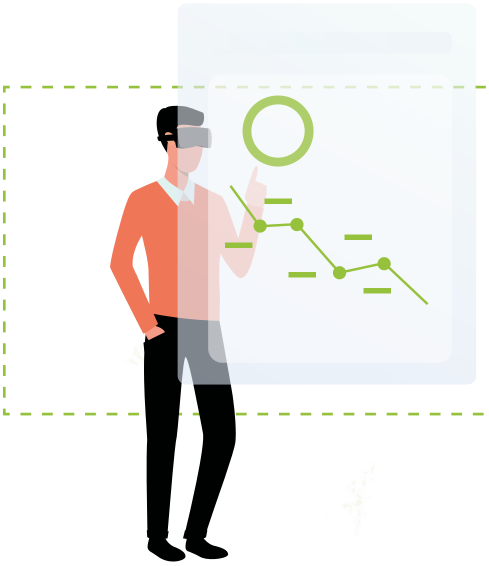
X-tendo



ENERGY PERFORMANCE CERTIFICATES

ASSESSING THEIR STATUS AND POTENTIAL

MARCH 2020

BPIE

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Author(s)	Jonathan Volt, Sheikh Zuhaib, Senta Schmatzberger & Zsolt Toth at Buildings Performance Institute Europe (BPIE)
Reviewed by	Content: Lukas Kranzl & Ina Eugenio Noronha Maia - TU Wien, Maarten De Groote & Jan Verheyen – VITO, Neuza Rosa – ADENE, David Weatherall & Harry Mayers – Energy Saving Trust, David Frick - Energie Agentur Steiermark, Henrik Blyt – Danish Energy Agency, Jerzy Kwiatkowski – NAPE, Lena Lampropoulou – CRES, Fabio Zanghirella – ENEA, Kalle Virkus - Tartu Regional Energy Agency, Emilia-Cerna Mladin - The Romanian Association of Energy Auditors for Buildings, Marcus Hummel – E-think. Language: Barney Jeffries & Roberta D'Angiolella (BPIE)
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1 A CENTRAL BUILDING BLOCK IN THE EU'S ENERGY EFFICIENCY APPROACH

Mitigating the adverse climate impact of the buildings stock is a crucial objective of the European Union (EU). The energy performance certificate (EPC) was introduced by the EU almost 20 years ago and has continuously gained significance. The instrument has also faced a lot of criticism and still needs to overcome multiple challenges before the Europe-wide implementation can be seen as effective. At the same time EPC, with its surrounding infrastructure with trained experts and rich databases, also represents a huge opportunity for the EU. The EPCs could be an effective force that triggers a new wave of renovation activities across the EU if the full potential was explored. In order to become a catalyst for energy renovations, the next-generation EPC must provide an improved and more reliable service tailored for the end-users.

EPCs were first introduced by the Energy Performance of Buildings Directive (EPBD) in 2002 [2002/91/EC] with the aim to make the energy performance of individual buildings more transparent. The EPBD recast in 2010 [2010/31/EU] reinforced the legislation by introducing independent quality control of EPCs, penalties for non-compliance, the obligation to display the energy label in advertisements, a mandatory requirement to hand out a copy of the EPC in sale and rent transactions and improvement of featured recommendations.

The EPBD amendments in 2018 [2018/844] strengthened the provisions again by setting out that the Member States should provide information to owners and tenants on the purpose and objectives of EPCs, energy efficiency measures and supporting financial instruments through accessible and transparent advisory tools such as direct advice and one-stop-shops.

All EU Member States have now implemented national EPC regimes. Different implementation approaches have led to a diverse set of instruments, varying in terms of scope and available information, resulting in some cases in limited reliability, compliance, market penetration and acceptance. Aspects like indoor environmental quality (comfort, health etc.) and smart data usage are not covered in current EPC regimes.

Good practices have shown that an EPC can become more than just an informative tool. It can become more useful to end-users, empower policymakers with better data on the building stock and enable them to monitor the impact of policies and financial support schemes. To realise these additional benefits, EPC regimes must first be properly implemented, well managed, and supported by effective compliance mechanisms. Only in this way will the EPCs increase the market value of energy-efficient buildings and effectively support the transition towards a low-energy real-estate sector.

1.1 Aim of the X-tendo project

The X-tendo project is developing a framework of ten "next-generation EPC features", aiming to improve compliance, usability and reliability of the EPC. The X-tendo partners cover ten countries or regions, including Austria, Belgium (Flanders) Denmark, Estonia, Greece, Italy, Poland, Portugal, Romania and the United Kingdom (Scotland), as displayed in Figure 1. The features that will be explored in the project fall into two broad categories:

1. New technical features used within EPC assessment processes and enabling the inclusion of new indicators on EPCs
2. Innovative approaches to handle EPC data and maximise their value for building owners and other end-users.

Figure 1 - X-tendo participants and target countries (see more on www.X-tendo.eu).

Figure 2 provides an overview of the 10 features, where the green features focus on innovative handling of EPC data while the pink features explore new EPC indicators. The figure is encircled by the four cross-cutting criteria: economic feasibility, compliance with international standards, quality and reliability and user-friendliness. The cross-cutting criteria will inform the overall work and the development of each feature. Each of the 10 features is briefly described below.

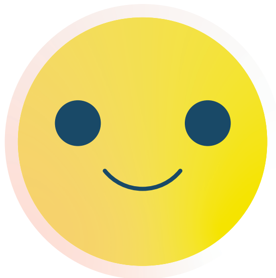
Figure 2 - X-tendo features

1

FEATURE 1: **SMART READINESS INDICATOR -** Smart technologies in buildings have the potential to contribute to increasing the energy efficiency of the building stock, to enhance the flexibility in smart energy grids, and to improve the comfort of building occupants. The introduction of a smart readiness indicator for buildings is included as an optional provision in the current amendments of the EPBD. This indicator would enable assessment of the building's level of adaptability to user needs and its ability to connect to the grid.

2

FEATURE 2: **COMFORT INDICATOR -** Although ensuring adequate levels of indoor air quality, thermal comfort, lighting and acoustics within buildings are among the most potent drivers for renovation, they are rarely covered by EPCs. This indicator would enable assessment of the levels of comfort in terms of indoor environmental quality for a specific building through reliable and evidence-based inputs.



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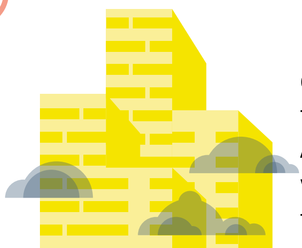


FEATURE 3: **OUTDOOR AIR POLLUTION INDICATOR -** Approximately one in eight deaths in 2012[1] were attributed to air pollution according to the World Health Organization, making it a crucial factor of health. A significant contributor to air pollution is the building sector, which in many Member States still uses highly polluting fuels and technologies to cover heating, hot water and cooking needs.

4

FEATURE 4: **REAL ENERGY CONSUMPTION DATA -** The gap between real energy performance and EPC modelled performance is a source of confusion to EPC users. X-tendo investigates if, and to what extent, actual consumption data can complement energy performance assessments and provide a more complete overview of building performance. The project also explores how this information can best be communicated to the end-users, including possible explanations for the discrepancy like user behaviour and climatic conditions.

5

FEATURE 5: **DISTRICT ENERGY SYSTEMS-** The project is developing the capacity of EPCs to assess and report on the potential for the building to benefit from – or contribute to - future development of district heating (and if relevant also district cooling) networks. This concerns the future decarbonisation of heat generation as well as the required transformation towards next generation (smart, lower temperature) district heating systems.

[1] http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/

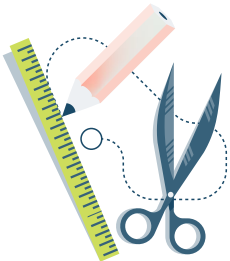
6

FEATURE 6: **EPC DATABASES -** X-tendo explores the value of EPC databases as a tool for quality assurance and data mining to enable more effective retrofit policies and programmes, which has been demonstrated in several Member States. The project specifies how public authorities, with different EPC database systems, can take steps towards the good practice examples.

7

FEATURE 7: **BUILDING LOGBOOKS -** Logbooks have been recognised and developed in some countries as a way to engage building owners and maximise the value of EPC data. The project will identify how EPC registers and systems at different stages of development can support the development of more dynamic logbooks.

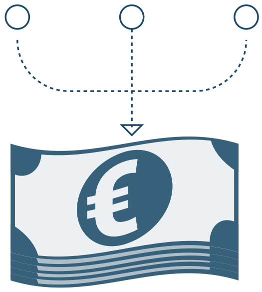
8



FEATURE 8: **TAILORED RECOMMENDATIONS -** Cost and time constraints often result in EPCs containing generic, and not so useful, recommendations to the homeowner. The project is exploring cost-effective approaches to deliver tailored renovation recommendations that can enhance the instrument's impact on renovation activities.

9

FEATURE 9: **FINANCING OPTIONS -** The project will identify which sources of information on financial support can be provided alongside, and integrated in, EPC recommendations. Financing options will mainly focus on public support schemes like soft loans and subsidy schemes, as well as incentives provided by energy suppliers under their energy-saving obligations. EPC data could also bring benefits to private sector financing actors, enabling them to recognise/underwrite energy-efficient assets.



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FEATURE 10: **ONE-STOP-SHOPS FOR DEEP ENERGY RETROFITS -** One-stop-shops are seen as a key means to reduce barriers and transaction costs for finding information regarding support schemes, craftspeople and public authorities. Obviously, these functionalities of one-stop-shops could and should also be linked to EPCs as has already been done in a couple of cases.

1.2 Objectives of this report

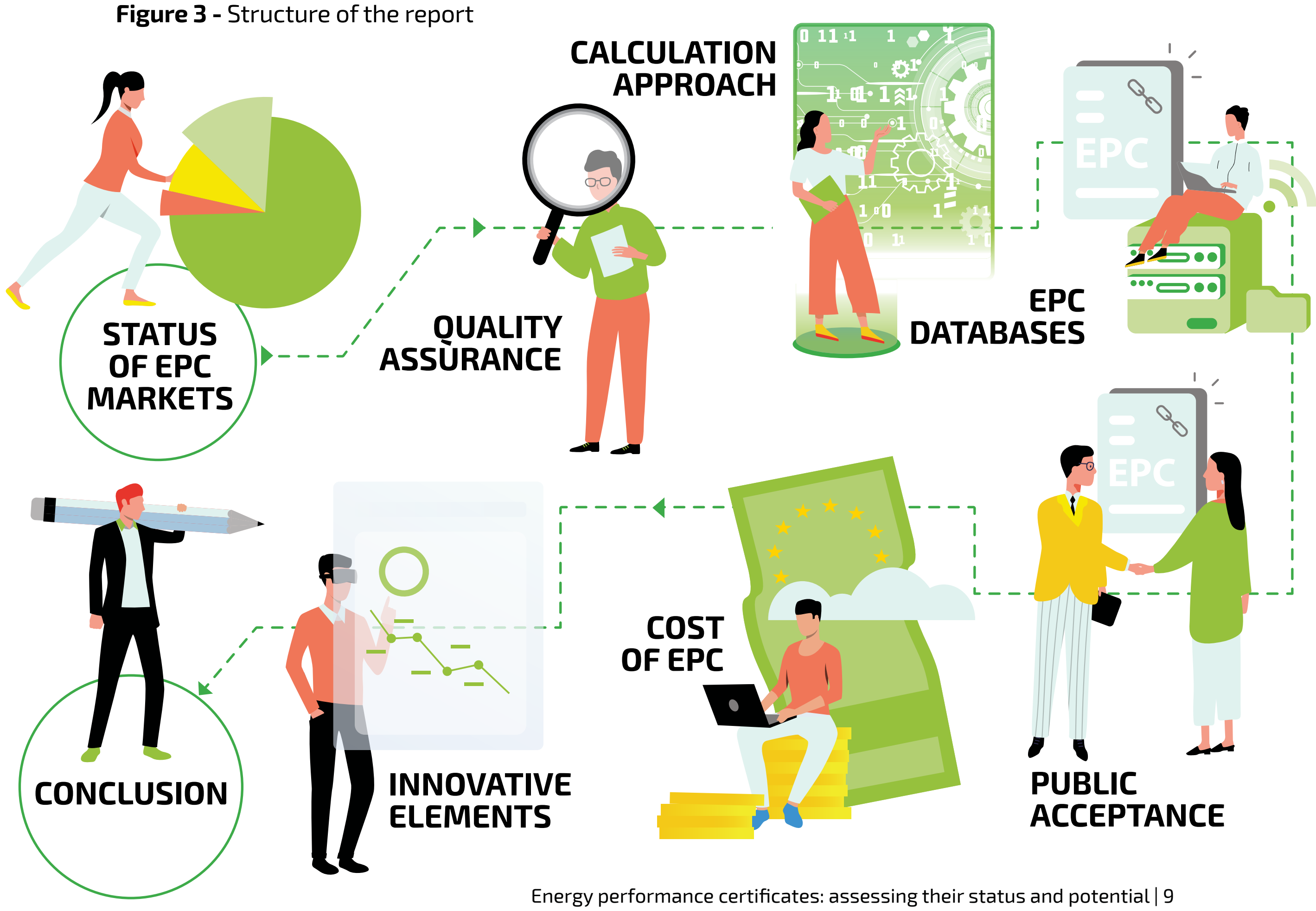
This report aims to contribute to a better understanding of the European implementation of EPCs, with a special focus on the X-tendo targeted countries. Before developing the "feature framework", this report provides a detailed assessment of current practices within European EPC regimes, identifying current weak points and gaps, while indicating how the 10 X-tendo features can support and improve the existing EPC regimes.

The objectives are threefold:

- Contribute to a more comprehensive understanding of existing EPC frameworks, including good practices, strengths and weaknesses.
- Identify existing gaps to show where the features can contribute.
- Validate the focus of the 10 X-tendo-features and explore how they can be streamlined in order to most effectively contribute to the next generation of EPC regimes in the EU.

The information described in this report is based on input from the X-tendo project partners as well as desk research. An open-ended survey questionnaire was shared with the X-tendo partners to collect detailed information and insights from the target countries. The questionnaire comprised 19 questions covering the different sections of this report, which were answered by the partners from Austria, Belgium (Flanders), Denmark, Estonia, Greece, Italy, Poland, Portugal and the UK (Scotland). This effort was complemented with comprehensive desk research including the work of the Concerted Action EPBD, the EU's Joint Research Centre, scientific reports (e.g. [1] [2] [3]) and other Horizon 2020 projects, such as iBRoad, Enerfund, U-CERT, QualDeEPC and QUALICHeCK.

Figure 3 - Structure of the report



2 STATUS OF EPC MARKETS

All Member States had introduced EPC regimes by 2015, implying that more than 28 EPC frameworks[2] exist in the EU and the UK. Based on publicly available EPC databases, together with overviews provided by public authorities, we gathered and compiled EPC label information for more than 45 million residential EPCs[3]. Information provided by the Member States suggests that around six million residential EPCs are issued every year [4]. The UK[4] is leading the market uptake with more than 20 million issued EPCs (see Figure 4). It also has the most EPCs per capita with 0.31, followed by Belgium, Ireland, Denmark and Portugal (see Figure 5).

The relatively low number of EPCs in some countries can be explained by several reasons:

- The EPC database is rather new and thus few EPCs have been registered (e.g. Finland).
- In some countries, the compliance rate is still relatively low for residential buildings which hampers the uptake of EPCs (e.g. Latvia, Bulgaria).
- In Bulgaria, the complex ownership structures in multifamily buildings (the most common building type in the country) make it difficult to get an EPC. As a result, EPCs are mainly attained if the building owners are planning to apply for a public renovation grant for which the EPC is a prerequisite.
- The number of real estate transactions influences the number of issued EPCs. The real estate market in the UK is one of the most liquid and has the highest number of transactions (as well as the shortest ownership period), which triggers many new EPCs.
- The country is relatively small with a low total number of buildings (e.g. Malta and Estonia).

For a few countries, data on the number of EPCs is missing or not attainable.

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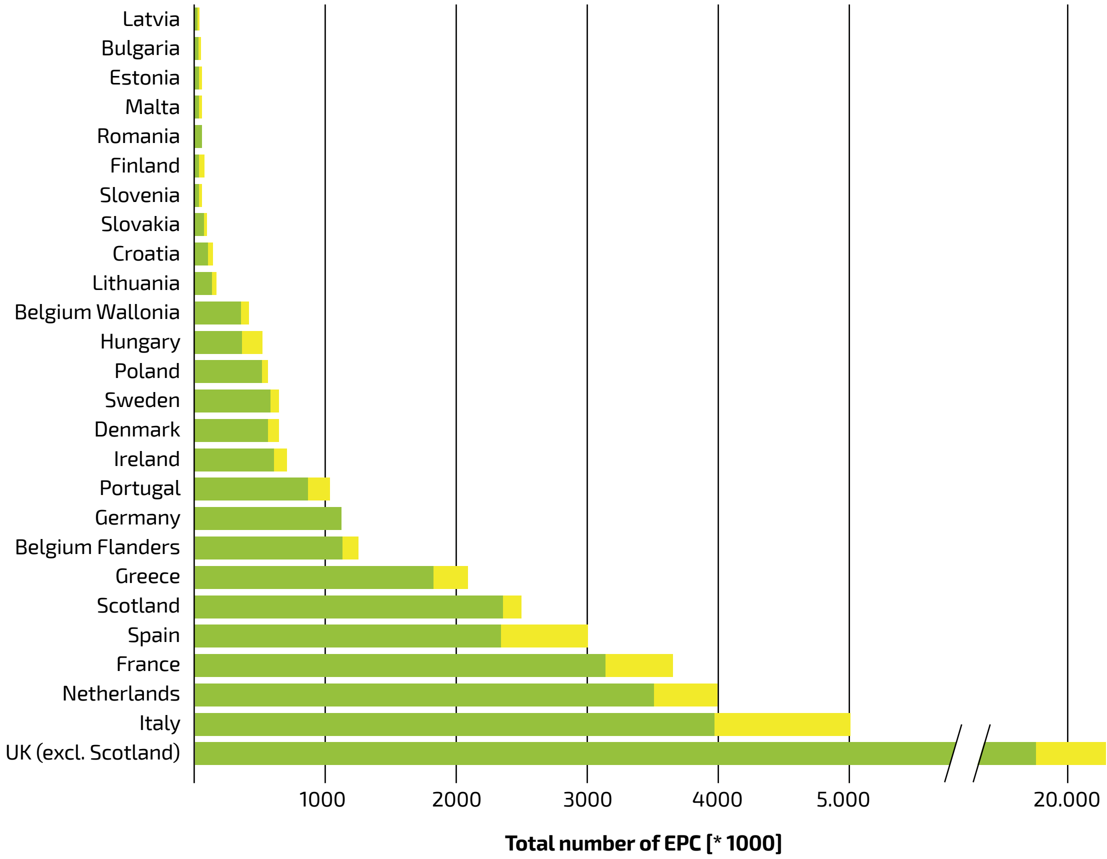
[2] In some Member States, the EPC development have been carried out mainly by the regional governments, including Austria, Belgium, Italy, Spain and the United Kingdom.

[3] Based on Xtendo's compilation of available EPC data, retrieved from national databases, Concerted Action EPBD and data provided by Xtendo's local partners.

[4] United Kingdom consists of three different EPC frameworks and databases, where England and Wales have one together but Scotland and Northern Ireland separate ones.

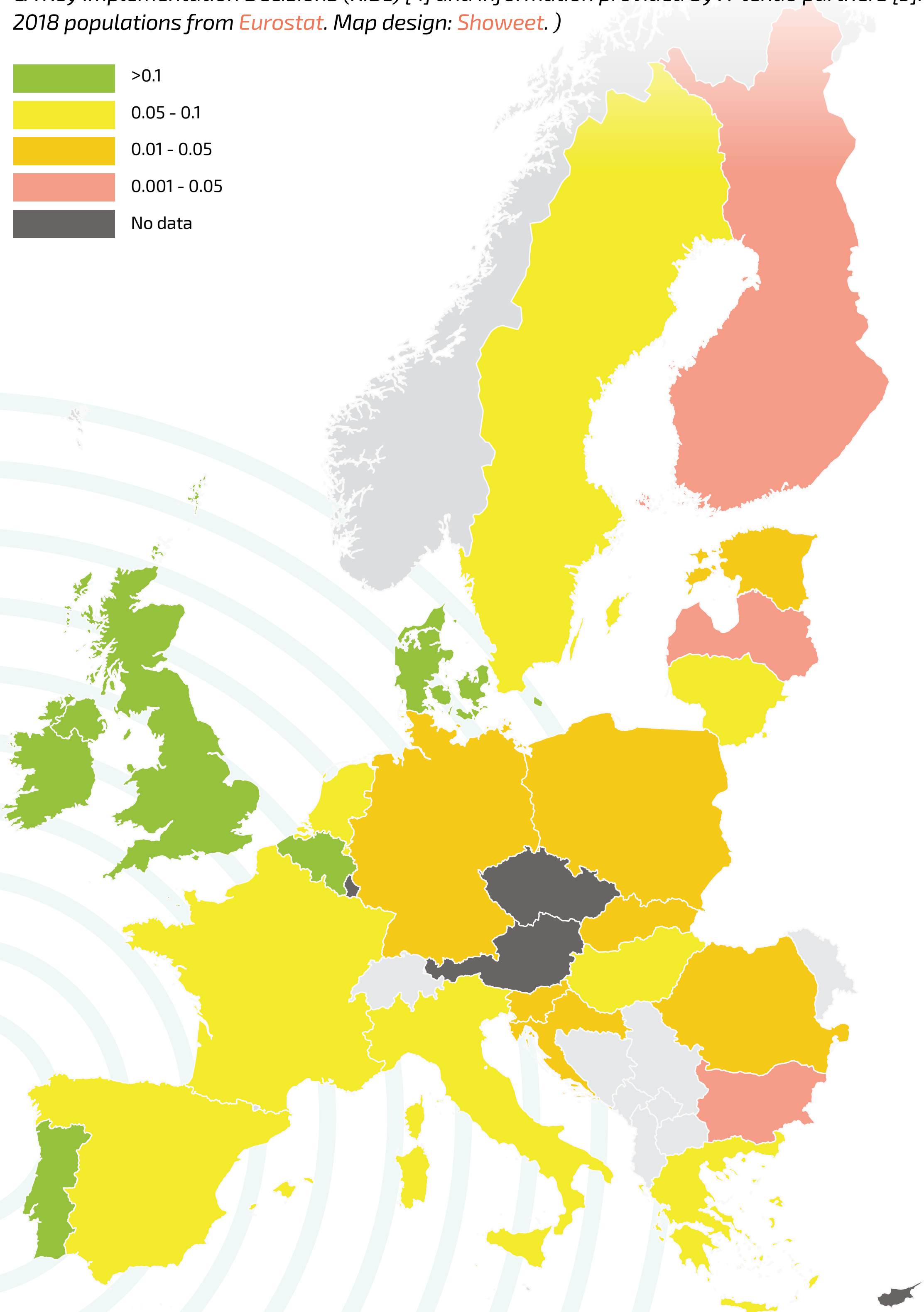
Figure 4 - Number of EPCs registered per country/region. The yellow part of the bars indicates the share that was issued per year during the most recent years (2016-2019). *Source: EPBD CA Key Implementation Decisions 2016-2017 [4], and information provided by X-tendo partners. No data on registered EPCs was found for Austria, Czechia, Cyprus and Luxembourg.*



INFORMATION PROVIDED BY THE MEMBER STATES SUGGESTS THAT AROUND 6 MILLION RESIDENTIAL EPCs ARE ISSUED EVERY YEAR

Figure 5 shows the number of registered EPCs per capita in the EU's 27 Member States and the UK. The graph provides an indication of the instrument's market penetration. However, it says little about the quality of the EPCs nor their impact on increasing awareness or influencing the renovation activity. The UK, Ireland, Denmark, Belgium and Portugal have all issued more than one certificate per 10 citizens.

Figure 5 - Total number of registered EPCs per capita. (*Source: EPC numbers come from EPBD CA Key Implementation Decisions (KIDs) [4] and information provided by X-tendo partners [5]. 2018 populations from Eurostat. Map design: Showeet.)*

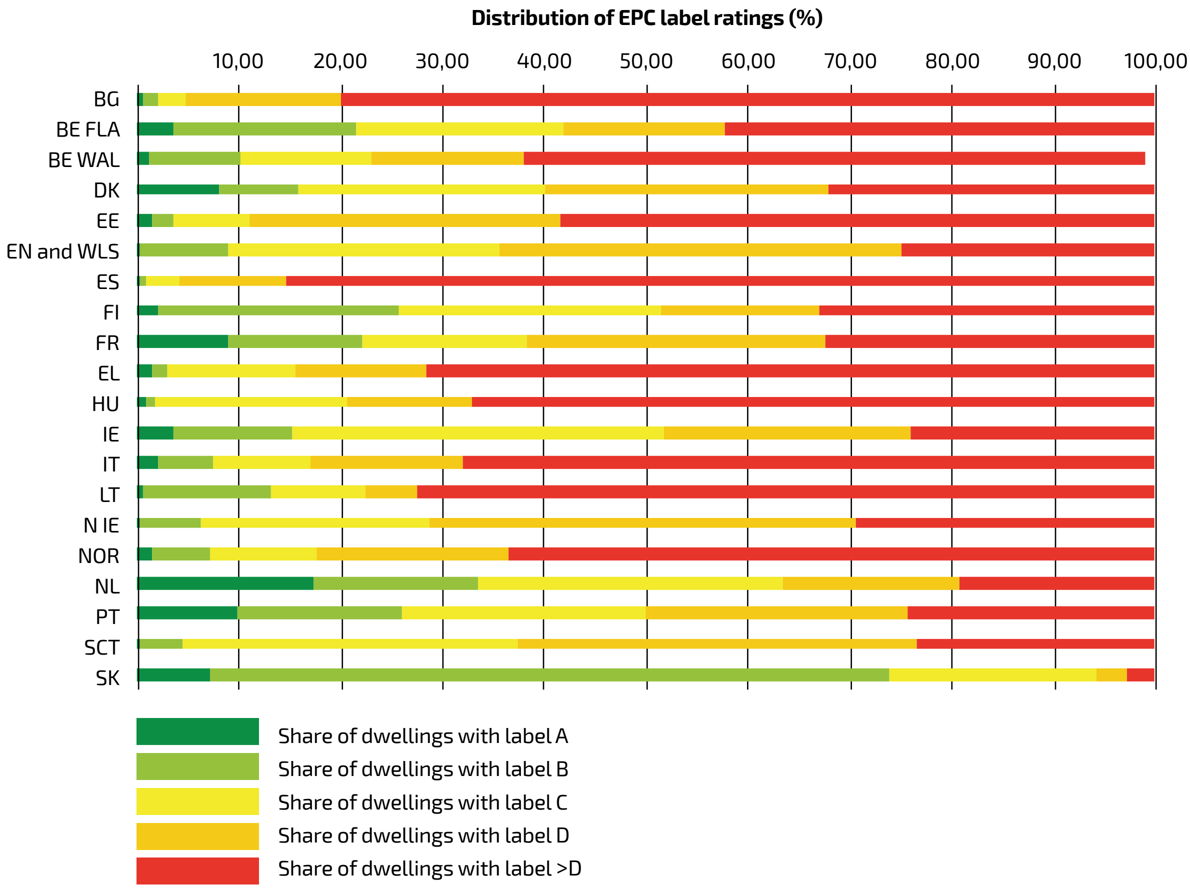


2.1 Overview of EPC ratings

EPC databases are currently one of the best sources for information on the EU's building stock. Yet the data lacks granularity across the EU and comparability between different countries (and regions) is limited. Inadequate data gathering, lack of compliance, different EPC definitions and calculation methods are hurdles that need to be overcome to make this possible [6] (see discussion in section 4).

Figure 6 displays an overview of the building stock of 20 Member States or regions, according to the ratings of the issued EPCs.[5] Slovakia, Netherlands and Portugal have the largest share of EPCs with a high rating (EPC A and B), which can be explained by the performance of the building stock but also the type of buildings included in the database, compliance rate and calculation methodology. Slovakia's relatively large share of efficient buildings can partly be explained by the fact that most registered EPCs have been issued for newly constructed buildings.

Figure 6 - Share of registered EPC ratings across the EU. Belgium and the UK have regional EPC regimes and statistics. Norway, while not being a Member State, is following EU EPC regulations. *Data has been gathered from national databases (see Annex) when attainable, CA EPBD [5] and the Building Stock Observatory.*



[5] Due to the diversity of EPCs across the EU, comparison between countries is problematic. Some are based on calculated energy performance, some (partly) on measured, while the methods do not include the same aspects (e.g. cooling or not). The distribution of ratings also depends on the share of certain building typologies (where a higher share of non-residential and public building correlates with better ratings) and the ratio of new to old buildings that have been rated.

3

QUALITY ASSURANCE

This chapter discusses the status of the quality assurance practices in the EU. The first part describes the overall quality control approach while the second part discusses the qualification and training of EPC experts.

3.1 Quality control

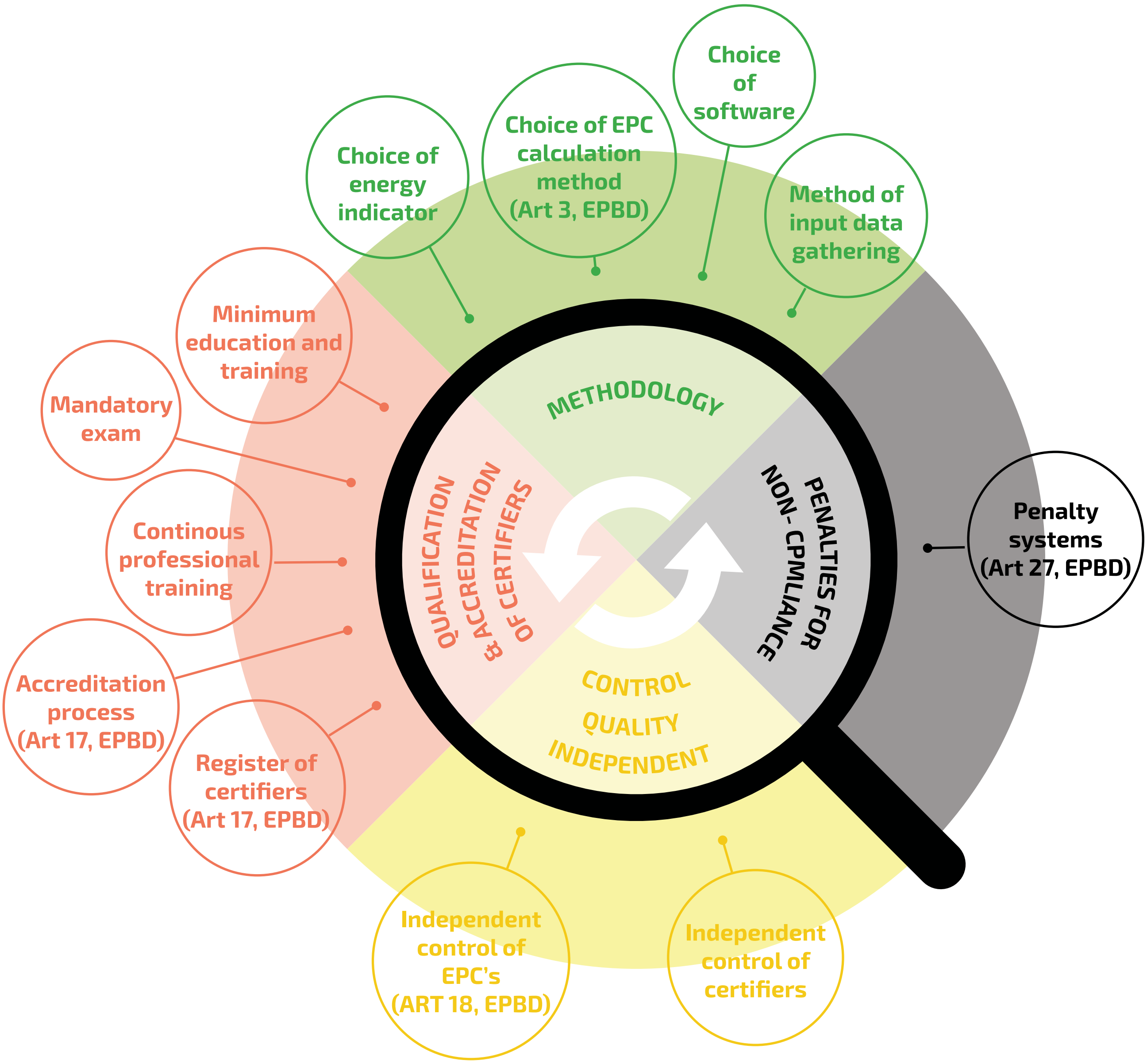
The introduction of the EPC system in the first EPBD was not sufficiently supported by quality assurance requirements [7]. Member States were obliged to introduce an independent system to issue the certificates by qualified and/or independent experts, but quality control was not foreseen. The EPBD recast in 2010 strengthened the quality assurance requirements. The 2018 amendments [2018/844] reiterates that "The current independent control systems for energy performance certificates can be used for compliance checking and should be strengthened to ensure certificates are of good quality"[6].

The implementation of effective systems of quality assurance is a challenging task. It needs to be considered at every stage of the certification process i.e. training and control of auditors, quality check in the software, verification of the certificates issued. At the same time, the cost of the system should be balanced in order to avoid a significant increase in the certificates' cost. Increasing trust and establishing a good reputation for the EPC among building owners, potential tenants and other market actors is a challenge that still needs to be improved.

The main elements of the quality assurance of EPCs, as required by the EPBD, are shown in Figure 7.

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=EN

Figure 7 - Elements of the quality assurance of EPC systems. *(Source: BPIE, 2014 [6])*

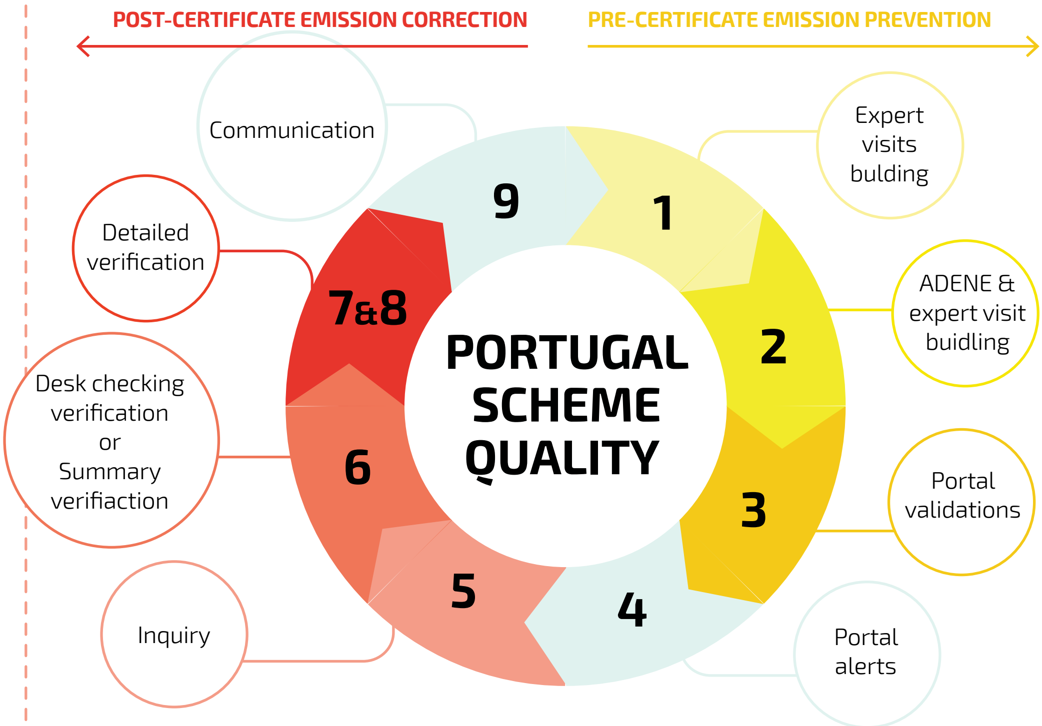


Case study: Portugal's quality assurance circle

The Portuguese "Quality Verification Scheme" is structured into two phases. The first is the prevention phase which take place before the EPC is issued, and includes an on-site visit and automatic database control. The second phase is the correction phase, taking place after the EPC has been issued. This comprises two types of checks, the (i) summary and (ii) detailed verification (see Figure 8) [8].

The schematic figure below shows the quality check/validation process, identifying nine procedural steps:

Figure 8 - Portugal's quality assurance circle. *(Source: ADENE [8], adapted by BPIE)*



Step 1 and 2: The expert visits the building on-site.

Step 3 and 4: Validation control of EPCs inserted in the database. This step aims to identify potentially erroneous values in the submitted EPC data, as the new EPC is uploaded to the system.

Step 5: Assess the building owner's satisfaction by performing a survey, in order to create a better relationship between the building owner and the EPC scheme. The questionnaire evaluates his/her satisfaction with the EPC process, the quality of the Portuguese energy certification scheme and what could be improved. Holistic analysis of the questionnaires will help the Portuguese Energy Agency (ADENE) to identify which areas of the EPC process to improve.

Step 6: The collected EPC data is controlled and verified.

Step 7 and 8: A detailed verification process that consists of total and partial verification.

In the **total detailed verification process**, after the EPC has been issued, an ADENE qualified expert will repeat the full process of issuing the same EPC that is being analysed. They perform the on-site visit and calculations, and compare their results with those of the EPC issued by the first expert. If ADENE's qualified expert notices any discrepancies between the results, clarifications will be requested.

In the **partial detailed verification process**, chosen by a random process, ADENE's expert is present during the first on-site visit (before issuing the EPC). During the visit, the ADENE expert evaluates the EPC expert's work quality, verifying if he/she complies with the established technical procedure, and the approach/relationship with the building owner. After this accompanied visit, the ADENE expert writes a report on what aspects the issuer could improve.

Step 9: The identified issues, if any, are communicated to the involved parties.

3.1.1 Quality control of data input to the EPC database

Following the EPBD legislation, all countries perform random quality checks of the EPC input. How this quality assurance is conducted differs between the Member States. Data inaccuracies can be caused by lack of competence of the EPC expert, procedures not being properly followed, incorrect on-site measurements or wrong pre-calculated values in the methodology lack of competences of the EPC expert:

- procedures have not been properly followed
- measurements on-site have been done be done correctly, or
- the pre-calculated value in the methodology is wrong [9].

EPBD

What does the EPBD say on quality control?

Article 18 of the EPBD [2010/31/EU] declares that:

"Member States shall ensure that independent control systems for energy performance certificates and reports on the inspection of heating and air-conditioning systems are established in accordance with Annex II. Member States may establish separate systems for the control of energy performance certificates and for the control of reports on the inspection of heating and air-conditioning systems."

Annex II of the same directive specifies that:

"The competent authorities or bodies to which the competent authorities have delegated the responsibility for implementing the independent control system shall make a random selection of at least a statistically significant percentage of all the energy performance certificates issued annually and subject those certificates to verification. "

"The verification shall be based on the options indicated below or on equivalent measures:

(a) validity check of the input data of the building used to issue the energy performance certificate and the results stated in the certificate;

(b) check of the input data and verification of the results of the energy performance certificate, including the recommendations made;

(c) full check of the input data of the building used to issue the energy performance certificate, full verification of the results stated in the certificate, including the recommendations made, and on-site visit of the building, if possible, to check correspondence between specifications given in the energy performance certificate and the building certified."

Country information:

Denmark: The Danish Energy Agency controls a statistically significant sample size (0.25%) of the EPCs issued every year. The quality control mechanism consists of a physical inspection from a qualified EPC company selected through a public tender. The quality inspector then reviews the randomly selected sample size of EPCs and reports to the energy agency, which then makes a decision on the quality of the reviewed EPC [8].

Estonia: The Consumer Protection and Technical Regulatory Authority is tasked to randomly check the quality of the issued EPCs. More checks are conducted on EPCs issued by experts where inadequate quality or "foul play" is suspected [8].

Flanders: The Flemish Energy Agency executes random checks of the presence of an EPC (when legally required), the credentials of experts and the EPC's compliance with the defined methodology [8].

Germany: An independent control system was introduced in 2014. A statistically significant sample of certificates is randomly selected from the EPC register, which includes the EPC's identification number and the contact details of the EPC assessors. Checks at all levels can only be performed after the responsible assessor of the selected EPC has provided additional input. Therefore, experts are required to store all relevant data for at least two years after the EPC has been issued [10].

Greece: Quality control is performed at the first step through random checks on data entry. By law, the randomly selected sample is 5% of the total of EPCs issued. Random checks are also conducted on-site, whenever required, depending on desk check results and in case of complaint [8].

Italy: The quality control varies from region to region. All the regions and autonomous provinces with a regional EPC database (i.e. Bolzano, Campania, Emilia Romagna, Friuli-Venezia Giulia, Lazio, Liguria, Lombardia, Piemonte, Toscana, Trento, Valle d'Aosta, Veneto) perform at least an "input/documentary data control". In seven of the regions on-site controls are performed, with different procedures and different targets; some regions control randomly, while others control on-site every new building and deep building renovation. Some regions control on-site when anomalies in the energy performance indexes are found, or in the case of buildings with very high energy performance levels [8].

Romania: The State Inspectorate for Construction (ISC) has been assigned to randomly control 10% of the EPCs and energy audits issued annually. So far, they have covered less than 1% (as reported in trimester ISC reports). The Romanian Association of Energy Auditors for Buildings signed a voluntary agreement to help ISC in assessing the technical quality of controlled documents, but this was rarely requested [8].

Scotland, UK: The Scottish government looks for discrepancies in the inserted EPCs but mainly identifies if any of the mandatory fields are blank. The system does not pick up if there are mistakes in the EPC assessment and the inserted values. An automated data control system is currently being developed that potentially could identify particular patterns and parameters in data which could be incorrect [11].

Styria, Austria: A sampling system selects EPCs to be tested when they are first uploaded to the database. The testing laboratory checks for mathematical correctness of the energy certificates. If the inspection reveals defects, these must be rectified within a reasonable period of time. If the issuer does not comply despite repeated requests for rectification, they will be ordered to remedy the deficiencies by written notification by the state government [8].

3.1.2 Penalties

A BPIE study showed that in 15 out of 28 states, administrative penalties are foreseen for qualified and/or accredited experts/companies that fail to comply with the EPBD. That may include a warning procedure, mandatory training, periodic suspension of licence and loss of accreditation. To date, the most widespread administrative penalty is an official warning to the qualified experts and re-certification [6].

Country information:

Austria: No penalty for non-compliance but a system to inform and correct the EPC [8].

Denmark: The penalty for issuing incorrect EPCs is the cost of revising the EPC and re-registering the corrected data into the EPC database [8].

Flanders, Belgium: EPC experts risk a fine for non-compliance with the method or when not having the required credentials, ranging from €250 to €5000. Multiple consecutive non-compliance issues can lead to the energy expert losing their permit. Non-compliant EPCs are withdrawn. In addition, fines ranging from €500 to €5000 can be given to the building owner when an EPC is not available when required [8].

Greece: Penalties for non-compliance are foreseen for EPC experts and building owners. The expert can face both administrative reprimands (such as licence suspension) and monetary fines of €500-20,000 [8].

Italy: The national law states that in the event of ascertained substantial irregularities, the EPC expert can be punished with an administrative fine of no less than €700 and no more than €4,200 [8].

Poland: No penalties for minor negligence. "Fault tolerance may reach up to 10%, depending on where the error was made. [8]

Portugal: Penalties for lacking an EPC expert certification range between €750 and €7500, while penalties of €250 to €3,500 wait for those who do not comply with the professional duties. Experts that don't comply with the technical and regulatory methodologies can face a fine of €500 to €7,000 [8].

Romania: The law foresees penalties in the range €250-€2,000 for non-compliance. Checks are rarely applied in the absence of a national database to register the issued EPCs [8].

3.2 Qualification of EPC experts

Member States have the flexibility to define the qualification of an EPC expert. There are a variety of requirements applied at the national level, such as minimum requirements specifying a certain level of education and professional experience, a training programme and/or a mandatory exam.

EPBD

What does the EPBD say on EPC experts?

Article 17 of the EPBD [2010/31/EU] declares that:

"Member States shall ensure that the energy performance certification of buildings and the inspection of heating systems and air-conditioning systems are carried out in an independent manner by qualified and/or accredited experts, whether operating in a self-employed capacity or employed by public bodies or private enterprises. Experts shall be accredited taking into account their competence.

Experts shall be accredited taking into account their competence.

Member States shall make available to the public information on training and accreditations. Member States shall ensure that either regularly updated lists of qualified and/or accredited experts or regularly updated lists of accredited companies which offer the services of such experts are made available to the public. "

In most Member States, the expert skills are differentiated according to complexity of the audit/energy check the building requires. Larger and more complex buildings typically require higher expertise and experience. See the Greek example below.

Case study: Greek EPC experts are classified into three categories:

1. All EPC experts have a category A qualification, which means they are allowed to carry out audits for buildings up to 250 m2 and heating or cooling systems up to 50 kW.
2. EPC experts that have proven experience (such as having carried out more than 30 smaller audits) can get a category B qualification. This means they can carry out audits for buildings between 250 and 1,000 m2 and heating and cooling systems of a total power of 50-400 kW.
3. Experts with more than 10 years of experience get a category C qualification, which enables them to carry out EPCs for all types of buildings.

A mandatory exam is required in most Member States, while in countries with a regional approach, the exam is only required in certain regions. In most countries, the examination is conducted by authorised examination bodies, often the same that carry out the mandatory training. The exam is typically a combination of written and oral sections and it may consist of both theoretical and practical knowledge (see Table 1 and country details).

Table 1 reaffirms that in most countries' the EPC expert must have obtained a technical university degree (often an engineering or architect degree), or training that integrates the aspects related to energy performance in buildings. Relevant professional experience might also be required, which typically ranges between two and six years depending on the level of required expertise and educational background.

Table 1 - Qualification for EPC experts

	Austria	Denmark	Estonia	Flanders	Greece	Italy	Poland	Portugal	Romania	Scotland (UK)
University degree		★	★	★	★	★	★	★		
Professional experience	★[7]		★	★	★		★	★		★
Exam		★	★	★		★		★	★	★
Mandatory continued professional development			★	★						
Voluntary continued professional development		★			★				★	

Country information:

Austria: The EPC expert needs to have a trade licence recognised by the Ministry of Economy in special sectors. No other examination or competencies are needed [8].

Denmark: The required training for an EPC expert is a postgraduate education in the existing educational system. Five universities in Denmark have been authorised to provide this education, which is paid by the trainee. Requirements for educational background and competencies are at minimum level 4 in the Danish Qualifications Framework[8] [8].

Estonia: There are several levels of experts with mandates to issue different kinds of EPC, with all levels requiring an engineering degree. The certification must be renewed every five years by verifying professional activity and proof of completed courses [8].

Flanders, Belgium: A base education is mandatory for qualified experts called 'Energy Experts Type A' and since 2017 additional courses need to be followed on a yearly basis. For new buildings, an engineering or architecture diploma is required, followed by specific training of at least 95 hours and an exam. Additional yearly training is needed to keep the permit [8].

Greece: EPC experts need tobe licensed engineers or engineering graduates [8].

[7] In Austria it is not exactly professional experience but connected to the ownership of a certain business licence/trade licence
[8] https://ufm.dk/en/education/recognition-and-transparency/transparency-tools/qualifications-frameworks/levels

Italy: The country follows a regional approach for the qualification of EPC experts. The qualified experts are accredited by the regional government bodies and professional associations. The qualification as an EPC expert is automatic for people who have a degree in certain technical disciplines (e.g. architecture, engineering etc.), are enrolled in their respective professional registers, or are formally qualified. For other professionals, who have a degree in other technical disciplines (e.g. IT engineering, mathematical sciences, etc.), the qualification also requires a specific training of at least 80 hours together with an exam [8].

Lithuania: The main qualification requirements for building certification experts are the same for all types of buildings: an engineering degree with three years' experience in the construction sector, the completion of a 48-hour training course and an exam, and practical experience in the certification of three buildings [5].

Poland: A qualified expert must have completed higher studies and obtained a technical title (e.g. engineer, architect etc.). Other building experience can also be enough to obtain a certification [8].

Portugal: Qualified EPC experts must have an architecture or engineering degree, and at least five years of experience in the energy efficiency of buildings. To obtain the accreditation, the expert must take a formal exam, managed by the Portuguese energy agency [8].

Romania: EPC experts are certified/accredited after an 80-hour training course on specific issues related to the energy performance of buildings. The accreditation requires the expert to pass two exams and carry out an academic project on a real building. Their accreditation is renewed every five years if the expert can show good quality work and participation at continuous professional training courses. The experts are trained at two levels: level 1 experts are entitled to issue EPCs and audits on all types of buildings, while level 2 experts can issue EPCs for smaller residential buildings and apartments. Their training differs accordingly and is paid by the trainee [8].

Scotland, the UK: EPC experts must complete a 3-5 day training course. In addition, relevant experience and sometimes a portfolio of cases are needed. Training courses are designed and delivered by several private organisations. The cost is paid by the expert and ranges from around £700 to £1,250 (~ €830 to €1,490[9]) [8].

[9] According to the currency exchange rate at 13/02/2020.

3.2.1 Lists of accredited EPC experts

Most Member States have made publicly available the list of qualified and/or accredited experts and organisations. A list of accredited EPC expert enables building owners to check that the expert actually has been certified to carry out the inspection.

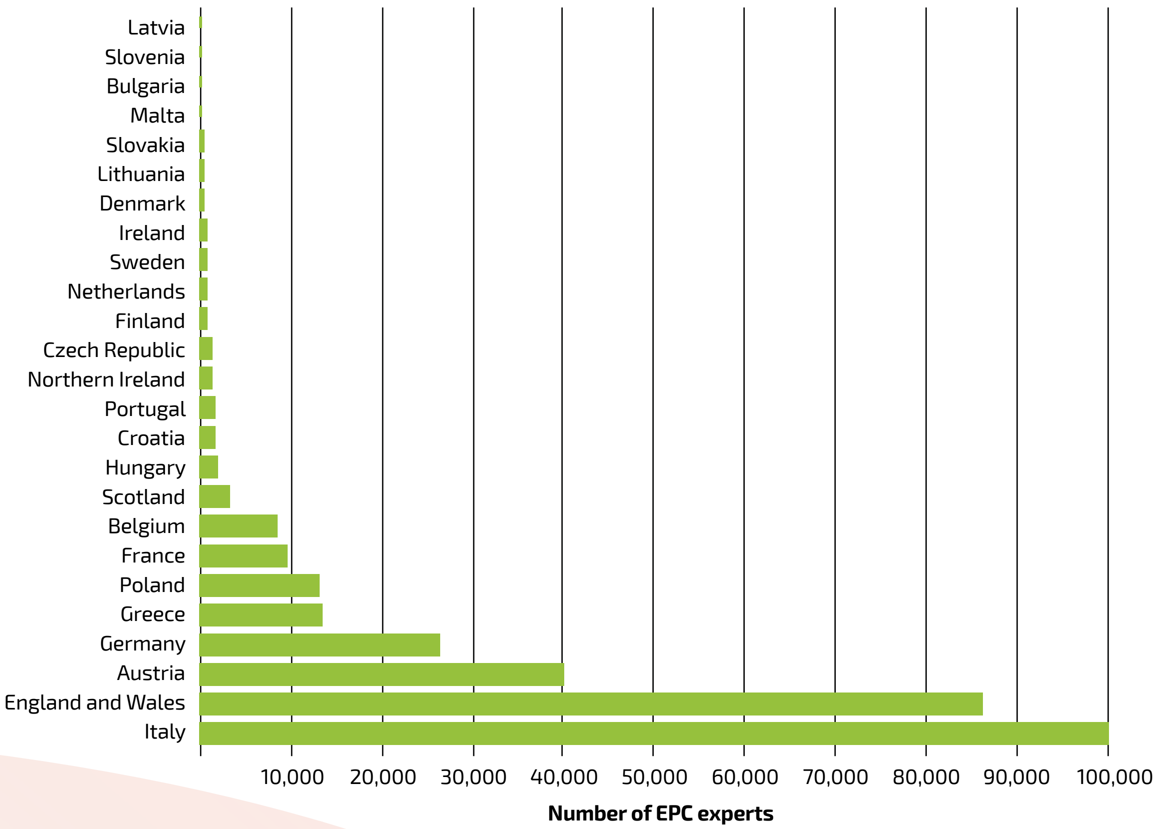
What does the EPBD say on list of EPC experts?

Article 17 of the EPBD [2010/31/EU] says that:

"Member States shall ensure that either regularly updated lists of qualified and/or accredited experts or regularly updated lists of accredited companies which offer the services of such experts are made available to the public."

Figure 9 shows that Italy has most certified EPC experts before England and Wales, Austria and Germany. Austria has the highest number of EPC experts per 1000 inhabitants with 4.53, followed by Italy with 1.65, England and Wales at 1.46 and Greece with 1.27. On average there are 0.69 EPC experts per 1000 inhabitants in the 24[10] Member States and regions where data was available.

Figure 9 - Number of registered EPC experts (latest year available, 2014 - 2019). Please note that what constitutes as an "EPC expert" depends on national/regional requirements. *(Source: EPBD CA Key Implementation Decisions and information provided by X-tendo partners)*



[10] No reliable data was found for Spain, Denmark, Luxembourg and Cyprus.

Country information:

Austria: No official national register for authorised EPC experts. There are commercial providers or training institutes for vocational training that offer databases for their members [8].

Czechia: The Ministry of Industry and Trade maintains a database of all approved energy specialists on its website [5].

Flanders, Belgium: All EPC experts need to be registered in the regional database in order to get a license and get access to the online tools for issuing EPCs. The mandatory continued professional development and quality control are linked to the registration on the platform [8].

France: A directory of qualified experts is available, allowing building owners to assure that the qualified expert is, indeed, certified [5].

Germany: A database of experts qualified in energy efficiency was introduced in 2011. The list only contains experts whose qualifications have been verified and regularly reviewed. The list was introduced to support the quality of the works conducted with the help of public support schemes [12].

Greece: All EPC experts need to be registered in the national database in order to get a license [8].

Ireland: All EPC experts are listed in a national register allowing users to search for names, building typology and geographical area [5].

Italy: 14 Italian regions have a regional register of EPC experts. Ten of these are registers whose data are publicly available. Where a regional register exists, the enrolment is mandatory in order to act as an EPC expert in that specific region. Depending on the region, the enrolment can have a cost or be free, and its duration can be annual, three-year or even without duration limits. In the autonomous province of Bolzano, compliance with national rules allows the EPC expert only to perform EPCs for change of ownership or lease, and a specific local diploma is required to issue EPCs of new buildings and larger building renovations. When a regional register is not present, the qualification as an EPC expert according to the national rules is enough to act as an EPC expert in that specific region [8].

Romania: All certified experts for buildings are publicly listed on the site of the Ministry of Public Works, Development and Administration (MLPDA). Names are accompanied by e-mail address, phone number and other contact information [8].

Scotland, United Kingdom: The approved EPC organisations are responsible for the management and quality control of EPC experts, ensuring that they have the required skills and expertise [8].

3.2.2 Training programmes

Most Member States offer training programmes for EPC experts, with the training being provided by a variety of institutions (including third-party bodies and private training organisations). The training curriculum is typically regulated by the government and may vary for different types of certifiers. Typical training modules are regulations on the energy performance of buildings; aspects of building physics and technical installations; methodology, procedures and tools for the assessment of buildings' energy performance; basics of a cost-effective recommendation for performance improvements; and other related aspects such as on-site renewable energy integration and indoor environmental quality [6].

Case study: Continuous training requirements in Romania

The accredited EPC expert for buildings must attend courses for continuous training, organised by professional associations and/or technical universities. Every five years, each accredited auditor must be re-evaluated by representatives of professional associations (for example, AAECR) and get a recommendation in order to have the working permit renewed by the public authority for another five years. If the recommendation is not positive the auditor must improve his/her work and present other results demonstrating their professional commitment for re-evaluation. The evaluation result is communicated to the MLPDA and to the EPC controlling body, the State General Inspectorate in Constructions (ISC). In the worst scenario, the working permit is suspended for six months. No working permit has ever been cancelled, regardless of the gravity of errors in documents issued by an energy auditor.

Country information:

Brussels, Belgium: The EPC expert can be obliged to join training sessions when requested by the Brussels Environment Office [5].

Greece: Mandatory training was in force up to 2016 but then abolished. Training is currently voluntary, but discussions are being held on the possibility of reinstating the mandatory requirement.

Lithuania: The EPC expert must have an additional 20 hours of training and pass an exam every five years in order to keep their certification.

Portugal: No mandatory programme of continuous professional development, although the Portuguese energy agency, and other entities, offer a regular training plan to improve the qualified experts' skills. Typically, energy experts have an interest in complementing and strengthening their technical knowledge, meaning that voluntary adherence to training is high.

4

CALCULATION APPROACH

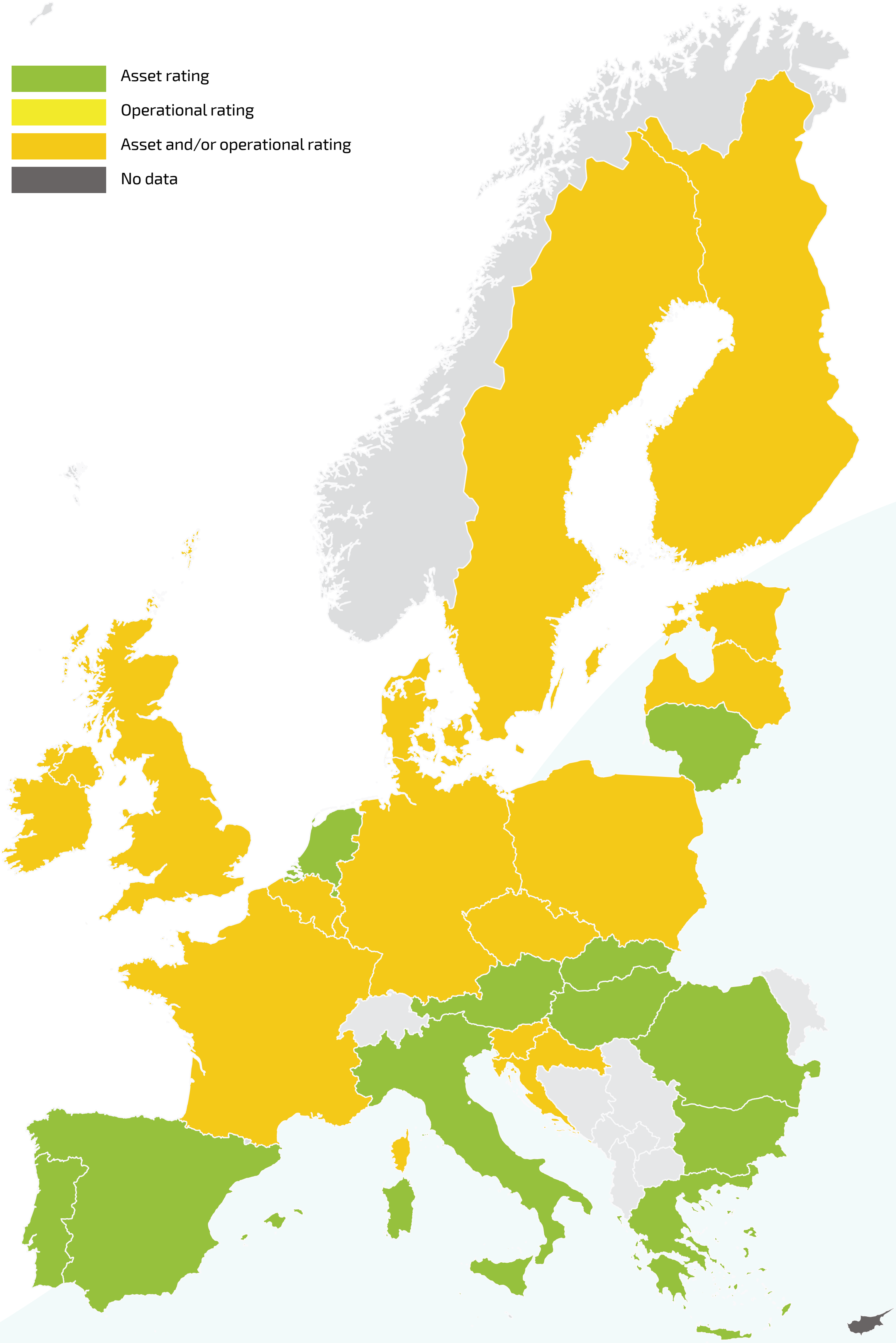
The EPBD [2010/31/EU] provides guidance for Member States regarding the EPC calculation methodology. Annex I to the EPBD states that the energy performance of buildings can be evaluated on the basis of the calculated (asset rating) or actual energy consumption (operational rating). Among the 27 EU Member States and the UK, 12 have adopted the methodology exclusively based on calculated energy consumption. In other countries, both the actual and calculated energy consumption are used (see Figure 10).

In the countries with both asset and operational ratings, the actual energy performance methodology depends on building typology, status and available data:

- In Belgium, operational ratings apply for public buildings while other buildings are evaluated based on asset calculations [8].
- In Luxembourg, the methodology differs depending on if the building is new (asset) or not (operational) [5].
- In the UK, the rating is based on the characteristics of the building itself, its services, a standardised occupancy profile and the building's energy consumption cost [8].
- In Germany and Latvia, all new buildings and buildings undergone a major renovation must have an EPC based on a calculation methodology [6].

While operational energy use is typically measured through utility bills, the Swedish EPC is based on real energy consumption taking into account smart meter data (for heating and electricity). The energy consumption is measured over 12 consecutive months and inserted in the database by an independent certified energy expert. The measured energy use is "normalised" taking climate, number of occupants and behaviour into account [13].

Figure 10 - Asset and operational rating methodologies. *Data provided by X-tendo partners [8] and gathered from CA EPBD [5]. Map design: Showeet.*



4.1 Tools and methodologies

To support the calculation process, the methodology implemented in most countries is in the form ofa software tool. In four countries (Luxembourg, Belgium, Malta and Lithuania) only the public softwarecan be used for the calculation of the energy indicators. In 12 countries, both public and commercialsoftware (in most cases approved by the government) are accepted. In these cases, qualified expertsmay have a choice according to the purpose, preferences, availability and quality of the software.

Typically, the commercial software is tested to comply with the national algorithm and standards. In 12 countries only commercial software is provided, and in five of these (Sweden, Slovakia, Czechia, Hungary and Croatia), validation is not requested [6].

EPBD

The amended EPBD [2018/844] amendments set out that:

The energy performance of a building shall be determined on the basis of calculated or actual energy use and shall reflect typical energy use for space heating, space cooling, domestic hot water, ventilation, built-in lighting and other technical building systems.

Member States shall describe their national calculation methodology following the national annexes of the overarching standards, namely ISO 52000-1, 52003-1, 52010-1, 52016-1, and 52018-1, developed under mandate M/480 given to the European Committee for Standardisation (CEN). This provision shall not constitute a legal codification of those standards.';

Country information

Austria: There are five commercial calculation programs in Austria: ETU, ecotech, GEQ, archiphysik, AX3000. The calculation programs are quality controlled by the public authorities (OIB) according to their calculation methodology and compliance with the valid directive [8].

Estonia: EPC for existing buildings is based on weighted specific energy use, considering the outdoor climate temperature. For new buildings, it is increasingly common to use energy simulation software. Most widely used is IDA ICE by EQUA Simulation AB as it is localised for Estonia [8].

Flanders: The use of an official software tool is mandatory. There are separate methods for new/renovated buildings and for existing buildings. In addition, there are different methods for residential, smaller non-residential, larger non-residential and public buildings. For small nonresidential and public buildings, the use of an official tool is mandatory. For large non-residential buildings, the method is currently being developed. The energy performance indicator is based on calculated energy consumption by using a simplified monthly energy balance method. The method for public buildings is based on measured energy consumption. All methods require mandatory onsite visits [8].

Greece: The methodology for the calculation of energy performance is based on EN ISO 13790 (monthly quasi-steady state method) and complementing standards. Calculations are performed with the use of the official national software (TEE-KENAK), available (at low cost) from the Technica Chamber of Greece and integrated in the EPC registry web platform. Other commercial software tools can also be used but these need to be checked and approved by the public authority [8].

Italy: The methodology is based on the group of Italian national standards "UNI/TS 11300". The technical standard "UNI/TS 11300-1" is the Italian application of EN ISO 13790: 2008. For evaluations of existing buildings, in the absence of reliable design data, the standard provides simplified data to be adopted in the calculation and definition of the input data. The simplifications in the definition of the input data represent the main cause of deviation among the results of the different calculation tools or, for the same calculation tool, among the different EPC experts using the tool. Some simplifications concern the use of pre-calculated data for the characterisation of individual components of the envelope (e.g. opaque, transparent, thermal bridges), to be adopted when there is no documented data and in-depth experimental investigations cannot be carried out [8].

Poland: There is no recommended software for the EPC calculation. The methodology is based on the monthly calculation method of the EN ISO 13790 standard. Few software products are compliant with this methodology, and the use of these is not mandatory [8].

Romania: A national regulatory methodology approach exists, but the actual calculation may be performed with personally developed tools (typically Excel files) or commercial codes. Out of many developed commercial codes, only those for residential apartments are validated; the rest are used under according to the buyer's own judgement. This situation offers little chance to correctly validate the results, while the results themselves depend on the user's ability to use the code [8].

Scotland and wider UK: The standard assessment procedure (SAP) is used for domestic and nondomestic buildings. The SAP rating allows for a comparison of the relative cost of heating and lighting different homes of the same size. The SAP scale ranges from 1-100, with a high number indicating a higher energy efficiency level (and thus also EPC label). SAP is a building energy model for homes, developed by the Building Research Establishment (BRE). Data on building performance (u-value of different components, heating etc.) is collected according to a standardised template. Data is then inserted into software that has been approved by BRE [8] [11].

4.2 Recommendations

Following the EPBD [2010/31/EU], EPCs should include "recommendations for the cost-optimal or cost-effective improvement of the energy performance of a building or building unit". The majority of EPCs feature recommendations like this ranging from no-cost measures, like changing behaviour, to medium- and high-cost measures, like enforcing thermal insulation or changing service systems.

Individual renovation recommendations are provided for domestic buildings and commercial establishments in countries like the UK, Austria and Denmark as additional advice accompanying the EPC reports. In most cases, standardised recommendations are provided to reduce the cost of a customised approach [5].

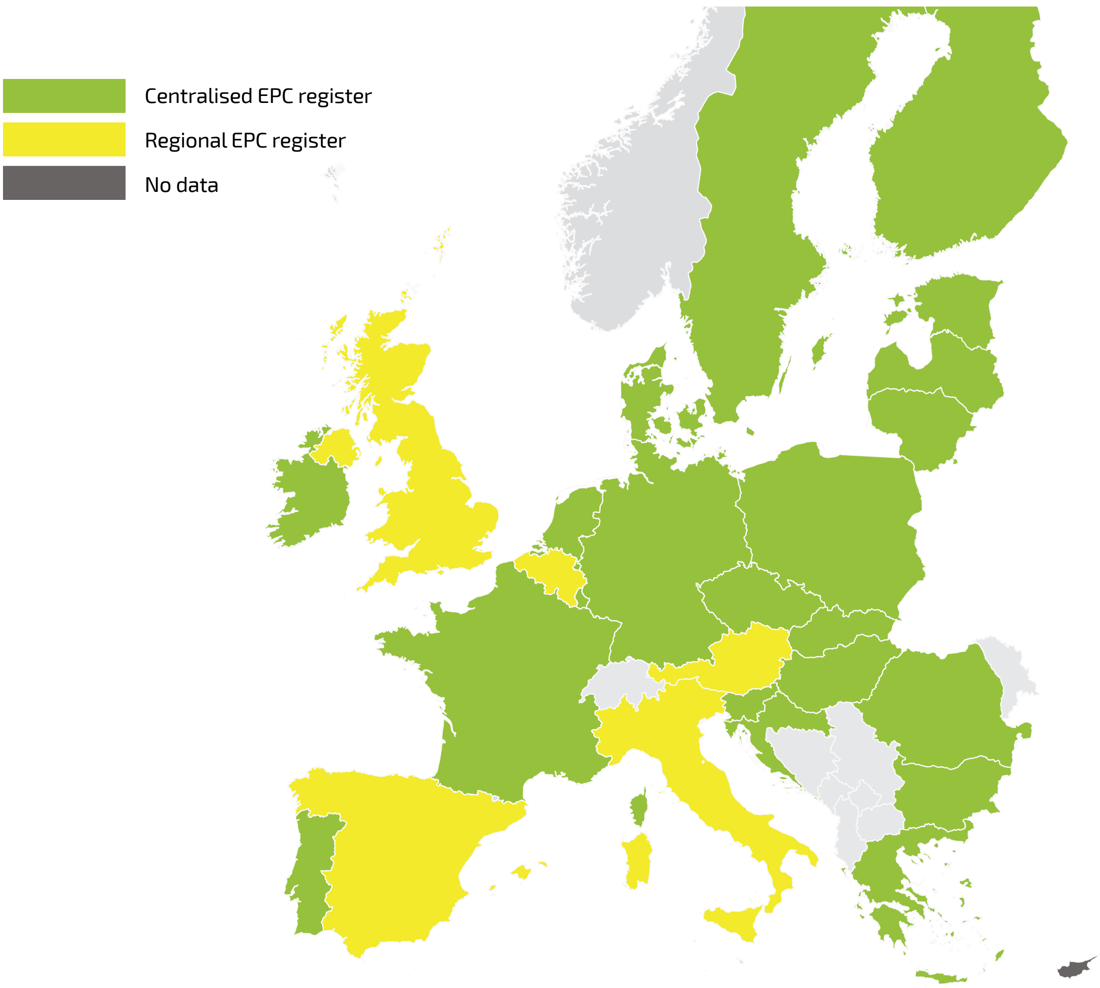
The EPCs themselves have not been effective in driving renovations. Cost and time constraints often result in EPCs containing poorly tailored recommendations. Evidence suggests that an on-site visit, including the chance for the user to interact with the expert, influences the perceived quality and reliability of the recommendations and the chance that they will be implemented.

5

EPC DATABASES

Each Member State has its own approach to gathering EPC data, and differing conventions make immediate comparison difficult. However, the experiences of other countries offer valuable insight into how the value of a database can be maximised and ultimately contribute to achieving energy efficiency targets and emissions reductions in the buildings sector. [6]. Today, almost all Member States have an EPC database.

Figure 11 - Centralised versus regional EPC database. *Data provided by X-tendo partners [8] and gathered from CA EPBD [5] Map design: Showeet*.



There are other aspects of EPC databases that can vary and affect quality and value, such as how the information is uploaded to the database and the amount and kind of information included. In nearly all Member States, upload is the responsibility of the qualified expert who conducted the assessment [6]. Table 2 shows what information is gathered and stored in the EPC databases. Almost all databases include general information, energy performance data and the current EPC rating. Only a few databases include information on the potential EPC rating, while indoor environmental quality is only featured in two databases.

Table 2 - Information included in the EPC database

		General building information	Energy performance data	Current EPC rating	Potential EPC rating	Indoor environmental quality
X-tendo countries	Austria	★	★	★		
	Belgium, Flanders	★	★	★	★	
	Denmark	★	★	★	★	
	Estonia	★	★	★		
	Greece	★	★	★		★
	Italy	★	★	★		
	Poland	★	★	★		
	Portugal	★	★	★	★	★
	Romania	★	★	★	★	
	Scotland	★	★	★		
Other countries	Germany	★				
	Ireland	★	★	★	★	
	France	★	★	★		
	England and Wales	★	★	★		
	Spain	★	★	★		
	Sweden	★	★	★		

6

PUBLIC ACCEPTANCE

The EPC of a building will only be able to serve its purpose if it is accepted and considered trustworthy. Increasing trust and establishing a good reputation for the EPC systems among building owners, potential tenants and other market actors is key to the success and effectiveness of the instrument. Important considerations include the actual use of EPCs in the retail market and the perceived value of the EPC information for the user [14]. The reliability of the information on the energy label is critical to the credibility of the whole system, and its acceptance and market uptake [15].

EPBD

The amended EPBD [2018/844] enforced the directive to strengthen the quality control and by extension the acceptance of the instrument.

"The current independent control systems for energy performance certificates can be used for compliance checking and should be strengthened to ensure certificates are of good quality. Where the independent control system for energy performance certificates is complemented by an optional database going beyond the requirements of Directive 2010/31/EU as amended by this Directive, it can be used for compliance checking and for producing statistics on the regional or national building stocks. High-quality data on the building stock is needed and this could be partially generated by the databases that almost all Member States are currently developing and managing for energy performance certificates."

Excerpts on public acceptance from some of the X-tendo countries [8]:

Austria: "Acceptance from the tenant and buyer point of view, lack of understanding on the seller and renter side".

Flanders, Belgium: "EPC is generally well accepted. EPC for newly constructed and renovated buildings is linked to the application of the building permit and is legally mandatory."

Greece: "EPCs are well accepted as an indispensable part of the legal documentation of the building file, e.g. when obtaining a permit or in market transactions. This conclusion is based on the fact that the majority of EPCs were issued for reasons of compliance with the regulatory framework on the energy performance of buildings (86 per cent), while for reasons of applying to national subsidy programs the corresponding percentage is 14 per cent."

Poland: "General opinion is that EPCs have little value. The form and information on the EPCs are unclear for the final user."

Romania: "The content of EPCs, with the exception of the coloured scales, is not connected to the common understanding of what energy consumptions are. Even the comparison with the reference building at current minimum requirements is not always relevant because its meaning is not explicit in the EPC. Almost nobody asks for an EPC unless it is required."

Table 3 shows different survey findings on public acceptance of EPCs. It shows that trust varies greatly between Member States.

Table 3 - A selection of survey findings on the trust of EPCs. *Sources: DK – Epinion, 2016. UK – BEIS, 2019. PT, BG, PL – iBRoad, 2018. Italy: information provided by the X-tendo partner ENEA . Germany - Climate Policy Initiative (CPI) study referred to by CA EPBD.*

Denmark	**A survey of 1006 people that bought a property in 2015** • Over half of the homeowners, who could remember that they received an EPC report, stated that the EPC had a significant importance for their decision to purchase the home (58 percent answered "to some degree" or "great extent)". • 24 percent indicate that the EPC was of less importance and 18 percent indicated that the energy label did not influence the purchase decision at all.
United Kingdom	**A survey of 4201 homeowners in the United Kingdom** • UK Government, reporting on the whole UK, found that 58% of people were aware of the EPC and 6% said they know the label of their home. • Almost three in ten (29%) of those aware of EPCs said they recalled seeing the section on how they could improve the energy efficiency of their home. • As with overall awareness of EPCs, owner occupiers were more likely to have seen a section in the EPC on how to make their home more energy efficient. More than two in ten owner occupiers (22%) said they had seen this.
Portugal	**A survey of 500 people either buying, selling or planning to move** • 47% of the respondents say they would trust the EPC for advice on energy renovation. The survey also showed that 67% considered the EPCs' information as useful or very useful, while 31% considered it not to be useful.

Bulgaria	**A survey of 500 people either buying, selling or planning to move**	
	• Only 9% would trust the EPC for advice about renovation measures.	
Poland	**A survey of 500 people either buying, selling or planning to move**	
	• Only 11% would trust the Energy Performance Certificate for advice about renovation measures.	
Italy	**A survey of 654 real estate agents in 2018**	
	• 9% thinks the EPC is a very useful tool to orient the choices of the buyers towards buildings or building units of higher energy quality. 42% thinks the EPC is useful; 22% thinks the EPC is quite useful; 19% thinks the EPC is not very useful; 8% thinks the EPC is useless.	
Germany	**A survey of 662 residents who recently purchased a house**	
	• It concludes that purchasers understand the information, but often do not trust or remember it. Furthermore, it concludes that "only a fraction remembered correctly the information of the EPC and only 44% of respondents found the EPC trustworthy".	

6.1 Certificate design and attractiveness

Since the launch of the EPCs, most Member States have implemented changes to their EPCs. The identified reasons are to increase the attractiveness of the EPCs and to reflect updates to the EPC definition and regulation [16]. A study issued by the Concerted Action EPBD [16] found several different "motivations to rescale the label", including:

- to adapt the scale because of stricter requirements for new buildings
- to make EPCs more attractive for very efficient buildings
- to make EPCs less attractive for inefficient buildings
- to solve problems with the old EPC, for instance for apartments
- to change from energy use to primary energy use

Research shows that a well-designed EPC can influence homeowners to renovate [17]. Figure 12– 15 display some of the more innovative EPC designs.

Using graphics and colours to help the end-user grasp the information in the EPC can increase its perceived usefulness. Italy and Portugal use this to highlight certain content in the EPC.

Italy: The energy performance of the building envelope is shown in the Italian EPC with qualitative "smileys", indicating its ability to thermally insulate the interior (in winter and summer conditions). The rating scale is divided into three values: high quality, medium quality or low quality, represented by the smileys (see Figure 16).

Portugal: Innovative indicators include renewable energy use and CO_2 footprint, which are both featured on the front page of Portugal's EPC (see Figure 17).

Figure 12 - Estonia's new EPC design

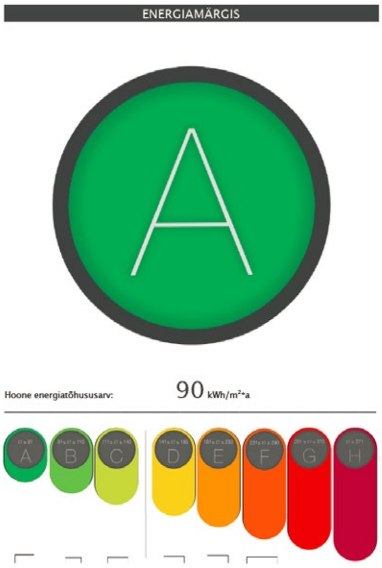


Figure 13 - Flander's new EPC design

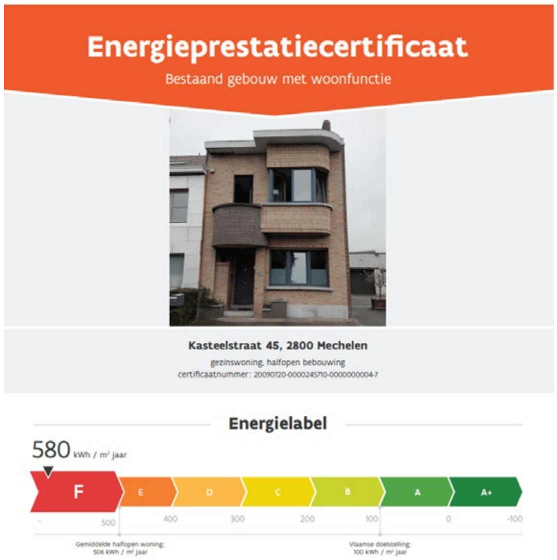


Figure 14 - Italy's EPC

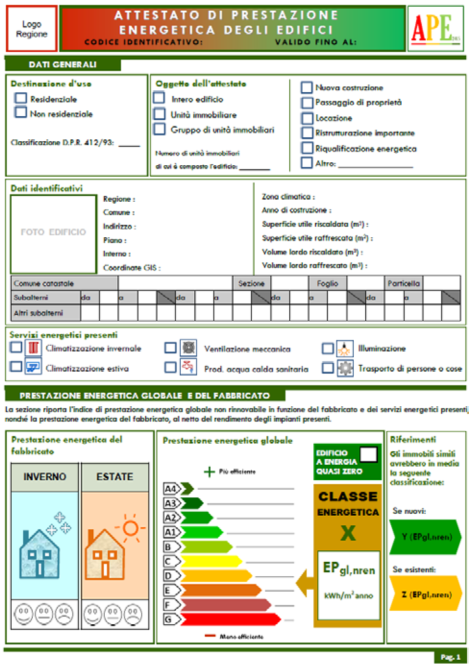


Figure 15 - Portugal's EPC

Figure 16 - User-friendly Italian EPC design

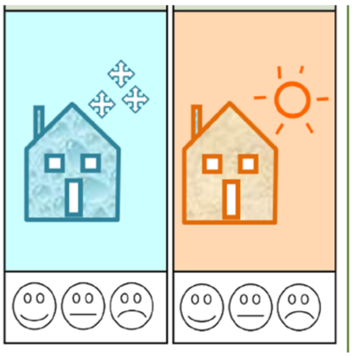


Figure 17 - Extract from Portugal's EPC

7 WHAT DOES AN EPC COST IN DIFFERENT MARKETS?

EPC prices are generally set on a market basis with no maximum ceiling. A small number of Member States, including Denmark, Croatia, Hungary and Slovenia, have regulated the cost for an EPC. In Denmark, the cost is capped at €884 for larger single-family buildings and in Slovenia at €170 for one-dwelling and two-dwelling buildings.[11] In Hungary, the cost of an EPC for apartments and single-family buildings is set by law (€40 + VAT per unit). Experts have criticised this as unrealistically low, undermining the quality of the certificate.[12]

Figure 18 shows that the cost ranges from €20 to €1000 for a single-family house EPC across the EU. The variation can be explained by factors such as quality/comprehensiveness of the EPC methodology, variation in labour cost across EU, number of competing actors on the market, cost of EPC software, involvement of trained experts, on-site audits, verification by an independent organisation, registration or not in a national EPC database, etc.

While it is positive that market forces have driven down the cost of EPCs in most Member States, very low costs for an EPC can be a concern. It calls into question the integrity, purpose and quality of those certificates and the ability of markets to function without properly regulating their border conditions, such as requiring the physical presence of a qualified expert and appropriate evaluation of the building [6].

At the same time, a low price for the EPC may aid public acceptability and uptake. It's noticeable that the UK has both the highest rate of issuing EPCs and one of the lowest prices for the certificates at €60-€70. The Energy Saving Trust explains the low price for issued EPCs in Scotland: "Homeowners regard the EPC as a bureaucratic necessity, rather than an important document in its own right, and are keen (usually working with their estate agent) to get it procured as quickly and cheaply as possible. From the supply side, pressure on the price comes from the lack of barriers in becoming an EPC assessor – there are more assessors than there is work available. The fact that EPCs can be produced this cheaply (and, therefore, quickly) may also point to a need for greater quality assurance of the assessment process." [11]

[11] Slovenia regulation on EPC cost (2014), www.pisrs.si/Pis.web/pregledPredpisa?id=SKLE9972
[12] https://epbd-ca.eu/wp-content/uploads/2018/08/CA-EPBD-IV-Hungary-2018.pdf

The same report emphasises that EPC regimes need to strike a balance between cost and quality: "There is a tension between speed/cost, accuracy and reproducibility (in the issuing of EPCs). A very short and very simple survey would be fast and reproducible but not accurate, while a very detailed in-home survey delivered over several hours would be reproducible and accurate, but not fast or cost-effective." [11]

Figure 18 - Cost range for an EPC for a single-family house. *Data sources: X-tendo partner provided information [8] and CA EPBD [5] [10].*

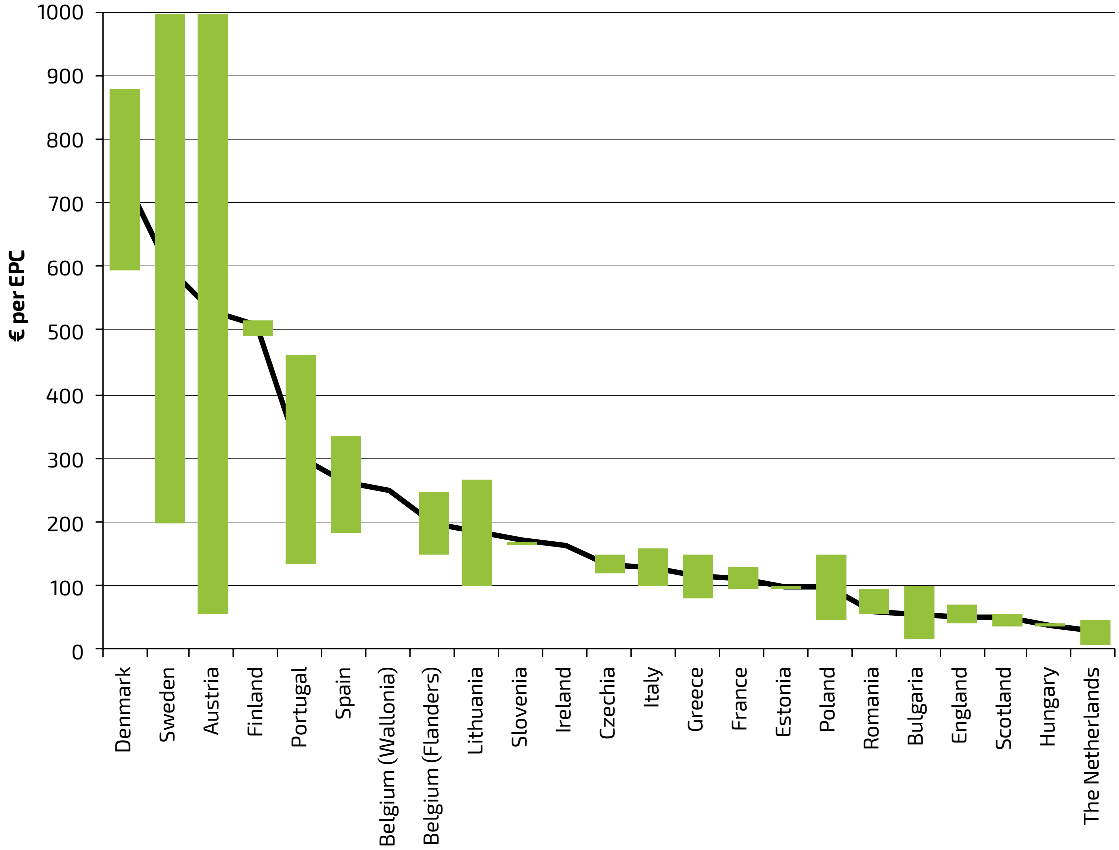
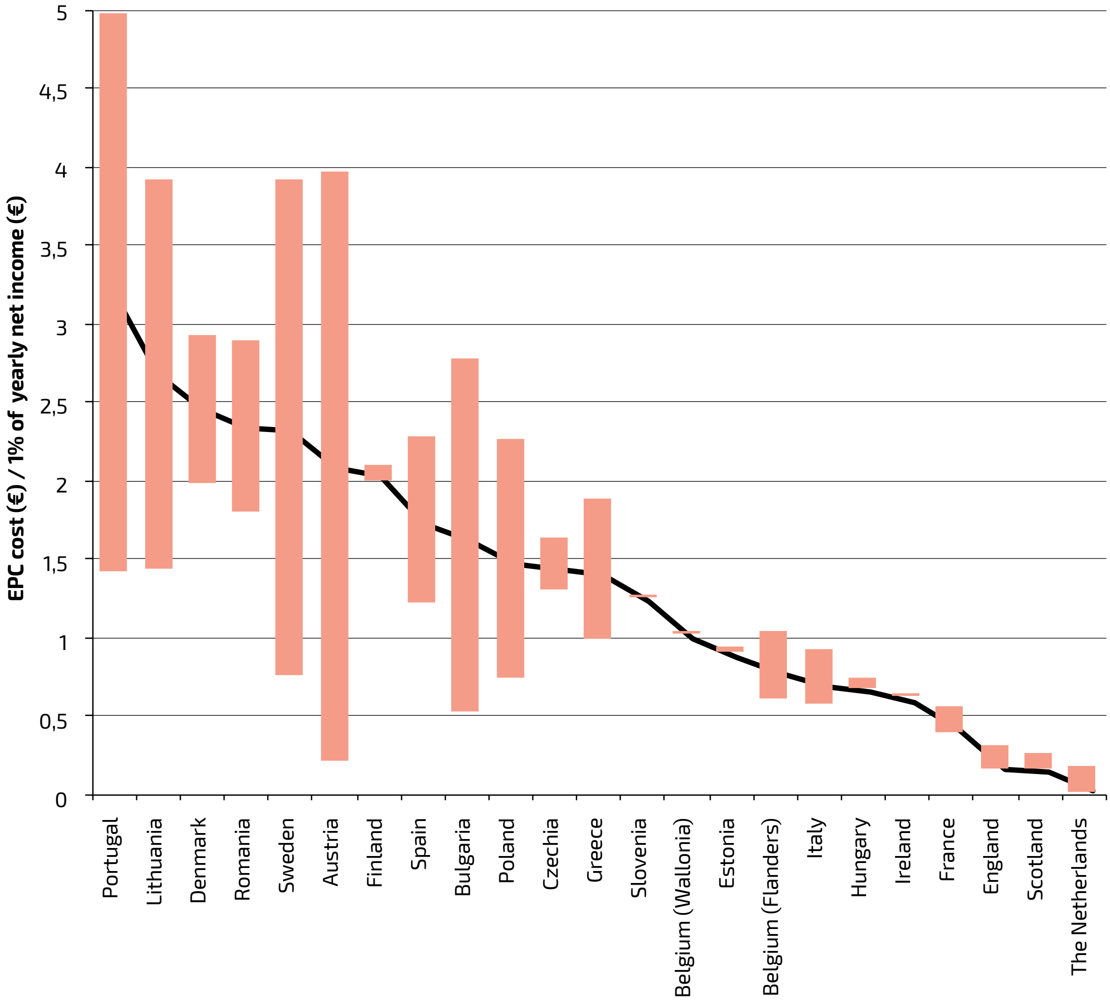


Figure 19 shows the cost of an EPC in relation to the average net income in the country. Building owners in Portugal, Lithuania and Denmark pay relatively the most for their EPC, while owners in the Netherlands, Scotland and England pay relatively little.

Figure 19 - Cost for an EPC for a single-family house divided by net income. *Data sources: X-tendo partner provided information [8] and CA EPBD [5] [10]. Average net income comes from Eurostat.*

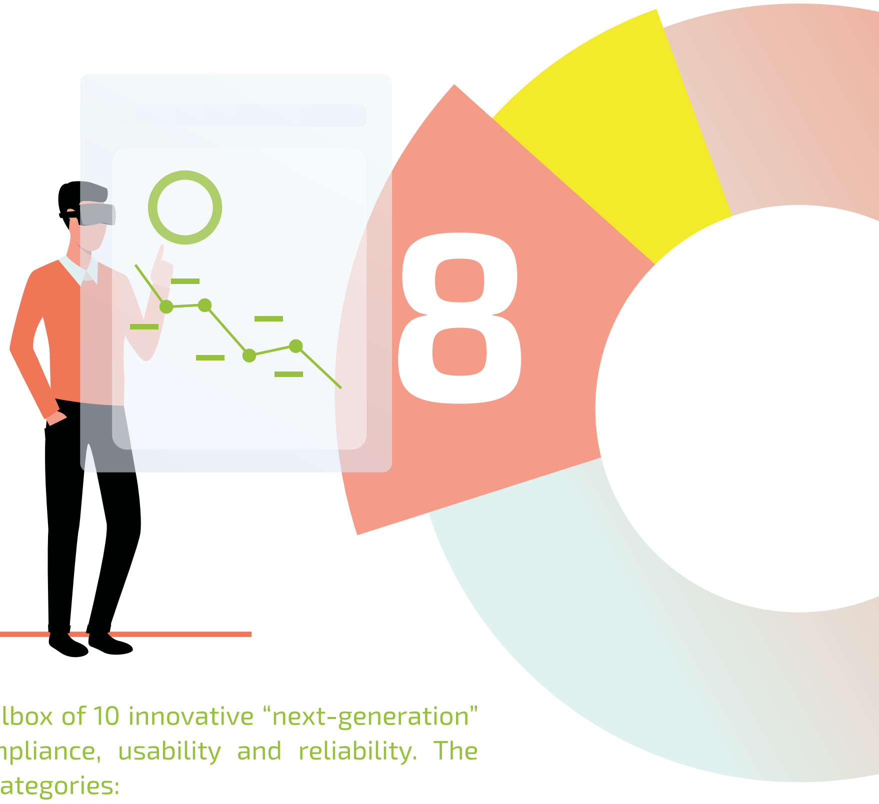


Case study: an automated approach in the Netherlands

The Dutch EPC process for residential buildings has been developed to keep the cost low. It comprises four steps:

1. Owners receive a temporary EPC, which indicates the energy performance of the residence based on cadastral data (area, date of construction, building type, quality of insulation of floors, roof and walls, and systems for heating, hot water and renewable energy).
2. The owner can change or add extra information on energy measures and select a qualified expert who has to approve the changes on the website. The owners have also to provide evidence of the measures taken, such as invoices and photos.
3. The qualified expert checks the uploaded changes and documents, before approving the definite EPC.
4. Finally, based on this approval, the new EPC is registered in the national database.

INNOVATIVE ELEMENTS OF EPCS



The X-tendo project is developing a toolbox of 10 innovative "next-generation" EPC features, aiming to improve compliance, usability and reliability. The innovative features fall into two broad categories:

1. New technical features used within EPC assessment processes and enabling the inclusion of new indicators on EPCs
2. Innovative approaches to handle EPC data and maximise their value for building owners and other end-users

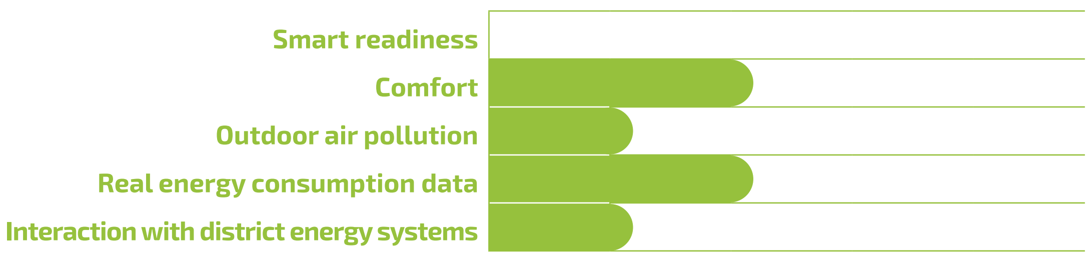
This chapter highlights the status of how the 10 features are being implemented across Europe.

8.1 Innovative use of EPC indicators

The EPC typically comprises an energy efficiency label indicating the energy performance level of the building, general information about the building (age, climate etc.) together with recommendations on how to improve the building's performance. The EPC indicators are already a powerful tool in some countries where the certificate is embedded within and recognised by the real estate market.[13] Despite the obvious potential, the introduction of new indicators has been limited.

Figure 20 displays our assessment of the current status of X-tendo's five innovative EPC indicators. An empty scale suggests that the indicator is still far from broad implementation, while a full scale indicates that the indicator is already being implemented in a number of Member States. While none of the indicators has penetrated the EPC market in a significant way, comfort shows the most progress as it's covered in many private building certifications (WELL, BREEAM etc.). The smart readiness indicator is still being developed by the EU and has not yet been launched in any market.

Figure 20 - Current status of X-tendo's EPC indicators



[13] See for example this Zebra 2020 compilation

8.1.1 Smart readiness

The goal of the indicator is to provide a common methodology to assess the capacity of a building to use information and communication technologies and electronic systems to adapt its operation to the needs of the occupants and the grid and to improve its energy efficiency and overall performance [18]. The amended EPBD [2018/844] formalised the need for a common EU scheme for rating the smart readiness of buildings (i.e. the "smart readiness indicator"). The methodology is still under development and no real examples exist in the EU.

8.1.2 Comfort

There are many existing building rating and assessment systems (e.g. WELL and active house) around the world that integrate comfort of occupants as an important aspect. Increased comfort tends to be a more important factor for occupants than energy savings [19] and could therefore be a potent renovation trigger. None of the Member States has included a comfort assessment as a part of its EPC calculation methodology.

Case study: Greek comfort

While comfort is one of the shortcomings identified in the Greek EPC, their template features a dedicated area for comfort and other indoor environmental quality parameters (e.g. thermal comfort, acoustics, lighting and air quality). Specifically, for thermal comfort, set points for indoor temperature and values for fresh air needs are set in the official software tool, varying by building type. The provided information only consists of a tick-box based on the subjective evaluation of the EPC expert.

The evaluation is based on the registered equipment, visible operational condition, and an interview with the occupant. The 'comfort' feature is not taken into account in the calculation methodology for the energy performance of the building [8].

INCREASED COMFORT TENDS TO BE A MORE IMPORTANT FACTOR FOR OCCUPANTS THAN ENERGY SAVINGS AND COULD THEREFORE BE A POTENT RENOVATION TRIGGER

8.1.3 Real energy consumption

The integration of real energy consumption data in EPCs can provide added value to the existing energy performance evaluation methods or can even serve as the basis for alternative evaluation methods, referred to as operational rating. The measured energy consumption can be obtained from energy bills, energy meter readings or building energy monitoring systems. These include in various levels of detail in terms of time resolution, subsystem measurement locations and monitoring parameters. Data from smart meters can be complemented by data on other parameters such as geometrical building characteristics and weather conditions obtained from various sources e.g. online databases or IoT devices [20].

At least three Member States use measured energy consumption as one of their EPC methodologies (see chapter 4):

- **Sweden:** the approach is part of a mandatory EPC assessment scheme, though verification by theoretical calculation is also possible [13].
- **UK:** energy performance rating based on measured energy consumption is mandatory for public buildings and can be commissioned for non-public buildings on a voluntary basis [8].
- **Flanders, Belgium:** the procedure based on measured energy consumption is mandatory for existing larger public buildings. The EPC based on measured energy consumption needs to be displayed on a publicly accessible and visible location in the building [8].

8.1.4 Outdoor air pollution

Air pollution is a key determinant for wellbeing and long-term health. Although important for many potential buyers of a property, air pollution is not covered by any EPC. The available information (e.g. nearby industries and energy need and source) makes it technically feasible to calculate the air pollution on a district level.

8.1.5 Interaction with the district energy system

Basic information on the district heating system is included in some EPCs. However, the information included, if any, is too generic to prompt any real benefits. No information is included on the building's suitability for district heating, such as the flow and return temperatures of the heat distribution system in the building.

- **Salzburg, Austria:** The region is planning to integrate the distance between the building and the existing district heating grid in one of the certified EPC software programs [8].
- **Netherlands:** There is a way to account for regional measures such as district heating/cooling and domestic hot water on a collective scale (outside the building), large-scale solar and wind energy (through NEN 7125 (2017) and addendum A1 to NEN 7120 (general EPC determination method)). The use of waste heat, combined heat and power, biogas or biofuels can also be accounted for [8].
- **Romania:** The EPC has a mandatory annex where the types, age and size of different installations/equipment are mentioned, including the connection to the district heating network and the presence of a calibrated meter [8].

8.2 Innovative use of EPC data

Several Member States do already use their EPC and related data in innovative ways. Figure 21 shows our assessment of the current status of X-tendo's five innovative EPC data usages (full green: feature has already been widely explored; no green: not explored at all). While most Member States use their EPC database to do automatic checks for compliance and detect mistakes (see chapter 4), some countries are also exploring links to building logbooks (Flanders and Portugal), tailored recommendations (Germany and Flanders), and integration of financial options (Denmark and Scotland). Portugal is currently exploring the possibility to link its EPC regime with a public one-stopshop.

Figure 21 - Current status of X-tendo's EPC data

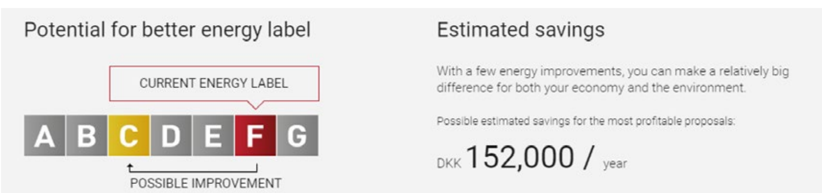
8.2.1 EPC databases

EPC databases offer opportunities to leverage the instrument's impact and perceived usefulness. Some Member States (e.g. Bulgaria, Germany, Greece, Finland) have EPC registers that store the input data used to calculate the EPC result, while others (e.g. Denmark, Estonia, Ireland, Netherlands, Portugal) have made the data publicly available [4]. Denmark made its database public in 1997 and the breadth, quality and accessibility of the Danish EPC database set an example to other countries and regions [4]. These more advanced national registers also allow for improved quality control of EPCs, as well as statistical analyses of the building stock. EPC databases can also be a useful source of information for analysis and independent research and policy development.

Case study: Denmark's innovative EPC database

Denmark has two advanced registries: one for EPC information and one building registry. All EPCs are registered in a publicly available database managed by the Danish Energy Agency (DEA). The database features the data inserted by the EPC expert, as well as the accompanying report for the building owner. This information includes the complete EPC information and other public information such as property and land value. More extensive data and a property data report with additional information (e.g. water supply and soil contamination) is available but access must be requested and granted by DEA [21].

By inserting an address, the user can retrieve information on the current status of the building (EPC grade, energy source and estimated consumption), suggested renovation measures and linked savings (as shown below).



8.2.2 Building logbooks

Logbooks have been recognised and developed in some countries as a way to engage building owners and maximise the value of EPC data for them. The X-tendo project will identify how EPC registers and systems can support the development of logbooks.

A digital building logbook is a new idea/concept that has gained some attention in the EU[14] and in several of its Member States[15]. A logbook is typically described as a digital repository where all building-related information (e.g. ownership, building design, materials used, structures, installations, systems, adaptations, investment, operational and maintenance costs, health and safety, performance indicators, certifications) can be compiled and updated when necessary. Compiling and streamlining the use of data could influence the effectiveness of policies, simplify administrative procedures and contribute to a stronger link between the buildings energy performance and its value.

Building logbooks are considered a highly promising tool to boost the availability of information to a broad range of market participants such as owners, real estate companies and facility managers, among others. Better information flows are a necessary part of improving the quality assurance system for buildings and the construction industry overall. Logbooks have been recognised – and developed in some EU countries - as a way to engage building owners and stakeholders to maximise the value and accessibility of EPC data. Projects such as iBRoad and ALDREN have explored the potential benefits of building logbooks across the EU. Countries like Belgium (Flanders) plan to fully develop building logbooks as part of a "building renovation passport", while France include a digital logbook for building monitoring and maintenance as part of its EPC system [6].

Case study: The Flemish Woningpas is leading the way

The Flemish Energy Agency (VEA), in cooperation with a wide network of stakeholders, designed and implemented the "Renovation Pact" (2014-2018) with the aim to improve the region's building stock. Flanders (Belgium) established that by 2050 the existing building stock should become as energy efficient as the current requirements for new buildings (E608). One of the main actions launched in the Renovation Pact is to develop the Woningpas, a logbook, as well as the EPC+, which is a more user-friendly version of the EPC, including a clear overview of measures, ordered by priority, needed to reach the 2050 objective.

The Woningpas is a unique integral digital file of each individual building. The file can be retrieved by the building owner and by individuals who have been granted access. The logbook features energy performance, renovation advice, the housing quality (such as stability, humidity, safety) and data on the environment. In the future other building aspects such as durability, water, installations and building permits will be included. The Woningpas makes it possible to track the evolution of each individual building. The first version of the instrument was launched in 2018.

[14] The European Commission has commission a study on "digital building logbooks" delegated by Executive Agency for Small and Medium-sized Enterprises (EASME). Two X-tendo partners, BPIE and VITO, are involved in the technical group that is carrying out this study in 2020.

[15] Flanders (Belgium), Portugal and regional developments in France have developed digital registries which could be described as building logbooks, with Flanders being the most advanced example. Denmark and Ireland have very advanced EPC registries, with innovative aspects that mirrors the one of a digital building logbook.

8.2.3 Tailored recommendations

Cost and time constraints often result in EPCs containing poorly tailored recommendations. Cost-effective approaches to deliver tailored renovation recommendations, in particular in the form of individual building renovation passports,[16] can help to overcome this barrier [6].

Individual renovation recommendations are being provided for domestic buildings and commercial establishments in countries including the UK, Austria and Denmark as additional advice accompanying the EPC reports. In most cases, standardised recommendations are provided to reduce the cost of a customised approach.[17] However, tailored recommendations are being focused more on new initiatives related to building renovation passports [7]. In Germany, energy advisors already provide tailored information to property owners in the form of renovation roadmaps.[18]

Case study: German renovation roadmap is tailoring long-term renovation advice

The German individueller Sanierungsfahrplan (iSFP) is a renovation roadmap for individual buildings, designed as an energy audit instrument and carried out by certified energy auditors. The iSFP has been designed to be a user-friendly tool that includes both short- and long-term renovation measures and suggests ways to avoid lock-in effects. This is important, as about 85% of the energy renovation measures funded in Germany concern only one building component; the iSFP puts a strong focus on staged renovation and the interdependences between the stages. The iSFP features an eight-page summary and a detailed booklet with a description of all the measures and renovation packages, including, if necessary, photos, sketches, graphics and further information relevant for tradespeople or planners. While the iSFP has been developed outside the German EPC regime, several Member States (e.g. Ireland, France, Flanders in Belgium) see a renovation roadmap as a natural evolution of the EPC.

Figure 22 - iSFP outlining a staged deep renovation approach

[16] Buildings Performance Institute Europe (BPIE), Building Renovation Passports: Customised roadmaps towards deep renovation and better homes. 2016.

[17] Concerted Action EPBD. Implementing the Energy Performance of Buildings Directive (EPBD)—Part A; ADENE: Lisbon, Portugal, 2016.

[18] www.bmwi.de/Redaktion/EN/Artikel/Energy/energy-efficiency-strategy-for-buildings.html

8.2.4 EPCs and financing options

Survey results show that users want to see links to potential financial options in the EPC [19]. Information on financial support alongside the EPC recommendations can help persuade building users to undertake energy saving measures. The impact would be even stronger if the hassle of applying for a renovation loan was reduced by including an automatic link to financial support schemes.

New technologies, and improved data gathering, enable new possibilities. The EPC could inform the building owner of financing options (e.g. green loans, incentives, tax credits etc.), while a database could enable a "hassle-free" application process [6]. Linking EPCs more closely to financing options is relevant from at least two perspectives:

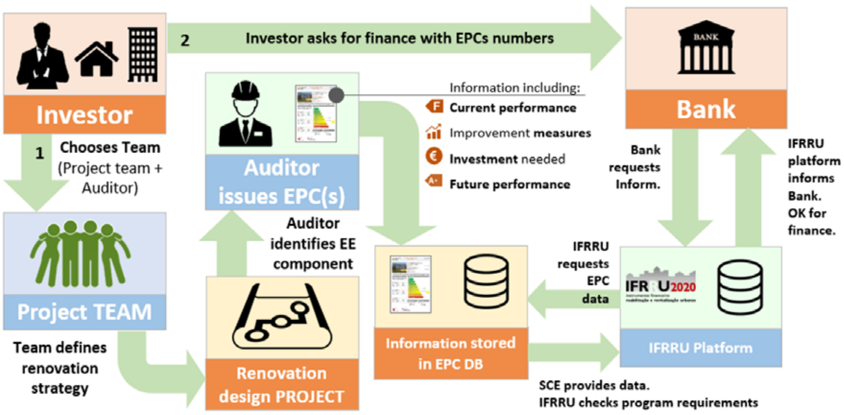
1. Providing information to homeowners on financing options, cost transparency and payback times
2. Providing relevant information to financial institutions about the quality of the underlying building (i.e. asset) [20].

Several countries (e.g. Bulgaria, Portugal, Scotland) use the EPC as a loan prerequisite. Scottish homeowners can, for example, access an interest-free loan for energy improvements if they apply for improvements recommended in 'an acceptable energy report', one of which is an EPC. In addition, there is a requirement that a post-improvement EPC is provided for all homes which benefit from the loans, to show how the home's energy performance has improved. Another example is the JESSICA programme[19] in Lithuania, which offered low-interest loans, over 10 and 20 years, on the condition that the building owner provided "proof through EPC information that the renovated property had reached at least energy class C" [22].

Case study: Portugal's EPC is integral to its financial instruments

EPCs in Portugal support national policies through financial instruments such as Urban Rehabilitation as an Instrument for the Revitalization of Cities (IFRRU 2020), The Energy Efficiency Fund (FEE), Portugal 2020 and the Operational Programme for Sustainability and Efficient Use of Resources (POSEUR).

Figure 23 - The EPC is used to check conformity with programme requirements, investments needed and potential energy savings, and inform financial institutions.



19 A joint financial instrument of the European Investment Bank (EIB) and the European Commission that made use of the European Regional Development Fund (ERDF).

8.2.5 Linking EPCs to one-stop-shops

One-stop-shops provide comprehensive information to home and property owners on renovation packages, benefits, support schemes, technical solutions, craftspeople etc. They are seen as a key means to reduce barriers and transaction costs [23]. These functionalities could and should also be linked to EPCs.

Energy efficiency renovations are notoriously complex undertakings, which is also the main reason why homeowners are reluctant to adopt cost-effective improvement measures. By reaching out to the entire renovation value-chain, one-stop-shops can overcome market fragmentation on both the demand and the supply side.

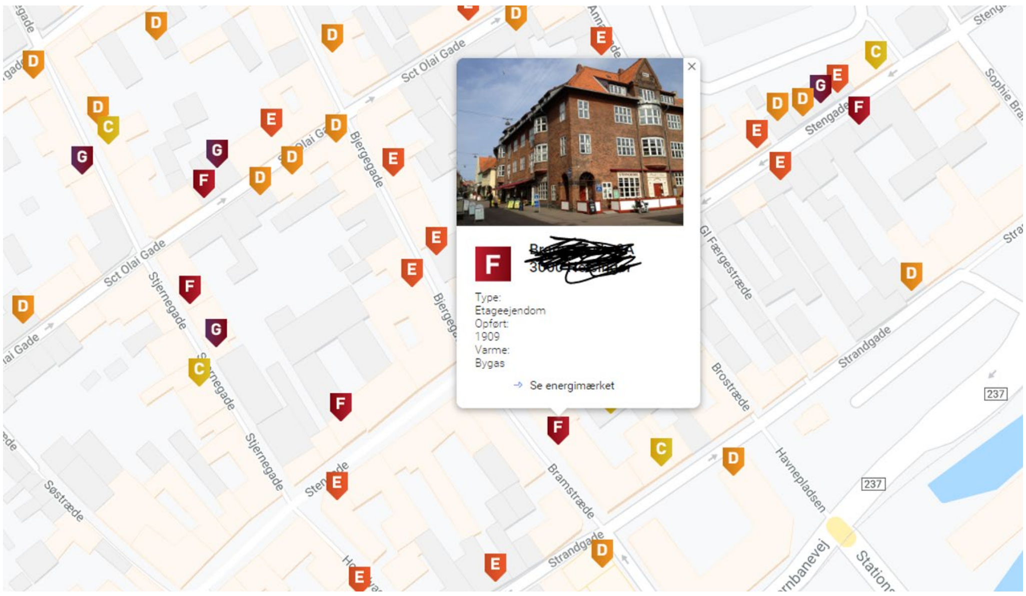
Many one-stop-shops already use EPC data in their business models [24] but much of the potential is still untapped. One-stop-shops need good information to find the right target group and to offer them a convincing product. In addition, post-renovation quality assurance is an essential, yet tricky, step for many of these business models. The EPC regimes could help by providing this information but, with a couple of exceptions, they currently don't.

Case study: Danish data availability is enabling one-stop-shops

BedreBolig is a publicly governed one-stop-shop in Denmark which guides building owners through the renovation process. Visitors are provided with a wide range of helpful information and guidance. The building owner can find their own energy label on the website, and compare variables, such as energy efficiency and costs, with neighbours. The map below shows the Danish city of Elsinore. All the energy labels are publicly available and the user will receive the full report by clicking on the specific building/label.

Better use of data can enable more accurate policies and measures, and faster progress in building techniques and innovation. Available and comparable building data, enabled by modern techniques, can increase awareness and demand for energy saving measures.

Figure 24 - Danish EPC map *(Source: Bedrebolig)*



Case study: EPCs supporting advice provision in Scotland

The Energy Saving Trust administers the Home Energy Scotland (HES) programme on behalf of the Scottish government. HES is a comprehensive advice service offering help and support and a 'single point of contact' for all households in Scotland, particularly people struggling with energy bills. It provides free, impartial advice on energy saving, renewable energy, sustainable transport and waste prevention. In 2016-17 for example, HES handled 300,000 telephone and face-to-face advice interactions, equivalent to 6%1 of Scotland's population. The HES advisors are able to access each caller's EPC and talk through the recommendations.

Using the EPC database to plan retrofit programmes and strategies

Building from the EPC data, the Energy Saving Trust has developed Home Analytics, which provides address-level data on the energy performance of Scottish homes. Critically, by using statistical modelling techniques, Home Analytics is able to present a view of the energy performance of even those Scottish homes that do not yet have an EPC. And by linking to census and other datasets, Home Analytics includes data on likely household characteristics (e.g. likelihood of being on a low income). An online GIS (mapping) portal makes it possible to visualise data.

8.2.6 EPCs as a tool to support the long-term decarbonisation of the building stock

The EPC is one of the EU's main existing instruments to facilitate the decarbonisation of the building stock, though only a few countries are fully exploring its potential. Scotland (like England and Wales) is using the EPC to set minimum energy efficiency standards for existing buildings, while Portugal is integrating the EPC in a number of policies and instruments.

EPCs are enabling minimum energy efficiency standards in Scotland

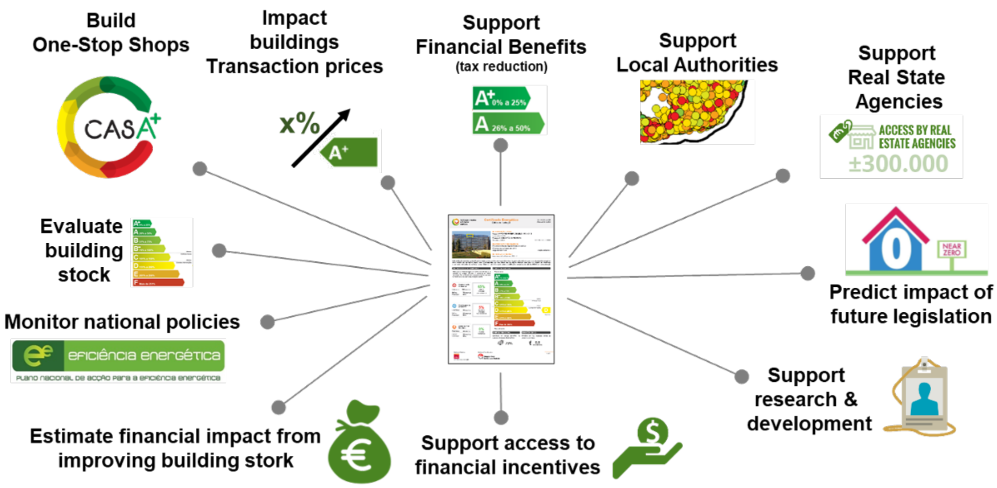
In Scotland, EPCs are used to set the policy language around energy performance in domestic buildings. The Scottish government plans to introduce regulations that all homes from 2020 should meet an EPC "E" standard before they can be rented out, and by 2022 this standard will rise to D. The government is also currently consulting on a minimum C standard that homeowners will need to meet before they can sell their home from 202420 (in all cases exemptions will apply where it is very expensive, technically difficult or undesirable to meet the C standard). The aim is that all homes should achieve at least an EPC C standard by 2040, where technically feasible and cost-effective.

[20] https://t.co/CMw7JfDSM2?amp=1

Portugal's innovative use of EPCs beyond energy declaration

The broader use of EPCs and their information includes supporting local authorities, real estate agencies and research activities. The EPC also gives homeowners access to public grants and low-interest loans. In addition, the EPC is used to monitor and evaluate policies and to develop more impactful future policies. Figure 256 illustrates some of the functions the EPC enables.

Figure 25 - The role of EPC beside the information *(Source: ADENE)*



9 CONCLUSIONS

EPCs vary from country to country due to the different starting points, diverse political and legal contexts, the maturity of different real estate markets, as well as the resources and capacity dedicated to the regime. The design, quality control and cost are other crucial factors that differ between Member States. A common theme is the (perceived) low reliability of EPCs, which hampers many of the potential benefits. While many of the weaknesses persist, this review also shows that some countries and regions are taking steps to develop their EPC and expand its functionalities.

This review has identified some important gaps where the X-tendo project can contribute:

- In all Member States, EPCs must become more transparent and reliable in order to build trust. Frontrunner countries (e.g. Denmark and Portugal) have proven that it is possible to build considerable trust around the EPCs, yet no Member State is perfect in this regard. Without trust, few additional benefits can be reaped.
- The current EPCs have not been tailored to the needs of the end-user. Displaying only the energy performance of the building brings limited benefits to most people, especially when the content is conveyed in technical terms. New EPC indicators could enhance the usefulness and attractiveness of the instrument.
- The introduction of EPCs can be described as a reaction to the information deficit that exists around building performance and the potential of energy renovations. Not using them to tackle the possibly even larger information deficit on indoor environmental quality (air pollution levels, comfort etc.) is a missed opportunity.
- Most Member States are missing the opportunity to make the EPC a more dynamic tool. Flanders and Portugal have started to explore the benefits of having an elaborate EPC database and building logbook. With a dynamic EPC database, it is possible to make links to third parties (such as financial institutions, real estate agencies and contractors) and by doing so enable better renovation packages for end-users.
- A well-functioning EPC regime, accompanied by an EPC database, provides a ready-to-use source of information on the building stock. There is an increasing number of good practices across Europe that demonstrate the added value of EPC data for policymaking (e.g. to inform relevant renovation strategies) and monitoring, as well as market and research analysis.
- Until now (as of early 2020), no Member States have taken steps to use their EPC regime to facilitate the uptake of smart buildings. An EPC that integrates new indicators like real energy consumption could strengthen the role of buildings in the energy system by supporting additional services, including demand response and dynamic pricing.
- A more harmonised European calculation methodology for the EPC could increase comparability between regions, confidence and market uptake. A common standard or guidance document would create synergies across the EU.

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[25] J. Zirngibl and J. Bendžalová, "Technical assessment of national/regional calculation methodologies for the energy performance of buildings," European Commission, 2015.

ANNEX
A SAMPLE OF EPC DATABASES

- **Bulgaria**
  https://www.seea.government.bg/bg/
- **Denmark**
  https://sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke
- **England and Wales, the UK**
  https://epc.opendatacommunities.org/login and https://www.epcregister.com/searchReport.html
- **Emilia Romagna, Italy**
  https://www.casaeclima.com/ar_23499__ITALIA-Regioni-ape-certificazione-energetica-emilia-romagna-LEmilia-R.-pubblica-il-report-sulla-certificazione-energetica.html
- **Finland**
  http://www.energiatodistukset.fi/
- **Flanders, Belgium**
  https://www.energiesparen.be/energiestatistieken-bestaande-gebouwen-in-vlaanderen
- **France**
  http://www.observatoire-dpe.fr/index.php/statistique
- **Greece**
  http://bpes.ypeka.gr/
- **Hungary**
  https://entan.e-epites.hu/?stat_megoszlas
- **Ireland**
  https://ndber.seai.ie/pass/ber/search.aspx
- **Italy**
  https://www.efficienzaenergetica.enea.it/vi-segnaliamo/disponibile-online-una-nuova-versione-di-docet-il-software-gratuito-per-la-certificazione-energetica-degli-edifici-residenziali.html
- **Lithuania**
  https://www.spsc.lt/cms/index.php?option=com_wrapper&view=wrapper&Itemid=288&lang=en
- **The Netherlands**
  https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/hulpmiddelen-tools-en-inspiratie-gebouwen/ep-online
- **Northern Ireland, the UK**
  https://www.epbniregister.com/reportSearchAddressByPostcode.html
- **Portugal**
  https://www.sce.pt/
- **Scotland, the UK**
  https://www.scottishepcregister.org.uk/
- **Slovakia**
  http://www.inforeg.sk/ec/
- **Spain**
  https://energia.gob.es/desarrollo/EficienciaEnergetica/CertificacionEnergetica/Documentos/Documentos%20informativos/informe-seguimiento-certificacion-energetica.pdf
- **Sweden**
  https://www.boverket.se/sv/energideklaration/energideklaration/bakgrund/statistik-om-energideklaration/

X-tendo

www.x-tendo.eu

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