCs should be linked to online services where homeowners receive the recommendations and an offer from the online platform for financing.
- For successful implementation of the feature, various public and private stakeholders must be involved in setting up and updating the information.
- There are methodological barriers to estimate prices and the percentage covered by grants/subsidies/funding for each EPC recommendation.
- It is key to increase the confidence of financing institutions to reduce perceived risk of investment in renovation

Key action points:



- A clear communication strategy is required for financing options and an interconnection to communicate the existing benefits available at national and regional level.
- To encourage deep, staged renovation instead of single measures, homeowners must be provided with continuous support to guarantee success during the whole process.
- Assessors involved in the energy audit may require minimum training because they already perform cost/benefit and payback calculations.



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.



GDPR

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:

$$E_k^* = \sum_j E_j \cdot S_{j,k}$$

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 of 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	<p>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;</p> <p>Österreichische Nationalbank. https://www.oenb.at/Publikationen/Volkswirtschaft/immobilien-aktuell.html. 09 Feb 2022;</p> <p>Statistics Austria. http://www.statistik.at/web_en/statistics/PeopleSociety/housing/housing_conditions/index.html. 09 Feb 2022;</p> <p>Statistics Austria. https://statcube.at/statistik.at/ext/statcube/jsf/tableView/tableView.xhtml. 09 Feb 2022;</p> <p>Statistics Austria. https://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/wohnen/wohnungs_und_gebaeudeerrichtung/fertigstellungen/026021.html. 03 March 2022;</p>
Belgium	<p>Eurostat. http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do. 02 March 2022;</p> <p>Statbel (Directorate General Statistics – Statistics Belgium). https://statbel.fgov.be/en/open-data/sales-real-estate-belgium-according-nature-property-land-register. 01 Feb 2022;</p> <p>Statbel (Directorate General Statistics – Statistics Belgium). https://statbel.fgov.be/en/themes/housing/building-stock#figures. 03 Feb 2022;</p> <p>Statbel (Directorate General Statistics – Statistics Belgium). https://statbel.fgov.be/en/themes/housing/building-permits#figures. 14 Feb 2022;</p>
Denmark	<p>Statistics Denmark. https://www.statbank.dk/EJEN88. 02 Feb 2022;</p> <p>Statistics Denmark. https://www.statbank.dk/statbank5a/selectvarval/save selections.asp. 02 Feb 2022;</p> <p>Statistics Denmark. https://www.statbank.dk/statbank5a/SelectTable/Omrade0.asp?SubjectCode=6&ShowNews=OFF&PLanguage=1. 15 Feb 2022;</p>
Estonia	<p>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;</p> <p>Republic of Estonia Land Board. https://www.maaamet.ee/kinnisvara/htraru/Result.aspx. 03 Feb 2022;</p> <p>Statistics Estonia. https://andmed.stat.ee/en/stat/majandus__ehitus__ehitus-ja-kasutusload/EH045/table/tableViewLayout2. 14 Feb 2022;</p> <p>Statistics Estonia. http://andmebaas.stat.ee/Index.aspx?lang=en&DataSetCode=KVE01#. 24 March 2022;</p> <p>Statistics Estonia. https://andmed.stat.ee/en/stat/majandus__ehitus__ehitus-ja-kasutusload/EH046/table/tableViewLayout2. 15 Feb 2022;</p>

Country	Data sources
Greece	<p>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;</p> <p>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;</p> <p>European Central Bank – Statistical Data Warehouse. https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=381.SHI.A.GR.TOOT.P; 21 Feb 2022;</p> <p>European Central Bank – Statistical Data Warehouse. https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=381.SHI.A.GR.TRAT.P; 21 Feb 2022;</p> <p>Hellenic Statistical Authority. https://www.statistics.gr/en/statistics/-/publication/SOP03/2021-M10; 17 Feb 2022;</p>
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Poland	<p>European Central Bank – Statistical Data Warehouse. https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.PL._T.N._TR.NPRO.PL2._Z.N._Z; 16 Feb 2022;</p> <p>European Central Bank – Statistical Data Warehouse. https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=430.RESH.A.PL._T.N._TR.TRAT.PL2._Z.N._RO; 16 Feb 2022.</p> <p>Statistics Poland. https://stat.gov.pl/en/topics/municipal-infrastructure/municipal-infrastructure/real-estate-sales-in-2020,2,13.html; 08 Feb 2022;</p> <p>Statistics Poland. https://stat.gov.pl/en/topics/industry-construction-fixed-assets/construction/construction-results-in-2020,1,14.html; 28 Feb 2022;</p>

Country	Data sources
Portugal	<p>Eurostat. http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do. 07 March 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0008330&contexto=pi&selTab=tab0&xlang=en. 10 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0007838&contexto=bd&selTab=tab2. 10 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpaginumber=1&PUBLICACOEstema=55534. 10 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0009632&contexto=bd&selTab=tab2. 10 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0008329&contexto=bd&selTab=tab2. 10 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0008320&contexto=bd&selTab=tab2. 17 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0008335&contexto=bd&selTab=tab2. 17 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0008334&contexto=bd&selTab=tab2. 17 Feb 2022;</p> <p>Statistics Portugal. https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indO-corrCod=0008330&contexto=bd&selTab=tab2&xlang=en. 17 Feb 2022;</p>
Romania	<p>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;</p> <p>European Central Bank – Statistical Data Warehouse. https://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=381.SHI.A.RO.TOOT.P. 15 Feb 2022;</p> <p>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;</p> <p>National Institute for Statistics – ROMANIA. http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table. 22 Feb 2022;</p> <p>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/journal/y2019i3p39-46.html. 08 Feb 2022;</p>
Scotland	<p>Registers of Scotland. https://www.ros.gov.uk/data-and-statistics/house-price-statistics. 07 Feb 2022;</p> <p>Scottish Government. https://www.gov.scot/publications/housing-statistics-stock-by-tenure/. 07 Feb 2022;</p> <p>Scottish Government. https://www.gov.scot/publications/housing-statistics-for-scotland-new-house-building/. 07 Feb 2022;</p>

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 administrations 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 administrations 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
IAP1	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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