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EPBD.wise

Bringing European Building Policy to Life

Energy Performance Certificates

Policy needs and best practices

Authors: Cátia Carvalho, João Cleto, Claúdia Monteiro, Joana Fernandes and Rui Fragoso (ADENE)
Reviewers: Denisa Diaconu, Jules Oriol and Caroline Milne (BPIE), Susanne Geissler and Bettina Sticher (SERA Global)

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About EPBD.wise

EPBD.wise aims to kickstart action to bring to life the recast European Performance of Buildings Directive (EPBD) as part of making EU climate goals a reality. Over the course of three years, project partners worked with public authorities (such as municipalities, energy agencies, etc.) in six European countries: Bulgaria, Greece, Hungary, Poland, Romania and Ukraine. The aim overarching aim was to ensure the design, implementation and evaluation of key provisions to ensure EU buildings align with climate goals. Starting with investigation of needs and good practices in the six focus countries, EPBD.wise builds replicable models to support the widespread implementation of effective measures across Europe.

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Executive summary

The EPBD.wise project supports six Member States (MS) in implementing instruments embedded in the Energy Performance of Buildings Directive (EPBD): zero-emission buildings (ZEBs), National Building Renovation Plans (NBRP); minimum energy performance standards (MEPS); renovation passport (RPs), and energy performance certificates (EPCs). It aims to ensure alignment with Fitfor55 and EU strategies and to create replicable models for implementing European Union (EU) legislation. The project analyses national examples, provides technical advice, and develops tailored policy packages, including guidelines for policy design and effectiveness measurement. It also fosters stakeholder engagement through policy forums and exchanges, sharing results via EU-level workshops for adaptation across the EU-27.

This Deliverable investigates policy needs and good practices related to EPCs in six European countries (Bulgaria, Greece, Hungary, Poland, Romania and Ukraine), aligning with the recent recast of the EPBD. The analysis focuses on four countries (Bulgaria, Greece, Hungary and Poland) that identified EPCs as a high priority for policy guidance. The analysis considers findings from the latest Concerted Action on the EPBD V (CA EPBD V), reports, scientific papers and European projects. Good practice examples extracted from these sources are examined for their potential to address the policy needs identified while considering requirements and opportunities presented by the EPBD recast, Directive (EU) 2024/1275.

Key policy needs identified include improving EPC database management through standardised data formats and accessible databases. Additionally, robust quality control measures are essential to ensure the accuracy and reliability of EPCs. Training programmes for assessors and verification mechanisms are crucial to achieving this. In turn, communication and public awareness campaigns are necessary to improve stakeholder understanding of the value of EPCs. Finally, integrating EPCs with other energy efficiency initiatives, such as RPs, can provide a more comprehensive approach to improving building energy performance. Solutions for these aspects will be developed in the further steps of the project.

This report also examines good practices from across the EU, providing valuable insights into addressing identified policy needs. For example, the Portuguese Quality Assessment System demonstrates ways to maintain EPC quality through rigorous verification processes. Sweden's EPCs Expert Training Programme underscores the importance of ensuring assessor expertise through stringent requirements. The Home Energy Scotland (HES) one-stop shops (OSS) serve as a comprehensive resource for homeowners seeking to improve home energy efficiency, offering tailored advice, financial incentives, and access to energy-efficient technologies to empower homeowners and promote energy-saving measures. Effective policy guidelines should also incorporate communication strategies to enhance public understanding and promote stakeholder engagement. A multipurpose approach to EPCs that provides diverse information for stakeholders and banks, along with financial incentives, can be highly effective. Resources that seamlessly address diverse policy needs, such as the X-tendo Toolbox, are valuable assets for policymakers.

This Deliverable is an essential step in the project, laying the foundational knowledge and strategic framework necessary for developing tailored, actionable policy recommendations in the next phases. By addressing the multifaceted challenges linked to decarbonising the building sector, from data collection to stakeholder engagement and financial structuring, this Deliverable aims to encourage robust, sustainable and inclusive policies that will drive significant improvements in the energy performance of buildings. By identifying and acknowledging existing policy needs, it sets the stage for developing effective policy guidelines that will support the successful implementation of the recast EPBD and help achieve ambitious energy efficiency targets across the European Union.

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List of abbreviations and acronyms

ADENE	Portuguese Energy Agency
CA EPBD	Concerted Action on the Energy Performance of Buildings Directive
DGEG	Directorate General for Energy and Geology
EPB	Energy Performance of buildings
EPBD	Energy Performance of Buildings Directive
EPC	energy performance Certificate
EU	European Union
GHG	greenhouse gas
GWP	global warming potential
HES	Home Energy Scotland
HVAC	heating, ventilation and air conditioning
IAQ	indoor air quality
IEQ	indoor environment quality
LCA	life-cycle assessment
LCC	life-cycle costing
LTRS	Long-Term Renovation Strategies
MEPS	minimum energy performance standards
MS	Member State
NBRP	National Building Renovation Plan
nZEB	nearly zero-energy building
OÉNY	national building registry (Hungary)
OSS	one-stop shops
R&D	research and development
RP	renovation passport
SEAI	Sustainable Energy Authority of Ireland
SRI	smart readiness indicator
WP	work package
WPB	worst-performing building
ZEB	zero-emission building

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1 Introduction

1.1 Scope and objectives of the Deliverable

This Deliverable dives into energy performance certificates (EPCs) within the focus countries (FCs) selected in the EPBD.wise project: Bulgaria, Greece, Hungary, Poland, Romania and Ukraine. It will identify specific policy needs for each country and analyse current EPC implementation cases, including best practices across EU MS. This analysis will inform future actions of the EPBD.wise project.

1.2 Structure of the Deliverable

The Deliverable focuses on addressing policy needs related to EPCs in each of the chosen countries. The methods and procedures to be used are explicitly outlined in the next chapter. Additionally, a set of good practice examples is provided to guide these countries in understanding the best strategy to tackle challenges related to EPCs. These examples of good practices are elaborated in detail in Annex 4: Good practices.

1.3 Relations to other tasks and deliverables

Methods and procedures have been jointly developed across the EPBD.wise project, namely ZEB and NBRP (WP2); MEPS (WP3); RPs (WP4); and EPCs (WP5).

2 Methods and procedures

2.1 Compilation and review of challenges and policy needs

The process of compiling and reviewing challenges and policy needs regarding EPCs involves drawing insights from various sources. Insights from previous EU projects, national initiatives, direct engagement with stakeholders, and a thorough review of pertinent literature form the foundation of this effort. Methods used include:

- **Desk research:** A comprehensive examination of existing literature, reports, and studies related to EPCs provides valuable insights into the prevailing challenges and policy needs.
- **Stakeholder interviews:** Engaging with stakeholders at national levels enables a deeper understanding of the specific challenges faced in each country regarding EPC implementation.
- **Workshops:** Collaborative workshops facilitate dialogue among experts, policymakers, and stakeholders, fostering the exchange of ideas and identification of key challenges and policy requirements.

While the primary focus of this report is on the six designated focus countries (FCs), it is imperative to consider broader implications across the EU. The compilation and analysis of policy needs thus extend beyond these FCs, ensuring a comprehensive understanding with potential applicability across all MS.

2.2 Survey of policy needs in focus countries

Questionnaires were distributed to the six FCs selected in the EPBD.wise project (Bulgaria, Greece, Hungary, Poland, Romania and Ukraine) to identify their most pressing needs regarding EPCs. The questionnaires, which can be found in Annex 2: Questionnaire to Focus Countries, allowed respondents to select the most important topics for further development in the EPBD.wise project. These topics were explored in more detail in a subsequent questionnaire. Results of both questionnaires were used to identify policy needs.

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2.3 Definition of good practice

2.3.1 General criteria

In general, good practice examples respond to several challenges. These include: poor governance due to insufficient collaboration among different levels of government; staff shortages in public administrations; and data-related issues such as availability and quality. In the construction industry, labour and skill shortages, along with fragmented supply chains, hinder workforce capacity and investment. Building owners need access to financing and technical assistance, while building occupants are burdened by high energy prices. Financial institutions are increasingly involved in funding renovations, supported by a clear and transparent EPBD implementation. These challenges are relevant for WP2 through WP5 and have been further developed to a set or criteria which is used to define good practice as shown in Table 1.

Good practice examples can provide a solution and/or a response to one or more criteria.

Table 1 Criteria for selection of good practice examples on EPCs

Criteria	EPC good practice examples
Good governance	
Collaboration among regional, federal and municipal levels (vertical and horizontal) to tap the full potential of available data	Unique number of identification (PT[1]); National Statistics (INE[2], PT)
Stakeholder participation, including civil society: know-how is available and being used in the policy process	EPC certification database (SCE[3], PT), CINERGIA (PT)
Staff shortages in public administration	
Overcoming the lack of staff capacity by means of tools	
Raising awareness of the need for personnel resources	
Data availability, accessibility, and quality for effective policymaking	
Data quality assurance: input data (reduce range of interpretation); calculation method (reduce range of interpretation)	
Data availability and access for understanding potential impacts of policies and different design options	iBRoad2EPC project
Data availability and access for monitoring progress in the building stock and evaluating policy impact	Long-Term Renovation Strategy (PT); iBRoad2EPC project
Estimation of the impacts, in particular the broader benefits of energy efficiency	
The complex interplay among different instruments, effects and measures is considered for assessing the impacts of policy instruments addressing the energy performance of the building stock	Long-Term Renovation Strategy (PT)
Other benefits, such as comfort, health and economic implications, are explicitly considered in the decision-making processes of target setting	Long-Term Renovation Strategy (PT)
Construction industry and labour and skill shortages	

[1] Portuguese
[2] National Institute of Statistics
[3] Portuguese Energy Certification System

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Regulatory framework, e.g. for certified installers	Classe+ (PT); casA+ (PT)
Investments in workforce capacity and upskilling	ACADEMIA ADENE (PT), Energy Transition Training Centre (PT)
Addressing fragmented supply chains in the construction sector	Classe+ (PT)
Reducing training needs through technology development	
Clear presentation of co-benefits	
Improved indoor environment and health, and better quality of life	Reliable project (PT), Long-Term Renovation Strategy (PT); SMARTER4EU project;
Shelter citizens from energy price hikes	Social energy tariff (PT)
Reduced energy poverty	Energy Poverty Index (CENSE, PT), SMARTER4EU project; Long-Term Strategy to combat Energy Poverty (PT)
Financing	
EU-Taxonomy alignment: target of major renovation	SMARTER4EU project;
OSS	casA+ (PT), Porto Energy Hub (PT), Energy Citizen Space (ELPPE, PT); Transition Point (PT)
Covering the upfront costs for developing a renovation project (technical assistance)	Environmental Fund – Efficiency Bonus (RRP, PT); 1st Right – Housing Support Program (PT)
Financing the investment cost of renovation measures	IFFRU2020 (PT), Environmental Fund – More Sustainable buildings program (RRP, PT), Environmental Fund – Energy Efficiency in Central Public Administration Buildings (RRP, PT); Environmental Fund – Support program for Multifamily Buildings (RRP, PT); Environmental Fund - Support to Renovation and Energy Performance of Services Buildings (RRP, PT)

In addition to the generally relevant challenges, specific aspects are important for ZEB and NBRP (WP2), MEPS (WP3), RPs (WP4) and EPCs (WP5), which differ depending on the WP.

2.3.2 Template for good practice description

Based on the good practice definition provided in the previous chapter, the EPBD.wise project developed a template for the documentation of good practice examples. The template is available in Annex 3: Template for good practice description. Good practice documents are also available as separate Annexes, enabling flexible use of good practice examples in discussions and for target-group oriented dissemination. Most examples were documented by the project team members; some were elaborated by other organisations interested in using the EPBD.wise good practice examples as dissemination

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material. With these purposes in mind, individual templates per case study are easier to use than one single, extensive document. The template was developed in such a way that, depending on the progress of the project and the number and quality of good practice examples, descriptions could be transferred to a database or documentation could even be carried out directly in a database. This makes it easier for stakeholders to find relevant examples for their work.

3 Energy performance certificates: status quo and criteria

The EPC is a crucial tool under the revised Directive (EU) 2024/1275 of the EPBD. This Directive, amending Directive 2010/31/EU, aims to enhance clarity and effectiveness in addressing current challenges in the context of ambitious climate targets, such as those set out in the Paris Agreement. The EU is committed to reducing greenhouse gas (GHG) emission by at least 55% below 1990 levels by 2030, supported by various other initiatives. The Renovation Wave Strategy, for example, seeks to double energy renovation rates and foster deep renovations in millions of buildings, promoting job growth and climate resilience. The European Climate Law (Regulation (EU) 2021/1119) solidifies the EU goal of achieving economy-wide climate neutrality by 2050. The Fit for 55 legislative packages, including the revised EPBD, integrates efforts across various policy areas to advance energy efficiency, renewable energy and reduction of fossil fuel dependency. Harmonising with other legislative proposals under Fit for 55 ensures coherence and synergy across EU policy domains. The new EPBD, Directive (EU) 2024/1275, strengthens the role of EPCs as a key tool for building energy assessment and transparency. These certificates will continue to express a building's energy performance through a numeric indicator of primary energy use. They will also reference crucial benchmarks, including minimum energy performance requirements, standards for nZEBs and ZEB requirements.

Introducing a clear and consistent A-to-G energy performance class labelling system across the EU is a cornerstone of the revised framework. This simplified scale allows building owners and potential occupants to make informed decisions. 'A' signifies ZEB, the most energy-efficient, while 'G' represents the very worst-performing buildings (WPBs) in the national building stock, as defined at the national level. MS can define a more stringent 'A+' class for buildings exceeding ZEB standards by at least 20% and generating additional renewable energy on-site. If MS choose to use it, 'A+' should be defined at the national level as a building with a maximum threshold for energy demand that is at least 20% lower than the maximum threshold for ZEB and which generates more renewable energy on-site annually than its total annual primary energy demand. For buildings undergoing renovations that achieve this 'A+' class, the EPC will include a life-cycle global warming potential (GWP) estimate, promoting transparency and life-cycle thinking.

The new EPBD, Directive (EU) 2024/1275, goes beyond simple information provision. It paves the way for action by seamlessly integrating with the concept of RPs, which empowers building owners with a roadmap for staged renovations that progressively improve the energy performance of a building. When a MS chooses to use RPs, these comprehensive documents will replace the recommendations traditionally included within EPCs.

To ensure the effectiveness of the recast EPC system, a robust six-step process exists for developing functional EPC schemes and inspection systems. At first, it is important to define the scope and objectives of the scheme, establishing its specific goals and the types of buildings it will encompass. Next, methodologies for calculating building energy performance are developed, ensuring consistent and accurate assessments across evaluations. Recognising the importance of qualified assessors, the process then defines minimum qualifications and accreditation procedures to guarantee the quality and reliability of their work.

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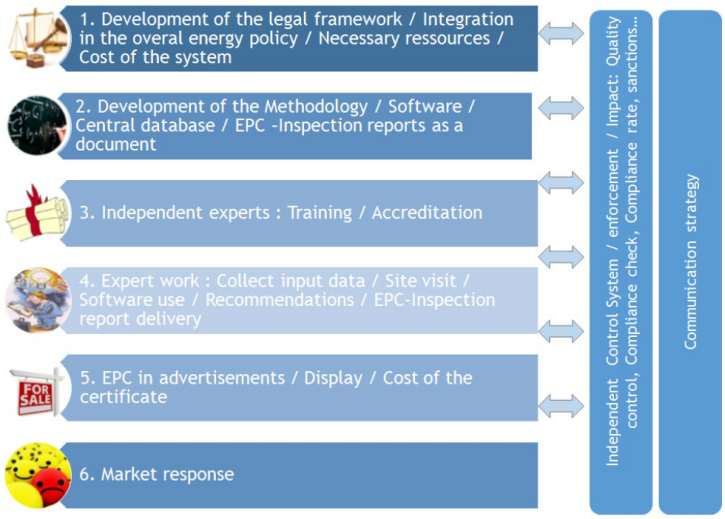
Regular inspections of heating, ventilation and air conditioning (HVAC) systems are crucial for maintaining optimal building energy efficiency. This step outlines the procedures for such inspections, ensuring these critical systems are rigorously evaluated. Following the establishment of these core elements, strategies for the practical implementation of the entire EPC scheme and inspection system are devised. Strong monitoring mechanisms are also integrated to track effectiveness and identify areas for improvement, ensuring the system remains dynamic and adaptable.

Effective communication strategies are crucial for raising public awareness about EPCs, their significance and benefits, and how they can empower building owners to make informed decisions. An independent control system and a well-defined communication strategy are also highlighted as central primary elements for the entire process, ensuring transparency and public trust in the EPC system.

Figure 1 Steps in the EPC and regular inspection scheme process[4]



1. [4]X. Loncour, N. Heijmans (2018), *Certification, Control system and Quality,* Concerted Action Energy Performance of Buildings, Copenhagen. Available: https://epbd-ca.eu/ca-outcomes/outcomes-2015-2018/book-2018/ct/certification-control-system-and-quality-update (Accessed on 06-11-2023)

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4 Policy needs and challenges of the new EPBD regarding implementing EPCs

In the following pages, specific attention is given to the six FCs selected in the EPBD.wise project: Bulgaria, Greece, Hungary, Poland, Romania and Ukraine. With replication to other MS in mind, the compilation and analysis of policy needs are not limited to only these FCs.

4.1 Policy needs and challenges of the new EPBD identified from desk research

The EPC is one of the EU's most relevant instruments to facilitate long-term decarbonisation of the building stock. To exploit its full potential, several challenges must be overcome, such as inadequate data gathering, lack of compliance, low or limited reliability, different definitions and calculation methods, low market penetration and end-user acceptance impacting the overall EPC perception [1]. Desk research was carried out to map the main policy needs and new challenges of implementing the new EPBD that MS may face when implementing EPC schemes. The results considered: outcomes from the latest CA EPBD V, which took place from 2018 to 2022 [2]; reports and scientific papers addressing this topic [1] [3] [4] [5] [6] [7]; a set of 13 European projects described in Annex 1: Survey of related projects, programmes, and initiatives; and the new EPBD, Directive (EU) 2024/1275 [8].

4.1.1 Policy needs

The most common policy needs identified include the following.

EPC quality control: Rigorous quality control processes in EPCs significantly enhance the accuracy of assessments. Challenges include assessors bypassing established procedures and limitations of random selection for verification. The current version of EPBD revision establishes that input data shall be verified with detailed information provided by the expert and on-site visits on at least 10% of the EPC sample.

- Addressing policy need: Develop harmonised quality control methods and minimum requirements for verification procedures across MS. Invest in tools and training for robust data validation.

Enforcement and/or penalties: Enforcement and penalties are sanctions that assessors can face when they perform poorly. MS recognise that regular EPC checks and cancellation of expert licenses are important to guarantee the EPC quality scheme, although they considered the effectiveness of sanctions one of the actions less implemented to improve the EPC quality scheme. Regarding the enforcement strategy, MS generally rely on two approaches: a) 'mechanisms in force' (e.g. independent control systems, complaints from owners, certified companies to issue EPCs, EPC inspection, information campaigns and training of experts); and b) 'sanctions' (e.g. fines, suspension/loss of accreditation, EPC rejection/cancelation, and publication of the list of charged companies).

- Addressing policy need: Standardise enforcement mechanisms and establish clear penalties for issuing inaccurate or low-quality EPCs.

Training and auditor capacity building: A relation exists between the good support provided to experts and the quality of assessment results. Generally, EPC experts must have an appropriate education background (e.g. architect, engineer, other) and a certain level of experience. They must also complete a training course and pass an examination to become a registered expert and be qualified to issue EPCs. In some MS, it is also mandatory to take regular training after becoming an independent expert.

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- Addressing policy need: Develop minimum training standards and mandatory certification programmes for EPC assessors across the EU. Ensure training programmes focus on best practices, compliance procedures and staying updated with evolving regulations.

EPC databases: Difficulties in the adoption of EPC databases among most of MS highlight the need for further standardisation to make EPC data consistent and benchmarkable across the EU. An EPC database provides a wealth of information that can be used for very different purposes, such as increasing knowledge of the existing building stock, supporting national renovation strategies or academic studies. It can also provide valuable insights for the financial sector or real estate agencies. The success of an EPC database comes from its use. Some MS indicated that different interoperability processes have been implemented and data are flowing from and into the EPC database. According to the revised EPBD, the EPC shall be available in a machine-readable format and MS should ensure a digital format of the EPC when this is issued or in existing public buildings.

- Addressing policy need: Develop and implement common data formats and exchange protocols for EPC databases. Encourage interoperability among national databases to facilitate EU-wide analysis of building energy performance.

Link to policy instruments (e.g. NECP, LTRS): By utilising a database, the EPCs become an important tool in understanding the energy performance of the national building stock. EPCs also play a crucial role in helping MS identify the WPBs. This information enables the development of strategies to promote cost-effective deep renovation of buildings. EPCs can, for instance, be linked to investment mobilisation and financial measures, allowing measurement of improvements before and after renovation.

- Addressing policy need: Develop clear guidelines and best practices for integrating EPC data into national renovation programmes and financial instruments. Establish mechanisms for using EPCs to target deep renovation efforts towards the WPBs in the national stock.

EPC perception and/or communication: Often, consumers show a low interest in the EPC, as they do not see it as a priority or do not understand it and its benefits in terms of energy savings. An EPC is the first tool for providing guidance to building owners or managers, offering a unique opportunity to raise awareness, improve perception and encourage action. The fact that EPCs are not sufficiently gaining the attention of building owners means their role as a communications tool needs to be improved so that they are noticed and used by building owners or managers. Apart from its presentation, it is important to focus on the public perception and what motivates requests for an EPC. This will help to evaluate communication campaigns promoting EPC use at national or regional levels. Making EPCs clearer, simpler and perhaps less costly could encourage more people to acquire one for their buildings and more likely to implement its recommendations.

- Addressing policy need: Implement public awareness campaigns and educational initiatives that explain the value of EPCs and encourage building owners to use them effectively. Develop clear, user-friendly EPC formats with targeted recommendations for building managers.

4.1.2 Policy challenges

As the new EPBD, Directive (EU) 2024/1275, will begin to be transposed and implemented, new challenges will arise that are transversal for all MS. Several are summarised below.

EPC rescaling: Currently, the use of different scales and formats hinders EPC comparability among different national schemes. Introducing a common scale of energy performance classes and a common template should ensure sufficient comparability. According to the new EPBD, the EPC shall specify the energy performance class of the building on a closed scale using only letters from A through G. The

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letter A shall correspond to ZEBs; the letter G to the WPBs [5] in the national building stock at the time the scale is introduced. This 'harmonisation' might be a challenge for some MS that may not have existing EPC schemes. Also, harmonising EPC scales involves navigating unique cultural, administrative and legal contexts. Some countries lack comprehensive data on building energy performance, making it difficult to develop a common scale that accurately reflects energy performance. MS can gradually phase in the new scale, provide technical assistance, and offer training and capacity-building programmes.

- Addressing this challenge: Educating stakeholders about the benefits of harmonisation and investing in robust data infrastructure will support accurate EPC assessments. Recognising that, due to unique circumstances, some MS may need flexibility in the transition process is also important.

Calculation methodologies: The EPC shall include the energy performance of the building expressed by a numeric indicator of primary (renewable and non-renewable) energy use in kWh/(m^2/y), and reference values such as minimum energy performance requirements, MEPS, and requirements for nZEBs and ZEBs. These elements will make it possible for owners or tenants of the entire building or building unit to compare and assess its energy performance.

- Addressing this challenge: MS should use a more standardised approach for energy performance of the building, expressed by a numeric indicator of primary energy use on the building energy performance assessment, allowing for better comparison across MS.

Introduction of MEPS: To drive improvements in energy efficiency, MEPS for non-residential buildings shall be established. These MEPS will be determined by setting maximum energy performance thresholds based on a comprehensive analysis of the existing non-residential building stock. This analysis will utilise all available information on building energy performance, supplemented by statistical sampling where necessary to ensure a representative picture of the stock. MS can set thresholds based on energy performance class and check compliance with EPCs.

- Addressing this challenge: Setting MEPS for non-residential buildings, based on national building stock data, directly addresses the need to incentivise energy efficiency improvements and phase out WPBs.

ZEBs and WPBs: MS shall set the maximum threshold for energy demand of a ZEB with a view to achieving at least the cost-optimal levels. The maximum threshold for energy demand of a ZEB shall be at least 10 % lower than the threshold for total primary energy use established at MS level for nZEBs. The letter A shall correspond to ZEBs. WPBs are classified within energy performance classes E, F and G. This designation is determined by a national approach, with the bottom 15% of each MS building stock being assigned this label.

- Addressing this challenge: Establishing minimum thresholds for ZEBs and defining WPBs (category G) addresses the need for clear benchmarks to promote highly efficient buildings and target renovations towards the most inefficient ones.

RPs and EPCs: RPs and EPCs can work together to assess a building's current performance and provide recommendations for improvement. To reduce costs, MS should allow these documents to be

[5] The scale assigns the letter G to the 15% WPB in the national building stock at the time of its introduction.

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drawn up jointly by the same expert and issued together. The RP could substitute the recommendations in the EPC.

- Addressing this challenge: Ambitious renovation targets are sometimes undermined by the lack of clear pathways for intervention priorities in the building stock and individual buildings. Exploring synergies between RPs and EPCs allow for a harmonised approach, based on specific building data and facilitates policy impact monitoring.

NBRPs based on EPCs: The national trajectory for the progressive renovation of the residential building stock shall refer to data on the national residential building stock, based, as appropriate, on statistical sampling and EPCs.

- Addressing this challenge: By mandating the use of EPC data for NBRPs, the new EPBD addresses the need for national renovation strategies to be informed by a comprehensive understanding of energy performance needs across the residential building stock.

EPC use in financing: Access to sufficient funding is crucial to meet the EU's 2030 and 2050 energy and climate targets. Such measures should include encouraging energy-efficient mortgages for certified energy-efficient building renovations and promoting investments for public bodies in an energy-efficient building stock (e.g. through public-private partnerships, energy performance contracts or reducing the perceived risk of the investments). Improvements achieved through building renovation can be checked by comparing the EPCs issued before and after.

- Addressing this challenge: Enforce the use of EPCs as a condition to access and monitor specific funding, namely for WPBs and vulnerable households.

OSS: Building-owners may want to renovate but are unsure what steps to take. Setting up schemes may help owners to make use of the renovation resources available on the EPC and/or the RP. OSS have been set up in some MS, bringing owners, experts and consultants together in the renovation process to achieve the aims of all parties. Importantly, overall simplification of the EPC process increased engagement. Many MS are committed to adopting some of these approaches – and others – to further develop their EPCs.

- Addressing this challenge: Develop and promote the implementation of OSS models for building renovations across the EU.

Integration of additional indicators: MS shall ensure that a life-cycle GWP is estimated and disclosed through the buildings' EPC. The EPC may include a 'yes/no' indication as to whether a smart readiness assessment was carried out and, when available, the value of the smart readiness indicator (SRI).

- Addressing this challenge: Standardise the inclusion and calculation of life-cycle GWPs and SRIs in EPCs across the EU.

Summary

Highlights of the challenges and opportunities for improving EPC schemes that must be addressed with support and guidance include the following:

- Rescaling of EPC labels and methodologies to redistribute the building stock along those scales.
- Introduction of MEPS based on EPC indicators, when applicable by MS, and the need to assure that all buildings have an EPC to check compliance with MEPS.
- The role of RPs and EPCs together and how can RPs expand EPC recommendations.
- ZEBs and NBRPs with targets based on the top EPC label and WPBs.
- Use of EPC in financing or the integration of additional indicators such as SRIs or GWPs.

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4.2 Policy needs identified from questionnaire to focus countries

To collect different policy needs from the FCs, EPBD.wise developed several questionnaires and carried out interviews. The first general questionnaire was carried out in all the six FCs, collecting a first round of responses in which FCs identified the matters on which they would like to receive support. The questions asked are presented in Annex 2: Questionnaire to Focus Countries, 1st general questionnaire – All Focus Countries. Four FCs (Greece, Bulgaria, Poland and Hungary) identified EPCs as their main interest to receive policy guidelines according to the policy needs identified. The second-round questionnaire posed more specific questions, allowing for a more exhaustive collection of information, which can be found in Annex 2: Questionnaire to Focus Countries. This section summarises the main results of the questionnaire, from all FCs considering the EPC topic.

4.2.1 Bulgaria

In Bulgaria, the legal framework governing EPCs includes provisions for both new and existing buildings. For new constructions, EPCs are typically derived from the energy efficiency design of the project, although exceptions exist. Conversely, EPCs for existing buildings require a comprehensive energy audit involving analysis of various parameters such as energy consumption, building structure, and systems. Subsequently, a complementary audit report is issued, with a summary forwarded to the Sustainable Energy Agency in Bulgaria. The calculation methodology uses a stochastic monthly model to assess the energy performance of all building types, including residential and non-residential structures. Bulgaria maintains an EPC database, aggregating data from public audit summaries available at the Sustainable Energy Agency.

Public perception of EPCs in Bulgaria generally considers the quality unsatisfactory, with frequent technical errors or erroneous acceptances aggravated by the absence of penalty mechanisms and limited quality control resources. Despite being mandatory for new buildings since 2009, EPCs have low acceptance rates for old residential buildings built before that date. They are more accepted for old public and commercial buildings from the same period. EPCs are primarily viewed as administrative costs or as a means to attract funding through grant schemes. The high cost, primarily attributed to the requirement for a complete energy audit (approximately €1 500), makes EPCs inaccessible for many, especially for single-family buildings. A notable shortage of qualified specialists (with only around 100 active companies in 2023), aggravated by the absence of training courses since 2012, further impacts the quality of EPCs and energy audits.

Policy needs identified for Bulgaria's EPC system include simplifying the EPC format to include additional information such as the SRI and the designation of RPs. Technical enhancements to the EPC database are necessary to improve efficacy and accessibility, thereby facilitating wider adoption of energy efficiency measures. Strengthening the quality control of EPCs is crucial, requiring robust mechanisms to verify technical accuracy and compliance. Integrating RPs within the EPC framework and enhancing the database capacity for RP storage and analysis could significantly reduce costs and enhance market readiness. Efforts to transparently calculate the SRI and integrate it into the EPC process should be pursued cautiously to avoid unnecessarily increasing audit costs.

In conclusion, Bulgaria's EPC system faces significant challenges related to public perception, database management, quality control, integration with other indicators, and auditor capacitation. Addressing these challenges through targeted policy interventions and technical improvements will be essential to enhance the effectiveness and acceptance of EPCs in the building sector.

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4.2.2 Greece

In Greece, EPCs are mandatory for most property transactions, including rentals, sales, new constructions, and projects funded through energy efficiency renovation programmes. The EPC class must be explicitly stated in all real estate advertisements. The regulatory framework is centrally overseen by the Ministry of Environment and Energy, under the Departments of Energy Inspection of Northern and Southern Greece.

The methodology for EPC calculation in Greece utilises a monthly, semi-stable calculation approach as per ISO standard 13790 E2 (2009). This ensures consistency across all building types, residential and non-residential alike. While there are calls to simplify the EPC procedure, particularly in calculation methodology and documentation, others argue that the current ISO standard already offers a streamlined approach. Integration with RPs favours a separate yet complementary approach to avoid overloading the EPC, seeking synergies with existing schemes and enhancing RP marketability.

The EPC calculation methodology was last updated in 2017, to align with standards and practices in place at the time. Rescaling EPC ratings from A-G presents a significant challenge. If public perception of EPCs is already poor, a change without adequate explanation may lead to further distrust in the certification system. Additionally, as certificates are renewed, if rescaling causes the new rating to be significantly lower, it could aggravate negative perceptions and distrust. On the other hand, rescaling may also lead to increased energy efficiency funding to improve buildings that receive a new, lower scale.

Greece maintains a centralised EPC database (‘www.buildingcert.gr) in which EPC issuers manually input building details, including address, permits, cadastre information and technical data (e.g. photos and topography maps). EPC emissions are calculated remotely on a server using national software.

Until 2016, EPC experts in Greece required mandatory training and certification. Since then, any qualified engineer can issue an EPC after conducting an energy efficiency study. The expertise of EPC experts varies, with generally strong scientific training but lacking specific training in EPC. Concerns exist about the quality of EPCs issued by inexperienced experts, despite the sufficient number of qualified engineers meeting market demand post-reduction in certification requirements.

Public perception of EPCs in Greece is generally negative, especially in the residential sector where they are viewed as a financial burden with little valuable information. In contrast, EPCs are valued in the service building sector, as they are accompanied by technical reports or energy audits. A marketing campaign or communication improvement is needed to enhance public perception. Currently, there is no OSS in Greece that could, by offering centralised access to information and to technical and financial solutions, improve the public perception of EPCs.

Efforts to enhance interoperability between the EPC database and RPs have been positively received by stakeholders. The flexible EPC database allows potential integration with initiatives such as iBRoad2EPC, facilitated by collaboration between entities such as the Center for Renewable Energy Sources and the Ministry of Environment and Energy.

During field tests of the SRI module under the iBRoad2EPC initiative, no significant challenges were reported by energy experts. Integrating SRI into the EPC emission procedure is expected to be feasible, particularly among experienced energy auditors accustomed to such calculations.

These results provide insights into the current implementation landscape of EPCs in Greece, highlighting strengths and areas for improvement in the regulatory framework, calculation methodologies, expertise, database management, and communication and perception of EPCs. Integration with complementary

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initiatives, such as RPs and SRIs, present opportunities to enhance the effectiveness and acceptance of EPCs in the Greek building sector.

Policy needs identified for the EPC system in Greece include: enhancing communication and perception; improving EPC quality control; capacity building and ongoing training for auditors; and integrating other indicators and schemes (e.g. RPs and SRIs) to enhance the overall effectiveness of the EPC framework.

4.2.3 Hungary

The current methodology for calculating EPCs in Hungary is defined by Decree ÉKM 9/2023 (V.25), effective from November 1, 2023. This update includes significant changes, such as the rescaling of classes, removal of the renewable energy share requirement, introduction of GHG limitations, and the elimination of mandatory renewable energy targets. Additionally, there are new requirements for calculating energy loss in floors, improved domestic hot water calculations, detailed assessments of shading and overheating, and mandatory evaluations for building automation and control systems and HVAC systems in non-residential buildings. New developments are now also required to include electric vehicle chargers. The revised EPC format demands more detailed information about substructures, with practical implementation still uncertain.

EPC calculations primarily employ simplified methods outlined in regulations. For complex or special buildings and systems, more intricate modelling techniques – such as EPB standards, numerical methods, or dynamic simulations – become necessary. While the seasonal method is partly used due to its inaccuracy, simplified procedures typically utilise the monthly method. Detailed calculations employ the hourly method or simulations closely resembling it.

Hungary has maintained a centralised EPC database since 2013, managed by the National Building Registry (OÉNY). Since January 1, 2024, new EPCs are mandatory for all buildings and apartments upon sale, rental or occupancy. These certificates are issued by independent experts who have successfully completed the necessary examination at either the Hungarian Chamber of Engineers or the Hungarian Chamber of Architects.

Quality control measures in Hungary involve sample checks and the application of sanctions and fines to ensure the reliability of EPCs. Despite these measures, the relatively low costs of EPCs (ranging from €200 to €500) could potentially lead to quality issues.

Enhancing perception and communication regarding EPCs in Hungary could be achieved through strategic public campaigns. Currently, there is no central OSS system. Discussions about an OSS have taken place, but there is no current governmental intention or budget allocated for its establishment. A successful European project, called RENOHUB, established OSS offices in some Hungarian cities within the project framework (which concluded in 2023). Long-term financing for the operation of these offices remains uncertain.

Stakeholders responsible for EPC implementation in Hungary seek support in various areas, specifically in data analysis, introduction of SRIs, and recommendations aligned with the reality of the building stock. Support is also desired for implementing extended purpose EPCs to bridge the gap between planned and actual data. Challenges persist regarding the practical aggregation of new datasets and ensuring the effectiveness of the updated EPC format.

Policy needs identified for Hungary's EPC system include: improving communication and perception; enhancing EPC databases; strengthening EPC quality control measures; providing recommendations based on EPC assessments; and integrating other indicators and schemes (such as SRIs) to enhance the overall effectiveness of the EPC framework.

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4.2.4 Poland

EPCs became mandatory in Poland on April 28, 2023, for buildings or flats being sold or rented. The legal framework requires EPCs to be displayed in public buildings over 250 m² where citizen services are provided, and in buildings over 500m² where customer services are offered – provided an EPC exists. Certain exemptions apply, including for buildings under monument protection, places of worship, industrial/commercial buildings without energy-consuming installations, seasonal residential properties, small standalone structures, and farms meeting specific energy performance criteria. A new EPC version, incorporating an energy class system and CO_2 emission factors, underwent pre-consultation in 2023 and is scheduled for further consultation in 2024.

Poland currently employs two methodologies for EPC calculations: computational (based on calculation) and actual use based. Technical aspects of these methodologies are under review, with consultations for a new EPC version in progress. The country has maintained an EPC database since 2023, administered by the Ministry of Development and Technology, although initial technical issues were encountered.

The current EPC layout in Poland, dating back to 2019, features a graphical 'slider' format. A new suggested graphical version, resembling the 'etiquette' or 'pyramid' layout used for electric products, is under consideration. Displaying EPCs in front of buildings is mandated but not widely observed, with ongoing efforts to develop a shorter, more easily understandable version of the EPC for display purposes.

Quality assurance measures for EPC in Poland are limited, with no specific tools or policies in place. EPCs are issued by individuals from various professions without stringent independent control systems. Current EPCs include recommendations for energy performance improvements but lack information on resulting energy and financial savings from renovations. The implementation of an RP complementary to the EPC remains uncertain, pending government decisions.

Stakeholders in Poland seek support in reviewing international best practices and enhancing public awareness campaigns. EPCs are generally perceived as an administrative burden rather than a valuable reflection of building energy performance. Despite being accepted as necessary, they are considered more of an administrative cost with limited usefulness. There is a need for improved communication campaigns and a re-evaluation of EPC layout and indicators to enhance public understanding.

Overall, while EPCs are legally mandated in Poland, their effectiveness in promoting energy efficiency and informing stakeholders remains limited, with challenges pertaining to public awareness, acceptance and quality assurance.

Policy needs identified for Poland's EPC system include improving communication and perception; enhancing quality control measures; and providing clear recommendations for energy performance improvements.

4.2.5 Romania

In Romania, the methodology for calculating building energy performance, designated MC001, was officially introduced on January 17, 2023, and fully enforced on July 17, 2023. This methodology operates within the broader legal framework established by Law 372/2005, with subsequent amendments and revisions up to September 2020. It delineates guidelines for energy performance assessments, energy certifications, and energy audits for both new constructions and renovations.

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EPCs in Romania involve evaluating a building's energy and environmental performance, including total annual primary energy consumption and equivalent annual CO_2 emissions. This assessment places buildings into one of eight energy performance classes, culminating with issuing of an EPC. EPC are obligatory for various building categories, including residential, commercial and public buildings exceeding certain size thresholds.

At present, Romania lacks a centralised national EPC database. Plans are underway to integrate EPC data into the National Building Registry, a development outlined in the Romanian National Recovery and Resilience Plan.

Stakeholders in Romania expressed a need for guidance on best practices concerning the National Building Registry and EPC implementation. Specific areas of interest include database management, data entry procedures, and use of EPC data to inform energy efficiency policies. Additionally, there is a keen interest in training opportunities for specialists involved in EPC-related activities.

Several challenges and considerations regarding EPC implementation in Romania were identified:

- **Lack of penalties:** Presently, there are no penalties for energy auditors producing substandard EPCs, potentially undermining the credibility of the certification process.
- **Quality concerns**: The quality of EPCs is also a matter of concern, possibly attributable to the absence of rigorous verification mechanisms.
- **Administrative capacity**: Insufficient administrative capacity for EPC verification poses obstacles to effective quality control.
- **Data digitisation:** The absence of digitalisation for EPC data hampers its accessibility and utility for policymaking and decision support.

4.2.6 Ukraine

The legal framework governing EPCs in Ukraine comprises the Law on Energy Efficiency of Buildings, enacted on June 22, 2017. This legislation mandates EPCs for reconstructions financed by public funds or international sources. Supporting this law are specific methodologies and procedures approved by the Ministry of Regional Development, Construction, Housing, and Communal Services.

In Ukraine, EPCs are calculated using a static methodology based on building type and number of storeys. This approach provides a standardised method for assessing energy performance across different building categories.

Ukraine has maintained an EPC database since 2021, which also includes information on certification experts and engineering systems inspectors. As of January 24, 2024, the database contains 19 141 entries. It allows for the storage of EPCs and provides public access, although with certain restrictions during times of conflict.

The Ukrainian stakeholders expressed a need for support in optimising the analytical parameters of the EPC database. This assistance aims to enhance data analysis capabilities and ensure compatibility with EU databases, facilitating broader energy efficiency initiatives.

The implementation of EPC in Ukraine is reinforced by robust legal and policy frameworks. However, ongoing support and collaboration with other projects initiatives are crucial for refining and improving existing practices, ultimately contributing to more effective energy efficiency strategies.

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4.3 Conclusions of policy needs identification

This section presents the results regarding policy needs for EPCs identified through a questionnaire distributed to stakeholders in six FCs. The analysis focused on four countries (Bulgaria, Greece, Hungary, and Poland) that highlighted EPCs as a top priority for receiving policy guidance.

Table 2 Policy needs identification per focus country

Policy needs identification	Bulgaria	Greece	Hungary	Poland
EPC communication/perception	**Yes**	**Yes**	**Yes**	**Yes**
EPC databases	**Yes**	No	**Yes**	No
EPC quality control	**Yes**	**Yes**	**Yes**	**Yes**
EPC recommendations	No	No	**Yes**	**Yes**
Integration of other indicators/schemes with EPC	**Yes**	**Yes**	**Yes**	No
Training and auditor capacitation	**Yes**	**Yes**	No	No

These outcomes highlight a range of areas in which policymakers can focus their efforts to strengthen EPC schemes in the participating countries. By addressing these needs, policymakers can create a more robust and effective system for driving improvements in building energy performance.

5 Good practice examples and status quo analysis

In this chapter, EPBD.wise focuses on analysing policy instruments and exemplary approaches related to EPCs. The aim is to extract pertinent information from previous work across the EU from good practices and align them with the project's objectives and the policy needs of the FCs identified in the previous chapter. Results of this analysis come from the latest CA EPBD V, which took place from 2018 to 2022 [9] [2] [10]; reports and scientific papers addressing this topic [11] [12] [13] [14]; and 13 European projects described in Annex 1: Survey of related projects, programmes, and initiatives. Good practice examples are documented based on the template available in Annex 3: Template for good practice description. Individual good practice descriptions follow in the subsequent annex - Annex 4: Good practices.

Sweden's EPCs Expert Training (Good Practice No. 1), exemplifies a commitment to ensuring high-quality assessments and enhancing the credibility of EPCs. This rigorous training initiative is designed to educate and certify EPC assessors, ensuring they meet strict requirements for education, experience, and comprehensive training. By fostering a highly qualified workforce capable of accurately evaluating building energy performance, Sweden addresses the policy need for ongoing training and auditor capacitation. This programme not only ensures the expertise of assessors but also enhances the integrity and reliability of EPC assessments. Sweden's programme includes specialised courses covering various aspects of building energy performance evaluation, energy-saving technologies and data collection methods. The training emphasises practical skills and theoretical knowledge, preparing assessors to handle complex evaluations and provide accurate recommendations for improving building energy efficiency. Assessors must undergo regular updates and refresher courses to keep pace with technological advancements and policy changes, ensuring their competence over time. The success of Sweden's programme directly addresses the policy need for ongoing training and auditor capacitation, ensuring the expertise of assessors and the integrity of EPC assessments. This is in line with the new Directive, which expressly states that MS shall ensure appropriate education and training, thereby ensuring an appropriate level of skills.

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Concerning EPC quality control, two good practices were presented. The focus on this policy need is important because – as explicit in the new directive (EU) 2024/1275 – MS must establish clear quality objectives and a specific level of statistical confidence (at least 95%,) for the results. An independent control system is crucial to verify that at least 90% of issued EPCs are valid within a clearly defined evaluation period, not exceeding one year. Aligned with this rigorous statement of the Directive is the Portuguese Quality Assessment System (Good Practice No. 2) managed by ADENE (Portuguese Energy Agency), which ensures the quality and reliability of EPCs through rigorous verification processes. Qualified experts meticulously examine data and information recorded by EPC assessors to ensure accuracy and compliance with established criteria and methodologies. This system is endorsed by the DGEG (national institution responsible for energy policy), which promotes confidence among stakeholders (including building owners, real estate agents and policymakers) by ensuring the reliability of the EPC database. ADENE's approach involves a systematic review of EPCs to verify the correctness of energy performance indicators, the appropriateness of the selected calculation methodologies, and compliance with national and EU regulations. This system's effectiveness is enhanced by close and effective communication with experts, focusing on error prevention rather than sanctions and penalties. Proactive monitoring and accompanying of assessors during building visits as needed are key to this system. The system includes regular audits and quality checks, with feedback provided to assessors to improve accuracy and consistency. By following to rigorous quality control measures, Portugal's system serves as a model for other countries seeking to enhance their own EPC quality assurance mechanisms.

Ireland's Quality Assurance (Good Practice No. 3) addresses quality control policy needs, stating that EPCs play a crucial role in ensuring accuracy and reliability. This system employs a risk-based approach to conduct targeted audits and inspections of EPCs. Clear guidelines and performance criteria are provided to assessors, ensuring their competency and upholding the credibility of EPCs. Continuous monitoring and stakeholder engagement contribute to the programme's success, making it a valuable model for enhancing the quality control of EPCs and promoting energy efficiency. The Irish system involves comprehensive checks on EPC data, assessment methodologies, and compliance with national and EU standards. Feedback mechanisms are established to improve the performance of assessors and maintain the accuracy of the EPC database. The system's risk-based approach prioritises high-risk cases and ensures that corrective actions are taken promptly to rectify any discrepancies found. Ireland's experience provides valuable insights for countries looking to implement effective quality assurance measures within their EPC frameworks.

Portugal's Multi-Purpose EPCs (Good Practice No. 4) serve various stakeholders and objectives by providing tailored recommendations, taxation benefits and financial incentives to promote energy efficiency initiatives. These EPCs play a pivotal role in incentivising renovation actions, facilitating access to funding schemes and supporting comprehensive energy efficiency improvements. By integrating various policy objectives into the EPC framework, Portugal addresses multiple needs, including EPC recommendations, database management, and the integration of other indicators and schemes. The Portuguese approach involves collaboration between ADENE and other stakeholders to ensure that EPCs not only comply with energy performance standards but also contribute to broader policy goals. EPCs are designed to inform policy decisions, support local authorities in planning energy efficiency measures, and encourage building owners to undertake renovations. Taxation benefits and financial incentives are aligned with EPC recommendations to maximise their impact on reducing energy consumption and GHG emissions. This good practice aligns with the provisions promoted in the recast Directive, establishing a more strategic and impactful financial framework.

Scotland's HES OSSs (Good Practice No. 5) stands out as a comprehensive resource for homeowners seeking to improve energy performance. This initiative provides tailored advice, financial incentives, and access to energy-efficient technologies, empowering homeowners to make informed decisions and take

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meaningful action to enhance energy efficiency. This service is funded by the Scottish Government and managed by Energy Saving Trust. Through effective communication channels and community engagement, Scotland addresses policy needs related to EPC communication and perception, fostering awareness and facilitating the adoption of energy-saving measures. The new Directive clearly states a stronger role for OSS, providing streamlined information, independent advice and holistic support related to the energy performance of buildings. Covering both technical and financial solutions at all stages of renovation projects, Scotland's OSS has a particular focus on WPBs and considers different housing typologies. This OSS offers a range of services, including energy assessments, advice on energy-efficient technologies, financial incentives, and contractor access. Tailored recommendations and community outreach initiatives enhance awareness and encourage homeowners to undertake energy efficiency measures. The initiative's success is demonstrated by the high satisfaction rate among customers and significant carbon and financial savings achieved through energy efficiency improvements.

Denmark's Owner-Oriented EPCs empower homeowners to embrace energy efficiency measures through simplified displays of potential savings, detailed budgets and tailored guides (Good Practice No. 6). This approach facilitates informed decision-making and promotes proactive energy efficiency improvements. It directly addresses the policy need for improved EPC communication and perception, as well as the quality of EPC recommendations. The approach also paves the way for the new EPBD, which requires EPC recommendations to have a wider scope and outlines how RPs should build on information included in EPCs. The redesigned layout and comprehensive online resources foster accessibility and understanding, ultimately driving increased adoption of energy-saving measures among homeowners. Danish EPCs provide clear information on potential energy savings, recommended improvements and budget estimates for renovations. Homeowners are guided through the decision-making process, from understanding their current energy performance to implementing cost-effective measures to improve efficiency. The emphasis on user-friendly formats and accessible online resources ensures that homeowners have the information they need to take action and reduce their energy consumption.

The X-tendo Toolbox (Good Practice No. 7) serves as an innovative resource of information facilitating the implementation of next-generation EPCs across Europe. This toolbox addresses ten key features essential for enhanced compliance, reliability, usability, and convergence of energy performance assessment and certification. By providing problem-solving solutions, methodological approaches, calculation procedures, and implementation guidelines, the X-tendo Toolbox ensures transparency, understanding, and effective integration of innovative EPC features. The toolbox prioritises good quality and reliability, user-friendliness, economic feasibility, and consistency with ISO/CEN standards. It fosters improved energy performance assessments and promotes energy renovations by incorporating smart readiness, comfort, outdoor air pollution, real energy consumption, district energy, EPC databases, building logbooks, enhanced recommendations, financing options, and OSS. The X-tendo Toolbox is designed to be scalable and adaptable, making it a valuable resource for addressing diverse policy challenges across different contexts.

For Bulgaria, Greece, Hungary and Poland, adaptation and implementation of insights and strategies derived from identified good practices can significantly enhance their EPC frameworks. By examining the successful approaches of Sweden, Portugal, Scotland, Denmark and the X-tendo Toolbox, these countries can tailor these practices to address their specific policy needs and improve their compliance with the new Directive (EU) 2024/1275.

Bulgaria and Greece can particularly benefit from establishing rigorous EPC training programmes for assessors, similar to Sweden's EPCs Expert Training. This would ensure that assessors meet high

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educational and training standards, thereby enhancing the accuracy and reliability of EPC assessments. Although Hungary does not have a significant policy need for training and education, the gap between expert recommendations and practical implementation can be addressed through enhanced capacitation and training.

All four FCs can draw inspiration from Portugal's quality assessment system for EPCs, which employs rigorous verification processes to ensure precision. This approach would help them meet the new stringent requirements imposed by the Directive.

Portugal's implementation of a multi-purpose EPC system, which integrates taxation benefits and financial incentives to stimulate energy efficiency renovations, could serve as a holistic model for Bulgaria, Greece, Hungary and Poland. Such a system would not only incentivise energy efficiency improvements but also streamline the overall EPC process, making it more comprehensive and beneficial for property owners.

Greece, Bulgaria, Hungary and Poland could also explore establishing OSS initiatives similar to Scotland's HES. These initiatives would provide comprehensive support, advice and information to homeowners regarding energy efficiency improvements. This approach could be instrumental in addressing issues related to the public perception of EPCs. By serving as a platform for marketing and information campaigns, these OSS would facilitate implementation of the new Directive, particularly in the context of EPC rescaling.

Hungary and Poland, in particular, could benefit from adopting owner-oriented EPCs modelled after Denmark's approach. This would involve providing simplified information and detailed guidance to homeowners, encouraging the adoption of energy-saving measures. Such a focus on user-friendly and actionable information would likely increase homeowner engagement and compliance with energy efficiency standards.

The X-tendo Toolbox offers a scalable and adaptable resource for all FC countries, facilitating implementation of new indicators as foreseen in the updated EPC framework. By leveraging this resource, Bulgaria, Greece, Hungary and Poland can enhance the compliance, reliability and usability of their EPCs.

In summary, detailed examination of these good practices reveals specific aspects that contribute to their success, providing a roadmap for other countries to adapt and implement similar approaches. This analysis offers a foundational understanding of effective EPC implementation strategies, presenting a robust framework for future policy development and execution. Through these targeted adaptations, Bulgaria, Greece, Hungary and Poland can significantly improve their EPC systems, ensuring better compliance with the new EU Directive and promoting greater energy efficiency across their building sectors.

6 Conclusions for developing the policy guideline summary

Analysis of the identified good practices highlights critical areas for developing policy guidelines aimed at advancing energy efficiency initiatives, particularly concerning EPCs within the FCs and beyond. By synthesising the insights gathered from these practices, it becomes evident that several key policy needs emerge, which serve as foundational pillars for formulating of effective policy guidelines.

First, the emphasis on training and capacity building, as exemplified by Sweden's EPCs Expert Training, underscores the imperative of investing in the expertise of auditors responsible for EPC assessments.

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This highlights the necessity of incorporating comprehensive training programmes into policy guidelines, ensuring that auditors possess the requisite skills and knowledge to conduct accurate and reliable evaluations. This programme includes specialised courses covering various aspects of building energy performance evaluation, energy-saving technologies, and data collection methods, ensuring the competence of assessors over time through regular updates and refresher courses.

Emphasis on quality assurance measures, as demonstrated by the Portuguese Quality Assessment System managed by ADENE and Ireland's Quality Assurance, reinforces the importance of robust quality control mechanisms within the EPC framework. Policy guidelines should incorporate rigorous quality assurance protocols to preserve the integrity and credibility of EPC assessments. These systems employ meticulous verification processes and risk-based approaches to conduct targeted audits and inspections, ensuring the accuracy and compliance of EPCs with established criteria and methodologies.

The multifaceted approach adopted by Portugal's Multi-Purpose EPCs, which integrates EPCs into various decision-making processes within the building sector, underscores the importance of aligning policy guidelines with broader strategic objectives. This practice leads to addressing immediate concerns, such as EPC recommendations and database management, while recognising EPCs as versatile tools capable of driving systemic change within the built environment. This approach involves collaboration among stakeholders to ensure that EPCs not only comply with energy performance standards but also contribute to broader policy goals, including providing tailored recommendations, taxation benefits, and financial incentives to promote energy efficiency initiatives.

Implementation of Scotland's HES OSS exemplifies an integrated approach to providing EPC recommendations alongside other energy-related services. This practice contributes to meeting the policy need for comprehensive support mechanisms facilitating energy efficiency improvements and emphasising the importance of holistic approaches in policy formulation. The OSS offers a range of services, including energy assessments, advice on energy-efficient technologies, financial incentives, and contractor access, enhancing awareness and encouraging homeowners to undertake energy efficiency measures.

A focus on communication and perception management, exemplified by Denmark's Owner-Oriented EPCs, underscores the need for proactive strategies to enhance public understanding and acceptance of EPCs. Policy guidelines must include provisions for targeted communication campaigns and outreach efforts aimed at fostering awareness and engagement among stakeholders. The Danish EPCs provide clear information on potential energy savings, recommended improvements, and budget estimates for renovations, guiding homeowners through the decision-making process and promoting the adoption of energy-saving measures.

Lastly, the transversal nature of the X-tendo Toolbox exemplifies a versatile resource that seamlessly integrates various policy needs. Policy guidelines should encourage the development of concise frameworks detailing how to effectively manage databases, provide recommendations, and integrate additional indicators. The X-tendo Toolbox addresses ten key features essential for enhanced compliance, reliability, usability, and convergence of energy performance assessment and certification, promoting improved energy performance assessments and energy renovations.

For Bulgaria, Greece, Hungary and Poland, the adaptation and implementation of insights and strategies derived from identified good practices can significantly enhance EPC frameworks. By examining the successful approaches of Sweden, Portugal, Scotland, Denmark and the X-tendo Toolbox, these countries can tailor practices to address their specific policy needs and improve their compliance with the new Directive (EU) 2024/1275.

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The synthesis of these insights provides a solid foundation for developing policy guidelines to support FCs in transposing and implementing the recast EPBD. By addressing key policy needs (such as EPC communication and perception, training and auditor capacitation, EPC databases, EPC quality control, EPC recommendations, and integration of other indicators and schemes with EPCs), these guidelines will play an essential role in guiding the design, implementation, and evaluation of effective policies and instruments tailored to the specific contexts and needs of each MS within the framework of the EPBD. By fostering intensive stakeholder engagement and providing ongoing support and technical advice, these guidelines will facilitate the iterative process of policy refinement and adaptation, ensuring alignment with EU and national objectives while driving tangible progress towards a more sustainable and energy-efficient built environment.

In summary, the detailed examination of these good practices reveals specific aspects that contribute to their success, providing a roadmap for other countries to adapt and implement similar approaches. This analysis offers a foundational understanding of effective EPC implementation strategies, presenting a robust framework for future policy development and execution. Through these targeted adaptations, Bulgaria, Greece, Hungary and Poland can significantly improve their EPC systems, ensuring better compliance with the new EU Directive and promoting greater energy efficiency across their building sectors.

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Annex 1: Survey of related projects, programmes, and initiatives

QualDeEPC

Project name	High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation
Duration	September 2019 – February 2023
Project website	https://qualdeepc.eu/
Objective	The QualDeEPC project is aiming to both improve quality and cross-EU convergence of EPCs schemes, and the link between EPC and deep renovation: High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation. The objective of the project is to improve the practical implementation of the assessment, issuance, design, and use of EPC as well as their renovation recommendations, in the participating countries and beyond. Recommendations for renovation shall be made coherent with deep energy renovation towards a nearly-zero energy building stock by 2050.
Elements of EPC	EPC Recommendations for renovation (and deep renovation); Assessors Training; EPC user-friendliness; EPC advertising;
Building types covered	Residential and non-residential
Tools available	QualDeEPC Master Tool;
Participating countries/pilots	Bulgaria, Germany, Greece, Hungary, Latvia, Spain and Sweden
Relevant documents and links	Report on EPC best practices; Conclusive policy recommendations guide; Green paper on good practice in EPC assessment, certification and use; White paper on good practice in EPC assessment, certification, and use; Guidebook for improved EPC;

D^2EPC

Project name	Next-generation Dynamic Digital EPC for Enhanced Quality and User Awareness

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Duration	September 2020 – August 2023
Project website	https://www.d2epc.eu/en
Objective	The D^2EPC project aims to develop the next generation of dynamic EPC for buildings. It is based on the 'digital twin' concept to advance building information modelling and a new set of energy, environmental, financial and well-being indicators. According to the project, these indicators will ensure the EPC are realistic and can accurately lead the transformation of Europe's building stock into zero-energy buildings. The framework is demonstrated at six different sites.
Elements of EPC	EPC calculation methodology; EPC user-friendliness; SRI; Human Comfort and Wellbeing Indicators; LCA indicator; Financial indicators; RPs
Building types covered	Residential and non-residential
Tools available	D^2EPC Web Platform; D^2EPC WebGIS
Participating countries/pilots	Austria, Cyprus, Germany, Greece, Lithuania, Netherlands and Spain. Case study 1: nZEB[6] Smart House DIH in Thessaloniki, Greece; Case study 2: residential multi-family building in Velten, Germany; Case study 3: a tertiary building in Berlin, Germany; Case study 4: new wing building of Frederic's University in Nicosia, Cyprus; Case study 5 & 6: two multi-family buildings located in Berlin
Relevant documents and links	Next-generation EPC's user and stakeholder requirements & market needs; Final Project Report; Financial indicators for next generation EPC; SRI indicators for next generation EPC; Human-Centric indicators and user profiles for next generation EPC; Life Cycle Indicators for next generation EPC; EPC and Renovation Passport;

[6] Abbreviated as nearly zero-energy building (adapted in annex for consistency with the series of documents)

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EPC RECAST

Project name	Energy Performance Certificate Recast
Duration	September 2020 – June 2024
Project website	https://epc-recast.eu/
Objective	EPC RECAST aims to set a well-structured process and a toolbox supporting the development, implementation and validation of a new generation of Energy Performance Assessment and Certification, with a deliberate focus on residential buildings, more specifically existing ones, for which retrofit is one of the most challenging and pressing issue.
Elements of EPC	SRI, RP, EPC user-friendliness, EPC reliability, EPC assessors
Building types covered	Residential
Tools available	EPC Recast Toolbox
Participating countries/pilots	France, Germany, Italy, Luxembourg, Slovakia and Spain
Relevant documents and links	Long-Term Monitoring Strategies for Increasing EPC Reliability; New generation of the Energy Performance Certificate;

X-tendo

Project name	eXTENDing the energy performance assessment and certification schemes via a modular approach
Duration	September 2019 – August 2022
Project website	https://x-tendo.eu/
Objective	The EU-funded X-tendo project aims to provide support to the EU market and authorities for the next-generation EPC schemes and usability. It will do this through the X-tendo toolbox, a freely available online hub presenting all provided innovative features from smart solutions and trusted examples or calculations to guidelines and recommendations. Next-generation EPC and innovative tools will help the EU market, building owners, the construction industry, and the finance sector

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Elements of EPC	SRI; EPC databases; District Energy; Outdoor Air Pollution; EPC recommendations; Building Logbook; Real Energy consumption; Comfort indicator; OSS; Financing options
Building types covered	Residential and non-residential
Tools available	X-tendo toolbox
Participating countries/pilots	Austria, Portugal, Romania, Greece, Denmark, Italy, UK, Poland, Estonia, Belgium
Relevant documents and links	Advancing energy performance certificates to next generation – Recommendations to integrate new features into EPC schemes; Implementation guidelines and replicability potential of the innovative features for the next generation EPC;

SmartLivingEPC

Project name	Advanced Energy Performance Assessment towards Smart Living in Building and District Level
Duration	July 2022 – June 2025
Project website	https://www.smartlivingepc.eu/en
Objective	SmartLivingEPC project aims to deliver a certificate which will be issued with the use of digitised tools and retrieve the necessary assessment information for the building shell and building systems from BIM literacy, including enriched energy and sustainability related information for the as designed and the actual performance of the building.
Elements of EPC	SRI; Digital Logbooks; RPs; EPC databases; Indoor environmental quality (IEQ); LCA and LCC analysis
Building types covered	Residential and non-residential
Tools available	Not available
Participating countries/pilots	Austria, Belgium, Cyprus, Estonia, Greece, Ireland, Italy, Netherlands, Romania and Spain Demo Site 1: nZEB Smart House DIH, Mixed-use, Thessaloniki Greece Demo Site 2: Frederick University Main Building, Limassol, Cyprus

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	Demo Site 3: Ehituse Mäemaja, Tallinn University of Technology (TalTech), Tallinn, Estonia Demo Site 4: Single family house, Leitza, Spain Demo Site 5: Private flat, Leitza, Spain Demo Site 6: Mixed-use Building, Leitza, Spain Demo Site 7: Town Hall, Leitza, Spain Demo Site 8: School Building Facilities, Leitza, Spain Demo Site 9: Sports Centre, Leitza, Spain
Relevant documents and links	From EPC schemes gaps and opportunities to SmartLivingEPC requirements, recommendations and market needs;

U-CERT

Project name	Towards a new generation of user-centred Energy Performance Assessment and Certification
Duration	September 2019 – February 2023
Project website	https://u-certproject.eu/
Objective	The EU-funded U-CERT project aims to make the new certification schemes more practical and reliable via a holistic and user-centred approach. It also aims to make the new set of energy-performance standards easily accessible to a wide range of users by leveraging the diverse services offered by the EPB centre. The new approaches facilitate the shift towards a decarbonised EU building stock.
Elements of EPC	SRI, EPC calculation methodology, EPC communication, IEQ indicators,
Building types covered	Residential and non-residential
Tools available	U-CERT tooling
Participating countries/pilots	Bulgaria, Estonia, Spain, France, Hungary, Italy, The Netherlands, Romania, Slovenia and Sweden.
Relevant documents and links	Catalogue (report) of user and beneficiary profiles for tool development; U-CERT Guidelines: recommendations for harmonized, holistic and user-centred EPC;

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	Report on users' perception about EPC scheme in U-CERT partner countries; Report on implementation of EPC schemes in U-CERT partner countries; Final report and executive summary of total project results;

ePANACEA

Project name	Smart European Energy Performance AssessmeNt and CertificAtion
Duration	June 2020 – October 2023
Project website	https://epanacea.eu/
Objective	The objective of the ePANACEA project is to develop a holistic methodology for energy performance assessment and certification of buildings that can overcome the lack of accuracy, the gap between theoretical and real consumption patterns, the absence of proper protocols for inclusion of smart and novel technologies, little convergence across EU schemes, the lack of trust in the market and very little user awareness related to energy efficiency of EPC schemes.
Elements of EPC	EPC calculation methodology; SRI; IEQ indicators; EPC Recommendations; EPC Communication; RPs; Digital Building Logbooks
Building types covered	Residential and non-residential
Tools available	Smart Energy Performance Assessment Platform
Participating countries/pilots	Austria, Belgium, Finland, Greece and Spain
Relevant documents and links	Insights on user perceptions and needs regarding the Energy Performance Certificate (EPCs); Recommendations for the design of the next generation of EPC; Guidelines on how national EPC schemes and SRI could be linked; Report on the use of innovative certification schemes and their implementation; Energy Performance Certificates (EPCs) potential linkage with Digital Building Logbooks and Renovation Passports;

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EUB

Project name	European Building Sustainability performance and energy certification Hub
Duration	June 2021 – May 2021
Project website	https://eubsuperhub.eu/
Objective	The EUB SuperHub project will support the evolvement of the certification process in the EU by development of a scalable methodology to view, assess and monitor the buildings through their lifecycle (embedded energy, costs etc.)
Elements of EPC	Building Logbook; LCA and LCC indicators; SRI; RP; OSS;
Building types covered	Information not yet available. https://eubsuperhub.eu/case-studies
Tools available	EUB SuperHub Platform
Participating countries/pilots	Germany, Croatia, Italy, France, Austria, Ireland and Hungary
Relevant documents and links	Next generation energy certification: stakeholders' needs and expectations; Quality, usability and visibility of energy and sustainability certificates in the real estate market;

iBroad2EPC

Project name	Integrating RPs into Energy Performance Certification schemes for a decarbonised building stock
Duration	September 2021 – August 2024
Project website	https://ibroad2epc.eu/
Objective	iBRoad2EPC aims to bridge the RP with the EPC, and expand, improve and broaden their format and joint scope to consider additional features and become applicable also to multi-family and public buildings. The aim is to improve reliability, usefulness and effectiveness, thereby establishing the next generation of EPC that will support Europe's decarbonisation ambitions while improving conditions for building occupants.

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Elements of EPC	RP; Building Logbook; Auditors Training; EPC recommendations; EPC communication;
Building types covered	Residential and non-residential
Tools available	iBRoad2EPC Assistant (integrates RP features into existing EPC systems), iBRoad Roadmap Assistant (software to present a step-by-step improvement plan) and iBRoad-Log (Digital Building Logbook)
Participating countries/pilots	Bulgaria, Greece, Poland, Portugal, Romania and Spain
Relevant documents and links	How Energy Performance Certificates (EPCs) can be upgraded with Renovation Passport (BRP) elements; Technical report on the definition of the proposed concept, content and methodology of iBRoad2EPC;

TIMEPAC

Project name	Towards innovative methods for energy performance assessment and certification of buildings
Duration	July 2021 – June 2024
Project website	https://timepac.eu/
Objective	TIMEPAC project will improve the current energy performance certification (EPCs) system by transitioning from a single, static certification to one that is more holistic and dynamic. This new approach considers buildings as dynamic entities that never stop changing. TIMEPAC will combine EPC databases with other data sources to make certification more effective and reliable.
Elements of EPC	EPC calculation methodology; RPs; SRI; environmental Sustainability indicators; EPC recommendations; EPC data quality control; EPC databases; Training
Building types covered	Information not available
Tools available	Transversal Deployment Scenarios (TDS)
Participating countries/pilots	Austria, Croatia, Cyprus, Italy, Slovenia and Spain

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Relevant documents and links	Context analysis of EPC generation;

EDYCE

Project name	Energy flexible DYnamic building CErtification
Duration	September 2020 – August 2023
Project website	https://edyce.eu/
Objective	E-DYCE project is developing a methodology for dynamic EPC intended to replace or be used in conjunction with the current static or steady-state methodology. It will consider the temporal nuances of energy use on scales of minutes, hours and days rather than annual averages, providing better opportunities to suggest more effective energy-efficient behaviours to consumers
Elements of EPC	EPC calculation methodology; IEQ indicators; SRI; Renovation Recommendations - **Renovation Roadmap DSS (Decision Support System)**;
Building types covered	Residential and non-residential
Tools available	DEPC tool
Participating countries/pilots	Denmark, Germany, Greece, Italy and Switzerland,
Relevant documents and links	EPC regional report;

crossCert

Project name	Cross Assessment of Energy Certificates in Europe
Duration	September 2021 – August 2024
Project website	https://www.crosscert.eu/
Objective	crossCert project will create a product testing methodology for new EPC approaches. The aim will be to improve the accuracy and usability of the EPC and boost homogeneity across Europe. Beyond accuracy, usability and harmonisation, crossCert will use the cross-assessment exercise to conduct research and issue guidelines on: training and education of certified EPC issuers; EPC promotion and marketing; adapting EPC

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	investor needs; linking next-generation of EPC to energy audits, logbooks and RPs; and EPC and OSS for building renovation
Elements of EPC	EPC communication; EPC quality control; Training;
Building types covered	Residential and non-residential
Tools available	EPC Knowledge Exchange Centre
Participating countries/pilots	Austria, Bulgaria, Croatia, Denmark, Greece, Malta, Poland, Slovenia, Spain and United Kingdom
Relevant documents and links	Report on existing EPC attitudes, expectations and needs; Review of approaches to EPC assessment across chosen member states; Cross-country comparison of format and nature of recommended improvements in different EPC;

Turnkey Retrofit

Project name	Turnkey Retrofit
Duration	June 2019 – February 2022
Project website	https://www.turnkey-retrofit.eu/
Objective	The Turnkey Retrofit project aimed to develop and replicate an integrated home renovation service that transforms the complex and fragmented renovation process into a simple, straightforward, and attractive process for the homeowner. The service was designed to be homeowner-centric, offering tailor-made solutions aimed at home improvement, increased comfort, energy consumption reduction, and enhanced health and quality of life.
Elements of EPC	EPC Recommendations for renovation (and deep renovation); Assessors Training; EPC user-friendliness; EPC communication;
Building types covered	Residential
Tools available	Digital Platform, Solutions4Renovation
Participating countries/pilots	France, Ireland and Spain

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Relevant documents and links	Conclusions of the identification of local needs and actors in place Guidelines for implementation in different European countries Lessons learnt to inform future large-scale uptake Lessons learnt from the local implementation

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Annex 2: Questionnaire to Focus Countries

1st general questionnaire – All Focus Countries

1. What is the national legal and policy framework regarding the design and implementation of EPCs? (EPBD version, last updates, covers all legislation, regional or national approaches, exemptions, or omissions)
2. What kind of methodology do you use for EPC calculation (static, dynamic, seasonal, monthly, hourly) by building type (residential and non-residential)?
3. Do you have an EPC database in your country? What are the uses of the EPC database?
4. What kind of support would you and the representatives in your country responsible for implementing EPCs like to receive from the EPBD.wise project in terms of EPCs implementation?

Bulgaria

Communication and perception

1. In general, what is the perception of the quality of EPCs in your country?
2. What is the level of acceptance of EPCs in your country?
3. Are EPCs considered useful in your country or rather an administrative cost?
4. Are EPCs considered to have an appropriate cost?
5. Are there any one-stop shops (or similar) in place in your country and does the EPC have a role?

Layout and indicators

6. How old is/are the EPC layout(s) in your countries?
7. Are the EPCs displayed in front of buildings, when applicable (e.g., public buildings)?
8. In general, do you consider that the EPC indicators are well understood by their target audience (homeowners, building managers, etc.)? Why?

EPC Databases

9. Do you have a digital EPC database in your country?
10. Regardless of the support of the EPC scheme, are there additional uses of the EPC database?
11. Do you consider GDPR an issue for the use/settlement of the EPC database?
12. Does the EPC database interoperate with other databases (e.g. banks, one-stop shops, etc.)
13. What technical improvements would you like to do in your EPC database (please identify functionalities you would like to implement)?

Training and auditor capacity building

14. What requirements exist to become an EPC expert?
15. Are there any requirements to maintain qualification over time? If yes, which?
16. What is your perception in terms of the quality/capacity of the existing EPCs experts?
17. Are there sufficient EPC experts to fulfil market demand?

Calculation methodology

18. What kind of simplification would you like to implement in your country (e.g. energy audits, indicators, calculation procedure, EPC layout and documentation, etc.)? Please explain why.
19. Policy Need ID and Integration of other indicators/schemes with EPCs

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20. Do you think that there should be only one system in place (e.g. EPC with BRP embedded) or that the EPC and BRPs should be separated yet complementary? Please justify.
21. How can EPC and BRP implementation be better streamlined/integrated in your country?
22. How do you foresee the level of interoperability between the EPC database and the BRP? As the things are in place now is this possible or it is necessary an effort to improve the EPC database to make it possible?
23. What are the challenges you expect to face to calculate SRI and integrate it in the EPC?

Greece

Experts and skills

1. What requirements exist to become an EPC expert?
2. Are there any requirements to maintain qualification over time? If yes, which?
3. What is your perception in terms of the quality/capacity of the existing EPCs experts?
4. Are there sufficient EPC experts to fulfil market demand?

Calculation methodology

5. When was the last time the current methodology was deeply updated?
6. What are the challenges you expect to face when you rescale from to A-G?
7. What kind of simplification would you like to implement in your country (e.g. energy audits, indicators, calculation procedure, EPC layout and documentation, etc.)? Please explain why.

Integration of other indicators/schemes with EPCs

8. Do you think that there should be only one system in place (e.g. EPC with BRP embedded) or that the EPC and BRPs should be separated yet complementary? Please justify.
9. How can EPC and BRP implementation be better streamlined/integrated in your country?
10. How do you foresee the level of interoperability between the EPC database and the BRP? As the things are in place now is this possible or it is necessary an effort to improve the EPC database to make it possible?
11. What are the challenges you expect to face to calculate SRI and integrate it in the EPC?

Hungary

EPC Databases

1. Do you have a digital EPC database in your country?
2. Regardless of the support of the EPC scheme, are there additional uses of the EPC database?
3. Do you consider GDPR an issue for the use/settlement of the EPC database?
4. Does the EPC database interoperate with other databases (e.g. banks, one-stop shops, etc.)
5. Does the current EPCs database allow you to quickly extract analytical/statistical information from current data?
6. What kind of analysis would you like to perform with the EPC database (please identify functionalities you would like to implement)?

EPC Quality Control

7. Are there any tools or policies for quality assurance of the EPCs?
8. Which tools or polices do you use in your country for EPC quality assurance?
9. Integration of other indicators/schemes with EPCs
10. What are the challenges you expect to face to calculate SRI and integrate it in the EPC?

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EPC Communication/Perception

11. In general, what is the perception of the quality of EPCs in your country?
12. What is the level of acceptance of EPCs in your country?
13. Are EPCs considered useful in your country or rather an administrative cost?
14. Are EPCs considered to have an appropriate cost?
15. Are there any one-stop shops (or similar) in place in your country and does the EPC have a role?

Layout and indicators

16. How old is/are the EPC layout(s) in your countries?
17. Are the EPCs displayed in front of buildings, when applicable (e.g., public buildings)?
18. In general, do you consider that the EPC indicators are well understood by their target audience (homeowners, building managers, etc.)? Why?

Poland

Communication and perception

1. In general, what is the perception of the quality of EPCs in your country?
2. What is the level of acceptance of EPCs in your country?
3. Are EPCs considered useful in your country or rather an administrative cost?
4. Are EPCs considered to have an appropriate cost?
5. Are there any one-stop shops (or similar) in place in your country and does the EPC have a role?
6. Are/were there communications campaigns in place to explain the EPC to the target audiences? If yes, do you think that it had impact in improving the EPC awareness? Why?

Layout and indicators

7. How old is/are the EPC layout(s) in your countries?
8. Are the EPCs displayed in front of buildings, when applicable (e.g., public buildings)?
9. In general, do you consider that the EPC indicators are well understood by their target audience (homeowners, building managers, etc.)? Why?

EPC Recommendations

10. Does current EPCs have recommendations for improvement measures with the calculation of energy and financial savings or are measures just informative?
11. Are you considering implementing a RP complementary to EPC with stepped/tailored recommendations? Please explain why.
12. Do you have access to databases with information to calculate the potential savings from the EPC recommendations (e.g. construction costs, metered energy data, etc.)?

EPC Quality Control

13. Independent control system
14. Are there any tools or policies for quality assurance of the EPCs?
15. Which tools or polices do you use in your country for EPC quality assurance?

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Annex 3: Template for good practice description

EPBD.wise	Good Practice #1
Author: Name and organisation	Date: Month yyyy
Contributors: Name and organisation, Name and organisation, Name and organisation, Name and organisation	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

General challenges addressed		Specific challenges addressed: EPC	
Good governance	☐	Legal framework	☐
Staff shortage in public administration	☐	Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☐	Type of approach (national, regional, etc.)	☐
Data accessibility for effective policies	☐	Exemptions or omissions	☐
Data quality for effective policies	☐	Calculation Methodology	☐
Estimation of impacts (broader benefits)	☐	EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐	Building typologies	☐
Clear presentation of co-benefits	☐	Indicators	☐
Financing	☐	Experts	☐
		Requirements	☐
		Training	☐
		Experts quality perception/evaluation	☐
		Independent control system	☐
		Databases	☐

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			Input data	☐
			Additional uses/indicators	☐
			GDPR	☐
			Communication	☐
			Perception	☐
			Layout	☐
			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☐

Legend: Tick the appropriate box

Short description of good practice - summary	
Text Text Text Text Text Text Text Text	Image / Figure

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	
Administrative	
Societal	
Economic	

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

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Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☐	☐
Non-residential buildings	☐	☐
Office	☐	☐
Educational	☐	☐
Health	☐	☐
Other (explain)		

Scale addressed	
Building	☐
Neighbourhood	☐
District	☐

Legend: Tick the appropriate box or add explanation

Target group(s) addressed				
Building owners	☐		Scientists	☐
Property managers	☐		Professional associations	☐
Energy companies	☐		Municipal administration	☐
Architects, engineers	☐		Regional administration	☐
Consultants	☐		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice	
Description of the elements which work well Text Text Text Text Text	Image / Figure

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Description of the enabling environment for the development / establishment Text Text Text Text Text Text Text Text Text	Image / Figure
Description of success factors for continuing operation Text Text Text Text Text Text Text Text Text Text	Image / Figure
Lessons learnt and key recommendations Text Text	Image / Figure

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Text Text Text Text Text	

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Annex 4: Good practices

Good practice #1

EPBD.wise	Sweden's EPCs Expert Training for EPCs
Author: Boverke	Date: April 2024
Contributors: -	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

General challenges addressed		Specific challenges addressed: EPC	
Good governance	☐	Legal framework	☐
Staff shortage in public administration	☐	Legislation coverage (partly)	☒
Data availability for effective policies	☐	Type of approach (national)	☒
Data accessibility for effective policies	☐	Exemptions or omissions	☐
Data quality for effective policies	☐	Calculation Methodology	☐
Estimation of impacts (broader benefits)	☐	EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐	Building typologies	☐
Clear presentation of co-benefits	☐	Indicators	☐
Financing	☐	Experts	☒
		Requirements	☐
		Training	☒
		Experts quality perception/evaluation	☐
		Independent control system	☐
		Databases	☐
		Input data	☐

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			Additional uses/indicators	☐
			GDPR	☐
			Communication	☐
			Perception	☐
			Layout	☐
			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☐

Legend: Tick the appropriate box

Short description of good practice - summary	
Sweden's EPCs expert training programme focuses on ensuring high-quality assessments by establishing rigorous requirements for assessors. The programme mandates a minimum level of education and experience for assessors, along with comprehensive training and examination processes. By prioritising a well-educated and experienced pool of assessors, Sweden aims to enhance the reliability and credibility of EPC, contributing to improved building energy performance and energy efficiency goals.	Image / Figure

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	Qualification of experts
Administrative	
Societal	
Economic	

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

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Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☒	☒
Educational	☒	☒
Health	☒	☒
Other (explain)		

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

Legend: Tick the appropriate box or add explanation

Target group(s) addressed				
Building owners	☐		Scientists	☐
Property managers	☐		Professional associations	☐
Energy companies	☒		Municipal administration	☐
Architects, engineers	☒		Regional administration	☐
Consultants	☒		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice	
Description of the elements which work well Sweden places great importance on energy efficiency through its robust system for building EPCs. This system relies on a well-defined path for training qualified EPC experts. The entry criteria for becoming an EPC expert includes having a strong background in engineering (building physics, energy systems, construction), often paired with a bachelor's degree in a relevant field to ensure a solid knowledge base. To gain practical experience, it is recommended to have at least 5 years of experience in building assessment, energy efficiency, or related fields to effectively evaluate real-world scenarios.	Image / Figure

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Mandatory training equips individuals with the necessary skills to issue EPC effectively. Standardised exams ensure all certified experts possess a strong foundation in key areas like building physics, energy needs calculations, indoor air quality and improvement measures calculation. Continuous improvement is ensured through continuing professional development programmes, enabling experts to stay informed and maintain their expertise. Sweden's robust EPC expert development programme fosters a highly qualified workforce, leading to accurate building energy assessments, and ultimately contributing to national energy efficiency goals.	
Description of the enabling environment for the development/establishment The success of the development and establishment Swedish system of training qualified EPC experts was possible through several factors. Firstly, the government provides crucial support by endorsing the programme to encourage participation. Secondly, industry collaboration between training providers, professional bodies, and the government ensures that the programme remains relevant and up to date. Finally, public awareness campaigns educate the public on the benefits of EPC and increase the demand for qualified experts. Overall, Sweden's EPC system is a clear example of how a well-designed programme, with support from the government, collaboration from industry partners, and public awareness, can lead to the establishment of a successful and sustainable energy efficiency programme.	Image / Figure
Description of success factors for continuing operation The success of Sweden's EPC expert training programme relies on ongoing monitoring and evaluation to ensure the continued effectiveness of training and examination processes. Regular updates to training materials and examination criteria, along with opportunities for assessors to engage in professional development, contribute to the programme's success.	Image / Figure
Lessons learned and key recommendations Sweden's experience highlights the importance of setting clear requirements and standards for EPC assessors,	Image / Figure

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including minimum education, experience, and training criteria. Regular review and updates to training programmes and examination processes are essential to keep pace with evolving industry standards and best practices. Additionally, collaboration with stakeholders, including industry associations, academic institutions, and government agencies, can help ensure the relevance and effectiveness of EPC training initiatives.	

Good practice #2

EPBD.wise	Portuguese Quality Assessment System
Author: ADENE	Date: April 2024
Contributors: Rui Fragoso (ADENE), Nuno Baptista (ADENE) e Margarida Pinto (ADENE)	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

General challenges addressed		Specific challenges addressed: EPC	
Good governance	☐	Legal framework	☒
Staff shortage in public administration	☐	Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☐	Type of approach (national)	☒
Data accessibility for effective policies	☐	Exemptions or omissions	☐
Data quality for effective policies	☐	Calculation Methodology	☐
Estimation of impacts (broader benefits)	☐	EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐	Building typologies	☐
Clear presentation of co-benefits	☐	Indicators	☐
Financing	☐	Experts	☐
		Requirements	☐

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			Training	☐
			Experts quality perception/evaluation	☐
			Independent control system	☒
			Databases	☐
			Input data	☐
			Additional uses/indicators	☐
			GDPR	☐
			Communication	☐
			Perception	☐
			Layout	☐
			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☐

Legend: Tick the appropriate box

Short description of good practice - summary	
The Portuguese EPCs system prioritises the quality of energy certification processes for buildings. ADENE, the managing entity, upholds this commitment through a rigorous verification process. This process meticulously scrutinises data and information recorded by qualified experts, aiming to maintain unwavering confidence in the produced information. ADENE employs criteria and methodologies established by the Directorate-General for Energy and Geology (DGEG) to assess the quality of information and documents submitted to the EPCs portal. By upholding standards and conducting thorough assessments, the assessment grants trust among stakeholders and promotes the reliability of the EPCs database.	Image / Figure

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	Data quality control
Administrative	
Societal	

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Economic	

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☒	☒
Educational	☒	☒
Health	☒	☒
Other (explain)		

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

Legend: Tick the appropriate box or add explanation

Target group(s) addressed				
Building owners	☐		Scientists	☐
Property managers	☐		Professional associations	☐
Energy companies	☒		Municipal administration	☐
Architects, engineers	☒		Regional administration	☐
Consultants	☒		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice	
Description of the elements which work well ADENE, Portuguese entity managing EPCs system, employs a well-defined set of criteria and methodologies to conduct quality assessments. These criteria encompass a range of factors including complaints received by ADENE or DGEG, requirements from the	Image / Figure

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DGEG, initial submissions by qualified technicians, alterations made to energy improvement plans during their validity period, and a random sampling approach based on Portal data and the total number of issued documents. The assessment itself utilises four distinct models. The first involves accompanying a qualified technician during a building visit to verify pre-emission documentation and subsequent portal registration. The second model, termed aggregated verification, involves analysing pre-selected parameters from a collection of registered documents within the Portal. Here, ADENE provides a report with improvement recommendations to the technician without altering individual registry entries. The third model, summary verification, entails a technical analysis of submitted documents and their registered content within the Portal. In some cases, ADENE may conduct an accompanying visit to the building or technical system under evaluation. This model involves interaction between ADENE and the technician as outlined in subsequent sections. The final model, detailed verification, involves replicating and meticulously analysing the qualified technician's work, often including an accompanying visit to the building or technical system. Similar to the summary verification model, this approach necessitates interaction between ADENE and the technician. The quality assessment results are categorised as 'compliant', 'compliant with observations' or 'non-compliant'. For non-compliant outcomes, a severity level (level 1, level 2, or level 3) is assigned. Depending on the assessment findings, a series of actions may be taken. These include filing the assessment by ADENE, recording annotations in the technician's individual registry for non-compliant or compliant with observations results, prompting updates to the verification document by the technician for non-compliant outcomes with severity levels 2 and 3, document cancellation (with removal from the Portal) by either ADENE or the technician in situations where updates are not feasible or not completed by the technician, and finally, communication to the DGEG in cases of non-compliant findings with severity level 3 or when technicians fail to cooperate with quality assessment procedures. It is important to note that financial penalties and additional sanctions can be imposed on technicians for non-compliance and	

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negligence. These sanctions can even lead to disqualification from practicing as a qualified EPC technician. From 2021 nearly 3000 EPC were checked by ADENE. Errors were found in 568 EPC and required correction by qualified experts. About 80% of EPC were correct. Fines were applied to 22 technicians. The strategy aimed to ensure that all qualified experts undergo at least one verification process within a three-year period. In cases where irregularities are identified, the qualified expert may be subjected to further in-depth verification procedures.	
Description of the enabling environment for the development / establishment The Portuguese quality assessment process for EPCs exhibits several strengths. The foundation upon a well-defined set of criteria and methodologies fosters consistency and transparency. Furthermore, the utilisation of four distinct models allows for tailored assessments based on specific EPC types and scenarios. The severity scale associated with non-compliant outcomes enables a nuanced evaluation of identified issues. Lastly, the possibility of implementing various corrective actions based on assessment results ensures that appropriate measures are taken to address deficiencies.	Image / Figure
Description of success factors for continuing operation The success of this quality assessment process is attributed to several enabling factors. A robust regulatory framework governing EPCs in Portugal establishes a strong foundation. The presence of a centralised database for EPCs facilitates efficient data collection and analysis. Most importantly, ADENE's commitment to quality assurance underpins the entire process. The quality assurance process prioritises the allocation of preventive assessment models (guided EPC registry and site visit or EPC aggregated analysis), in order to prevent error and ensure a closer and positive collaboration between ADENE and qualified experts. However, whenever necessary a more in-depth analysis is performed, and penalties maybe applied.	Image / Figure

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To ensure the process's continued effectiveness, several factors require consideration. Regular reviews and updates to the selection criteria and methodologies are essential to maintain their relevance in the evolving EPC system. Ongoing training for ADENE staff on the details of the quality assessment process is crucial for consistent implementation. Finally, establishing clear communication channels with qualified EPC technicians regarding the process promotes understanding and cooperation.	
Lessons Learned and key recommendations The quality assessment process serves as a valuable tool in maintenance the reliability of EPCs. Periodic reviews and updates are necessary to adapt the process to changes within the EPC regime. Effective communication with stakeholders, including regulatory bodies, qualified technicians, and building owners, is vital for the process's ongoing success. In conclusion, the quality assessment process for EPCs implemented in Portugal represents a well-designed and effective approach. This method can serve as a valuable model for other countries seeking to ensure the accuracy and reliability of EPCs and consequently promote energy efficiency in the building sector.	Image / Figure

Good practice #3

EPBD.wise	Quality Assurance of EPCs in Ireland
Author: Sustainable Energy Authority of Ireland	Date: April 2024
Contributors: Georgina Molloy (SEAI)	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

General challenges addressed			Specific challenges addressed: EPC	
Good governance	☐		Legal framework	☐
Staff shortage in public administration	☐		Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☐		Type of approach (national)	☒
Data accessibility for effective policies	☐		Exemptions or omissions	☐
Data quality for effective policies	☒		Calculation Methodology	☐
Estimation of impacts (broader benefits)	☐		EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐		Building typologies	☐
Clear presentation of co-benefits	☐		Indicators	☐
Financing	☐		Experts	☐
			Requirements	☐
			Training	☐
			Experts quality perception/evaluation	☐
			Independent control system	☒
			Databases	☐
			Input data	☐
			Additional uses/indicators	☐
			GDPR	☐
			Communication	☐
			Perception	☐
			Layout	☐
			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☐

Legend: Tick the appropriate box

Short description of good practice - summary	
The Quality Assessment of EPCs in Ireland ensures reliability and integrity through rigorous selection, verification, and follow-up processes. The system has 3 main components:	Image / Figure

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1. An audit framework which utilises a risk associated approach with targeted and random audits, coupled with clear guidelines and consequences for non-compliance, to ensure assessor competency and maintain the integrity of EPCs. 2. A competency framework which utilises training standards, occupational standards for EPC assessors and mandatory CPD to create a learning environment with a focus on continuous improvement and right-first time assessments. 3. A governance framework which continually reviews the effectiveness of the overall system.	

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	Data quality control
Administrative	
Societal	
Economic	

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☒	☒
Educational	☒	☒
Health	☒	☒

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

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Other (explain)			

Legend: Tick the appropriate box or add explanation

Target group(s) addressed				
Building owners	☐		Scientists	☐
Property managers	☐		Professional associations	☐
Energy companies	☒		Municipal administration	☐
Architects, engineers	☒		Regional administration	☐
Consultants	☒		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice

The Irish quality assurance system for EPCs incorporates several successful elements. Firstly, it employs a risk-based selection process. Audits target areas deemed high-risk, while also randomly sampling a statistically significant portion of all issued EPCs. This ensures comprehensive coverage and the identification of potential shortcomings across the assessor population.

Secondly, the system emphasises verification and follow-up. SEAI verifies the selected EPCs and conducts follow-up audits to confirm that corrective actions are taken to address identified issues. This feedback loop strengthens the programme's effectiveness.

Thirdly, the programme fosters assessor competency through a CPD and mentoring system. Assessors receive feedback from audits and participate in mentoring visits arranged by SEAI auditors. This approach provides valuable opportunities for continuous learning and improvement in EPC assessment practices. In addition, a CPD policy mandates the requirement to participate in CPD. SEAI supports assessors' participation by running regular technical webinars. Feedback loops and programme developments inform the content.

Finally, the system is underpinned by a well-defined Code of Practice and a Disciplinary

Figure 2 Classification system for audit findings of non-compliance [10]

Severity of non-compliance	Penalty points	Revocation of EPC
Compliance	0	No
Severity 3	1	No
Severity 3 (Advisory)	0	No
Severity 2	2	Yes
Severity 2 (Advisory)	0	Yes
Severity 1	3	Yes
Severity 1 (Advisory)	0	Yes

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Procedure. These documents establish clear guidelines for EPC assessors, outlining expectations for quality and imposing proportionate penalties for non-compliance. This framework incentivises assessors to maintain high standards and uphold the integrity of the EPC system.	
Description of the enabling environment for the development / establishment The enabling environment for this system is supported by two key factors. SEAI's role is crucial, as the organisation possesses the authority and resources to oversee the programme effectively. Building regulations in Ireland further strengthen the system by mandating EPCs and endorsing the implementation of quality assurance measures. This legal framework provides a strong foundation for the programme's operation.	Image / Figure
Description of success factors for continuing operation Several factors contribute to the programme's ongoing success. SEAI's commitment is vital for maintaining the programme's effectiveness. Continued dedication from SEAI ensures the programme receives the necessary resources and focus to remain impactful. Secondly, stakeholder engagement with assessors and industry stakeholders is crucial. Collaboration fosters a system that remains adaptable and efficient in addressing emerging challenges within the EPC landscape. Finally, regular analysis of audit data is essential. By identifying trends and areas for improvement, the programme can be continuously refined to maintain its effectiveness.	Image / Figure
Lessons learned and key recommendations	

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From this system is possible to highlight several key takeaways, such as, targeted auditing is a valuable tool in driving continuous improvement, a programme focuses on supporting assessors in getting their assessments right first time ensures resource allocation is optimised and on areas of higher risk are addressed as a priority. Clear communication of expectations and consequences to assessors is essential for programme success. Finally, the importance of continuous improvement through regular review and updates cannot be overstated. In conclusion, Ireland's quality assurance system for EPCs presents a well-structured approach that safeguards the integrity of EPCs and promotes competence among assessors. The combination of risk-based audits, mentoring, clear guidelines, and ongoing programme evaluation fosters a robust system that can serve as a valuable model for other countries implementing similar programmes.	Image / Figure

Good practice #4

EPBD.wise	Multi-Purpose EPC in Portugal
Author: ADENE	Date: April 2024
Contributors: Rui Fragoso (ADENE)	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

General challenges addressed			Specific challenges addressed: EPC	
Good governance	☐		Legal framework	☐

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Staff shortage in public administration	☐		Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☒		Type of approach (national, regional, etc.)	☐
Data accessibility for effective policies	☒		Exemptions or omissions	☐
Data quality for effective policies	☒		Calculation Methodology	☐
Estimation of impacts (broader benefits)	☒		EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐		Building typologies	☐
Clear presentation of co-benefits	☐		Indicators	☐
Financing	☒		Experts	☒
			Requirements	☐
			Training	☐
			Experts quality perception/evaluation	☐
			Independent control system	☐
			Databases	☒
			Input data	☒
			Additional uses/indicators	☐
			GDPR	☐
			Communication	☐
			Perception	☐
			Layout	☐
			Others	☐
			Monitoring of national policies	☒
			Financing/Incentives	☒

Legend: Tick the appropriate box

Short description of good practice - summary	
Portugal utilises EPCs for a variety of purposes, including informing policy, incentivising renovations, and supporting stakeholders such as local authorities, real estate agencies, and research activities. EPCs serve as a mandatory document for accessing funding schemes, accessing public grants, and securing low-interest loans. They also play a crucial role in monitoring and evaluating	Image / Figure

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policies, as well as in developing impactful future policies. The broader use of EPCs includes improving building stock knowledge and statistics, monitoring national policies such as the Long-Term Renovation Strategy (LTRS), estimating financial needs for renovations, and predicting the impact of future legislation. Additionally, EPCs incentivise renovation actions by awarding taxation benefits, supporting access to financial incentives, influencing building transaction prices, facilitating OSS for building renovation, and considering multiple dimensions such as comfort, indoor air quality (IAQ), and in the future, sustainability, SRI, and mobility. Furthermore, EPCs support stakeholders by fostering research and development (R&D), providing better information for real estate agencies, assisting local authorities in designing and monitoring plans, and enhancing reporting for banks' taxonomy support.	

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	Future legislation, supporting stakeholders
Administrative	Data availability, accessibility and database
Societal	
Economic	Financial incentives

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☒	☒

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

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Educational	☒	☒		
Health	☒	☒		
Other (explain)				

Legend: Tick the appropriate box or add explanation

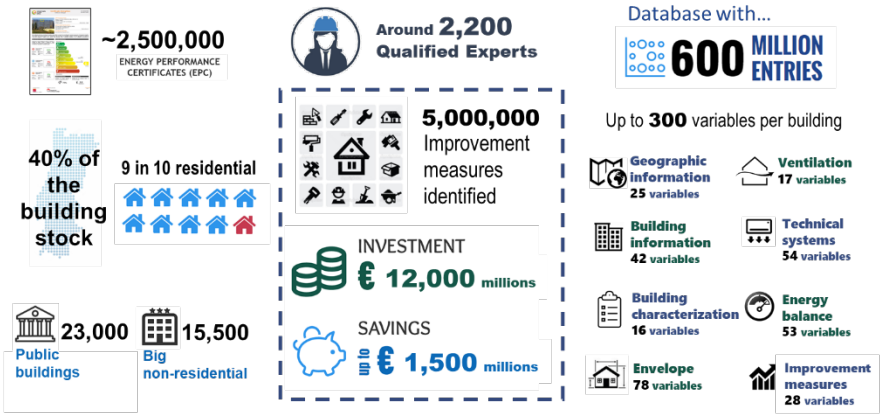
Target group(s) addressed				
Building owners	☒		Scientists	☒
Property managers	☒		Professional associations	☒
Energy companies	☐		Municipal administration	☒
Architects, engineers	☒		Regional administration	☒
Consultants	☒		Federal administration	☒
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice

Portugal multi-purpose EPCs serve as a versatile tool that efficiently accomplishes various functions for all stakeholders involved. With over 2.5 million certificates issued, covering close to 40% of the building stock, overseen by approximately 2,200 Qualified Experts, Portugal's EPC scheme has identified 5 million potential improvement measures, backed by a €12,000 million investment, potentially saving €1,500 million. These EPCs are designed not only to validate and monitor pre- and post-renovation works but also to track energy savings over time. The centralised database, containing more than 600 million entries and up to 300 variables per building,

Figure 3 EPCs scheme in Portugal



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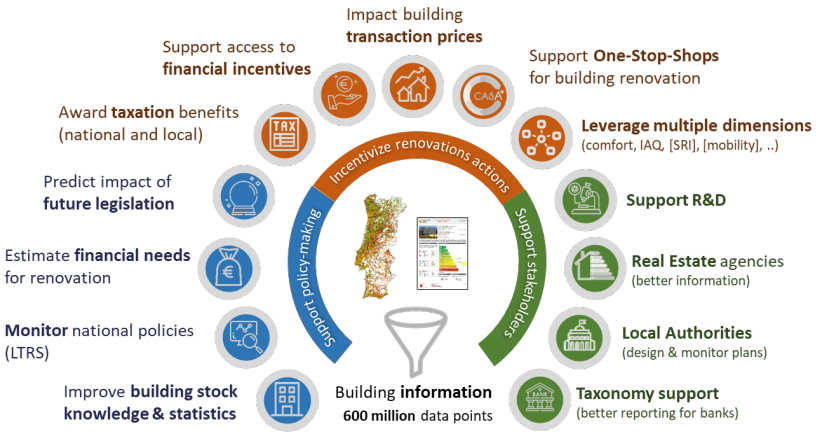
with unique EPC IDs, simplifies data access for technical and non-technical users, thereby streamlining information management effectively. Moreover, EPCs provide targeted information to homeowners, emphasising key recommendations and offering clear, easy-to-follow guides that enhance their understanding of potential improvements. Through marketing campaigns, these recommendations are prioritised and communicated in a manner that resonates with homeowners, encouraging them to take action and make energy-efficient changes that can save them money and help reduce their carbon footprint.	
Description of the enabling environment for the development / establishment The enabling environment for the development and establishment of energy efficiency improvements includes several key factors. Firstly, mandatory EPCs are essential for collecting data and establishing a baseline for renovation projects, ensuring that energy efficiency improvements are based on accurate and reliable information. Secondly, financial	**Figure 4** Portugal examples of EPCs and its data use 

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incentives are often available for those who implement EPC recommendations and make energy efficiency improvements to their buildings, counterbalancing the costs and providing a financial incentive for homeowners to invest in energy efficiency. Lastly, mechanisms for data sharing between EPC databases and other relevant databases exist, facilitating the exchange of information that informs decision-making and supports the development of effective policies and programmes.	
Description of success factors for continuing operation Several success factors were helpful in the development of this good practice. Data Quality Control involves regularly verifying the accuracy of data stored in the central database, indispensable for maintaining data integrity. Public Awareness Campaigns are crucial as homeowners need to understand the benefits of EPCs and energy efficiency improvements. Monitoring & Evaluation is essential for tracking the efficacy of financial incentives and campaign materials, determining their impact, and making necessary adjustments. By	Image / Figure

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implementing these success factors, operations can be sustained and improved over time.	
Lessons learned and key recommendations EPCs can be an incredibly versatile tool for policymaking, incentivisation, and stakeholder support. To accurately assess the impact of renovation projects, conducting pre- and post-renovation monitoring is essential. Providing clear and accessible information to homeowners, and other stakeholders, empowers them to make better-informed decisions about energy efficiency upgrades. Based on these lessons learned, key recommendations include adopting a multi-purpose EPC system, implementing pre- and post-renovation EPC for validation and monitoring, developing a centralised database with unique IDs for easy data access and analysis, and designing targeted information campaigns to educate homeowners about EPC recommendations.	Image / Figure

Good practice #5

EPBD.wise	Home Energy Scotland One-Stop Shop
Author: Save Energy Trust	Date: April 2024
Contributors: -	

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Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

General challenges addressed			Specific challenges addressed: EPC	
Good governance	☐		Legal framework	☐
Staff shortage in public administration	☐		Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☐		Type of approach (national, regional, etc.)	☐
Data accessibility for effective policies	☐		Exemptions or omissions	☐
Data quality for effective policies	☐		Calculation Methodology	☐
Estimation of impacts (broader benefits)	☒		EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐		Building typologies	☐
Clear presentation of co-benefits	☒		Indicators	☐
Financing	☒		Experts	☐
			Requirements	☐
			Training	☐
			Experts quality perception/evaluation	☐
			Independent control system	☐
			Databases	☐
			Input data	☐
			Additional uses/indicators	☐
			GDPR	☐
			Communication	☒
			Perception	☒
			Layout	☐

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			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☒

Legend: Tick the appropriate box

Short description of good practice - summary	
Home Energy Scotland (HES) operates as a One-Stop shop providing comprehensive support and advice for individuals seeking to improve energy performance in their homes. By offering accessible guidance, tailored recommendations, and facilitating deep renovation initiatives, HES enhances communication and perception regarding EPCs, fostering a culture of energy efficiency.	

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	Deep renovation and one-stop shop
Administrative	
Societal	
Economic	Subsidy schemes

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☐	☐
Educational	☐	☐

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

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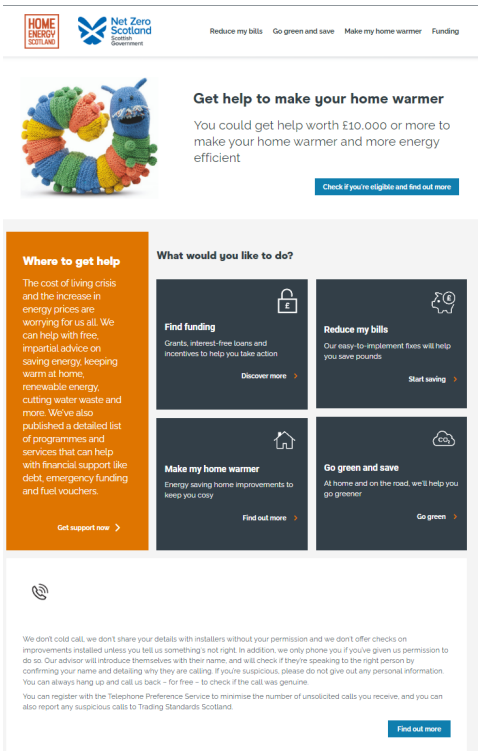
Health	☐	☐		
Other (explain)				

Legend: Tick the appropriate box or add explanation

Target group(s) addressed				
Building owners	☒		Scientists	☐
Property managers	☒		Professional associations	☐
Energy companies	☒		Municipal administration	☐
Architects, engineers	☒		Regional administration	☐
Consultants	☒		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice	
The Home Energy Scotland One-Stop Shop provides comprehensive services to homeowners, assisting over 90,000 customers annually in Scotland with a 97% satisfaction rate. Notably, customers achieved a lifetime carbon savings of over 382,000 tonnes of CO_2 in 2019-20, demonstrating significant environmental impact. Additionally, total lifetime energy bill savings exceed a billion pounds, highlighting tangible financial benefits. Services include energy assessments, advice on energy-efficient technologies, financial incentives, and contractor access. Tailored recommendations, with 83% customer recall, lead to 44% adopting energy efficiency measures and 38% planning to do so within 12 months. The OSS advocates deep renovation projects, fostering long-term energy efficiency enhancements. On average, each customer advised verbally saves 4.3 tonnes of CO_2, equating to £1,600 in financial savings. Accessibility and clarity of information on EPCs and energy efficiency are central to success, facilitated through various communication channels like online resources, telephone helplines, and face-to-face consultations.	**Figure 5** Homepage of OSS 
Description of the enabling environment for the development / establishment	

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The Home Energy Scotland One-Stop Shop is a service that provides homeowners with energy efficiency solutions. The development and establishment of this service is made possible by various factors such as strong government support and funding, the service is funded by the Scottish Government and managed by Energy Saving Trust. This support allows HES to offer its services to homeowners at little or no cost. Collaborations with local authorities, energy companies, and community organisations also help expand the reach of HES and facilitate the delivery of integrated energy efficiency solutions. In addition, supportive policies and regulations, including mandatory EPCs for property sales and rentals, create a favourable environment for HES's activities by emphasising the importance of energy performance improvements.	
Description of success factors for continuing operation The success of this service relies on several critical factors that ensure its continued operation and efficacy. Firstly, the service must have a User-Centric Approach, which means that it must continuously adapt to meet the evolving needs and preferences of homeowners. By keeping up to date with the latest trends and technologies, the service can remain relevant and effective in providing homeowners with the most useful and up-to-date information. Secondly, Continuous Improvement is essential for the service's continued success. Regular evaluations and refinements of the service's processes and offerings based on feedback and performance metrics are necessary to enhance its overall impact and efficiency. This will help to ensure that the service is continually improving and providing homeowners with the best possible advice and support. Finally, Sustainable Funding is crucial to safeguard the service's ability to deliver high-quality services over time. The service must secure long-term financial support and diversify funding sources to ensure its long-term sustainability. This will help to ensure that the service can continue to operate and provide essential assistance to homeowners for years to come.	Image / Figure

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Lessons learned and key recommendations Education and Awareness: Increasing public awareness of the benefits of energy efficiency and the role of EPC is crucial for fostering widespread adoption of energy-saving measures. Integration of Services: Streamlining access to various energy efficiency programmes and resources, including financial incentives and technical support, simplifies the process for homeowners and encourages participation. Community Engagement: Engaging with local communities and stakeholders fosters trust, enhances outreach efforts, and promotes the adoption of energy-saving practices at the grassroots level. In summary, Home Energy Scotland's One-Stop Shop approach effectively improves communication and perception regarding EPC while encouraging deep renovation initiatives to enhance energy efficiency in homes. Through comprehensive support, tailored recommendations, and collaborative partnerships, HES establishes an enabling environment for sustainable energy performance improvements, ensuring continued success through user-centric approaches, continuous improvement, and community.	**Figure 6** Examples of communication campaign 1  **Figure 7** Examples of communication campaign 2 

Good practice #6

EPBD.wise	Owner-oriented Energy Performance Certificates (EPCs) in Denmark
Author: Danish Energy Agency	Date: April 2024
Contributors: -	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐

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EPC – Energy Performance Certificates	☒

Legend: Tick the appropriate box

General challenges addressed			Specific challenges addressed: EPC	
Good governance	☐		Legal framework	☐
Staff shortage in public administration	☐		Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☐		Type of approach (national)	☒
Data accessibility for effective policies	☐		Exemptions or omissions	☐
Data quality for effective policies	☐		Calculation Methodology	☐
Estimation of impacts (broader benefits)	☐		EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐		Building typologies	☐
Clear presentation of co-benefits	☐		Indicators	☐
Financing	☐		Experts	☐
			Requirements	☐
			Training	☐
			Experts quality perception/evaluation	☐
			Independent control system	☐
			Databases	☐
			Input data	☐
			Additional uses/indicators	☐
			GDPR	☐
			Communication	☒
			Perception	☒
			Layout	☒
			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☐

Legend: Tick the appropriate box

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Short description of good practice - summary	
Denmark's new Owner-oriented EPCs empower homeowners to enhance energy efficiency. These certificates offer simplified displays of savings, recommended improvements, detailed budgets, tailored guides, and online resources, encouraging an informed decision-making and proactive pursuit of energy efficiency.	Image / Figure

Characteristics and detailed description of solution

Context addressed	
Technical	
Legal	EPC layout
Administrative	
Societal	
Economic	

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☐	☐
Educational	☐	☐
Health	☐	☐
Other (explain)		

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

Legend: Tick the appropriate box or add explanation

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Target group(s) addressed				
Building owners	☒		Scientists	☐
Property managers	☒		Professional associations	☐
Energy companies	☐		Municipal administration	☐
Architects, engineers	☐		Regional administration	☐
Consultants	☐		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

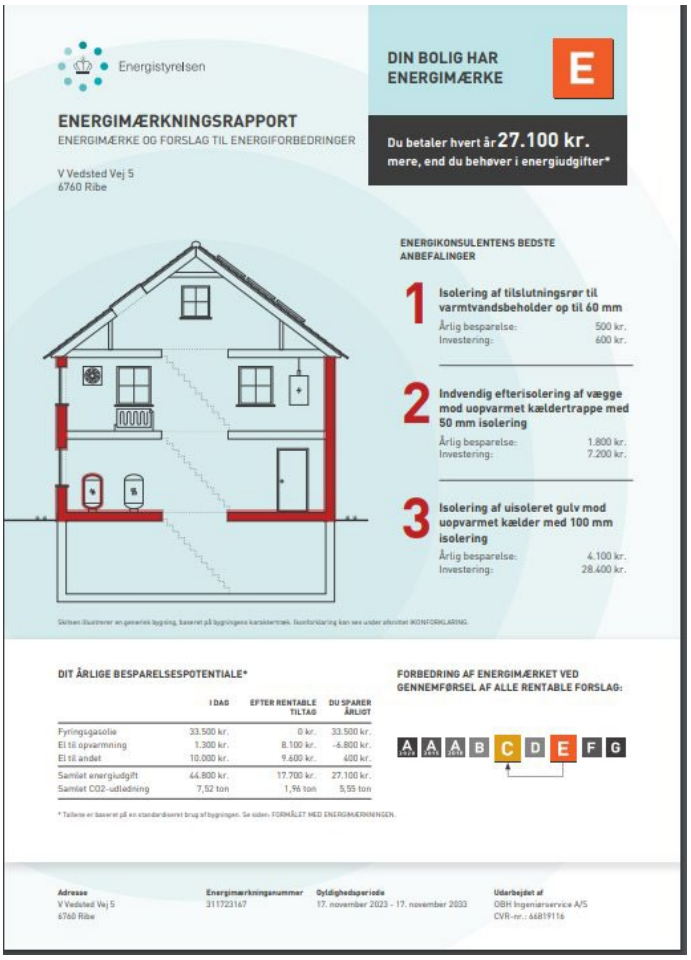
Detailed description of good practice

Description of the elements which work well

The implementation of user-friendly Danish EPCs has resulted in notable improvements in the comprehension and utilisation of energy efficiency information among building owners. A study conducted in 2021 indicated a significant increase in the emission of EPC following revisions and digitalisation efforts. Specifically, the emission rose from [15] approximately 68,000 in 2020 to roughly 81,000 in 2021. This increase underscores the effectiveness of the redesigned layout in facilitating accessibility and understanding.

The reimagined EPC reports aim to transition homeowners from considering energy improvements to actively implementing them, leveraging a behavioural-optimised approach. The front page offers a simplified display of potential savings, dynamic visualisations highlighting recommended improvements, and a detailed budget showcasing potential returns on investment. Additionally, on the second page, the layout features the three most beneficial

Figure 8 Denmark EPC new layout (front page)



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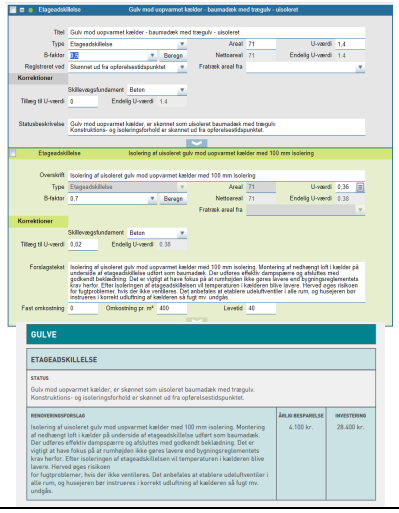
recommendations and dynamically illustrates the cumulative impact of implementing all profitable suggestions. There is also an online access to more valuable information, videos, drawings and craftsmen list.	
Description of the enabling environment for the development / establishment Supportive government policies and incentives create an enabling environment for the development and establishment of owner-oriented EPC. Technological advancements, including dynamic visualisations and comprehensive online resources, leverage the latest tools to enhance efficacy. Collaborative efforts among government agencies, energy experts, and craftsmen ensure the availability of accurate information and resources, further supporting the implementation process.	**Figure 9** Denmark EPC new layout (second page) 
Description of success factors for continuing operation Continuous user engagement through feedback mechanisms and updates ensures ongoing relevance and effectiveness of the EPC. Regular revisions reflecting advancements in technology and best practices sustain their efficacy over time. Rigorous quality assurance measures uphold the accuracy and reliability of data and recommendations, bolstering trust in the certification process.	**Figure 10** Denmark EPC new layout (Online access to more information) 
Lessons learnt and key recommendations	Image / Figure

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Personalisation, accessibility, and education are key lessons learned from the implementation of owner-oriented EPC. Tailoring recommendations and guidance to individual homeowner characteristics and preferences maximises effectiveness. Ensuring easy access to resources and support services simplifies the implementation process and fosters action. Continuous educational initiatives are vital for promoting understanding and adoption of energy efficiency measures among homeowners, fostering long-term sustainability. In conclusion, Denmark's owner-oriented EPCs exemplify best practices in empowering homeowners to embrace energy efficiency measures. By providing accessible information, personalised guidance, and comprehensive resources, these certificates play a pivotal role in advancing the green transition and improving the sustainability and comfort of residential buildings.	

Good practice #7

EPBD.wise	X-tendo Toolbox
Author: X-tendo project	Date: April 2024
Contributors: -	

Aspects addressed	
ZEB – Zero-Emission Building	☐
MEPS - Minimum Energy Performance Standards	☐
NBRP – National Building Renovation Plan	☐
RP – Renovation Passport	☐
EPC – Energy Performance Certificates	☒

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Legend: Tick the appropriate box

General challenges addressed			Specific challenges addressed: EPC	
Good governance	☐		Legal framework	☐
Staff shortage in public administration	☐		Legislation coverage (all, partly, older, etc.)	☐
Data availability for effective policies	☒		Type of approach (national, regional, etc.)	☐
Data accessibility for effective policies	☒		Exemptions or omissions	☐
Data quality for effective policies	☐		Calculation Methodology	☒
Estimation of impacts (broader benefits)	☐		EPC calculation type (static, dynamic, seasonal, monthly, hourly)	☐
Industry and labour and skill shortages	☐		Building typologies	☐
Clear presentation of co-benefits	☐		Indicators	☒
Financing	☒		Experts	☐
			Requirements	☐
			Training	☐
			Experts quality perception/evaluation	☐
			Independent control system	☐
			Databases	☒
			Input data	☐
			Additional uses/indicators	☒
			GDPR	☐
			Communication	☒
			Perception	☒
			Layout	☐
			Others	☐
			Monitoring of national policies	☐
			Financing/Incentives	☒

Legend: Tick the appropriate box

Short description of good practice - summary	
The X-tendo toolbox is an innovative resource facilitating the implementation of next-generation EPCs across	

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Europe. It addresses ten key features essential for enhanced compliance, reliability, usability, and convergence of energy performance assessment and certification. Through problem-solving solutions, methodological approaches, calculation procedures, and implementation guidelines, the toolbox ensures transparency, understanding, and effective integration of innovative EPC features. It prioritises good quality and reliability, user-friendliness, economic feasibility, and consistency with ISO/CEN standards, thereby fostering improved energy performance assessments and promoting energy renovations.	Image / Figure

Characteristics and detailed description of solution

Context addressed	
Technical	Smart readiness indicator, Comfort indicator, Outdoor air pollution indicator, Real energy consumption, District energy, Enhanced Recommendations
Legal	Building logbooks
Administrative	Databases, One-Stop Shops
Societal	
Economic	Financial subsidies

Legend: Allocate a topic

Technical: e.g. construction types, materials, heating and cooling systems, electricity supply

Legal: e.g. federal or regional/municipal responsibility; relation with building regulation, energy audit, RES legislation

Administrative: e.g. is the unique definition of building address and unit address available or not; databases, tools

Societal: e.g. how is energy poverty dealt with

Economic: e.g. which subsidy schemes exist on what basis

Built environment addressed		
	Small	Large
Residential buildings	☒	☒
Non-residential buildings	☒	☒
Office	☒	☒
Educational	☒	☒
Health	☒	☒
Other (explain)		

Scale addressed	
Building	☒
Neighbourhood	☐
District	☐

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Legend: Tick the appropriate box or add explanation

Target group(s) addressed				
Building owners	☒		Scientists	☐
Property managers	☒		Professional associations	☐
Energy companies	☒		Municipal administration	☐
Architects, engineers	☒		Regional administration	☐
Consultants	☒		Federal administration	☐
Other (explain)			Other (explain)	

Legend: Tick the appropriate box or add explanation

Detailed description of good practice	
Description of the elements which work well The X-tendo toolbox demonstrates its effectiveness through several key elements. Firstly, it offers comprehensive coverage by incorporating ten innovative features critical for next-generation energy performance assessments and certifications (EPCs). These features include: smart readiness, comfort, outdoor air pollution, real energy consumption, district energy, EPC databases, building logbook, enhanced recommendations, financing options and OSS. This holistic approach ensures a complete evaluation process that goes beyond traditional EPCs. Secondly, the toolbox prioritises a solution-oriented approach. It incorporates problem-solving methodologies and solutions derived from established best practices, so facilitating the replication and implementation of these methods within new EPC projects. Furthermore, the X-tendo toolbox emphasises transparency and understanding. By providing clear calculation procedures, it empowers users to not only implement the new EPC features but also develop a deeper understanding of their underlying functionalities. Finally, the toolbox incorporates guidelines for integration. These recommendations assist in seamlessly embedding the innovative features within	**Figure 11** X-tendo toolbox 

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existing EPC frameworks, ensuring their successful adoption and widespread use.	
Description of the enabling environment for the development / establishment The development and establishment of the X-tendo toolbox are facilitated by an enabling environment that recognises the importance of energy efficiency and the role of EPC in achieving this. This environment is characterised by supportive policies, collaboration between stakeholders, and a commitment to continuous improvement and innovation	Image / Figure
Description of success factors for continuing operation The X-tendo toolbox outlines several success factors crucial for its continued operation and widespread adoption. First, the toolbox prioritises stakeholder engagement. Active involvement and support from key stakeholders, such as policymakers, industry professionals, and building occupants, ensure the ongoing relevance of the toolbox and its uptake within the target community. Secondly, scalability and flexibility are central design principles. By being adaptable to different contexts, the toolbox allows for customisation as per specific requirements. This enables widespread adoption across a range of building types, regions, and regulatory frameworks. Furthermore, the toolbox promotes knowledge sharing. By facilitating the exchange of knowledge and dissemination of best practices among users, the X-tendo toolbox promotes mutual learning and collective improvement within the building performance community. Finally, the success of the toolbox centres on measuring its impact. Establishing clear metrics and indicators allows for the evaluation of the toolbox's effectiveness in driving energy efficiency outcomes. This data-driven approach enables evidence-based decision-making to further refine and enhance the X-tendo toolbox.	Image / Figure
Lessons learned and key recommendations	

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The X-tendo project provides valuable insights into the development and implementation of next-generation EPC features. Understanding user perception through user testing emerged as a critical step for ensuring the effectiveness and adoption of the developed materials. A key challenge identified relates to the performance of on-site measurements. The additional effort and costs associated with installing, uninstalling, and operating the necessary equipment and staff were thought to be significant barriers to incorporating this feature into national EPC schemes. These findings highlight the importance of further exploring the future format of EPCs. The potential widespread adoption of smart sensors and controls in buildings offers a promising scenario for facilitating future assessments. Building upon the project's results, X-tendo provides key recommendations for integrating new features into EPC schemes. This guidance aims to propel EPC schemes to the next level of effectiveness. Additionally, the project serves as a comprehensive resource for implementing and replicating the innovative features designed for next-generation EPCs. By consolidating the evaluations of test projects alongside user and stakeholder insights, the X-tendo report offers a valuable roadmap for practical application. Finally, the project emphasises the importance of linking EPC schemes with financial instruments. This can be achieved by establishing the EPC as a mandatory eligibility criterion for specific financial mechanisms, both before and after project implementation (ex-ante and ex-post evaluation). This approach strengthens the role of EPCs in facilitating access to financing for energy efficiency improvements.	Image / Figure

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