

# Harnessing energy performance certificates for deep energy renovation: Policy recommendations and evidence from testing

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## Abstract

To achieve the EU's energy efficiency targets, both the rate of building energy renovation and its depth, i.e., the amount of energy savings post renovation need to be improved. Energy Performance Certificates (EPCs) are key to make energy efficiency measures transparent for the building market and to promote the energy efficiency of buildings through renovation. The revision of the Energy Performance of Buildings Directive (EPBD) is seen as a pre-condition to meet the Renovation Wave objectives and to reach a highly energy efficient and decarbonized building stock by 2050. One focus of the current revision of the EPBD is therefore the improvement of EPCs. QualDeEPC – High-quality Energy Performance Assessment and Certification in Europe Accelerating Deep Energy Renovation, funded under the EU's Horizon 2020 programme, is a project that aims to improve EPCs. Following an EU-wide review of existing EPC schemes, and extensive stakeholder discussions in the seven partner countries, QualDeEPC found that EPCs and EPC schemes need to enhance particularly in the following three ways:

1. Establish a close link between EPCs and deep energy renovation
2. Improve the quality of EPC schemes, i.e., both the EPCs and their data, and the processes of assessment, certification, verification

3. Improve cross-EU convergence of EPC schemes.

Therefore, QualDeEPC developed an enhanced EPC scheme by improving seven elements of existing EPC schemes across the EU and tested their applicability and convergence potential for their EU-wide uptake. They include improved renovation recommendations consistent with deep energy renovation, high user-friendliness through an improved EPC template, mandatory regular training or examinations for EPC assessors, and four other measures to facilitate better implementation and compliance by Member States and market actors.

For testing the tools on renovation recommendations and user-friendliness in the enhanced EPC scheme, 98 pilot buildings were selected from seven partner countries. For all the pilot buildings, standard EPCs were prepared as per existing practice, and enhanced EPCs were prepared using the enhanced EPC scheme. Three further priorities – Online tool, Deep Renovation Network Platforms, and Advertisement Guidelines – were tested for their effectiveness by means of a questionnaire to building owners and other stakeholders.

The results show significant potential for improvement and convergence between various member states, and are discussed in the present paper. In most countries, the number of recommendations and their ambition increased in the enhanced EPCs that provide a clear list of options, and on average, almost 50 % of energy savings potential was suggested in the enhanced EPCs. Based on the analysis, tools developed, and evidence from testing, the paper summarizes the conclusive policy recommendations by the QualDeEPC project, to inform the further EPC policy process at EU level and particularly the EPBD revision.

## Introduction

To achieve the EU's energy efficiency targets, it is essential to improve the energy efficiency of existing buildings through deep energy renovation. Both the rate of energy renovation and its depth, i.e., the amount of energy savings during a renovation, need to be improved. QualDeEPC, funded under European Union's Horizon 2020 research and innovation programme, aims to develop high-quality energy performance assessment and certification in Europe that accelerates deep energy renovation (QualDeEPC, 2021). The project has national partners from Bulgaria, Greece, Germany, Hungary, Latvia, Spain and Sweden.

A detailed analysis of the EPC schemes in the partner countries and the EU was conducted (Gokarakonda, Venjakob, et al., 2020) and gaps, shortcomings (Gokarakonda, Thomas, et al., 2020), and best practices (Kostova, Gokarakonda, et al., 2020) were identified, and also based on the national stakeholder workshops, QualDeEPC identified seven priorities for improvement in the proposed enhanced EPC scheme (Kostova, Thomas, et al., 2020; Thomas et al., 2021).

The seven priorities have been further developed in the course of the project and the preliminary results of the enhanced EPC were summarised in a Green Paper (Veselá et al., 2020). A second round of national workshops was organized, where the results from the Green Paper were discussed (Veselá, Thomas, & Pannier, 2021). Furthermore, the enhanced EPC scheme proposed in the Green Paper was tested for its applicability in a total of 98 pilot buildings from the seven QualDeEPC partner countries. The testing facilitated a cross national comparison of the enhanced EPC scheme. Then, the Green Paper was further advanced to the White Paper on good practice in EPC assessment, certification, and use. This includes the drafts for the enhanced EPC assessment scheme containing a draft of the enhanced energy performance certificate of four pages and the concept for the Deep Renovation Network Platforms as well as for the tools. All of this was the basis for developing the national adaption of the enhanced EPC scheme and dialogue activities (Korma & Lampropoulou, 2022; Salve & Thomas, 2022) and the conclusive policy recommendations (Thomas & Venjakob, 2022).

This paper has two parts: the first part presents the testing results of the enhanced EPC scheme, along with relevant information from the pilot cases, such as the stakeholder feedback, with particular focus on similarities and differences between the QualDeEPC partner countries to demonstrate the convergence potential of enhanced EPCs for their EU-wide uptake (point two above – only testing). In the second part, it presents policy recommendations, which are based on the national and

local experience and that could be used by the European Commission, the European Parliament, and the Member States to accelerate the development of the EPC policy and regulation towards higher quality, convergence, and usefulness for deep energy renovation at reasonable costs.

## Testing of the pilot buildings

### SELECTION OF PILOT BUILDINGS

In total, 98 pilot buildings were selected from all QualDeEPC partner countries along well defined criteria (Latvia – 15; Greece – 12; Bulgaria – 8; Sweden – 11; Spain – 15; Germany – 20; Hungary – 17) (Žogla, 2021). Most pilot buildings were built between 1960 and 1980. Among them, 61 are residential buildings, of which 33 are multi-apartment buildings, 20 are single family or row buildings and 8 are single apartments; and 37 are non-residential buildings, consisting of educational buildings, office buildings and other types of non-residential buildings. 50 pilot buildings have had existing EPCs.

### METHODOLOGY

For all the pilot buildings, standard EPCs were prepared as per current practice, and enhanced EPCs were prepared using the enhanced EPC scheme, as proposed in the Green Paper. Additionally, specific questionnaires on the enhanced EPC were presented to facility managers/building owners for their responses on the user friendliness of the enhanced EPCs and usefulness of online tool, Deep Renovation Network Platforms, and advertisement guidelines. Furthermore, the results from the pilot cases were presented to the stakeholders and discussed in a series of roundtable discussions in all QualDeEPC partner countries. The participants in the roundtable consisted of various stakeholders, including EPC issuers, policy makers, and building owners. Their feedback was collected, documenting the differences, experiences, and what worked well or not during the preparation of the enhanced EPC in comparison to the standard EPC. For assessing the priorities, A and E (see Table 1), the standard and enhanced EPCs were compared to identify changes and improvements, or lack thereof, from the standard EPCs. In addition, responses to the questionnaires from the building owners were collected for priority E. Three priorities, B, C, and F, were tested by means of responses to the questionnaires from the building owners and feedback from the stakeholder roundtables. Two remaining priorities, D and G were beyond the scope for testing. Furthermore, based on this information, the theoretical potential for EU-wide convergence (i.e.,

Table 1. Seven priorities for improvement in the proposed enhanced EPC scheme.

A.	Improving the recommendations for renovation, which are provided on the EPCs, towards deep energy renovation.
B.	An online tool for comparing EPC recommendations with deep energy renovation recommendations.
C.	Creating Deep Renovation Network Platforms (One-Stop Shops plus networking and joint communication of supply-side actors).
D.	Regular mandatory EPC assessor training (on assessment and renovation recommendations) required for certification/ accreditation and registry.
E.	Achieving a high user-friendliness of the EPC.
F.	Mandatory or at least voluntary advertising guidelines for EPCs.
G.	Improving compliance with the mandatory use of EPCs in real estate advertisements.

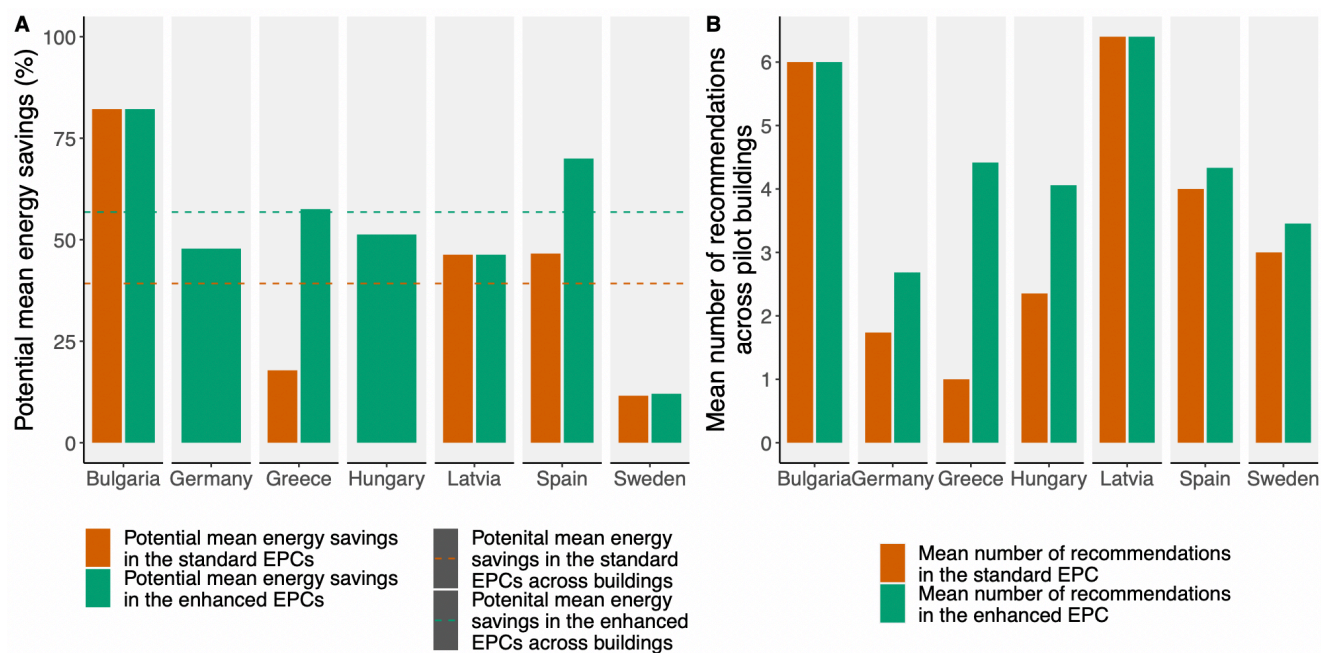


Figure 1. A) Mean number of recommendations provided in the enhanced and standard EPCs of pilot buildings; B) Potential mean energy savings (in percentage) in Enhanced EPCs. Source: Authors, based on (Gokarakonda et al., 2022).

adaptation and adoption in a coherent manner in most or all EU Member States) for all the priorities was discussed.

## RESULTS

Key results from testing of the pilot buildings are presented for each of the seven priorities in the following subsections. More details can be found in (Gokarakonda et al., 2022; Žogla & Gokarakonda, 2022).

### Priority A. Improving the recommendations for renovation towards deep energy renovation

QualDeEPC developed a set of more energy-efficient renovation recommendations to guide the EPC assessors towards deep energy renovation (Veselá, Thomas, et al., 2021).

#### Comparing the recommendations and their presentation between the enhanced and standard EPCs

Compared to the renovation recommendations in most standard EPCs that usually only meet minimum legal requirements, the recommendations in enhanced EPCs are proposed to be consistent with, and guide towards 'deep energy renovation'. In all pilot buildings, the recommendations and their presentation in the enhanced EPCs were compared with the standard EPCs to identify changes and improvements, or lack thereof. Overall, the enhanced EPC presents many features regarding the renovation recommendations that are not usually present in standard EPCs. The results from 1) a comparison of the standard and enhanced EPCs by the QualDeEPC country partners 2) questionnaires answered by pilot building representatives, and 3) stakeholder roundtable meetings indicate that while many features in the enhanced EPC are perceived to be a clear or partial improvement over the standard EPC, a few are better represented in standard EPCs. The feature related to presenting energy rating with a 'traffic light system' for recommendations is seen as an improvement in the majority of the partner coun-

tries, although this information is not present in any of their standard EPCs (Žogla & Gokarakonda, 2022).

What is important for stimulating deep energy renovation, enhanced EPCs show a significant increase compared to the standard EPCs in the mean number of renovation recommendations in Greece and Hungary; and some increase in Germany, Spain and Sweden. In Bulgaria and Latvia, where the standard EPC is already based on a thorough energy audit, there is no change in the already high number of recommendations between the standard and enhanced EPCs (see Figure 1A). Compared to the recommendations in the standard EPCs, the enhanced EPCs show a significantly higher potential for energy savings in Greece and Spain, and a low to marginal additional potential in Bulgaria and Sweden. In Bulgaria, the reason for this result seems to be that the standard EPC is already based on a thorough energy audit, and the EPC comes with detailed information on the recommendations. In Germany, Hungary and Latvia, potential energy savings are not provided in the standard EPC, but the potential for energy savings in the enhanced EPC is quite high, in the range of 40 to 50 per cent on average (see Figure 1B). Overall, potential mean energy savings in the enhanced EPCs across all buildings exceed that of standard EPCs by 17.5 %.

#### Feedback from stakeholder discussions

Overall, the recommendations and their presentation in the enhanced EPC are seen as a clear improvement over the standard EPCs. The 'main option', which combines a set of cost-effective recommendations, and the energy rating with a 'traffic light system' for individual building component and technical system wise recommendations are seen as clear improvements across the partner countries (Veselá, Thomas, Gokarakonda, et al., 2021, Figure 11). The enhanced EPC clearly shows what energy efficiency measures should be implemented, and helps in decision-making to actually implement these measures by showing the full potential (energy saving potential) of these

measures. Key challenges include features that are either missing from or better represented in some of the standard EPCs, including lack of CO<sub>2</sub> emission reductions for main option, lack of energy savings by end-use and fuel source, and a way to convert this information into monetary terms, lack of information on capital cost investment for component and system wise recommendations, lack of guidance to EPC assessors for providing the recommendations and traffic light system, and cost and payback information for individual recommendations.

#### *Potential for convergence*

Out of 10 primary features, four have high, two have medium and four have low potential for convergence. Therefore, the overall potential for convergence of recommendations for renovation can be rated as medium.

#### **Priority B. An online tool for comparing EPC recommendations with deep energy renovation recommendations**

QualDeEPC developed a concept for a simple online calculation tool that building owners could use for estimating the potential energy efficiency measures and resulting energy savings in buildings, e.g., to better inform themselves prior to consulting an energy consultant or an EPC issuer (Veselá, Thomas, et al., 2021).

#### *Responses to the questionnaires from the building owners*

Building representatives (owners) were provided with a structured questionnaire regarding the tool itself and the information contained in such a tool. The question to the building representatives was: "Would you like to receive the following information from such a tool?" and the responses were recorded as 'yes' or 'not interested'. Most questions received an average interest of above 75 %. Across countries, building owners are interested in understanding the total costs for renovation, simple payback period, energy cost savings, and improvement in energy class, if the renovation recommendations are implemented. Comparatively, CO<sub>2</sub> emissions savings and economic gains, which are expressed in accurate but less understood metrics, such as net present value received the lowest interest, although it is still above 60 %.

#### *Feedback from stakeholder discussions*

Overall, the online tool received wide acceptance from the stakeholders. On national level, these platforms should be operated by the energy agencies, which will give the possibility to consult them not only online, but also physically and receive the required support from them. The cost related information is perceived as unreliable due to the dynamically fluctuating market environment. However, this could be overcome by annually updating the cost database. Instead of a standalone online tool, few participants proposed that this should be part of the DRNPs (see priority C.).

#### *Potential for convergence*

The potential for convergence for such an online tool is high. Most stakeholders have expressed interest in the information provided in such an online tool and in many of its features, suggesting that stakeholders in most countries have similar needs. Some MS already have such tools, sometimes more than one, others don't. Implementing it in more countries will increase the potential for convergence.

#### **Priority C. Creating Deep Renovation Network Platforms (One-Stop Shops plus networking and joint communication of supply-side actors)**

QualDeEPC proposes a Deep Renovation Network Platform (DNRP) that provides all relevant information on EPCs, building renovation and building energy efficiency in one place (Veselá, Thomas, et al., 2021).

#### *Responses to the questionnaires from the building owners*

The question asked to the building representatives was whether they would use a type of information or not. Most questions received an average response ("I would use it") of above 75 %. Building owners found these as the most interesting features

- Finding general information on costs of and financing opportunities for deep renovation,
- Potential for energy and cost savings; building components, building services, renewable energy systems that are required for deep renovation; and
- A platform for finding and receiving offers/quotes from energy efficient experts, contractors, technicians, and vendors to implement recommendations.

#### *Feedback from stakeholder discussions*

For both EPC certifiers and end users, providing as much relevant information as possible would be useful. Few suggestions that could maximise the impact of the platform include:

- A good definition of the recommendations for improvement measures, and characteristics of the construction systems and equipment (prices, transmittances, or the relevant data according to the improvement).
- Featuring on the platform the catalogues with ideas and standard equipment to guide the EPC certifier.
- Investment planning for end consumers.
- Include national case studies/best practices with technical and financial information
- Link to a database of certified technicians

#### *Potential for convergence*

The potential for convergence for such an online tool is high. Most stakeholders have expressed interest in the information provided in a Deep Renovation Network Platform and in many of its features, suggesting that stakeholders in most countries have similar needs.

#### **Priority E. Achieving a high user-friendliness of the EPC**

QualDeEPC developed an enhanced general template for the EPC form as a policy proposal (Thomas et al., 2021; Veselá, Thomas, Gokarakonda, et al., 2021).

#### *Comparing the user-friendliness between the enhanced and standard EPCs*

Compared to the standard EPCs, in the enhanced EPCs, the following features are perceived as clear changes and improvements in most partner countries: scale of energy class; identification of new energy class and annual energy savings after implementing the recommendations in the main option; ener-



gy rating of existing building elements and renovation recommendations with traffic light system; and useful combinations of recommendations for staged deep renovation. However, in Hungary and Latvia, most of these features are presented in the Annex, rather than on the main EPC, where they are prominently visible. Some standard EPCs present more detail on energy use in the existing building than the enhanced EPC. However, this can be easily addressed.

#### *Feedback from building representatives*

To evaluate the user friendliness of the enhanced EPC template, a questionnaire was sent out to pilot building representatives together with the standard and enhanced EPC of their pilot buildings (Žogla & Gokarakonda, 2022). They were asked to answer these questions for both standard EPC and enhanced EPC. In total 69 questionnaires were filled in and considered in this analysis. Overall, the enhanced EPC template received a 71.4 % score (averaged out by 7 countries) and 72.7 % score (averaged out by 69 respondents), while the user friendliness of the standard EPC received 62.2 % (averaged out by 7 countries) and 60.6 % (averaged out by 69 respondents), indicating an improvement in the enhanced EPC compared with the standard EPC by 10.65 %. The enhanced EPC scored high (and higher than the standard EPC) in all countries for most of the statements related to renovation and renovation recommendations. However, an exception is Latvia, which already had a very good presentation. In Germany and Latvia, the standard EPC has an additional scale of comparison to other buildings, but the enhanced EPC does not, so the enhanced EPC scores worse for the questions relating to those features.

#### *Feedback from stakeholder discussions*

The enhanced EPC has been considered an improvement over the standard EPCs in the way it presents key information about the building energy performance. The energy rating of the existing building envelope and technical systems with a 'traffic light system' was perceived as a key improvement. Key challenges include unclear identification of renewable energy fraction, energy consumption by end-use and fuel source, and other country specific requirements. Most of these challenges could be overcome through national adaptation.

#### *Potential for convergence*

In general, the results from the questionnaire for building representatives and the discussions with stakeholders showed that the enhanced EPC template proposed by QualDeEPC has high potential for convergence between EU Member States, for its four pages. Because, most of the proposed features in the enhanced EPCs already exist in the standard EPCs, and where they are non-existing, e.g., in countries that have had EPCs with one or two pages only, they are perceived as at least partial improvement. If a Member State has different legal requirements or thinks more information is still important and necessary to inform building owners and users e.g., on the current energy status of the building, this can be added in one or more additional pages to the enhanced EPC. Space for important simple additional check boxes may also be found on the four pages of the enhanced EPC template. The results of the testing also showed that more guidance for EPC assessors is needed, e.g., on how to select recommendations based on cost-effectiveness,

how to assess their energy rating and cost-effectiveness, and how to combine them to the main option.

#### **Priority F. Voluntary/mandatory advertising guidelines for EPCs**

According to the EPBD, it is mandatory to show the energy class and energy data from the building's EPC in advertisements when selling or offering a building for rent, although compliance with this regulation may be often low. QualDeEPC has, therefore, proposed that Member States offer advertisement guidelines to ease compliance with this requirement. This is following the example of Sweden, where there is practical guidance on how to comply with the regulation that efficiency class, scale of energy consumption, and CO<sub>2</sub> emissions should be shown at least (Veselá, Thomas, et al., 2021).

#### *Feedback from building representatives*

A question regarding this proposal was also included in the questionnaire to building representatives in six of the seven EU Member States represented in the QualDeEPC project, but not in Sweden, where such guidelines already exist. A number of features were presented under the general question: "Which guidance would be useful for you to comply with this regulation when selling/letting a building?". Among the aspects that received most interest are ways to find out the current energy demand/consumption and energy costs of the building, energy class and date of issue of the EPC.

#### *Feedback from stakeholder discussions*

Stakeholders broadly agreed that in general, control mechanisms to monitor the energy class and energy data from the building's EPC in advertisements need to be strengthened. The provision of guidelines on "how to" find, present, or calculate different values, is a task that also the EPC assessors should undertake when handing in the EPC to the building owner/representative. Furthermore, stakeholders supported the proposal to provide general/indicative guidelines for building owners/users related to the legal requirements when advertising to media. In Sweden, most stakeholders find the guidelines to be very useful for the compliance.

#### *Potential for convergence*

The potential for convergence is high for the existence of such guidelines, and moderate for their content (depends on the legal requirements for which information to show, which may differ between Member States).

### **EU-level policy recommendations**

First, an overview and general recommendations are offered in this section. Second, it provides specific policy recommendations related to the seven priorities of QualDeEPC for the development of enhanced EPC schemes. These are, on the one hand, formulated in a general way directed to all Member States, which would improve cross-EU convergence of EPC schemes. On the other hand, there are suggestions for potential regulations that may be included in the revised EPBD, which would oblige or support the Member States to implement the policy recommendations we suggest to them here. These recommendations will be further discussed with EU and national policy-makers and stakeholders during the project and may be developed further.

**OVERVIEW AND GENERAL POLICY RECOMMENDATIONS BY QUALDEEPC**

QualDeEPC found that EPCs and EPC schemes need to be enhanced particularly in the following three ways:

- Establish a close link between EPCs and deep energy renovation
- Improve the quality of EPC schemes, i.e., both the EPCs and their data, and the processes of assessment, certification, verification
- Improve cross-EU convergence of EPC schemes.

**Establish a close link between EPCs and deep energy renovation**

In general, we see the need to enhance EPCs and EPC schemes particularly in the following three ways to establish a close link between EPCs and deep energy renovation, as described in the subsections below.

1. Implement a clear and ambitious definition of ‘Deep Energy Renovation’
2. Provide a better specification of energy data and classes on EPCs in the EPBD
3. Increase the coverage of the building stock with EPCs – or better with Building Renovation Passports

**Improve the quality of Energy Performance Certificate schemes**

The quality of the Energy Performance Certificate schemes can be improved in all of assessment, certification, and verification, as well as the usefulness and use of EPCs in the market, building on QualDeEPC’s results:

- Improve EPCs’ renovation recommendations towards deep energy renovation.
- Mandatory regular training or examination of EPC assessors.
- High user-friendliness through an enhanced EPC template.
- Advertising guidelines and other measures to improve compliance with presenting energy class and/or data from EPCs in advertisements.

**Improve cross-EU convergence of Energy Performance Certificate schemes**

All seven priorities developed by QualDeEPC, if implemented by many or all Member States, would contribute to improving cross-EU convergence of Energy Performance Certificate schemes. There is particular potential for higher convergence in the enhanced EPC form.

**DETAILS ON ESTABLISHING A CLOSE LINK BETWEEN EPCS AND DEEP ENERGY RENOVATION**

*Recommendation 1: Implement a clear and ambitious definition of ‘Deep Energy Renovation’*

**a) Background and problem to be addressed**

The European Commission’s previous proposals for defining ‘Deep Renovation’ often suggested an energy savings threshold of 60 %. However, this was not clearly defined, e.g., regarding energy savings or energy efficiency improvements, and whether it concerns delivered, final, or primary energy. There is, therefore, the need for a clear and ambitious definition of ‘Deep Renovation’.

**b) Policy recommendation to EU Member States**

Following a proposal by the European Commission and agreement, create a consistent definition for ‘deep energy renovation’.

**c) Proposal by the EC in the draft revised EPBD and how it could be further enhanced**

The Commission’s proposal for the Recast of the EPBD (EC, 2021) includes the following definition in Art. 2: “19. ‘deep renovation’ means a renovation which transforms a building or building unit (a) before 1 January 2030, into a nearly zero-energy building; (b) as of 1 January 2030, into a zero-emission building; “. This is, therefore, linked to two further definitions of the ‘zero-emission building’ and the ‘nearly zero-energy building’.

The Commission’s proposal also includes a definition of ‘staged deep renovation’, which is based on a voluntary ‘renovation roadmap’ that is also defined in the draft Directive, and will not be operational before 2025. Therefore, we still see the need

Table 2. QualDeEPC proposal for four staged criteria and nZEB-based approach for defining ‘deep energy renovation’.

<b>For Member States,</b>	<b>Criteria definition</b>
1. with objective or legal nZEB definitions or standards for <i>existing</i> buildings	Link deep energy renovation with these definitions of nZEB; and define deep energy renovation as ‘renovation achieving component energy standards equal to at least those that are usually required to meet nZEB requirements for existing buildings.’
2. with nZEB definitions <i>only for new</i> buildings, and in which the nZEB requirements <i>can be achieved through renovation</i>	Define deep energy renovation as ‘renovation achieving component energy standards equal or close to those that are usually required to meet nZEB requirements for new buildings.’
3. with nZEB definitions <i>only for new</i> buildings, and in which the nZEB requirements are <i>too ambitious to achieve through renovation</i>	Define deep energy renovation as ‘renovation achieving component energy standards close to nZEB requirements for new buildings, when possible’.
4. without current availability of such improved component energy standards or with very lax nZEB definitions	Recommends adopting best practices and component improvements in deep energy renovation from other member states with similar climates, and where such standards exist.

for ensuring that partial or staged renovations are in line with deep renovation also for buildings that do not have a renovation roadmap. This could be done by including the nZEB-based approach in the definition of ‘staged renovation’, as outlined in the following recommendation.

**d) Recommendation by QualDeEPC on enhancing the European Commission proposal for the Recast of the EPBD further**

A second part – written in italics – could be added to the definition of ‘staged deep renovation’ Art. 2 (20):

20. ‘staged deep renovation’ means a deep renovation carried out in several steps, following the steps set out in a renovation passport in accordance with Article 10, *or, where such a renovation passport is not available for a building, in steps that achieve energy standards for building elements equal to at least those that are usually required to achieve deep renovation;*

The definition based on nZEBs until 2030 could be further refined too. QualDeEPC proposes an nZEB-based approach for defining ‘deep energy renovation’, based on four staged criteria reflecting nZEB definitions available in Member States. We have proposed this approach, because we consider a uniform 60 % threshold problematic, as Member States have a different history of building regulations and different climatic conditions (see Table 2).

As additional guidance, a definition of deep energy renovation could recommend aiming for values for non-renewable primary energy savings above 60 %, if the original building energy performance of existing buildings is at levels achieved before building energy standards or with early historic building energy standards. In staged deep renovation, the component energy efficiency levels that are legally required or usually necessary to achieve deep energy renovation in the above nZEB-based definition should apply. In addition, it is always recommendable to install renewable energy systems in addition to deep energy renovation.

*Recommendation 2: Provide a better specification of energy data and classes on EPCs in the EPBD*

**a) Background and problem to be addressed**

Energy data presented on EPCs varies between Member States. It can be final, primary, non-renewable primary energy, CO<sub>2</sub> emissions, and sometimes the share of renewable energies. For deep energy renovation, non-renewable primary energy or CO<sub>2</sub> emissions are informative, but they do not distinguish between the energy efficiency of the building envelope and heat/cold distribution system and the energy efficiency and emissions of the heat/cold supply systems. An additional indicator to measure the energy efficiency of the building shell would therefore be needed. Final energy is not sufficient for that either. On the other hand, potential buyers or tenants are interested in final energy consumption, to estimate energy costs. QualDeEPC’s enhanced EPC form leaves flexibility to Member States for using the energy terms they have been using so far. Here, we offer some recommendations for converging energy/CO<sub>2</sub> terms in the future, which could be regulated in the revised EPBD.

**b) Policy recommendation to EU Member States**

On the EPC, provide the following energy and climate-related information:

1. An indicator for heat/cold input demand (kWh/m<sup>2</sup>/yr) for space heating and cooling and water heating, i.e., the amount of heat or cold that needs to be fed into the building to balance heat losses or gains, respectively, plus electricity for lighting (non-residential buildings) and ventilation; this indicator would inform about the efficiency of the building shell and the heat/cold/air distribution; => this indicator should become the basis for the energy efficiency class of the building; it is also an indicator of costs;
2. GHG emissions (t CO<sub>2</sub>eq/yr) to inform about the climate impact of the building, as the result of both energy efficiency of the building shell, the heat/cold/air distribution, and the installed heating and cooling system(s) => the specific value (kg CO<sub>2</sub>eq/(m<sup>2</sup>\*yr)) should be the basis for a new climate class of the building; if that is not possible to agree, a second-best alternative could be non-renewable primary energy
3. final energy demand (kWh/m<sup>2</sup>/yr and kWh/yr) and type of energy source, for informing real estate transactions and calculating energy costs

For all of these three terms, the potential savings and changes in the energy efficiency and climate classes from implementing a recommended combination of deep energy renovation actions should be provided as well.

**c) Proposal by the EC in the draft revised EPBD and how it could be further enhanced**

In a new Annex V to the EPBD, the Commission has proposed a template for the EPCs, which Member States should follow from 2026 at the latest (Art. 16 (2)).

In addition, Annex 1 (1) specifies that “The energy performance of a building shall be expressed by a numeric indicator of primary energy use per unit of reference floor area per year, in kWh/(m<sup>2</sup>.y) for the purpose of both energy performance certification and compliance with minimum energy performance requirements.”

The main indicator, on which the energy performance class shall be based, would continue to be primary energy use. The indicator 1) proposed above, heat/cold input demand (kWh/m<sup>2</sup>/yr) for space heating and cooling and water heating plus electricity for lighting (for non-residential buildings) and ventilation, and splitting the energy performance class into a new energy efficiency class and a climate class, is not considered in the draft recast of the EPBD. However, the template seems to allow Member States to develop a greenhouse gas emission class.

**d) Recommendation by QualDeEPC on enhancing the European Commission proposal for the Recast of the EPBD further**

We consider our above proposal to use two indicators for the heat/cold input demand and the GHG emissions as easy to calculate as primary energy. It removes the need to define primary energy factors (but introduces the need to define greenhouse gas emission factors, including energy conversion efficiencies from input demand to primary energy), and provides a more accurate presentation of both the energy efficiency of the building envelope and the climate impact of building energy systems and energy supply. It is as follows:

1. change the energy performance calculation from primary energy to an indicator 1) heat/cold input demand (kWh/m<sup>2</sup>/yr) for space heating and cooling and water heating plus electricity for lighting (non-res.) and ventilation, and an indicator 2) on operational greenhouse gas emissions (kg CO<sub>2</sub>/(m<sup>2</sup> year)), and
2. consequently, split the energy performance class into a new energy efficiency class and a climate class or greenhouse gas emission class.

We therefore suggest to revise the recast EPBD according to this proposal. If that is considered too ambitious for this recast, a requirement for the Commission to conclude a feasibility study for this proposal should be introduced, to prepare the change for the next recast or amendment.

*Recommendation 3: Increase the coverage of the building stock with EPCs – or better with Building Renovation Passports*

#### a) Background and problem to be addressed

Only those buildings that get sold or rented out currently need an EPC. On the other hand, the Commission has proposed a Building Renovation Passport in the communication on the Renovation Wave of October 2020 (EC, 2020), which is more informative for deep energy renovation than currently in most Member States' EPCs.

#### b) Policy recommendation to EU Member States

1. Ensure that all buildings built before the introduction of a national building energy code that required at least low-energy buildings and are not renovated to close to an nZEB level have a Building Renovation Passport at least by 2028.
2. In addition, ensure that the renovation recommendations on the EPCs are presented in a way consistent with a full Building Renovation Passport.

#### c) Proposal by the EC in the draft revised EPBD and how it could be further enhanced

The Commission's draft proposal for the recast of the EPBD includes a new article 10 on renovation passports. These are defined in Art. 2: "18. 'renovation passport' means a document that provides a tailored roadmap for the renovation of a specific building in several steps that will significantly improve its energy performance;"

Article 10 states that by 31 December 2023, the Commission shall establish a common European framework for renovation passports and that based on this framework, by 31 December 2024, Member States shall introduce a scheme of renovation passports. The explanatory memorandum clarifies (p. 14 of the Commission document for the recast, recital (b)) that the renovation passports shall be voluntary.

The Commission's proposal does not include any targets to Member States for equipping all energy-inefficient buildings with a renovation passport. It only includes indirect incentives, e.g., in Art. 15 (11) on financial incentives for staged deep renovation, and in Art. 16 (11) on simplified updating of EPCs when a renovation passport exists. Therefore, the speed and coverage of the voluntary uptake of renovation passports

by building owners is uncertain. Furthermore, renovation passports will only be available in most Member States from 2025. In the meantime, at least the enhanced EPCs could serve as a first step towards BRPs, and even if the latter are introduced in 2025, the enhanced EPCs and their renovation recommendations should be consistent with the BRPs. However, neither article 16 nor Annex V of the Commission's proposal specify that the renovation recommendations on the EPCs are presented in a way consistent with a full renovation passport.

#### d) Recommendation by QualDeEPC on enhancing the European Commission proposal for the Recast of the EPBD further

We recommend to add to the EPBD to require the Member States to ensure the following:

1. New Art. 10(4): Member States shall ensure that all buildings built before a national building energy code that required at least low-energy buildings and are not renovated to close to an nZEB level have a renovation passport the latest by 2028.
2. Add to Art. 16(4, 5): Member States shall ensure that the renovation recommendations on the EPCs are presented in a way consistent with a full renovation passport.

#### SPECIFIC POLICY RECOMMENDATIONS ON QUALDEEPC'S SEVEN PRIORITIES

Table 3 presents specific policy recommendations on the seven development priorities identified by QualDeEPC.

#### Conclusions

Various aspects of Energy performance certificates (EPCs) differ between various Member States. However, there exists a high potential for convergence of EPCs between them. Evidence from testing the enhanced EPC scheme developed by QualDeEPC clearly shows that improved renovation recommendations and their presentation on the EPCs in a user-friendly manner is an important first step towards deep energy renovation. This should be accompanied by tools such as an online tool to calculate energy savings post deep energy renovation. An eco-system for deep energy renovation should be fostered e.g., with the deep renovation network platform. The policy guidelines presented in this paper are formulated after extensive stakeholder discussions in the QualDeEPC partner countries and at EU level, and are useful to inform the further EPC policy process at EU level and particularly the EPBD revision. During the remainder of the project duration, they will be further discussed with national and EU-level policymakers and stakeholders, and further enhanced if necessary.

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Table 3. Specific policy recommendations. (Continues on the next page.)

	Policy recommendation to EU Member States	Policy recommendation by QualDeEPC on enhancing the European Commission's proposal for the Recast of the EPBD further
A. Improving the recommendations for renovation, which are provided on the EPCs, towards deep energy renovation	<ol style="list-style-type: none"> <li>Specify the energy efficiency levels to be recommended for different types of actions, so that these are consistent with deep energy renovation leading to NZEB standards for existing buildings, even when implemented step by step according to a Renovation Passport</li> <li>Define NZEB standards for existing buildings or 'deep energy renovation', if these definitions do not yet exist<sup>1</sup>.</li> <li>Include in the EPC all potential recommendations needed to achieve NZEB standards for existing buildings or 'deep energy renovation', but clarify whether they are cost-effective only with financial incentives, or in connection to renovation works that are scheduled anyway<sup>2</sup>.</li> <li>Develop a set of methods and data to include co-benefits of building renovation into the cost-effectiveness calculation and require their use</li> <li>Include all of the former into the mandatory training or examination.</li> </ol>	<p>We recommend to add to the EPBD the following provisions:</p> <p><b>Require Member States to specify the renovation recommendations</b> according to no. 1), 3), and 4) of the policy recommendations to Member States above (in Article 16 (4) or a new paragraph in Art. 16); possibly also no. 5) (Art. 22 on independent experts).</p>
B. An online tool for comparing EPC recommendations to deep energy renovation recommendations	Create a high-quality tool, if it doesn't already exist. Ensure that it is kept updated and that the renovation recommendations provided are consistent with deep energy renovation. Member States could use the concept and master tool provided by QualDeEPC.	<p>We recommend to add to the EPBD the following provision (in Art. 26 (2)):</p> <p><b>Require Member States to provide a high-quality tool</b>, and to ensure that it is kept updated and that the renovation recommendations provided are consistent with deep energy renovation.</p>
C. Creating Deep Renovation Network Platforms (One-Stop Shops plus networking and joint communication of supply-side actors)	<p>Each EU Member State should operate a combination of two types of Deep Renovation Network Platforms:</p> <ul style="list-style-type: none"> <li>Basic Deep Renovation Network Platform, which would be a national level web platform that provides a one-stop-shop including all relevant information (including on EPCs; and the enhanced renovation recommendations), plus active marketing<sup>3</sup>.</li> <li>A network of local or regional physical hubs with combined core funding from the national level and income from some of the services. These hubs could offer most of the services of an extended platform. They would be part of a national network within the central platform (see above) and receive technical and financial support from the national level for their information, active marketing, training, and other agreed activities.</li> </ul>	<p>We recommend to add to the EPBD (Art 15 (6)) the following provision:</p> <p><b>"These technical assistance facilities, including one-stop-shops, shall be established in the forms of both an online platform at the national level and a network of local or regional physical hubs, and be endowed with sufficient resources to actively reach out to at least 5 % of building owners each year."</b></p>
D. Regular mandatory EPC assessor training (on assessment and renovation recommendations) required for certification/ accreditation and registry	Either an initial and regular training or a regular examination of EPC assessors should be mandatory as the precondition to be certified or accredited and registered as an EPC assessor; regular means every 3 to 5 years. Renovation recommendations consistent with deep energy renovation should be a special focus.	<p>We recommend to add to the EPBD (Art 22) the following provision:</p> <p><b>Oblige the Member States to require either an initial and regular training or a regular examination</b> of EPC assessors as the precondition to be certified or accredited and registered as an EPC assessor. Renovation recommendations consistent with deep energy renovation should be a special focus.</p>

<sup>1</sup> E.g., using the Proposal for principles of defining 'deep energy renovation' provided by QualDeEPC.

<sup>2</sup> I.e., based on energy-related costs only, as already specified in the EPBD.

<sup>3</sup> Chapter 5 of the White Paper presents a detailed list of seven types of information and activities that could be offered by the basic version (Veselá, Thomas, Gokarakonda, et al., 2021).

(Continuation: Table 3. Specific policy recommendations).

E. Achieving a high user-friendliness of the EPC	<ul style="list-style-type: none"> <li>Enhance the data and presentation of the EPC further, e.g., using the draft offered by QualDeEPC, and requiring that the renovation recommendations be consistent with deep energy renovation in their selection and energy efficiency levels, and that possibilities for a stepwise implementation are indicated.</li> <li>In addition, develop a guidebook or tutorial for EPC assessors on how to fill in the enhanced EPC form.</li> </ul>	<p>We recommend to add to the EPBD (Art 16) the following provisions and add detail for Annex V:</p> <p><b>Require additional content</b>, e.g., from the list included in draft offered by QualDeEPC, and a <b>length of the main document</b> of 3 to 5 pages, as well as that the <b>renovation recommendations</b> be consistent with deep energy renovation in their selection and energy efficiency levels, and that possibilities for a stepwise implementation are indicated.</p> <p><b>Particularly, add to Annex V the additional indicators<sup>4</sup>.</b></p>
F. Voluntary or mandatory advertising guidelines for EPCs	<ul style="list-style-type: none"> <li>Create easy-to-use advertising guidelines, the use of which would ensure compliance with the mandatory display of EPC energy data/class.</li> <li>Communicate the existence and usefulness of the guidelines widely and actively.</li> <li>Consider making the use mandatory.</li> <li>Oblige EPC assessors to hand over a leaflet with the guidelines and respective links, as well as the legal requirements, to building owners together with the EPC, particularly if using the guidelines is made mandatory.</li> </ul>	<p>We recommend to add to the EPBD (Art 17 (4)) the following provisions:</p> <p><b>Oblige the Member States to create easy-to-use advertising guidelines</b>, communicate the existence and usefulness of the guidelines widely and actively, and to <b>consider making the use mandatory</b>.</p>
G. Improving compliance with the mandatory use of EPCs in real estate advertisements	<ul style="list-style-type: none"> <li>Appoint a nodal authority with sufficient resources and the mandate to - perform <b>random checking</b> of a sample of advertisements, and denouncing non-compliance to the authorities able to impose penalties (if these are not the nodal authorities themselves); and <b>raising awareness</b> of the duty to display EPC energy data/class in real estate advertisement, and of the advertisement guidelines</li> <li>Define staged penalties for non-compliance.</li> </ul>	<p>We recommend to add to the EPBD (Art 17 (4)) the following three further provisions:</p> <ul style="list-style-type: none"> <li>Oblige Member States to Appoint a <b>nodal authority with sufficient resources</b> and the mandate to perform the random checking and raising awareness of the duty to display EPC energy data/class in real estate advertisement, and of the advertisement guidelines.</li> <li>Define staged penalties for non-compliance.</li> </ul>

- <sup>4</sup> Display of improved classifications and energy performance after implementing a recommended combination of renovation actions ('main option') on p. 1 of the enhanced EPC
- Potential energy savings (in kWh/yr) after implementing the 'main option' on p.1
- Details on building envelope and building HVAC system, using a traffic light system
- Detailed renovation recommendations by component, consistent with deep energy renovation, using the traffic light system too
- Useful combination of renovations and stepwise implementation – as a first step towards a Building Renovation Passport
- Link to a Deep Renovation Network Platform

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