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Green paper on good practice in EPC assessment, certification, and use

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ABBREVIATIONS

DHW: Domestic hot water

EBPD: Energy performance of buildings directive

EPC: Energy performance certificate

HVAC: Heating, ventilation, and air conditioning

nZEB: nearly zero energy building

RES: Renewable energy sources

PROJECT PARTNERS

WI: Wuppertal Institut für KLIMA, UMWELT, ENERGIE gGMBH

CRES: Centre for renewable energy sources and saving

DENA: Deutsche Energie-Agentur GmbH (dena)

EAP: Energy agency of Plovdiv Association

EKODOMA

ENERGIAKLUB: Energiaklub Szakpolitikai Intezet Modszertani Kozpont Egyesulet

E-P-C: EPC Project Corporation Climate. Sustainability. Communications. mbH

FEDARENE: Federation euopeenne des agencies et des regions pour l'energie et l'environnement

ESCAN: Escan SL

CIT ENERGY MANAGEMENT AB

BME: Budapest University of Technology and Economics

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PUBLISHABLE SUMMARY

This document presents the Green paper on good practice in EPC assessment, certification, and use. It provides detailed analysis, draft policy proposals and draft descriptions of tools on the seven areas that the QualDeEPC project has identified as its priorities for the development of enhanced EPC schemes:

- Improving the recommendations for renovation provided on the EPCs towards deep energy renovation
- Online tool for comparing EPC recommendations to deep energy renovation recommendations
- Creating Deep Renovation Network Platforms
- Regular mandatory EPC assessor training (on assessment and renovation recommendations) required for certification/accreditation and registry
- High user-friendliness of the EPC
- Voluntary/mandatory advertising guidelines for EPCs
- Improving compliance with the mandatory use of EPCs in real estate advertisements

For each topic, the situations in the partner countries are evaluated, best practice examples are described and cross-national measures for improvements are suggested. The major outcomes at this stage are:

- A text-based list of deep energy renovation recommendations,
- The concept for the online tool development,
- The concept for a Deep Renovation Network Platform,
- A universal, enhanced user-friendly EPC form template and background on the proposed content
- A general policy proposal for regular mandatory EPC assessor training, and
- A general policy proposal for advertisement guidelines and for actions to improve the compliance with the mandatory use of EPCs in real estate advertisements.

These suggested enhancements are intended to be the basis for both a discussion with stakeholders at national workshops and for their testing in WP4. For example, the Green paper provides a universal EPC form template, including deep energy renovation recommendations, to be evaluated by the building representatives of the pilot buildings in WP 4. The feedback of the stakeholders will be processed in a feedback report on the national workshops (D3.4), and the results and feedback from the testing will be documented in a transnational comparison report (D4.4) and a summary evaluation report (D4.5). In addition, with testing results and the feedback by the building representatives and stakeholders, and with further developments by the project partners, the Green paper will be enhanced to deliverable D3.2, the *White paper on good practice in EPC assessment, certification, and use*.

Moreover, the Green paper and the White paper will be the basis for the country-specific adaptation, discussion, and to the extent possible, implementation of the developed policy proposals in WP5.

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1 INTRODUCTION

The QualDeEPC project is aiming to both improve quality and cross-EU convergence of Energy Performance Certificate schemes, and the link between EPCs 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 EPCs as well as their renovation recommendations, in the participating countries and beyond.

Work package 3 of the QualDeEPC project aims to develop practical concepts, proposals, and tools for an enhanced EPC scheme linked to deep renovation based on the selected priorities of the Development Strategy Plan (D2.4). The seven priorities selected in D2.4 are:

A) Improving the recommendations for renovation provided on the EPCs towards deep energy renovation
B) Online tool for comparing EPC recommendations to deep energy renovation recommendations
C) Creating Deep Renovation Network Platforms
D) Regular mandatory EPC assessor training on assessment and recommendations required for certification/accreditation and registry
E) High user-friendliness of the EPC
F) Voluntary/mandatory advertising guidelines for EPCs
G) Improving compliance with the mandatory use of EPCs in real estate advertisements

Generally, the Green paper summarizes the analyses and assembles the results for each priority. Since the priorities A), B), C) and E) depend on the definition of “deep energy renovation”, chapter 2 assesses the proposals by the European Commission and develops a refined proposal that would take specific national situations into account and could therefore be more universally applied.

Chapter 3 firstly summarizes the available information on renovation recommendations that can be found on EPCs across the partner countries. Secondly, it compares in more detail typical, legal and improved renovation recommendations for different building components and aspects given on EPC forms in each partner country. The Green paper builds on this information to present text-based proposals for enhanced recommendations targeting deep energy renovations for a variety of components of the building envelope and the technical systems. Country-specific values for these recommendations will have to be developed in WP5.

The concept, content and user interface of the online tool is described in Chapter 4. In this part, ,the general structure, the input parameters of building components and systems as well as the results (outputs) of the tool are thoroughly presented. The tool is aiming to be used by all users and in particular the homeowners to calculate an estimation of the current energy characteristics of their home, and also to acquire knowledge on the available technical solutions and the steps need to be taken in the future to improve the energy efficiency and proceed with a deep energy renovation of their home.

The Deep Renovation Network Platforms are part of the project structure of the entire QUALDeEPC project. The main objective is creating concepts for platforms providing one-stop-shops for deep renovation linked to EPCs, including administrative, energy advice, financial, and supply-side information to building owners. The developed concepts in Chapter 0 are adapted to project partner country circumstances and partners’ possibilities. The basic version includes an online platform

providing a one-stop-shop for information and other services for seven different topics. The project partners, supporters and other stakeholders could further enhance the basic platform as an extended platform depending on the national situation and resources. Which service elements are needed and feasible in each country is part of work in Task 3.4 and will be analysed in detail in WP5.

The cross-country comparison of training guidelines for EPC assessors is summarized in Chapter 6. Best practices examples by Hungary and Sweden are described. Furthermore, an overall general policy proposal on regular mandatory training is provided as a basis for the discussion with national stakeholders.

A detailed analysis of the EPC forms about user-friendliness for all partner countries is shown in Chapter 7. Furthermore, short summaries of the questionnaires on the national EPC forms for stakeholders and building owners are provided by each partner, if available. In summary, twelve elements of improvement have been identified. A detailed assessment of each of these elements led to seven elements that are implemented in the enhanced EPC form by this project.

Chapter 8 and 9 hold the analysis and proposals regarding the last two areas of enhanced EPC schemes, Voluntary/mandatory advertising guidelines for EPCs (Chapter 8) and Improving compliance with the mandatory use of EPCs in real estate advertisements (Chapter 9). Since the former is also one possible action to improve the use of EPCs in real estate advertisements, Chapter 8 starts with an overview of the legal requirements to present EPCs and the relevant data in the QualDeEPC partner countries. Based on a good example found in Sweden and examples from other EU Member States, a general policy proposal for the contents of advertisement guidelines is derived, and a text proposal for countries wishing to make the use of these guidelines mandatory is provided in addition.

Chapter 9 discusses a set of direct and indirect actions that could improve compliance with the mandatory use of EPCs in real estate advertisements. For the direct actions identified, 1) appointment of a nodal authority with the competences and resources to control and enforce the use of EPCs in advertisements, and penal provisions for non-compliance, a policy proposal is presented, taking into account the current situation in QualDeEPC partner countries.

These suggested enhancements are intended to be the basis for both a discussion with stakeholders at national workshops and for their testing in WP 4. For example, the Green paper provides a universal EPC form template, including deep energy renovation recommendations, to be evaluated by the building representatives of the pilot buildings in WP 4. The feedback of the stakeholders will be processed in a feedback report on the national workshops (D3.4), and the results and feedback from the testing will be documented in a transnational comparison report (D4.4) and a summary evaluation report (D4.5). In addition, with testing results and the feedback by the building representatives and stakeholders, and with further developments by the project partners, the Green paper will be enhanced to deliverable D3.2, the *White paper on good practice in EPC assessment, certification, and use*.

Moreover, the Green paper and the White paper will be the basis for the country-specific adaptation, discussion, and to the extent possible, implementation of the developed policy proposals in WP5.

2 DEFINING 'DEEP ENERGY RENOVATION' – A PROPOSAL FROM QUALDEEPC

2.1 Different approaches to Deep energy renovation found in literature and policy

The first mention of 'deep renovation' can be found in the Energy Efficiency Directive (EED; Directive 2012/27/EU of 25 October 2012. Article 4(c) of the EED already required the Member States to ensure that their Long-Term Renovation Strategies encompass "policies and actions to stimulate cost-effective deep renovation of buildings, including staged deep renovation". Recital 16 of the EED stated that these strategies "should address cost-effective deep renovations which lead to a refurbishment that reduces both the delivered and final energy consumption of a building *by a significant percentage* compared with the pre-renovation levels leading to *a very high energy performance*. Such deep renovations could also be carried out in stages." (*highlighting in italics* added by the authors of this report)

In the Staff Working Document (SWD(2013) 143 final), the European Commission provided a more concrete definition of the significant efficiency improvements resulting from deep renovation, by indicating that "deep renovations (are) leading to significant (typically more than 60 %) efficiency improvements." Here, a concrete number – *more than 60%* - was introduced.

Commission Recommendation (EC) 2019/786 of 8 May 2019 on building renovation reiterated the definition from the EED and related again to this SWD: "According to the staff working document accompanying the Commission's 2013 report on Financial support for energy efficiency in buildings https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32019H0786 - ntr9-L_2019127EN.01003701-E0009, 'deep renovation' can be considered as a renovation that leads to significant (typically more than 60 %) efficiency improvements."

The recent Communication from the Commission: 'A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives' (SWD(2020) 550 final) of 14 October 2020 relates to the Recommendation (EC) 2019/786 and speaks of "deep renovations that reduce energy consumption by at least 60%".

It can be noted that now, energy consumption should be reduced by 60%, whereas before it was more than 60 % of efficiency improvements, but it now is unclear whether this is delivered, final, or primary energy.

The 'Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU' (EC, 2019) aims to create a more concrete definition of the 60%. It distinguishes the following:

'The determination of renovation rates and depths requires a clear common understanding of what renovation "rate" and "depth" mean. To reduce uncertainty about definitions, this study proposes and applies clear definitions for different renovation depths, relating them to non-renewable primary energy savings achieved in a specific calendar year:

Below threshold ($x < 3\%$ savings)
Light renovations ($3\% \leq x \leq 30\%$ savings)
Medium renovations ($30\% < x \leq 60\%$ savings)

Deep renovations (x > 60% savings)'

Therefore, *non-renewable primary energy savings achieved in a specific calendar year* would be the metric for measuring whether deep renovation has been achieved or not.

This is the starting point for our analysis of what could be an even more concrete and universally applicable definition of deep energy renovation that guides our further work in developing enhanced EPC schemes and can be operationalized for renovation recommendations, training, etc. The most important question in this respect is, whether a target of at least 60% of non-renewable primary energy savings is universally achievable and appropriate. This will be analysed in the next subchapter.

Note: In our work, we will speak of 'deep *energy* renovation', although the official documents always use the term 'deep renovation'. It must be noted, however, that there are countries, in which 'deep renovations' are also defined based on the extent of renovation *overall*, i.e., the quantity and quality of work undertaken for the renovation of a building's interior and exterior, not only for energy efficiency. In order not to create confusion, we use 'deep *energy* renovation'.

And deep energy renovation should also not be confused with 'major renovation' according to the EPBD, which triggers the legal requirement to renovate the whole part of the building shell that is subject to the planned renovation according to legal standards for component energy efficiency in the renovation. Such major renovations are defined based on the extent of energy renovation, i.e., the quantity of work undertaken for energy renovation, e.g., as a certain percentage of total building shell area or area of walls, roof, windows etc.

2.2 Appropriateness of a 60% savings threshold for defining deep energy renovation and conclusion on the preferred approach

It is clear from above that the 'significant percentage of energy savings' is not strictly defined and only provides an indication of a statistical percentage of resulting savings. Besides, discussion among QualDeEPC project partners revealed that the above indication by the European Commission that deep energy renovation should 'typically' lead to more than 60% energy savings is not fitting all countries well. While it may be useful in many countries particularly in central Europe, there are warmer climate zones, in which humidity may make it difficult to achieve this 60% target or mild climates that would even enable 100% of savings on the energy demand relevant for EPCs in residential buildings (no heating or cooling needed any more). On the other hand, Sweden has had energy efficiency regulations for new buildings for many decades, so that in most buildings only 20 to 40 % of further savings are both feasible and needed to achieve low-energy building performance levels.

Respecting this condition, it seems more adequate **to build** our working definition of 'deep energy renovation' **on target values for the energy performance of a building that should be reached by a 'deep' energy renovation**. It would seem natural to take the definition of nZEB that all EU Member States have had to create by end of 2020 as such a level. However, the level defined as 'nZEB' varies between the Member States even in the same climate zone. And nZEB levels achievable for new buildings may not be achievable in building renovation, as e.g. the geometry and orientation towards the sun of existing buildings usually can't be changed. For example, the Latvian partner estimates that the ambitious nZEB levels for new buildings in Latvia are usually impossible to reach through renovation. In addition, nZEB definitions involve the use of renewable energies, while deep energy renovation aims at improving energy efficiency only. This is reflected in the above proposal to use

non-renewable primary energy savings achieved in a specific calendar year as the metric for measuring whether deep renovation has been achieved or not. Since the deep renovation in this sense can be achieved by appropriate insulation levels (U-values), energy-efficient heating or cooling systems and other highly energy-efficient components, our conclusion is to use component efficiency levels consistent with nZEB requirements as the basis for our working definition of 'deep energy renovation'.

2.3 QualDeEPC proposal for defining deep energy renovation

Based on the above, QualDeEPC proposes a modified nZEB-based approach for defining deep energy renovation, based on the following four staged criteria:

1. For those member states that have their objective or legal *nZEB definitions/ standards for existing buildings*, QualDeEPC proposes to 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. For countries that only have nZEB definitions for new build but not existing buildings, and in which the *nZEB requirements for new build* are not so ambitious and *would be achievable through renovation*, QualDeEPC proposes to define deep energy renovation as 'renovation achieving *component energy standards* close to those that are usually required to meet nZEB requirements for new buildings'.
3. In countries that only have nZEB definitions for new build but not existing buildings, and in which the *nZEB requirements for new build are too ambitious to reach through renovation*, QualDeEPC proposes to define deep energy renovation as 'renovation achieving component energy standards close to nZEB requirements for new buildings, when possible'. QualDeEPC partners have been asked to present values for improved component energy standards that are better than the legal requirements in case of a major renovation, and are often proposed in practice by energy consultants. It can be assumed that these are somewhat accepted and available in the market, and not considered too far outside of cost-effectiveness considerations. They could be adopted as component energy standards for deep renovation.
4. In countries *without* current availability of such improved component energy standards *or with very lax nZEB definitions*, QualDeEPC recommends adopting best practices and component improvements in deep energy renovation from other member states with similar climates, and where such standards exist.

As additional guidance, a definition of deep energy renovation could *recommend* aiming for values for *non-renewable primary energy savings*[1] 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 (which would be worse than e.g. most buildings in Sweden). Such savings can usually only be achieved through a full renovation of all parts of a building and its technical systems (**whole-building renovation**). For a **staged approach** according to a deep energy renovation roadmap for a building, the **component energy efficiency level**s that are legally required or usually necessary to achieve deep energy renovation in the above nZEB-based definition would apply.

[1] A more precise definition of this metric will be needed, since primary energy factors e.g. for district heat or electricity already take renewable energy shares into account.

In any case, where this is feasible for a building, it is always recommendable to install renewable energy systems in addition to deep energy renovation.

3 IMPROVING THE RECOMMENDATIONS FOR RENOVATION PROVIDED ON THE EPCS TOWARDS DEEP ENERGY RENOVATION

3.1 Analysis of renovation recommendations in current EPC practice for residential buildings

This chapter analyses the renovation recommendations in the current EPC practice. The display of the recommendations is discussed in the analysis of the EPC forms (see chapter 7). In the project, the focus is set on residential buildings. However, most renovation recommendations are applicable also for non-residential buildings.

The EPBD specifies in Art 11 (2) and (3):

> *2. The energy performance certificate shall include recommendations for the cost-optimal or cost-effective improvement of the energy performance of a building or building unit unless there is no reasonable potential for such improvement compared to the energy performance requirements in force.*
>
> *The recommendations included in the energy performance certificate shall cover:*
>
> *(a) measures carried out in connection with a major renovation of the building envelope or technical building system(s); and*
>
> *(b) measures for individual building elements independent of a major renovation of the building envelope or technical building system(s).*
>
> *3. The recommendations included in the energy performance certificate shall be technically feasible for the specific building and may provide an estimate for the range of payback periods or cost-benefits over its economic lifecycle.*

3.1.1 Summary of country-specific information on renovation recommendations

In the strategy plan of this project (D2.4), the country partners described the current situation on renovation recommendations as required in EPC forms. The results are summarized in Table 4 and sections 3.1.1.1 to 3.1.1.6. They were completed for this report by the partners.

Table 4 Summary table on country-specific information on current renovation recommendations in EPC forms

In case of a renovation of a building, there is/ are:	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
A minimum requirement for specific building components	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A minimum requirement for overall energy performance of the building	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Official renovation recommendations towards the deep renovation	Yes	No	No	Yes	No	No	Yes
A link between renovation recommendations and EPC classes	No	No	Yes	Yes, impact on class	No	No	No
A link of legal requirements to EPC values/ classes	No	Yes, checkmark on EPC form	No	Yes, values	Yes, values	No	Yes
A link between financial incentive programs to EPC values/ classes	No	No	Yes, upgrade to specific energy class is usually required	No	Yes, values	Not always	No
A definition of cost-effectiveness is provided	Yes, but non-specific	No	Yes, but non-specific	Yes, payback time but no specific limit	No	Yes, but non-specific	Yes, but non-specific
Highly energy-efficient options provided by an official (or unofficial) software.	Yes	No	No	No	No	No	Yes, in unofficial software
Financial aid programs for measures to ensure the minimum requirement	Yes	No	Yes	Yes	Yes	Yes, but few	No
Financial aid programs for ambitious renovation measures	Yes	Yes	No	No	Yes, sometimes	Yes, but few	Yes, sometimes

3.1.1.1 Minimum regulation requirements for energy renovation of buildings

The minimal regulation requirements for the energy-efficient renovation of buildings are usually described in each national regulation for energy-efficient buildings of the partner countries. The requirements might be defined for a renovated component and/ or for the overall energy performance of the building. Depending on the country, the renovation requirements can differ for climatic areas (e.g. Spain). In some countries, the requirements have only to be met when the extent of the renovation exceeds a specified value ('major renovation' according to Art. 7 of the EPBD, e.g. 10% of the total component area of the building in Germany). In the EPC forms, when the issuers recommend a

certain renovation action, they often recommend the minimum requirements related to that action, to meet all legal necessities.

3.1.1.2 Official recommendations for improved renovation recommendations towards deep energy renovation

Only few partner countries provide official (sets of) energy-efficient renovation recommendations (e.g. Bulgaria, Greece). However, these sets do not necessarily lead to "deep renovation", since it is often not specifically defined.

3.1.1.3 The link between EPC renovation recommendations and EPC classes, legal requirements or financial incentive programs

In most countries, the renovation recommendations or legal requirements are not directly connected to the EPC class, but often to the corresponding energy performance or component energy efficiency values. In some countries, financial incentive programs, and hence, renovation recommendations are usually linked to the EPC class or corresponding energy performance or component energy efficiency values.

Financial incentive programs exist in all seven EU member states represented in the QualDeEPC project team. They often require better energy efficiency levels than the legal minimum requirements for renovation, but they sometimes also fund renovations meeting only the minimum requirements.

3.1.1.4 Specification of cost-effectiveness or cost-optimality

In most partner countries, the relevant legal documents include a general statement that the renovation measures recommended in EPCs have to be cost-effective. However, details on the desired profitability (internal rate of return for a specified lifetime) or similar specifications are usually not given.

3.1.1.5 Main barriers

- No official set of renovation measures or guidelines towards deep renovation for the recommendations in EPCs
- No or misinformation on benefits of high energy-efficient renovation options.
- Sometimes low cost-effectiveness of deep renovation measures (e.g. because of low energy prices)
- Few financing opportunities (Spain)
- Training of EPC issuers does not sufficiently clarify which recommendations are appropriate
- Already high renovation quota, i.e. energy saving potential is relatively low (Sweden)

3.1.1.6 Measures to overcome barriers

- Expert training on deep renovation and corresponding recommendations for EPCs
- Guidelines on recommendations towards deep energy renovation for EPCs
- Clearer definition of cost-effectiveness or cost-optimality, with appropriate (long) lifetimes and interest rates; based on EU guidance?
- Control/ legal obligation of renovation recommendations towards the deep renovation
- Improved funding options, especially for ambitious energy renovation options
- Information campaigns (for owners)

3.1.2 Current renovation recommendations on EPCs and improved values potentially leading to deep energy renovation

This section evaluates the current renovation recommendations in the seven partner countries. Special attention is paid to recommendations that are more ambitious than legal standards. These measures might be a good indicator for selecting "deep energy renovation" recommendations. Table 5 to

Table 14 on the following pages show typical, legal and improved renovation recommendations for elements of the building envelope and technical system *if* the corresponding element is recommended. *Whether* an element is often included in the recommendations on EPCs *or not*, has been analysed in chapter 3.1.2.2 below, based on the EPCs issued during Task 4.2 of the project.

The following definitions apply:

- Typical: Value that is commonly used in EPCs
- Legal: Value to meet legal (minimum) requirement given in standards or laws e.g. for the case of a major renovation.
- Improved: Value that is usually better than the legally required value. A voluntary low-energy standard, law or a financial support program might provide this information.

Table 5 Comparison of heat transmission coefficients in W/m²K for standard windows (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	1.4	Unknown	same as "Legal"	1.15 (wooden or PVC frame) 1.4 (metal frame)	Windows: 0.9-1.1 W/m2K	2.5 – 5.7, depending on year of construction	1.2-2.9
Legal	1.4	1.3 (standard. window) 1.4 (roof window)	2.6 – 3.2 (depending on climate zone)	Same as above	<1.1 W/(m²K)	1.8 – 2.7 (depending on climate zone)	1.2
Improved	1.1	0.95 (standard window) 1.0 (roof window)	Not available	Not available	0.8		0.9

Table 6 Comparison of heat transmission coefficients in W/m²K for standard doors (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	1.4	Unknown	same as "Legal".	1.45 (door bw. heated & non-heated area)	Doors: 1.3 – 1.6 W/m^{2}K	Unknown	1.4-3
Legal	1.4	1.8	2.6 – 3.2 (depending on climate zone)	Same as above	<1.8 W/(m^{2}K)	5.7	1.2
Improved	1.1	1.3	Not available	Not available	1.1 – 1.3 W/(m^{2}K)	2	0.6

Table 7 Comparison of heat transmission coefficients in W/m²K for external walls (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	0.28	unknown	same as "Legal"	0.24	0.22 W/(m^{2}K)	0.7 – 2.5 (depending on year of construction)	0.3-0.6
Legal	0.28	0.24	0.4 – 0.6 (depending on climate zone)	0.24	<0.23 W/(m^{2}K)	0.37-0.7 (depending on climate zone)	0.18
Improved	0.22	0.20	Not available	0.17	0.18 W/(m^{2}K)	0.3	0.1

Table 8 Comparison of heat transmission coefficients in W/m²K for roof or attic insulation (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	0.25	unknown	same as "Legal"	0.17	attic 0.11 roof 0.14	0.6-2.5 (depending on year of construction)	0.2-0.4
Legal	0.25	0.24	0.35 – 0.5 (depending on climate zone)	0.17	<0.2 W/(m^{2}K)	0.33-0.5 (depending on climate zone)	0.13
Improved	0.22	0.20	Not available	0.12	0.09 – 0.11 W/(m^{2}K)	0.25	0.1

Table 9 Comparison of heat transmission coefficients in W/m²K for insulation of ceiling of an unheated basement (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	0.5	unknown	same as "Legal"	0.26	0.2	unknown	Unknown
Legal	0.5	0.3	0.7 – 1.2 (depending on climate zone)	0.26	<0.3 W/(m^{2}K)	0.59 – 0.8 (depending on climate zone)	0.15
Improved	0.25	0.25	Not available	0.2	0.17 W/(m^{2}K)	0.6	unknown

Table 10 Comparison of measures to improve ventilation systems (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	The most commonly used plate heat exchangers with air flow cross-section, which have an efficiency of 50-60% or rotary heat exchangers with an efficiency of 55-75%.	Unknown	Unknown for residential buildings	80-85% efficiency in HRV units in new office buildings residential: natural ventilation with improved air tightness	Cleaning of existing natural ventilation shafts Air change valves in window frames	Natural ventilation	-Adjusting/balancing of the system - Installation of variable speed fans - Heat recovery
Legal	Not less than 70% efficiency (for ventilation with recovery In heating mode)	No specification	No specification for residential buildings	No direct requirements heat recovery efficiency, but indirect overall requirements on building performance, the choice is the designer's competence.	No legal requirements	No direct requirements	No direct requirements of efficiency, but indirect with overall requirements on building performance. For alterations in the ventilation system, there are recommendations for specific fan power.
Improved	In buildings with high energy class and NZEB, modern recuperative heat exchangers with "cellular counterflow" are used, which have an efficiency of 80-95%	Efficient ventilation system, e.g. $P_{el}<0.2 W/(m^3/h)$ or $\eta>80\%$ for heat recovery, $P_{el}<0.45 W/(m^3/h)$	Not applicable	Not available	Heat recovery systems partly using existing natural ventilation shafts for exhaust air and making new air inlet openings in walls	Ventilation with heat recovery	Heat recovery of 80-90%

Table 11 Comparison of measures to improve heating systems (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	Installation of condensing gas boiler or biomass boiler (heating and DHW)	Unknown	In the case of boiler-burner systems: SCOP: 85% In the case of heat pumps: SCOP: 3.2 Installation of thermo-static valves	Installation of condensing gas boiler (heating and DHW)	Renewing heat insulation on pipes in basements and attics, balancing valves on risers. Sometimes the whole heating system is changed to a new system with radiators with thermo-static valves and individu-al heat metering in every apartment	Boiler-burner systems: SCOP: 80% Centralised heating: -replacement of the boiler and sometimes also the whole radiators and thermostatic valves For individual systems: - incorporate a boiler providing heating & DHW for 1 apartment	- Limiting the indoor temperature -Adjusting/balancing of the system - Cleaning of the heating system - Installation of auto-matic pressure con-trolled pumps -Replacement of radia-tor valves
Legal	N/A	The product of the ex-penditure factor (e_g) and the primary energy factor (f_p) has not to be greater than 1.30.	In the case of boiler-burner systems: SCOP: 85% In the case of heat pumps: SCOP: 3.2	Hydraulic balancing; system control	It is planned to pass a requirement for individu-al heat metering in each apartment by using heat meters or allocators At the moment no legal requirement exists	The efficiency of the boilers new legislation RITE: >=92% total load >=89% partial load RD 736/2020: - Individualized meters for heating & cooling con-sumptions for centralized installations before 2023.	Heating and cooling supply should have an automatic control sys-tem.
Improved	Energy management; Installation of RES Installation of the heat pump unit Centralized heat supply with a modernized sub station	Replacement with a heat-ing system using renew-able energy source(s); hydraulic balancing	Not available	Replacement with a heating system utilizing renewable energy source(s); hydraulic bal-ancing	Exchange of complete heating system in a build-ing. Installing heat meter-ing in each apartment and thermostatic valves on each radiator	Minim. requirements for energy performance of heat generators: fossil fuel heating boilers that do not have: i) Efficiency at nominal useful power and Tª boiler 70 ºC: η > 90 + 2 log Pn. ii) Efficiency at partial load of 0.3 Pn and at T boiler >= 50 ºC: η > 86 + 3 log Pn Another legislation is RD	

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
						736/2020, metering of individual thermal consumptions in heating systems of buildings	

Table 12 Comparison of measures to improve cooling systems (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	Not applicable	Not applicable	For local cooling units: SEER: 3.0	Not applicable	N/a Buildings usually are not cooled		Not applicable
Legal	No specific requirement for modernization of cooling systems		For local cooling units: SEER: 3.0			The market is improved by more efficient products heating pumps that provide cooling and heating with inverter technology Installation of individualized meters for heating and for cooling consumptions for centralized installations before 2023 will be mandatory	
Improved	Heating and cooling systems with utilization of solar energy - Adsorption systems Better shading against sunlight		Not applicable			PV system for self-consumption	

Table 13 Comparison of measures to integrate renewable energy sources (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	Solar installations for DHW	unknown	60 % of DHW demand to be covered by Solar collectors (if technically feasible)	No requirement for renovation.	Usually, no measures are done for this	Few solar thermal for hot water; Few biomass boilers for single houses and DHW; PV in large energy consumption buildings (not often in residential)	- Installation of solar thermal or PV system
Legal	No specific requirement for RES. There is the only requirement for NZEB: Not less than the required heat for heating, cooling, ventilation, DHW and lighting is energy from renewable energy sources located in the building or near it	No specifications, but requirement to install specific percentage or some equal measures	60 % of DHW demand to be covered by Solar collectors (if technically feasible)	No requirement for renovation.	You have to have renewable energy source if you are building NZEB	PV Solar parameter, q solar, kW/m2month=>2 For apartment or houses with surfaces > 120m2. - Minimum 60% of RES contribution for hot water and pool heating if demand <5000 l/day. - minimum 70% of RES contribution for hot water and pool if demand >=5000 l/day	No specific requirement for RES. But you can reduce primary energy with solar energy produced (and used) on-site.
Improved	Geothermal heat pump Combined systems for utilization of solar energy in the production of cold with ozone-safe refrigerants Photovoltaic systems for electricity production for own consumption	See heating; with PV on roof primary energy demand might be lowered	Not available	PV, heat pump or biomass	Solar collectors for hot water and part of space heating Solar PV for self-use	New legislation to include PV for auto-consumption, geothermal	

Table 14 Comparison of measures to improve lighting efficiency (in residential buildings)

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Typical	Energy efficient LED lighting	Not applicable for residential buildings	Not applicable for residential buildings	Not applicable for residential buildings	LED lights	Only for common areas of the building	Presence controlled lighting - Time - Energy-efficient lighting
Legal	Energy efficient LED lighting				No legal requirement	Renovation: VEEI lim=4.0	Energy-efficient lighting
Improved	Automatisation of the lighting systems				LED lighting		

3.1.2.1 Other renovation recommendations or remarks

Bulgaria

- Modernization of an existing vertical heating installation by building a horizontal heating system with individual metering
- Control and measuring devices for regulating the temperature of indoor air and water
- Improving the use of daylight
- Replacement of pumps and fans
- Thermal insulation of pipes
- Alternative systems, such as decentralized energy supply systems, cogeneration in district heating and district cooling systems, etc.
- Installation of energy-efficient office and household appliances
- Building automation and control systems. The measure is performed in combination with an intelligent measuring system

Hungary

- Development of building user manual for operating the building efficiently

Sweden

Recommendations that are suggested in the EPC also include measures to decrease the domestic hot water demand.

3.1.2.2 Collection of renovation recommendations for EPC forms from WP 4 (Task 4.2)

In Task 4.2, EPCs according to the currently existing national schemes were or will be issued for 10 to 15 buildings in each of the 7 countries represented in QualDeEPC. The following lists recommendations typically found in these EPCs.

Bulgaria

Most of existing EPC of the pilot buildings recommend the following measures:

- External wall insulation
- Roof and floor insulation
- Windows replacement
- Energy-efficient lighting

Germany

Not yet available

Greece

- Replacement of windows
- Roof insulation (in low-height buildings)
- Replacement of boiler
- Installation of thermostatic valves
- Installation of solar water heaters
- Replacement of light bulbs (in non-residential buildings)

Hungary

- External wall insulation
- Replacement of windows
- Roof insulation
- Replacement of boiler
- Installation of thermostatic valves
- Hydraulic balancing of HVAC systems
- Adding insulation on pipes (heating and DHW)
- Installation of PV systems
- Replacement of light bulbs in non-residential buildings

Latvia

Not yet available

Spain

- Adding thermal insulation on the façade from outside or inside or in the cover
- Replacement of the entire window
- Replacement by high-efficiency combustion boiler (heating and DHW)
- Replacement by high-efficiency heat pump (heating, cooling)
- Energy-efficient lighting

Sweden

- "Installation of solar PV"
- "Replacement of pumps"
- "Replacement of thermostatic radiator valve"
- "Replacement of door and window seals"
- "Installation of energy-efficient lighting"
- "Lower the indoor temperature in the stairway (to decrease the heating demand) "
- „Installation of water radiator instead of electric floor heating in the laundry room"
- „Adding thermal insulation in external walls"
- „Replacement of windows"
- „Installation of presence controlled lighting"
- "Adjusting/balancing the heating system"
- "Installation of air to air heat pumps"

3.1.3 Summary of current renovation recommendations

As shown in Table 5 to

Table 14, the specific renovation recommendations selected by EPC assessors/issuers differ by country. This observation can be explained by specific climate zones, national requirements and building standards, but also by the uncertainty about the interpretation of "cost-effectiveness". Often "typical" values are hard to specify because no official documentation about renovation recommendations exist. Hence, mostly the minimum legal requirement is proposed. Similarly, "improved" values are not always available or are taken from other sources such as funding programs.

Considering the renovation recommendations of the pilot buildings, similarities between the countries can be found. In most cases, it is recommended to add thermal insulation to external walls, the roof or ground floor and/ or replace the windows. For technical systems, often the replacement of a

boiler by a highly efficient one or a highly efficient heat pump is suggested. For renewable energies, photovoltaic or solar heating systems are often proposed.

3.2 Proposed renovation recommendations towards 'deep energy renovation'

Based on the above findings, we can conclude that there is an important need to create guidance on (1) which renovation actions should usually be recommended on EPCs, and (2) what should then be their energy efficiency or rating levels, so that the renovations will be consistent with 'deep energy renovation', even when implemented step by step according to an individual renovation roadmap. The project team, therefore, developed a proposal for such a set of renovation recommendations, based on the definition of 'deep energy renovation' developed in chapter 2.

Table 15 summarizes the proposed deep energy renovation recommendations. Since the specific values differ by country and climate zone (see section 3.1.3), it was decided to use text-based recommendations in WP 3 for this Green paper and then provide country-specific values in WP 5. For illustration purposes, country-specific values are exemplarily shown for Germany in the rightmost column of Table 15.

In the cases of added insulation at the external walls and roof as well as for the replacement of windows and doors, two categories for deep energy renovation options are proposed. Firstly, "enhanced" insulation, which should be more energy-efficient than the legal option. Secondly, "exceptional" insulation, which might also be described as the "best reasonable option available". Here, 'reasonable' means that the measure is still cost-effective, but may be less profitable. For the insulation of the ground floor, the project partners agreed on "reinforced" insulation, because it is mostly only used if no insulation was present. For windows, the best available options, depending on country, are either double glazed low-emissivity windows with sun films, triple glazed windows, etc and PVC or aluminium framed windows with reduced thermal bridges for the windows frames.

In more and more countries, also the use of shading is or becomes important to reduce the cooling load during summer. Here, the most efficient option is to add shading externally, either using Venetian blinds, shutters or awnings or to add fixed horizontal/vertical shading devices, such as overhangs or louvers. Another option is the use of vegetation for shading.

Mechanical ventilation systems help to supply the needed air exchange efficiently, especially in otherwise airtight buildings. Hence, these systems should either be newly installed or replaced by energy-efficient options. An exemption could be made if natural ventilation works sufficiently well. For deep energy renovation, it is proposed to either use an exhaust fan system with an exceptionally low need for electrical power or a ventilation system with at least 80 or 90% heat recovery and very low or low electrical power consumption of the fans, respectively.

For the heating, cooling and DHW systems, a large variety of options is available on the market. Moreover, the specific choice depends on the system that was already installed and environmental conditions (i.e. climate zone). Hence, it was found difficult to list the best options for deep energy renovation. However, for all of these technical systems, an EU energy label is available. This label provides detailed requirements and calculation methods. Thus, a category A or above of this label is suggested for deep energy renovation.

For some partner countries, the lighting is also evaluated in residential buildings. LED lighting and the installation of dimmers are chosen as deep energy renovation options.

It also should be mentioned that some renovation recommendations rely on, or are a consequence of other recommendations. This observation is especially true for the options “reducing thermal bridging”, “air tightness”, “integration of renewable energy sources”, and “insulation of pipes”. The first two options rely mainly on the external wall, roof and ground floor insulation as well as on the window replacement. The integration of renewable energy sources, as well as the insulation of pipes, might already be covered by installing or replacing HVAC systems. Nevertheless, these elements should be listed as criteria for deep energy renovation, since also stand-alone options are available.

Even though the recommendations should be generally applicable in all partner countries and climate zones, there might be specific conflicting requirements. For example, the “wall with exceptional thermal properties” is not recommended in Bulgaria, because of the requirement for night cooling in summer. Moreover, in most partner countries, lighting is not relevant toresidential buildings. These elements will be evaluated further for country-specific purposes in WP5.

Table 15 Deep energy renovation recommendations by QualDeEPC

	Specific recommendation	Example value (Germany)
External wall insulation	Wall with enhanced thermal insulation properties (nZEB for renovation standard or similar)	U=0.2 W/(m²K) [funding program]
	Wall with exceptional thermal insulation properties (nZEB for new buildings standard or similar)	U=0.15 W/(m²K) [quality requirement passive house]
Roof insulation	Roof with enhanced insulation	U=0.2 W/(m²K) [Reference building]
	Roof with exceptional thermal insulation properties	U=0.14 W/(m²K) [funding program]
Insulation of ceiling of an unheated basement/ ground floor	Floor connected to the unheated basement or ground floor with reinforced insulation	U=0.25 W/(m²K) [funding program]
Window replacement	Window with enhanced insulation properties: e.g. Double glazed window equipped with thick argon or krypton thermal break and low-emissivity glass	U_W=1.3 W/(m²K) (g=0.6) [new building}
	Window with exceptional insulation properties, e.g. triple glazed window	U_W=0.95 W/(m²K) (g=0.6) [funding program]
Door replacement	Door with enhanced insulation properties	U = 1.8 W/(m²K) [new building]
	Door with exceptional insulation properties	U=1.3 W/(m²K) [funding program]
Replacement/ Installation of shading	External blinds (Venetian, shutters or awning)	Funded in combination with the exchange of windows
	Fixed horizontal/vertical shading devices, such as overhangs, louvers	
Replacement/ installation of the mechanical ventilation system	Ventilation system (no heat recovery) with an exceptionally low electrical power requirement	P_{el}<0.2W/(m³/h)
	Ventilation system with heat recovery of min. 80% and very low electrical power consumption	η>80%, P_{el}<0.45W/(m³/h)
	Ventilation system with heat recovery of min. 90% and low electrical power consumption	
Replacement/ modernization of the heating system	Generally: heating systems with EU energy label Cat. A or above, for example:	
	Condensing gas boiler in combination with solar thermal collectors	
	Geothermal heat pump	

	Specific recommendation	Example value (Germany)
	Reversible inverter air-air heat pump	
	District heating	Hydraulic balance required
Replacement/ modernization of the cooling system	Generally: cooling system with EU energy label Cat. A or above	
	Geothermal heat pump	
	Reversible inverter air-air heat pump	
Replacement/ modernization of the DHW system	Generally: DHW system with EU energy label Cat. A or above	
	Combination with the heating system through storage	
	Energy-efficient boiler with solar thermal collectors	
Integration of renewable energy sources	significant extent of energy demand/ consumption should be covered by renewable energy sources; *alternatively*, all external walls, the roof and ground floor should be insulated with exceptional thermal insulation	
	photovoltaic system (including for self-use)	
Lighting	LED	
	Dimmers	
Reduction of thermal bridging	Reduced thermal bridging for non-structural building elements, such as balconies, terraces, dormers, and fixed shading devices	
Increased air tightness	Air exchange rate of 1.5 h^{-1} or lower at 50 Pa pressure difference OR Air tightness according to new building standard	$n_{50} \leq 1.5 h^{-1}$
Others	Insulation of all pipes	
	Building automation system	
	Replacement of circulation pumps that meet minimum requirement of ErP label	
	Hydraulic balance optimisation for water-based heating systems	

4 ONLINE TOOL FOR COMPARING EPC RECOMMENDATIONS TO DEEP ENERGY RENOVATION RECOMMENDATIONS

4.1 General Structure of the QualDeEPC Master tool Input parameters

The Master[2] tool is the general version of a friendly platform for all users, who want to be informed about the energy demand, rating and CO_2 emissions of their residential building. It is easy to use allowing the homeowners mainly, to simulate their dwellings, by input of the necessary characteristics of them (typology, geographical area, floor area, characteristics of heating/ cooling systems, etc.) in a few (13) steps only. In addition, the user can receive recommendations for improving the energy efficiency of their home to high levels (equivalent to deep renovation) and see the results and the indicative cost of the potential renovation activities.

4.2 Master tool structure

The Master tool structure was designed to use the necessary information in order to run an appropriate software for energy building calculations and building energy classification, and is adapted for the purpose of QualDeEPC. Special care was given, however, to provide a general result in order not to be regarded as an official Energy Performance Certificate. Compared to the Greek Home Energy Check tool, the Master version of the tool for the QualDeEPC project introduces additional building typologies and selection options for other building components and systems.

Another feature will be a statement that informs whether the deep renovation criteria have been met or not[3]. Finally, a recommendations list will be prepared and proposed for every case and presented in a hierarchical list.

[2]The master tool is based on the Greek Home Energy Check tool - http://www.cres.gr/energyhubforall/HEC.html

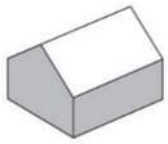
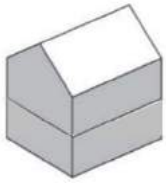
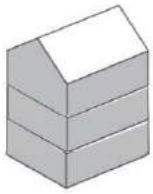
[3] Based on the concept of QualDEPC definition of deep energy renovation, and its variants for the partner countries

4.3 Input parameters

4.3.1 List of building types (screen 1)

The master tool provides a list of building types that can be used as input by the user. They are all residential buildings, from fully detached houses to multifamily buildings. Table 16 shows the building types.

Table 16 Greek HEC Building types

Building Type			
a/a		Existing Greek HEC tool	
	Type	Vicinity	Shape
1	1 storey single house	detached	
2	2 storey single house	detached	
3	3 storey single house	detached	
4	Flat in multifamily building	In touch with the ground	
5	Flat in multifamily building	Intermediate floor	

Building Type			
6	Flat in multifamily building	Upper floor	
	Additional types to be selected for Master tool for QualDeEPC[4]		
7	Multifamily building	Whole building	

4.3.2 Geographical area/climate zone and floor area of the building (screen 2)

In the second screen, the climatic conditions are determined by the selection of the geographical area where the building is located (see Figure 1). The selection comprises data from representative cities from QualDeEPC partner countries. Another selection whether the building is located at an altitude higher than 500 meters may be made. Also, the floor area of the house must be given, either by stating the exact floor area or by selecting the area from 3 choices: < 100 m², between 100 and 150 m², between 150 and 200 m², and above 200 m². In the latter case, the exact value must be stated.

Note. Climatic data/zones/maps of partner countries may be added, after the consortium decision on how and by which partner the tool will be finally used.

[4] Further building types can be developed by March 2021

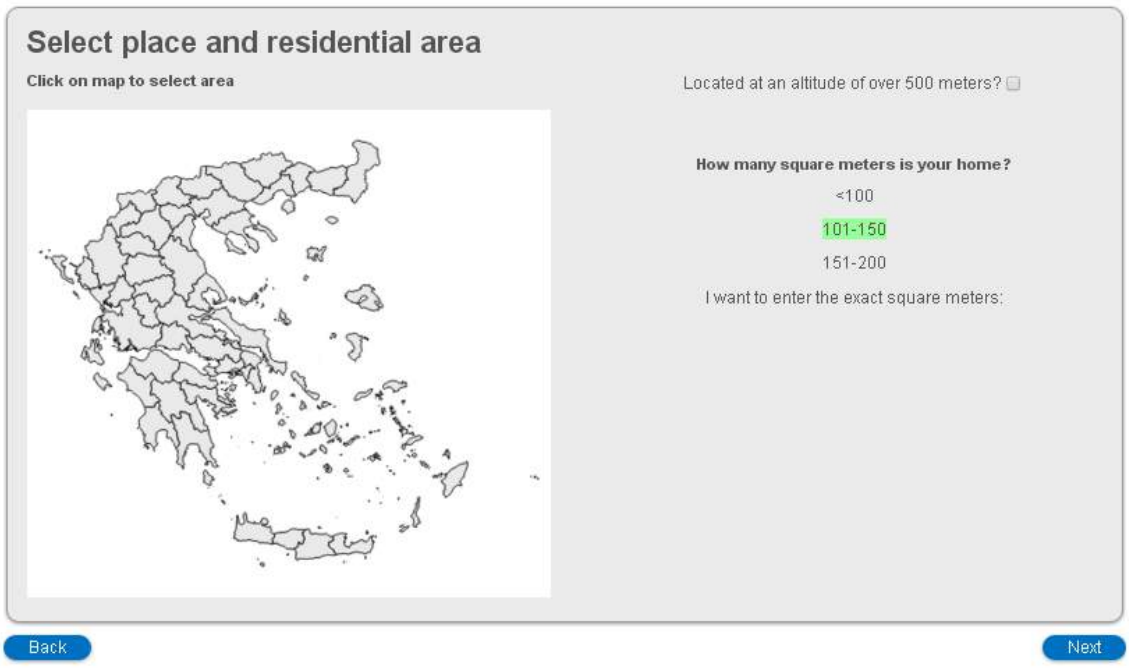


Figure 1 Geographical area selection, floor area and selection of altitude of the house location.

4.3.3 Selection of building components and technical systems (screen 3)

Then the user has to provide information about the building envelope, and technical systems installed. Ten categories are available (see Figure 2).

1. Walls
2. Roof
3. Floor
4. Windows
5. Shading
6. Heating systems
7. Cooling systems
8. Ventilation
9. Hot water equipment
10. Renewable energy sources

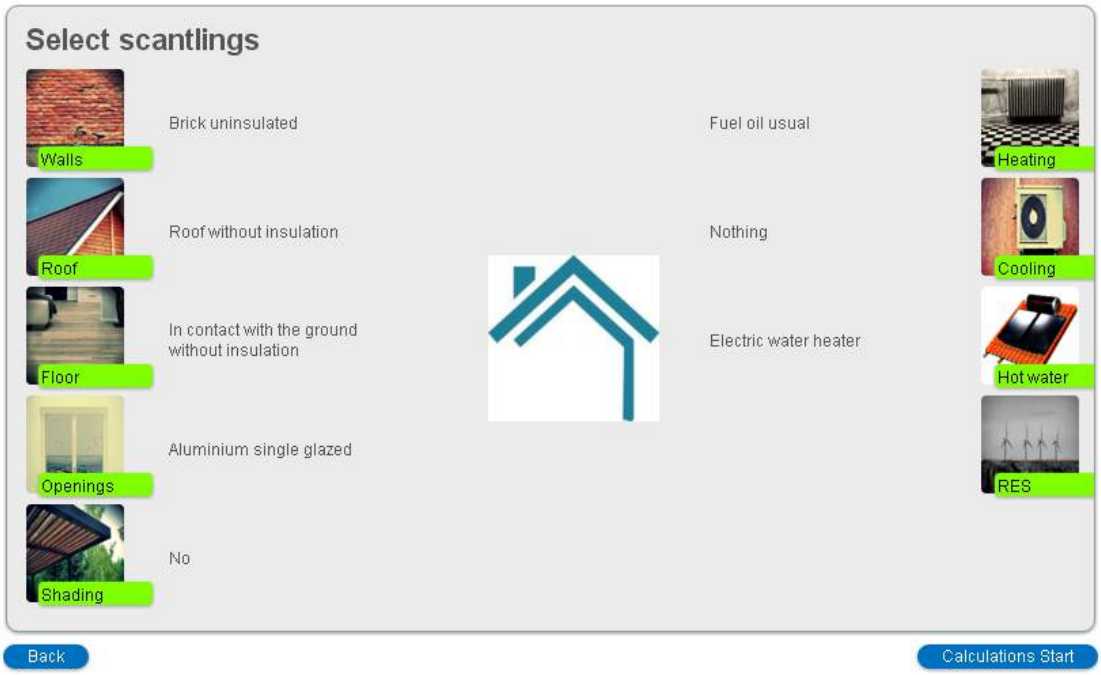


Figure 2 Information about the building envelope and installed equipment.

Based on the inputs from the partners, the master tool in English provides various choices for input parameters for various building components and technologies.

The user also has the choice not to provide any information and proceed to the calculations of the current situation. In that case, default values for all building systems are taken which, however, are the worst-case scenarios.

4.3.3.1 Specifications of the building systems: Walls (screen 4, Figure 3)

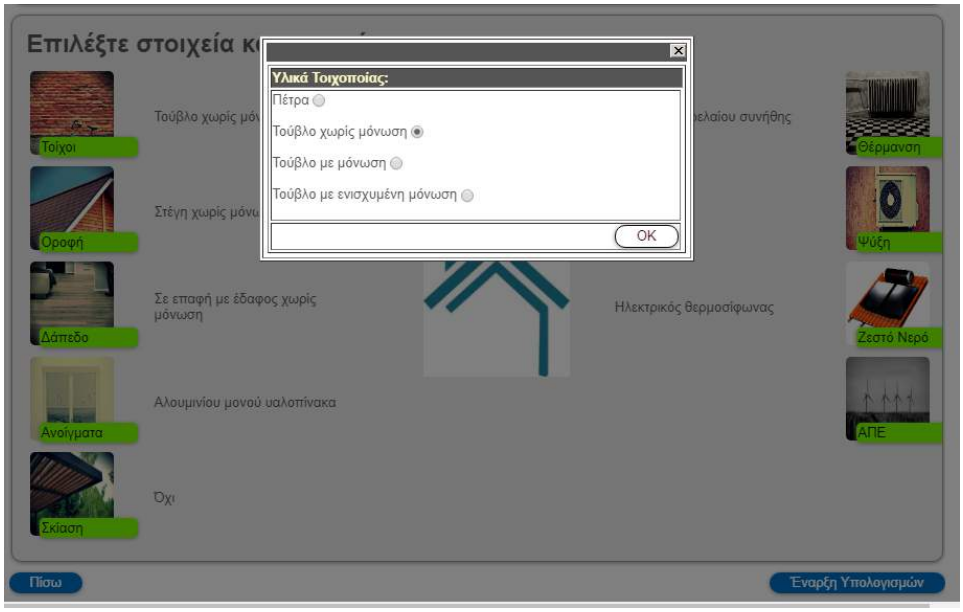


Figure 3 Wall construction choices

Regarding the walls, the user has the following options to select as show in Table 17.

Table 17 Input selection for external wall

Construction type	U-value (examples for Greece, may need to be adapted to national situation)
Stone Wall	4.25 W/(m2K)
Brick wall without thermal insulation	2.5 W/(m2K)
Brick wall with thermal insulation	0.7 W/(m2K)
Brick wall with reinforced thermal insulation	0.6, 0.5, 0.45 and 0.4 W/(m2K) according to the climatic zone where the building is located
Timber Wall	n/a
Light concrete Wall	n/a
Reinforced concrete panels	n/a
Any wall with “high” thermal insulation properties	[e.g. U=0,2 W/(m^2K)]
Other type (i.e exceptional thermal insulation properties, reinforced concrete, waterproof coating with exposed face brick)	1.80

More options could be included in the adaptation phase of the project in the national contexts.

4.3.3.2 Specifications of the building systems: Roofs (screen 5, Figure 4)

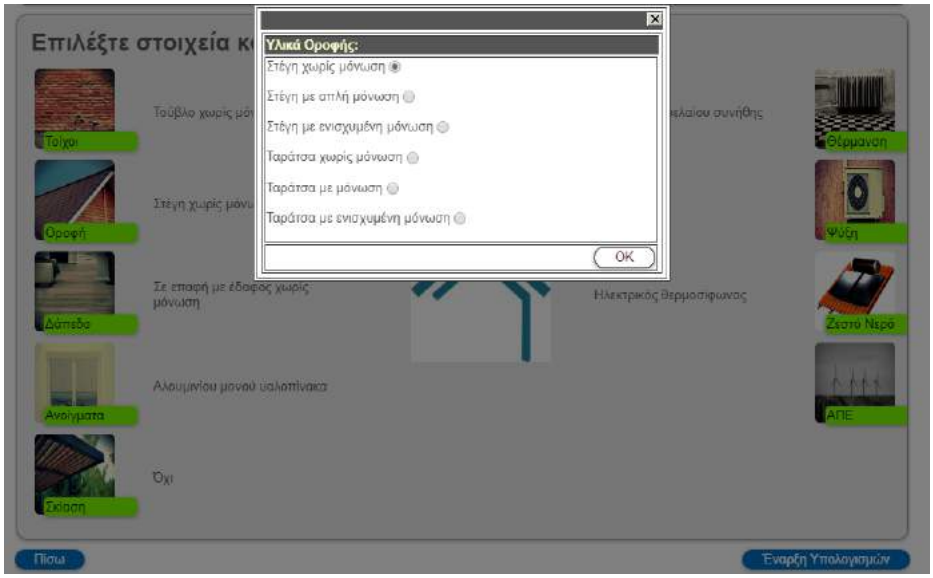


Figure 4 Roof categories

The roof construction can be selected from 7 alternatives as shown in Table 18.

Table 18 Input selection for heat transmission coefficients in W/m²K for roof or attic insulation (in residential buildings)

Construction type	U-value (examples for Greece, may need to be adapted to national situation)
Uninsulated Pitched roof	4.25 W/(m2K)
Pitched roof with insulation	0.5 W/(m2K)
Pitched roof with reinforced insulation	0.5, 0.45, 0.4 and 0.35 W/(m2K) according to the climatic zone
Flat roof without insulation	3.05 W/(m2K)
Flat roof with typical insulation	0.5, 0.45, 0.4 and 0.35 W/(m2K) according to the climatic zone
Flat roof with reinforced insulation	U=0,2 W/(m2K)
Other type (i.e exceptional thermal insulation properties)	*n/a*

More options could be included in the adaptation phase of the project in the national contexts.

4.3.3.3 Specifications of the building systems: Floors (screen 6, Figure 5):

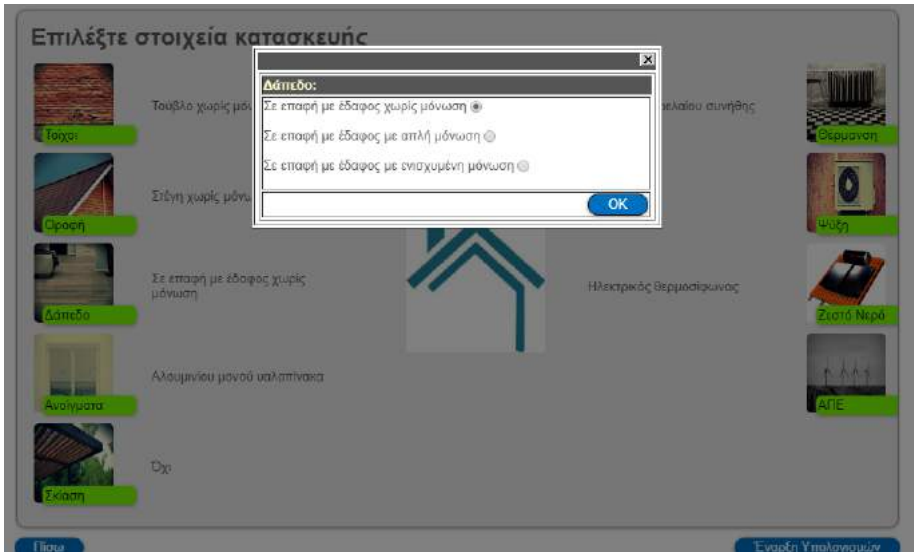


Figure 5 Floor alternatives

Similarly, for floor construction 5 alternatives can be selected as shown in Table 19.

Table 19 Input selection for heat transmission coefficients in W/m²K for insulation of ceiling of an unheated basement (in residential buildings)

Construction type	U-value (examples for Greece, may need to be adapted to national situation)
Floor in contact with the ground without insulation	3.1 W/(m2K)
Floor in contact with the ground with insulation	3, 1.9, 0.8 and 0.8 W/(m2K), according to the climatic zone
Floor in contact with the ground with reinforced insulation	1.2, 0.9, 0.75 and 0.7 W/(m2K), according to the climatic zone
Ground floor in contact with unheated basement without insulation	2.00
Ground floor in contact with unheated basement with insulation	0.80

4.3.3.4 Specifications of the building systems: Windows (screen 7, Figure 6):

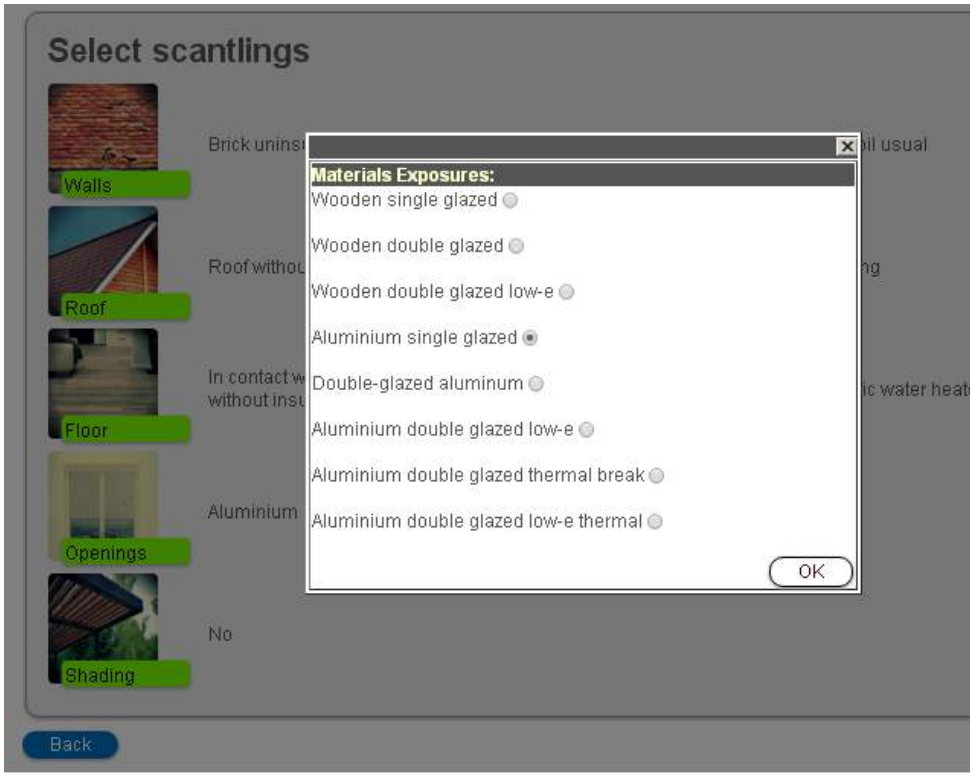


Figure 6 Windows energy characteristics

Regarding the windows the user can find 11 choices as shown in Table 20.

Table 20 Input selection for heat transmission coefficients in W/m²K for standard windows (in residential buildings)

Construction type	**U-Value** (examples for Greece, may need to be adapted to national situation)
Wooden frame single glazed windows	5 W/(m^2K)
Wooden frame double glazed windows	2.9 W/(m^2K)
Wooden frame double glazed low-e (low-emissivity) windows	2.1 W/(m^2K)
Aluminium frame single glazed windows	6 W/(m^2K)
Aluminium frame double glazed window	3.7 W/(m^2K)
Aluminium frame with double low-e glazing	3 W/(m^2K)
Aluminium frame with thermal break and double glazing	2.9 W/(m^2K)
Aluminium frame with thermal break and double low-e glazing	2.3 W/(m^2K)
Synthetic frame single glazed windows	5.0 W/(m^2K)
Synthetic frame double glazed windows	3.0 W/(m^2K)
Aluminium frame double glazed equipped with thick argon or krypton thermal break and low-e glass	1.5 W/(m^2K)
Synthetic or wooden frame double glazed with thick argon or krypton thermal break and low-e glass	1.2 W/(m^2K)

Construction type	U-Value (examples for Greece, may need to be adapted to national situation)
Other window type with very low U-value (e.g. triple glazed, vacuum gap)	U < 0.9 W/(m^{2}K)

4.3.3.5 Specifications of the building systems: Shading (screen 8, Figure 7)

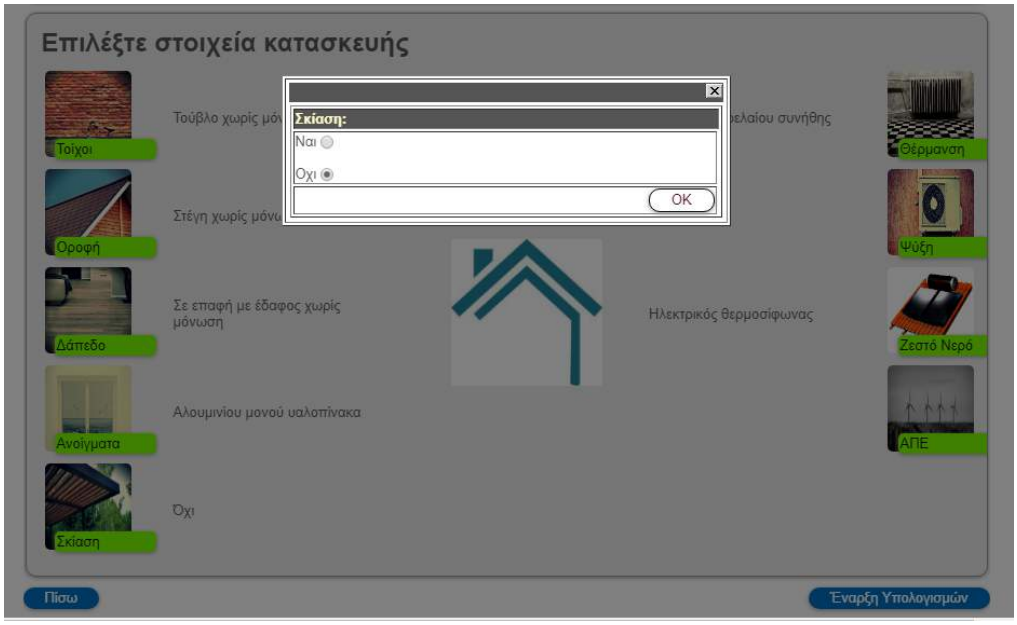


Figure 7 Shading choices

Table 21 Input selection for shading (in residential buildings)

Shading type	Value
Shading not present	Shading coefficients: F_{hor}=0.91, F_{on}=0.93,F_{fin}=0.46
Shading present (shading covering 30% of the facade)	0.2/0.3 according to the orientation of the building component Shading coefficients: F_{hor}=0.86, F_{on}=0.73, F_{fin}=0.28
Shading present (shading covering 70% of the facade)	Shading coefficients: F_{hor}=0.91, F_{on}=0.93,F_{fin}=0.46

4.3.3.6 Specifications of the building systems: Heating systems (screen 9, Figure 8)

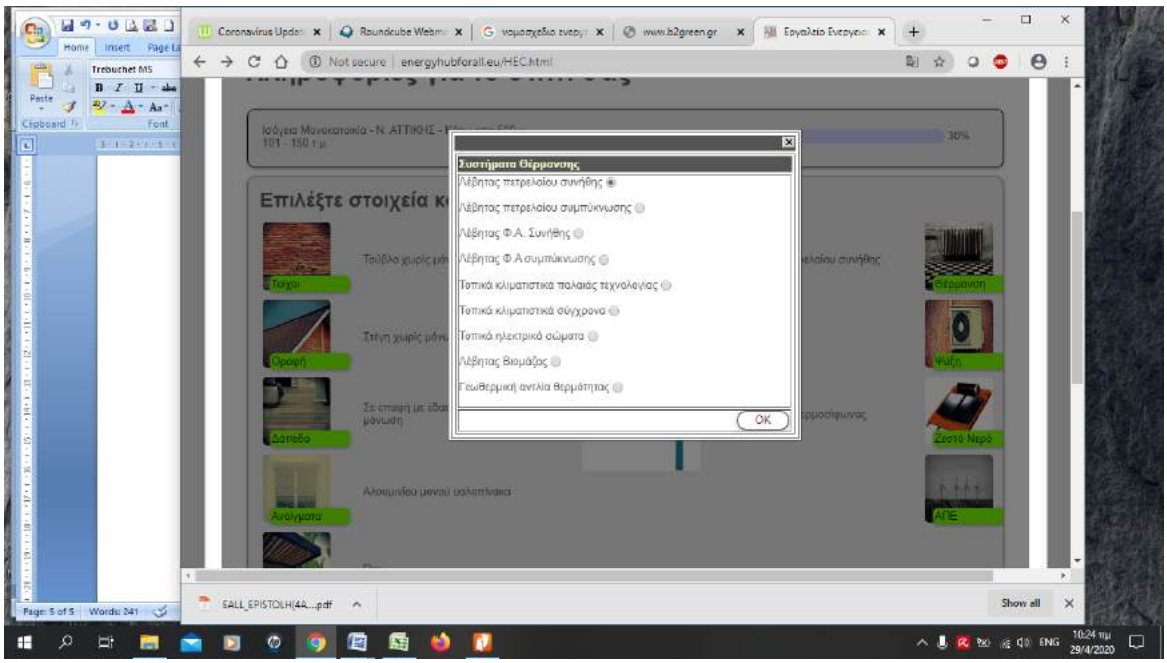


Figure 8 Heating systems selection

Table 22 Input selection for heating systems (in residential buildings)

Heating system type	**Efficiency** (examples for Greece, may need to be adapted to national situation)
Conventional fuel oil boiler	0.84
Condensing fuel oil boiler	0.97
Conventional Gas boiler	0.90
Condensing gas boiler	0.97
Conventional air conditioning unit – (old technology)	2.00
Air conditioning unit (with inverter)	3.20
Local electrical units	1.00
Biomass boiler	0.95
Biomass pellet boiler	0.95
Geothermal heat pump	4.80
Air-to-water heat pump	n/a
Air-to-air heat pump	n/a
Exhaust air heat pump	n/a
Stove	0.57
District heating	0.98
Small-scale CHP unit	0.75

4.3.3.7 Specifications of the building systems: Cooling systems (screen 10, Figure 9)

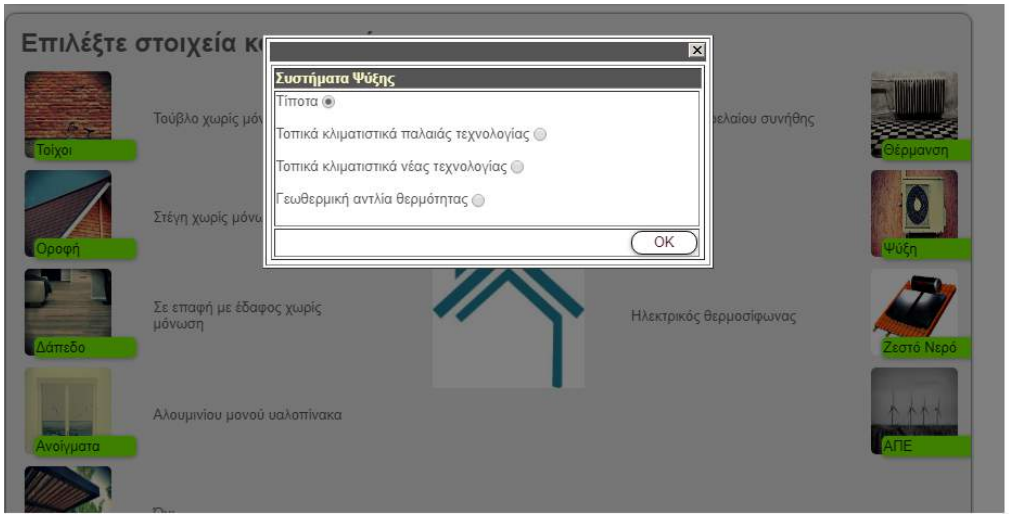


Figure 9 Cooling systems selection

Table 23 Comparison of measures to improve cooling systems (in residential buildings)

Cooling system type	**Efficiency (**examples for Greece, may need to be adapted to national situation)
No cooling system	-
Local air conditioning units – (old tech)	2.2
Local air conditioning units – (with inverter)	3.3
AC units with inverter driven technology (VRF/VRV)	3.5
Geothermal heat pump	4
District cooling system	*n/a*
Central cooling system	3.5

4.3.3.8 Specifications of the building systems: Ventilation (screen 11, Table 24)

Table 24 Mechanical Ventilation system options for heating and coolng systems

System Type	Mechanical Ventilation
Heating System	☐ or ☑
Cooling System	☐ or ☑

4.3.3.9 Specifications of the building systems: DHW (Screen 12, Figure 10)

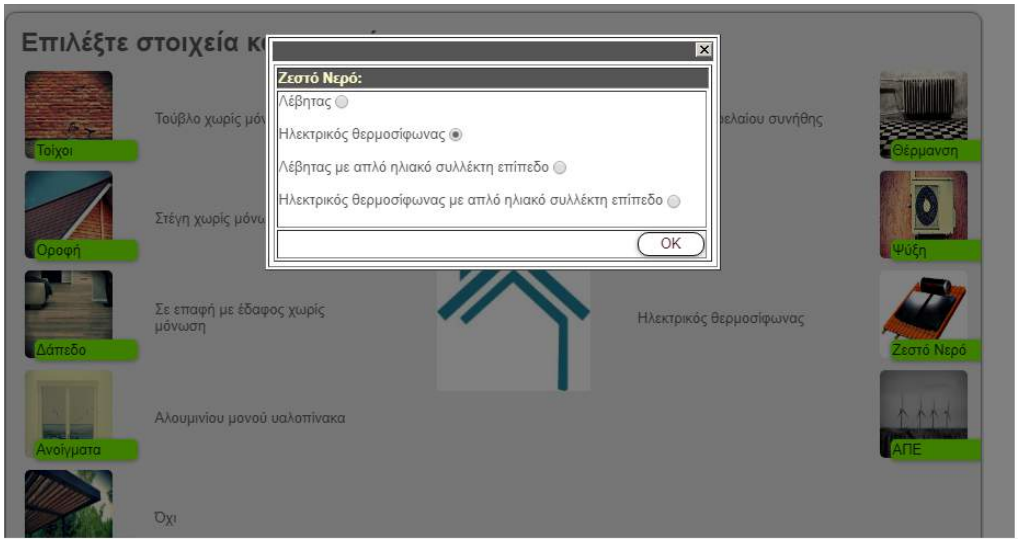


Figure 10 Hot water production systems selection.

Table 25 Selection input for DHW systems (in residential buildings)

Hot water system type	**Efficiency (**examples for Greece, may need to be adapted to national situation)
Boiler	0.88, 0.9/0.97 according to the boiler type
Electrical resistance heater (instantaneous)	1
Electrical resistance storage heater	n/a
Boiler and solar collector	0.88, 0.9, 0.97 according to the boiler type (flat solar collector)
Electrical resistance storage heater and solar collector	1 (flat solar collector)
Geothermal heat pump	n/a
Domestic hot water heat pump	n/a
Exhaust air heat pump	n/a
District heating	0.98

4.3.3.10 Specifications of the building systems: RES (Screen 13,Figure 11)

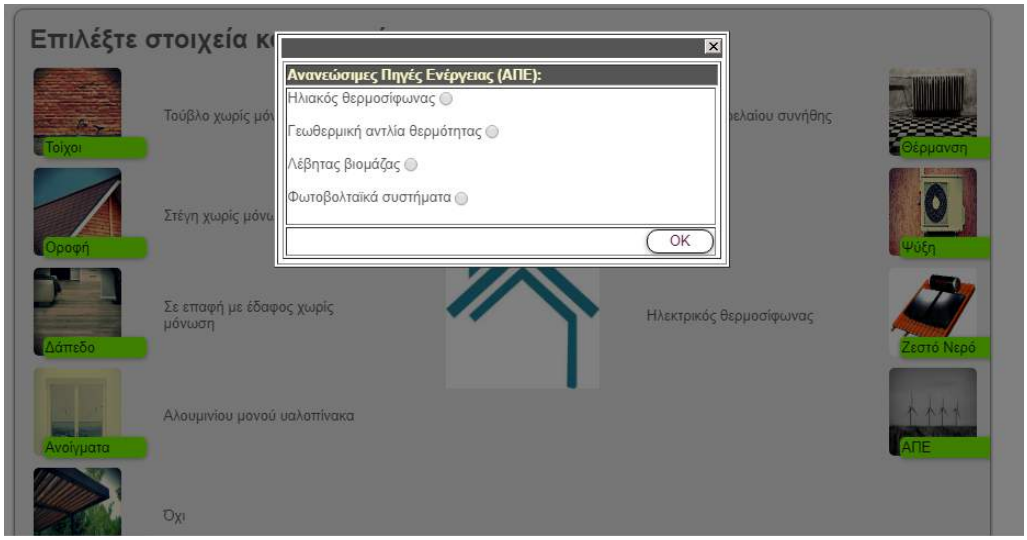


Figure 11 Renewable energy sources selection

In case of the RES system selection, if made, the software takes into account the total floor area of the building unit considered, calculates the demand and the dimensioning of the system and finally the heat or electricity produced. The solar collector (for DHW) is a conventional flat type one with a utilization factor of 0.332 (for the Greek case). The PV system consists of monocrystalline cells with an efficiency of 16%.

Table 26 Comparison of measures to integrate renewable energy sources (in residential buildings)

RES type	**Description (**examples for Greece, may need to be adapted to national situation)
Solar Thermal collector (for DHW)	0.5
Geothermal Heat Pump (for space heating & DHW)	4.8
Biomass boiler (for space heating & DHW)	1
Solar photovoltaic (monocrystalline efficiency 16%)	efficiency 16%
Solar thermal collector for space heating	0.9
Solar photovoltaic (Polycrystalline and thin film PVs)	efficiency 19%

4.4 Results

Then all inputs are used to run the software, which calculates the current energy situation of the house in energy figures and energy category. It provides the results for the yearly final energy consumption for heating, cooling and hot water production.

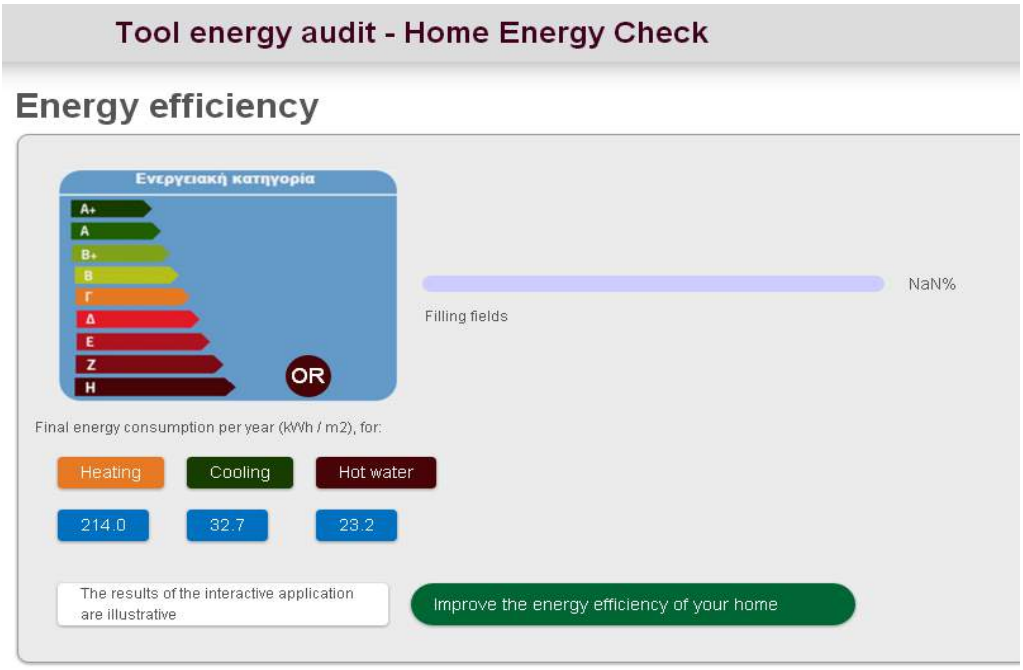


Figure 12 Current house energy consumption.

Then, improvements can be performed for the ten main fields of building systems (see Figure 13).

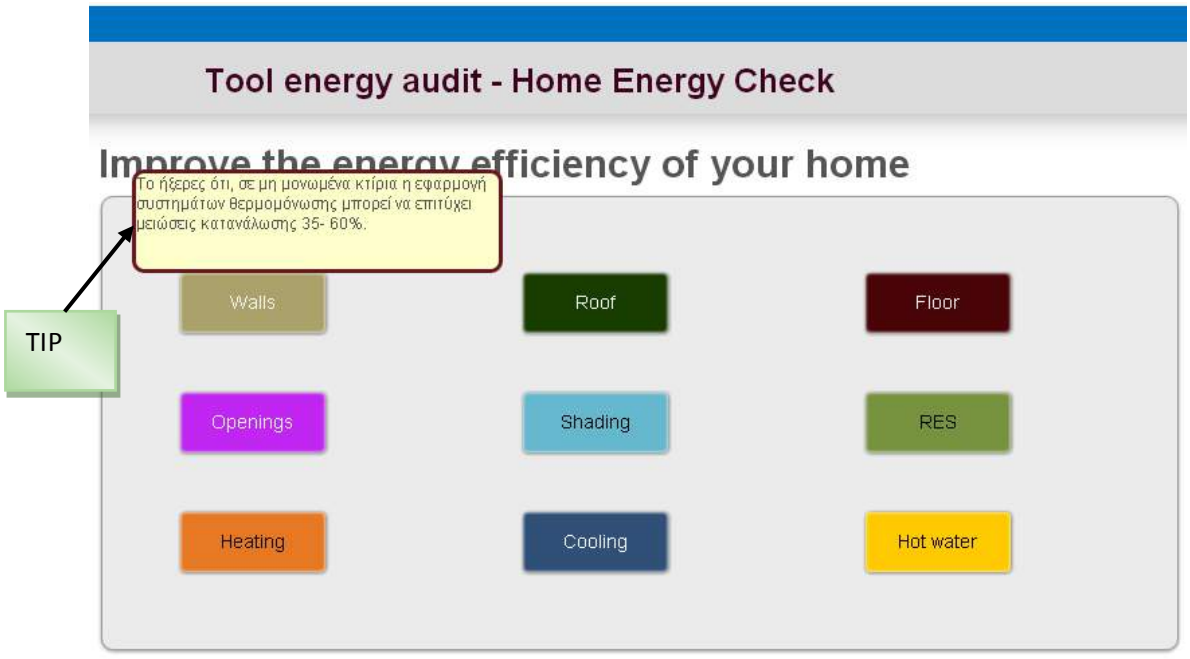


Figure 13 Improvements selection

Note however, that in the existing Greek tool, which is the basis for the master tool, the improvement measure or measures can be compared with the current energy figures of the house only once. In case someone wishes to check more options, he or she has to repeat the input values.

4.4.1 Renovation recommendations

The recommendations are mainly attributed to the various selections the user is free to use according to the energy measure. The renovation recommendations will be based on the list provided by

Table 15 on page 37. The detailed values for each measure are currently based on Greek tool, but may be adjusted to country specific needs in WP5.

4.4.2 *Comparison between existing and renovation case; and deep energy renovation checkmark*

Finally, the results from the comparison between the current and energy improved case are given. Additionally, the new energy class of the house is given together with the achieved energy conservation (in %), the CO_2 emissions reduction (in %) and an estimation of the cost for the improvement measures tested (refer to Figure 14).

From the moment the input data are completed, an .xlm file is produced and run by the software for the energy efficiency of buildings. The software is used again to test the selected energy improvements and all results are shown in the last screen of the tool (Figure 14 and Figure 15).

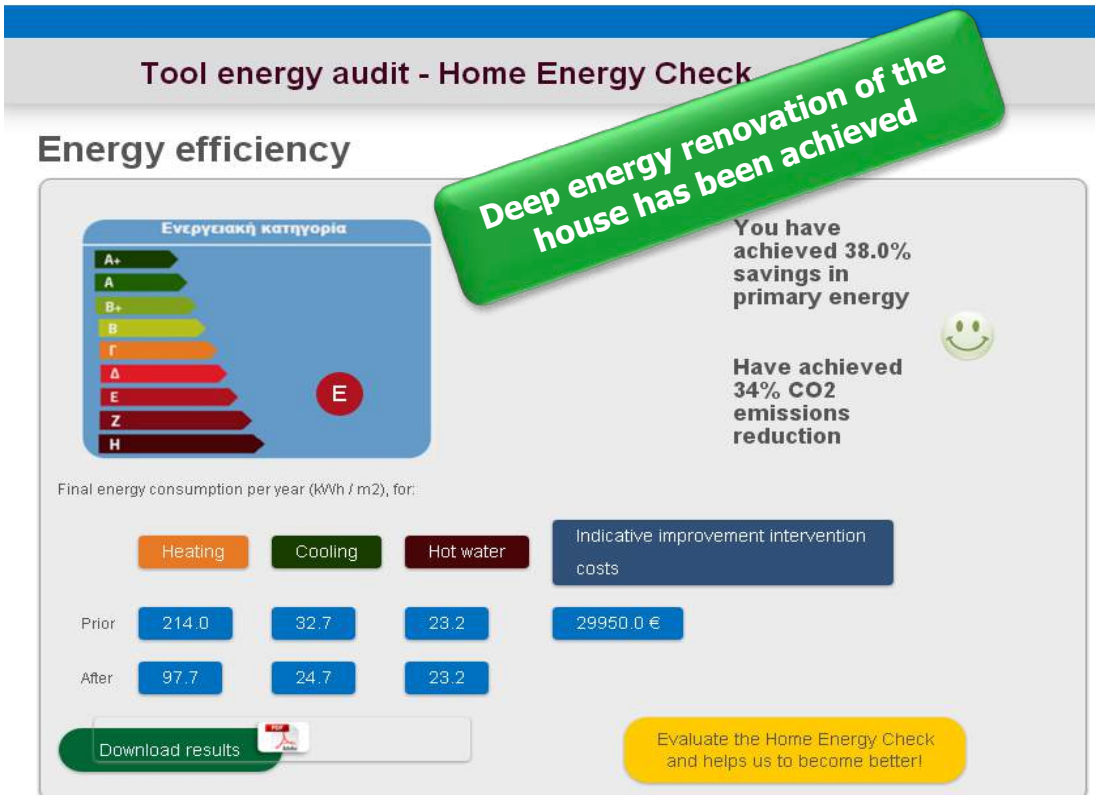


Figure 14 Comparison of results

An extra message states if Deep energy Renovation criteria have been reached (see Figure 14).

Deep energy renovation of the house/building will be achieved when fully implementing the recommendations. Or

Deep energy renovation of the house/building will not be achieved when fully implementing the recommendations. Or

Deep energy renovation of the house/building is lacking by XX%.

Output of recommendations

In the report for the test conducted by the user, recommendations will be available regarding which energy efficiency technology should take place first and in what order (see Figure 16).

The hierarchy of recommendations hierarchy will be based on construction restrictions, energy savings achieved, cost, and payback period.

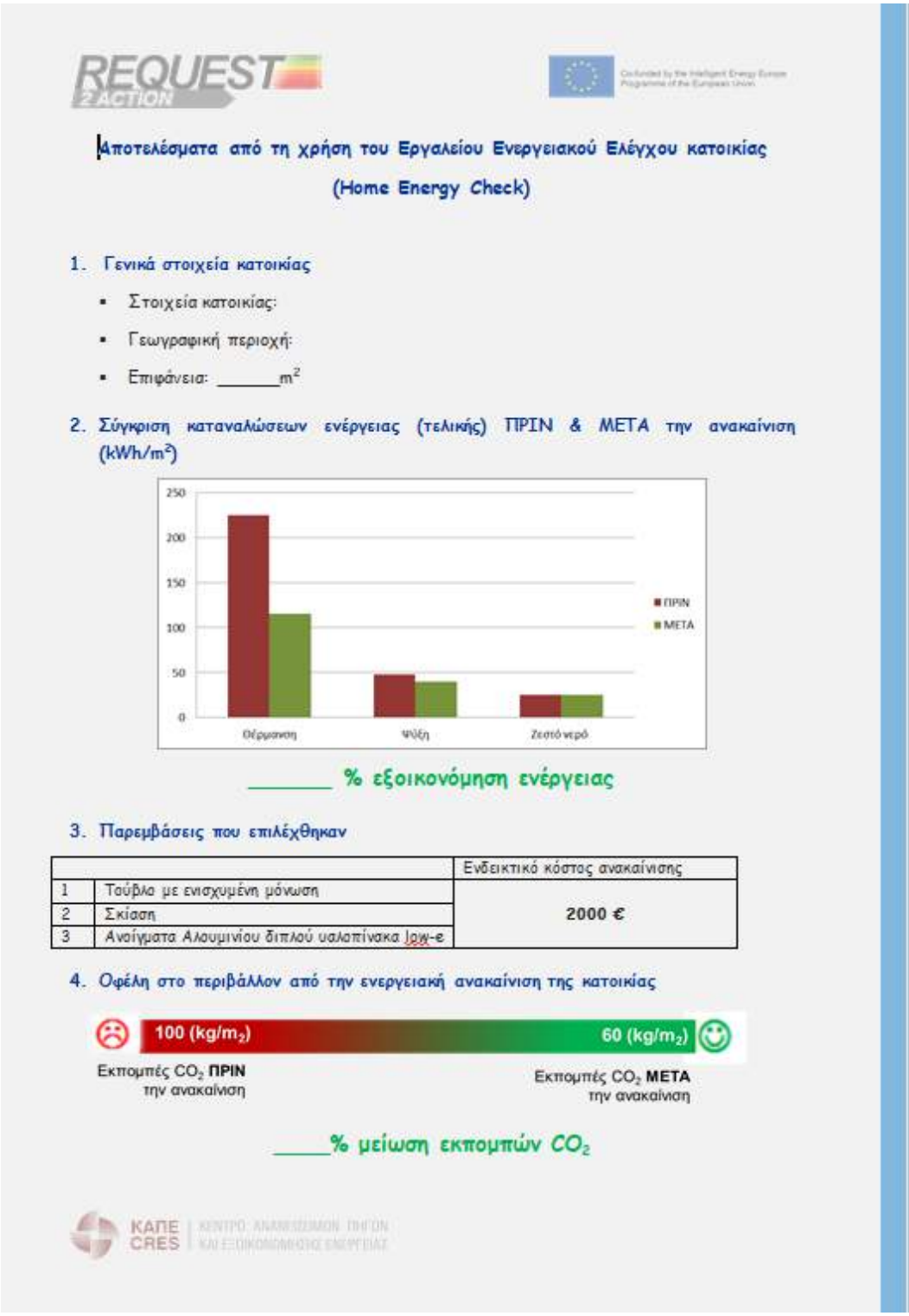
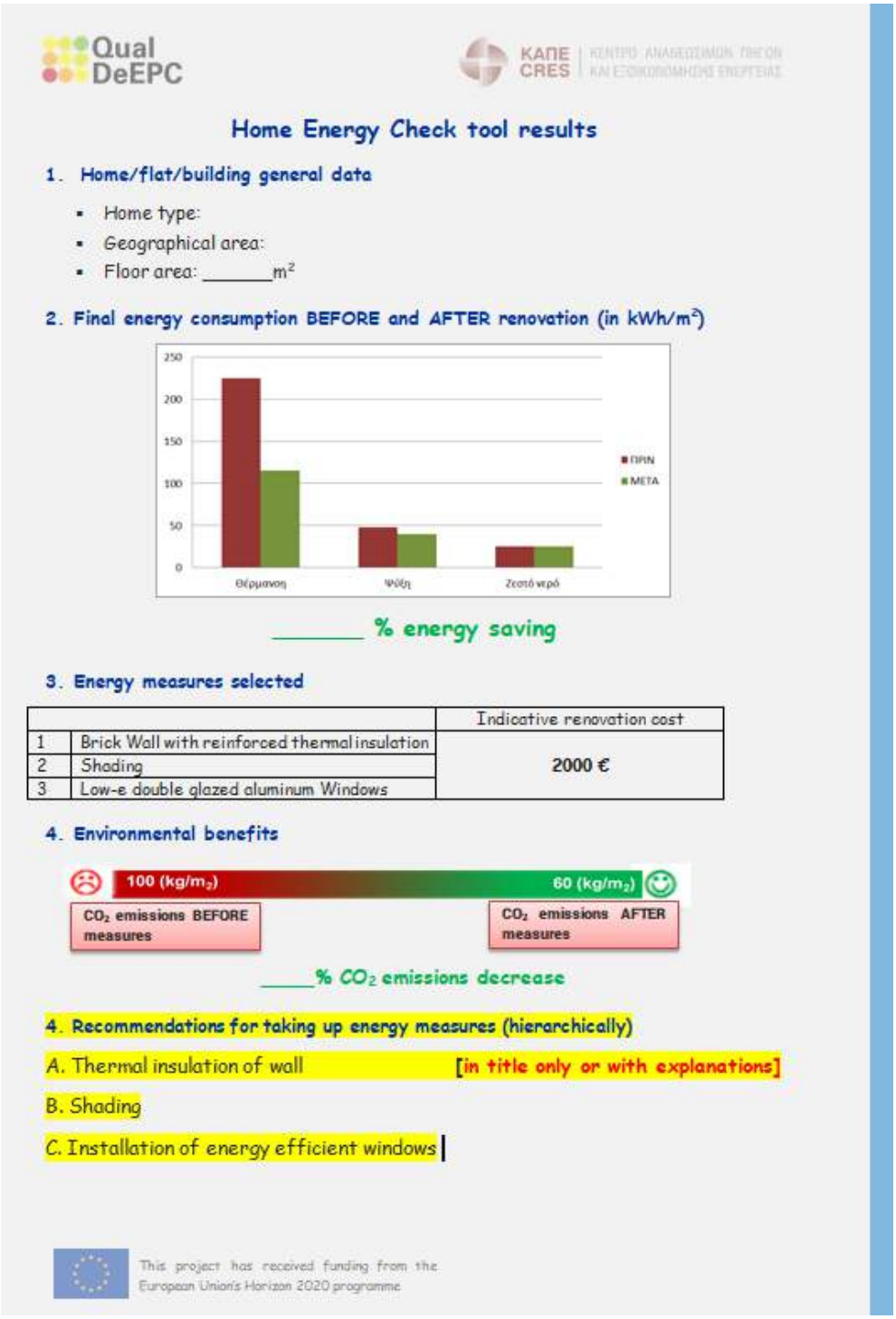


Figure 15 Tool results report layout (current version)



Home Energy Check tool results

1. Home/flat/building general data

- Home type:
- Geographical area:
- Floor area: _____m^2

2. Final energy consumption BEFORE and AFTER renovation (in kWh/m^2)

_____ % energy saving

3. Energy measures selected

		Indicative renovation cost
1	Brick Wall with reinforced thermal insulation	2000 €
2	Shading	
3	Low-e double glazed aluminum Windows	

4. Environmental benefits

100 (kg/m_2) — 60 (kg/m_2)

CO_2 emissions BEFORE measures

CO_2 emissions AFTER measures

_____% CO_2 emissions decrease

4. Recommendations for taking up energy measures (hierarchically)

A. Thermal insulation of wall [in title only or with explanations]

B. Shading

C. Installation of energy efficient windows

This project has received funding from the European Union's Horizon 2020 programme

Figure 16 Tool results report layout (upgraded version)

5 CREATING DEEP RENOVATION NETWORK PLATFORMS

5.1 Objectives for developing concepts for deep renovation network platforms

The concept, or rather several differentiated concepts for Deep Renovation Network Platforms are part of the project structure within the four phases of the entire QUALDeEPC project. The basis for this task is the Development Strategy Plan created in WP2, which will be guiding the development of next-generation EPC schemes in WP3 of the QualDeEPC project.

The Development Strategy Plan sets priorities for which elements the project will develop further and towards which outcome, serving which purpose. One among seven selected priorities is the creation of Deep Renovation Network Platforms.

The main objective of Task 3.2 is creating concepts for Deep Renovation Network Platforms providing one-stop-shops (OSS) for deep renovation linked to EPCs, including administrative, energy advice, financial, and supply-side information to building owners, with active marketing of deep renovation and EPCs, and coordinating supply-side actors and supporting their marketing, training, and quality.

The developed concepts are adapted to project partner country circumstances and partners' possibilities. The basic version includes an online platform providing a one-stop-shop for information and other services for seven different topics.

Under this basic version, a minimal version is defined by the column "minimum version". It is the minimal concept that project partners would aim to implement in each of the seven countries of QualDeEPC.

The Development Strategy Plan outlined two versions – basic and extended, defined by the type of services offered, and five potential subtypes, with a combination of services and the organisation as a nation-wide online platform or a local/regional physical hub of Deep Renovation Network Platforms.

NOTE: A **One-Stop-Shop** should offer all the products and services that customers need. Depending on the initial situation in each sector and country, the product range for a complete solution can look very different.
In most cases, the task is to relieve the customer of research, design, or bureaucratic processes. In extended cases, the One-Stop-Shop may perform the implementation on behalf of the customer, or even provide the financing.

5.2 Deep renovation network platforms: versions and subtypes

5.2.1 Basic platform

The basic platform will be a web platform that provides a one-stop-shop including all relevant information[5]. This will also either include an adaptation of the central tool to be developed in Task 3.3 or of similar existing tools, which will offer improved recommendations for residential buildings match-

[5] This is equivalent to subtype 1) a. discussed in the Development Strategy Plan.

ing deep renovation standards, as a tool for both EPC assessors, building owners, and potential buyers and tenants.

If such a tool already exists in a country, it will be checked whether it can be extended to the full functionality that is required for the basic platform.

The basic platform consists of seven services/products shown and described in table Table 27 Basic part of the DRNP below. All services will be offered by the provider of the platform itself, but possibly often in co-operation with partners, particularly for the last four services. Besides, if an existing tool is connected to the service of an online renovation calculator and tool, it may be provided by a third party. The basic version of the services is shown in Table 27 Basic part of the DRNP.

5.2.2 Extended platform

The project partners, supporters and other stakeholders could further enhance the basic platform depending on the current national situation and resources that can be committed. Which service elements are needed and feasible in each country will be discussed in Task 3.4 and will be analysed in detail in WP5. To the extent that partners can't be implemented in the course of the QualDeEPC project, this extended concept can be understood as a policy proposal, as outlined below.

The platform can be expanded to create a platform for suppliers to organize one-stop supply offers for renovation. Furthermore, the platform could be extended together with regional partners to become more than a website. A network of partners could provide a (virtual or even physical) hub for active marketing and connecting stakeholders, professional training and further necessary services.

The platforms can be adapted to country needs, and several services can be proposed or prepared and organised. Intended services are e.g. step-by-step guidance for deep renovation projects, or the use and linking or expansion of existing training and learning platforms to maintain specialist knowledge and sector capacities. The extended services can be found in Table 28 Extended part of the DRNP.

5.2.3 Typology of platforms

A typology of such platforms could include the following **subtypes:**

1. **an online platform:**

   1a) an online platform including information only by a One-Stop-Shop (OSS) such as the Greek www.energyhubforall.eu .

   1b) an online platform like the Danish BetterHome (including an OSS for information and implementation) https://www.betterhome.today

2. **a local or regional physical hub**
   i.e. a network of partners providing a hub for active marketing and connecting stakeholders, professional training, or whatever is needed, and also a ‚physical' OSS with energy advisors. This could take the forms of

   2a) OSS hub for information only, or

   2b) OSS hub for information and coordination (guiding/coaching through implementation), eg proKlima in Hannover (https://www.proklima-hannover.de) or

2c) OSS hub for information and implementation.

Subtypes could also be combined. For example, a combination of a 1a) national online platform and a network of several or many 2b) or even 2c) physical hubs may be best to advance deep renovation.

However, it should be noted that physical hubs involve higher costs than online-only solutions. Both types may need funding from the national or regional government to local/regional agencies implementing the hub, and support and coordination from the national or regional energy agency.

For each subtype and service/product, the potential service provider, description of services, and end-users addressed are shown in Table 29 Subtypes.

5.2.4 QualDeEPC policy recommendations

Based on the above analysis and the detailed concepts presented in the following tables, QualDeEPC recommends the following actions to national and/or regional governments competent for implementing energy efficiency policies for buildings and particularly EPC schemes.

Each EU Member State should operate a combination of two types of Deep Renovation Network Platforms:

1. An online platform at the national level, including a One-Stop Shop at least for information (subtype 1a), i.e. all information services 1. to 5. of the basic version.
   It should also be endowed with sufficient resources to perform the two further services of the basic version: 6. Active marketing of deep renovation and its benefits and costs and 7. Network (platform) for learning, exchange and cooperation (local/regional/ national). The networking could also be expanded to interregional or international networking (service 8. of the extended platform concept).
   Out of the extended concept, services 9. Capacity building and training, 11. Monitoring the implementation of the renovation project(s), and 14. Carrying out a deep renovation demonstration project(s) could also be linked to this platform or be implemented by the operator of the platform, particularly if the operator is a national energy agency or similar.

2. 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, including coordination of renovation projects (guiding/coaching through implementation, service 10.), which would be (subtype 2b), or even implementation (service 13.), which would be subtype 2c). 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.

Table 27 Basic part of the DRNP

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
1. Information on renovation actions **1.1 General information**	• Providing general information and other benefits due to renovation • Providing information on principles of insulation, heating, cooling, and ventilation systems, renewable energies • descriptive texts and graphics on the website with information • text and graphic documents downloadable as pdf-documents	General information on renovation actions • energy consulting/advice • deep (full) renovation • building insulation • air tightness • windows • shading • ventilation • heating system • cooling system • domestic hot water • lighting • renewables • monitoring • best practice • quality management • • The information should be in line with the concrete proposal by QualDeEPC for Improving the EPC recommendations towards deep energy renovation • • The above list should be made consistent with the renovation actions, for which we develop the improved recommendations	• Building owners • Prospective buyers • Tenants • Possibly EPC assessors	https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsanierung.html • Roof renovation: measures at a glance • Which technical measures are part of the roof renovation? • Which advantages and disadvantages do they bring? • When is a roof renovation worthwhile? • When does it make sense to combine different renovation measures for the roof? https://www.energiesparen.be/bouwen-en-verbouwen http://translate.google.com/translate?sl=nl&tl=en&u=https%3A%2F%2Fwww.energiesparen.be%2FEPB-burgers • Insulation and airtightness • Glazing and windows • Heating • Domestic hot water • Ventilation • Lighting • Electrical devices • Green energy	General information on: • building insulation • windows • ventilation • heating system • renewables • deep renovation

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
				https://www.greenmatch.co.uk/	
1.2 Information on potential savings and costs	Providing general information on costs of renovation for deep renovations, building components, building services, renewable energy, potential energy and cost savings	Information on renovation costs and savings, benefits • energy consulting/advice • deep (full) renovation • building insulation • windows • ventilation • heating system • renewables • monitoring • best practice • quality management • energy prices Same list as for 1.1 Link to the calculator for energy cost savings, possibly included in the tool (1.3)	• Building owners • Prospective buyers • Tenants • Possibly EPC assessors	https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsanierung/kosten.html Roof renovation: measures and costs at a glance • What does it cost? • Energy savings? https://www.energiesparen.be/energiewinst Calculation of the profit for the replacement of an old boiler (> 20 years old) with a condensing boiler in 5 steps	Information on renovation typical costs and savings for: • building insulation • windows • ventilation • heating system • renewables
1.3 Linking with renovation tools	Links to specific renovation tools and calculators which clearly outline the costs of renovation, potential energy savings and other benefits due to renovation (**QualDeEPC priority B)**)	Integration or linking of/to renovation tools in QualDeEPC partner countries, this would be the online tool for comparing EPC recommendations to deep energy renovation recommendations developed in Task 3.3 or information will be provided, how these existing tools can be ex-	• Building owners • Prospective buyers • Tenants • EPC assessors	https://www.energiesparen.be/energiewinst	Integration to renovation tools or linking of existing tools in QualDeEPC partner countries. This would be the online tool for comparing EPC recommendations to deep energy renovation recommendations developed in Task 3.3

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		panded in this regard.			
2.1 Linking with Energy Performance Certificates	• Providing detailed information on EPC assessment purposes/uses, procedure, tools and assessors • Comprehensive information on EPCs, including EPC obligations, registry of EPC assessors (with a link), explaining EPCs in terms of nZEB and national energy targets	Information on EPCs answering the following questions: • Who needs an EPC and for which purpose? • When is an EPC required? • How long is an EPC valid? • Read & understand the EPC. • Who can issue EPCs, where can I find issuer? • What types of EPCs existing? • Where EPCs are regulated? • Content of EPCs and for what it is useful. • Content of the renovation recommendations, incl improved recommendations (T.3.1) • Samples of EPCs • Linking to EPC-assessor and energy expert databases, regulations etc. • What to present in advertisements Links to • The online renovation calculator tool (1.3) • The deep renovation recommendations (1.1)	• Building owners • Prospective buyers or tenants • EPC assessors • Citizens • Public authorities	Information on EPCs – FAQs: • What is an EPC? • Which energy efficiency classes are there? • What does an EPC cost? • Consumption & demanded based EPC what is the difference? • Where can I apply for an energy certificate? • When is an EPC required? • How long is an EPC valid? • Read & understand the EPC. https://www.co2online.de/modernisiert-und-bauen/energieausweis • The EPC guide will help you on your way! • An EPC tailored to your building • Questions about the EPC? • Investigations into the EPC https://www.energiesparen.be/energieprestatiecertificaten	Detailed information on • EPC in general and purposes/uses/duties • EPC assessment procedure • EPC forms and types • Renovation recommendations • issue energy certificates and where this is regulated • Links to • The online renovation calculator tool (1.3) • The deep renovation recommendations (1.1) • Advertising guidelines for EPCs

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		• Advertising guidelines for EPCs			
2.2 Linking with building deep renovation roadmap and possibly a passport	• Linking EPC information to detailed analysis to upgrade it to a Building deep renovation roadmap • Possibly development of the content and form of the "Building Passport" for bringing together the history of a building and the information tied to it (roadmap, energy audits, energy-saving works and/or restoration works)	Information on building renovation roadmap and passport • What is it? • How can the EPC be a starting point? • Benefit of the renovation roadmap and passport: why is it useful? • The methodology of the building renovation roadmap and passport • Energy efficiency of buildings (link to 1.1) • costs of the roadmap or passport and existing subsidy measures Links to • A list of energy consultants who can develop a Building deep renovation roadmap, and link to grants offered for it (if available) • If available, a list of energy consultants entitled to issue a Building Passport, and/or link to a software for creating such a passport • Links to further information	• Building owners • Prospective buyers or tenants • EPC assessors • Public authorities	http://translate.google.com/translate?sl=de&tl=en&u=https%3A%2F%2Fwww.febs.de%2Fberaten-finanzieren%2Fisfp • Woningpas https://woningpas.vlaanderen.be/over-woningpas • Passeport Efficacité Énergétique https://theshiftproject.org/en/experience-p2e-2 • Individueller Sanierungsfahrplan https://www.febs.de/beraten-finanzieren/isfp	Information on building renovation roadmap and passport • What is it? • How can the EPC be a starting point? • Benefit of the renovation roadmap and passport: why is it useful? • Methodology of the building renovation roadmap and passport • Links to further information about the roadmap/passport • Energy efficiency of buildings (link to 1.1) Links to • Links to subsidy programmes • The online renovation calculator tool (1.3)

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		about the roadmap/passport • Links to subsidy programmes • The online renovation calculator tool (1.3)			
3. Information on building contractors/ technicians and energy-efficient-experts **Support with finding experts and building contractors/ technicians**	• Providing information regarding energy-efficient-experts, building contractors/ technicians/ installers • Providing a search engine or a databases of energy-efficient-experts/ contractors / technicians/ installers • Requesting various renovation offers/quotes from contractors/ technicians and comparing them so that the end-user can make an informed choice	• Information provided regarding: • Consultation of qualified experts and companies in the building sector • Instructions on how to find and recognize reputable and well-qualified companies and what to watch out for. • List of companies with authorised consultants • Link to the database of energy-efficient-experts and EPC assessors • How to use the service for requesting offers/quotas • Which EPC data could be the basis for requesting an offer	• Building owners	Find your professional https://www.energiesparen.be/bouwen-en-verbouwen ➔ find your professional https://translate.googleusercontent.com/translate_c?depth=1&pto=aue&rurl=translate.google.com&sl=nl&sp=nmt4&tl=en&u=https://www.buildyourhome.be/nl&usg=ALkJrhgpJFfgnCyt-O6mQmbSSkrR3BBw0Q ➔ find your contractor https://translate.googleusercontent.com/translate_c?depth=1&pto=aue&rurl=translate.google.com&sl=nl&sp=nmt4&tl=en&u=https://www.vinduwaannemer.be/&usg=ALkJrhhVoCwKqhc3GzZer2sipL8U5PVo5g Find your energy-expert: https://www.energie-experten.org/bauen-und-	• Information regarding energy-efficient-experts, building contractors/ technicians/ installers • Instructions on how to find and recognise reputable and well-qualified companies (contractors/ craftsman) and what to watch out for.

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
				sani-eren/altbausanierung/dachsanierung/kosten.html#c18593	
4. Information on material or product manufacturers/ suppliers	• Provides information on product manufacturers /suppliers required for deep renovation	Information on the currently most frequently used materials and technologies and their manufacturers and suppliers • building insulation • windows • HVAC systems • renewables • etc. Links to further independent lists and databases for materials, products, manufacturers, suppliers	• Building owners • Building contractors/ technicians/ installers	Compare insulation prices from independent providers for free! https://www.daemmen-und-sanieren.de/daemmung/hersteller Lists of manufacturers: https://www.energie-experten.org/bauen-und-sanieren/daemmung/daemmstoffe/hersteller.html https://www.carmen-ev.de/infothek/branchenadressen/301-adresslisten-aus-datenbank/933-hersteller-von-naturdaemmstoffen Database of products: https://www.greenbuildingproducts.eu/?lang=en http://reecl.org/en/eligible-installers	

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
5. Information on financing opportunities for deep renovation	• Provide information about financial incentives, loans, and subsidies or third party financing	Information on funding programmes for energy-efficient buildings • overview of programs for energy-efficient renovations • database of programmes for energy-efficient renovations, with links to programme websites • link to the database of energy-efficient-experts • How to use the service for help with applying for funding • Which EPC data could be the basis for applying for funding • Links to funding programmes	Building owners	Loans & credits: https://www.energiesparen.be/leningen Information on Support programs and database for experts: https://www.deutschland-machts-effizient.de/KAENEF/Redaktion/DE/Standardartikel/foerderprogramme-hauseigentuemer.html https://www.energie-effizienz-experten.de/	Information on existing support programs for energy-efficient buildings • Links to subsidy programmes
6. Active marketing of deep renovation and its benefits and costs	• Using all kinds of media and events to promote deep renovation and its benefits and costs to building owners and investors, involving supply-side actors in the media work, events, and funding • Using demonstration projects to show enhanced „quality of life through insulation and energy-saving“ by bringing together various stakeholders	Marketing instruments: • Media releases • Events fort he public • Events for stakeholders and experts Content for the marketing: e.g., Showing advantages of different energy renovation measures and co-benefits • Showing potential savings of	• Building owners • Citizens • Building contractors/ technicians/ installers • City/Municipality • local housing companies • the social credit agencies • Professional buildings and de-	https://translate.googleusercontent.com/translate_c?depth=1&pto=aue&rurl=translate.google.com&sl=nl&sp=nmt4&tl=en&u=https://www.energiesparen.be/ikBENOveer/10redenen&usg=ALkJrhi3sZt6DLjpSTaQ2GfY7VsyXlUiAg • 10 reasons to BENOver now • Download the 'I BENOveer' campaign material	• Showing advantages of energy renovation measures and co-benefits • Promotion of deep renovation network platform through media releases and in own events (which may be organised anyway for other purposes)

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
	listed in the next column	energy and costs → linking to 1.2 Information on potential savings and costs • Promotion of deep renovation network platform • Showing Best Practice and Pilot projects • Linking to a database of efficient homes/ buildings • Providing information material of benefits of various renovation measures on the building envelope as well as of various efficient heating and hot water technologies • Linking to 1. Information on renovation actions	velopers • Architects	dena Database of efficient homes: https://effizienzhaus.zukunft-haus.info/effizienzhaeuser/ https://www.greenmatch.co.uk/	

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
7. Network (platform) for learning, exchange and cooperation (local/regional/ national)	• Discussing active marketing activities and involving supply-side actors, city administration, energy companies, financial institutions etc, in the media work, events, and funding • Discussing training needs and the organizing of training	Information and activities provided: • List or database of training providers • List of network partners • Workshops on cross-disciplinary topics and/ or co-operation with workshop providers • Creation and maintenance of a training calendar with events, seminars, workshops in cooperation with training providers, consumer organisations and energy agencies etc. • (Online) Platform for exchange between professionals, e.g. EPC issuers	• Building contractors/ technicians/ installers • City/Municipality • local housing companies • the social credit agencies • Professional buildings and developers • Architects • Financial institutions • Energy companies	Info: The training calendar for energy efficiency experts offers you an overview of training courses throughout Germany, in which content from the training catalogues of the list of energy efficiency experts is taught.--> https://www.fortbildungskalender.de/termine https://www.energieagentur.nrw/veranstaltungen	• List of existing renovation platforms, involving supply-side actors, city administration, energy companies, financial institutions etc, • List of training providers for EPC assessors • Link to lists of workshops and seminars

Table 28 Extended part of the DRNP

Services/products	Description of services	Users addressed (examples)	Examples of organisations that could act as providers
8. Network (platform) for learning, exchange and cooperation (interregional/ transnational)	• Establishing interregional/transnational learning networks between project partners, stakeholders and complementary EU projects for enhancing mutual learning; exchange platform for good practice, innovation and expertise; and stimulating future partnerships • An exchange platform for EU member states best practises and learning paths, including those of the projects LIFE BE REEL! - via events and workshops on best practices and renovation expertise and via a digital platform. • **Examples**: a nucleus for such networks and exchange platforms between national policy-makers and energy agencies are the Coordinated Action (CA) EPBD and working groups of the EnR network of the national energy agencies. Between actors at the regional and local level, EU networks such s FEDARENE, Energy Cities, and the Covenant of Mayors serve similar functions. However, we are not aware of a thematic network for energy efficiency in buildings systematically connecting all these actors and projects in the EU.	• Construction and financial sector including sector federations, contractors, builders, renovation consultants, banks, financial institutions • All cities	• Platform facilitator itself • Energy Agency • Professional associations/ federations of energy assessors
9. Capacity building and training	• This service would implement the trainings that may be agreed under service 7. The training events organised here would be included in the training or event calendar under service 7. • Training and learning platform to obtain expertise and sector capacity • Dissemination of expert-knowledge on specific promising retrofitting topics to assure that the knowledge, best practices and techniques can be picked up by a large number of professional actors	• Sector/professional federations • Training organizations • Professional buildings • Architects • Contractors	• Platform facilitator itself • Energy Agency • Other third parties
10. Step-by-step guidance for renovation project from start to end	• Offering step-by-step guidance documents including monitoring of renovation project from start to end • Possibly: Requesting various renovation offers/quotes from contractors/technicians and comparing them so that the end user can make an informed choice • Full inspection of home and proposal for a renovation plan and quality control after renovation works • Possibly: Hotline in case of questions during decision-making and implementation of works	• Building owners • Prospective buyers	• Platform facilitator itself • Energy Agency • Third party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)

Services/products	Description of services	Users addressed (examples)	Examples of organisations that could act as providers
	• Drawing up a measurement report with an overview of costs and energy savings		
11. Monitoring the implementation of the renovation project(s)	• Monitoring works including, editing of financing files, preparation of the renovation works, monitoring of the site during the renovation work through site meetings and visits and reception of the works and closing of the financing • Follow-up of the renovation works • Making the citizens aware of the energy-saving potential of their property and to encourage them to renovate while becoming "energy" ambassador citizens among their peers.	• Owners • Trustees • Building professionals • EPC assessors • Communities • Social landlords • Third-party investors Renewable energy professionals	• City/Municipality • Platform facilitator itself • Energy Agency • Financial institution • Third-party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)
12. Operating a physical network hub and information centre	• A location that serves as an information centre and physical OSS for the public, and hosts the team facilitating the network platform for all services, including for supply-side actors	• Building owners and/or investors • Building professionals • All end-user groups	• Platform facilitator itself
13. Carrying out renovation project(s)	• Implementation of the works (Qualified energy advice, financing planning, renovation planning and professional construction supervision, choice of suitable craft businesses, correct acceptance of work and handover • Possibly providing the finance for the works	• Building owners and/or investors	• Financial institution • Third-party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers) • Platform facilitator itself (if it is a construction company or similar)
14. Initiation and coordinating deep renovation demonstration project(s)	• Undertaking deep renovation demonstration projects (in their city or region): „Undertaking collective renovation demonstration projects in their city including renovation residences to nZEBs, including installing roof, façade and floor insulation and installing super-insulating glazing in renovation demonstration projects“	• Building professionals • Building owners and/or investors • Third-party investors	• City/ Municipality • Platform facilitator itself • Energy Agency • Financial institution • Third-party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)

Services/products	Description of services	Users addressed (examples)	Examples of organisations that could act as providers
15. Aggregation of building renovation projects	• Aggregation of building renovation projects, Implementation of serial renovation solutions for affordable, climate-friendly living, digitised construction process, high-quality, standardised solutions with serially prefabricated elements and a long-term performance promise (Example: Energiesprong).	• Building owners and/or investors	• Platform facilitator itself • Energy Agency • Third party (Network partners from the platform)

Table 29 Subtypes

Subtype	Subtype 1a.	Subtype 1b.	Subtype 2a.	Subtype 2b.	Subtype 2c.
Subtype provider	National energy agency private company	Private company	Local/regional energy agency private company with public support	Local/regional energy agency private company with public support	local/regional energy agency and private company private company with public support
General information on: **1.1 renovation actions** **1.2 potential savings and costs**					
1.3 Linking with Renovation tool					
Linking with **2.1 Energy Performance Certificates**					
Linking with **2.2 Building deep renovation roadmap and possibly a passport**					
				link to local providers	link to local providers
3. Information on building contractors/technicians;					
support with finding building contractors/ technicians, **e.g. through obtaining three competitive offers (this may also be part of service #10)**					
		online		in person	in person

Subtype	Subtype 1a.	Subtype 1b.	Subtype 2a.	Subtype 2b.	Subtype 2c.
Subtype provider	**National energy agency** **private company**	**Private company**	**Local/regional energy agency** **private company with public support**	**Local/regional energy agency** **private company with public support**	**local/regional energy agency and private company** **private company with public support**
4. Information on material or product manufacturers/ suppliers					
5. Information on financing opportunities for deep renovation					
Help with applying for loan and grant programmes or third party financing					
		online		in person	in person
6. Active marketing of deep renovation and its benefits and costs					
	general media, online; possibly with local partners	general media, online; possibly with local partners	local and general media, physical events and online; with local partners	local and general media, physical events and online; with local partners	local and general media, physical events and online; with local partners
7. Network (platform) for learning, exchange and cooperation (local/regional/ national)					
	national; possibly local/regional with the partner network	national; possibly local/regional with the partner network	local/regional; possibly partner in the national network	local/regional; possibly partner in the national network	local/regional; possibly partner in the national network

Services/products	Subtype 1) a.	Subtype 1) b.	Subtype 2) a.	Subtype 2) b.	Subtype 2) c.
Subtype provider:	**national energy agency; private company**	**private company**	**local/regional energy agency; private company with public support**	**local/regional energy agency; private company with public support**	**local/regional energy agency and private company; private company with public support**
8. Network (platform) for learning, exchange and cooperation (interregional/ transnational)		possibly			
9. Capacity building and training					
	nation-wide	may be limited to implementation partners	local/regional; possibly partner in the national network	local/regional; possibly partner in the national network	local/regional; possibly partner in the national network
10. Step-by-step guidance for renovation project from start to end					
		as part of the implementation service		as a special service	as part of the implementation service
11. Monitoring the implementation of the renovation project(s)	possibly				X
		probably limited to own projects			probably limited to own projects
12. Operating a physical network hub and information centre					
13. Carrying out the renovation project(s)					
14. Initiation and coorditing deep renovation demonstration project(s)					
15. Aggregation of building renovation projects					

Explanation	Relevant for the subtype	Comments	Not relevant		

6 REGULAR MANDATORY EPC ASSESSOR TRAINING

EPC assessors should undergo mandatory training on EPC assessment and providing recommendations for being certified as an EPC assessor and included in the registry. Such training should also enable them to avoid common mistakes. Therefore, this chapter summaries the analysis on the current status for the EPC assessor training by D2.4 Development Strategy Plan. Moreover, examples of regular mandatory EPC assessor training are described. A short policy proposal is included, which will be the base for the discussion in the national workshops, where more specific content can be developed.

6.1 Analysis of the current status of EPC assessor training

6.1.1 Summary of country-specific information on EPC assessor training (from D2.1 and D2.4)

A mandatory training requirement for EPC assessors is available in 14 EU member states, including three QualDeEPC partner countries – Bulgaria, Hungary and Latvia. Besides, mandatory *periodic* training for *maintaining* certification and registration as an EPC assessor after the validity period of current certification is required only in eight member states, none of which are QualDeEPC partner countries. However, in many countries without the requirements for mandatory training, there are opportunities for voluntary training, and most often candidates should pass an examination for certification, undergoing mandatory training on EPC assessment and providing recommendations for being certified as an EPC assessor and included in the registry, which also enables EPC assessors to avoid common mistakes.

Table 30 Overview of EPC issuer training in the partner countries

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Basic qualification of EPC assessors							
University degree in architecture or engineering B.Sc. or above	Yes	Yes	Yes	Yes		Yes	Yes
Secondary technical education in the field of building works (e.g. technicians)	Yes	Yes	Yes	No		No	Yes
National regulations/ guidelines on							
Initial mandatory training	Yes	Yes	No	Yes		No	Yes
Regular mandatory training		No	No	Yes	No	No	No
Initial voluntary training	Yes	No	Yes	No		No	No
Regular voluntary training		No	No	Yes	Yes	No	Yes
Initial exams	Yes	No	No	Yes	Yes	No	Yes
Regular exams		No	No	No		No	Yes
Training content	Yes	Yes	No	Yes		No	Yes

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Registration of qualified EPC assessors							
National database or certification body	Yes	No	Yes	Yes		No	Yes
Other databases		No	No	No		No	No
Special training content							
Deep renovation recommendations	Yes	No	No	No		No	No
Common mistakes in EPCs	No	No	No	Yes		No	No

6.1.2 Official training content including deep renovation recommendations

6.1.2.1 Bulgaria

Detailed curriculum and structure are defined in ORDINANCE № E-RD-04-1 of 3 January 2018 of circumstances to be entered in the registers under the Energy Efficiency Act, listing and obtaining information from these records TERMS AND CONDITIONS FOR ACQUISITION OF QUALIFICATION OF CONSULTANTS IN ENERGY EFFICIENCY.

The curriculum is structured on a modular basis with a combination of teaching hours to ensure that the minimum qualification criteria are met. The technical and normative material is grouped into three theoretical modules with topics and subtopics. The curriculum includes a practical module - developing a course project.

The topics and subtopics refer to the specifics of the buildings, whose energy characteristics are subject to study and analysis in level 2, taking into account:

- the structural and operational features of the buildings in Bulgaria;
- climatic features for Bulgaria;
- the ways of energy supply and consumption by types of energy carriers, incl. renewable;
- the peculiarities of the installed systems for maintaining the microclimate;
- the type of hot water supply systems;
- technical rules and norms for the assessment of the annual energy consumption in buildings;
- Other normative features and policies for energy efficiency, environmental protection and sustainable development.

Concerning the deep energy renovation, the following training content is included:

- Evaluation of the effect of single energy-saving measures. An iterative process for evaluating the effectiveness of a package of energy-saving measures. Compatibility of energy-saving measures with the basic (essential) requirements for buildings.
- Assessment of the possibilities for energy efficiency of heating systems implemented according to classical schemes. Efficient technologies of heating systems with a conventional heat source. Evaluation of the efficiency of the systems in energy-saving measures, providing different levels of thermal comfort in the buildings. Specific requirements in the relevant national legislation, European standards and norms.
- Unconventional energy source systems for heating, air conditioning or ventilation of buildings. Heat pumps. Modern air conditioning systems for public service buildings. Systems for specific purpose buildings. Requirements in the relevant national legislation, European standards and norms
- Solar energy systems.

- Energy efficiency of pumps and fans. Factors affecting efficiency.
- Cooling and freezing systems. Types by functional purpose. Indicators for evaluating the efficiency of the systems.
- Modern lighting systems. Evaluation of the efficiency and energy consumption in the combined action of active artificial lighting systems and systems for increased use of daylight. Performance indicators of lighting systems in buildings. Specific requirements in the relevant national legislation, European standards and norms.
- Modern technologies and systems for monitoring, control and management of energy consumption in public service buildings. Requirements in the relevant national legislation, European standards and norms.
- Energy passive buildings and buildings with energy consumption close to zero. Connections and differences of concepts. National legislation, European standards and norms.
- Assessment of the economic feasibility of energy-saving measures. Indicators of economic feasibility. Specialized software for the economic evaluation of energy-saving measures.

6.1.2.2 Germany

The training content is described in the national Building Energy Act "Gebäudeenergiegesetz", attachment 11. There is a slight difference in training content for residential and non-residential buildings. The major topics of the training content are:

- Survey and documentation of the building, its construction and its technical systems
- Assessment of the building envelope
- Assessment of the technical systems for heating and DHW
- Assessment of the technical systems for ventilation and cooling
- Assessment of lighting systems (non-residential only)
- Provision of proofs concerning the energetic requirements on the building envelope and its technical systems
- Basics of the assessment of renovation recommendations and their technical and economic feasibility

There is no specific mention of the workload. Moreover, there is no specific training content on deep energy renovation recommendations.

6.1.2.3 Greece

There is no official training content. In voluntary the training, curricula differ by the institution providing the training.

6.1.2.4 Hungary

The Hungarian Chamber of Engineers is responsible for organizing energy assessors' trainings. The curriculum includes the following topics:

a) the scope of the regulation on energy requirements and certification,
b) indoor environment criteria (thermal comfort, indoor air quality and ventilation, humidity, lighting),
c) methods for calculating the energy demand of buildings, building envelopes and building services systems,
d) identification of HVAC systems (heating, ventilation, domestic hot water supply, cooling, lighting), their modernization, calculation of primary energy demand for each system, calculation of achievable savings from the building's energy systems, operating advice,
e) energy performance certification system (method) of buildings,
f) energy performance classes, classification rules,

g) certification documentation.

6.1.2.5 Latvia

There is no official training content.

6.1.2.6 Spain

There is no official training content.

6.1.2.7 Sweden

In addition to relevant education and work experience, detailed knowledge requirements are listed in regulation CEX. There are two levels of certification: one for simple buildings and one that also includes complex buildings.

Knowledge requirements (main subjects) for the certification for *simple buildings*:

- Indoor climate parameters and their connection to health and comfort
- Construction technologies – building shells and framework
- Building materials
- HVAC and control systems
- Heat production units (heat pumps, solar etc.)
- Systems for household and building electricity
- Elements included in the energy balance of a building
- Measurements as well as interpretation and evaluation of measurement results regarding elements included in the energy balance. In addition, approximate calculation/estimation of what the measured energy is actually used for.
- Possibilities, obstacles and risks in implementing energy efficiency measures about indoor environment and moisture
- Calculation of energy savings and cost-effectiveness
- Knowledge about relevant tools for calculation of energy savings, and ability to use at least one of such programs
- Knowledge of how to upload EPC in the database
- Knowledge of how the cultural and historical value of buildings may be affected by energy efficiency measures
- The environmental impact of different energy sources
- Valid laws and regulations related to buildings and energy performance and EPC.

Additional knowledge requirements for the certification for *complex buildings* are related to the need for cooling and the function of cooling systems.

6.1.3 Examples of implemented regular mandatory EPC accessor training

6.1.3.1 Hungary

From 1 January 2020, the obligation of regular mandatory trainings exists. It concerns both legal and technical trainings, and it is mandatory once in every five years. It is regulated in Government Regulation 266/2013.

Mandatory trainings are organised by the Hungarian Chamber of Engineers. EPC Experts must take a legal training every 5 years and a professional training every 5 years. Both are relatively short, less than one day which is not sufficient for a deep training. As the formulation of recommendations is

not specifically addressed within the trainings, there is a need to add this topic to the trainings, emphasizing recommendations towards deep renovations.

6.1.3.2 Sweden

For EPC assessors (certified energy expert), relevant technical education and documented experience of practical work (at least 5 years, of which 2 years should be related to energy and indoor climate in the corresponding category of buildings) is needed. Furthermore, to become a certified assessor it is mandatory to pass a theoretical test. It is not mandatory to do any specific training before this test. The certificate is valid for 5 years. After that, it needs to be renewed with a new theoretical test. The recertification test is less comprehensive than the first certification test. Between certification and recertification, regular training is not required. However, the EPC assessor needs to report the number of performed assignments and any updating of skills and send in assessed EPCs to the national certification body once a year.

6.1.4 Advantages and disadvantages of regular mandatory EPC accessor training

Advantages

- EPC assessors gain knowledge on the latest developments in the field of building services and renovation recommendations
- Building representatives can select highly trained EPC assessors

Disadvantages

- Registry/ database for EPC issuers may be required (bureaucracy), so that building representatives can be informed of qualified experts
- Regular mandatory training might be
    - expensive for the EPC assessors, especially if there issue a relatively small number of EPCs
    - time-consuming (during the courses, the expert cannot do their actual work)

6.2 General policy proposal

6.2.1 General framework

The project QualDeEPC proposes a regular, mandatory training for EPC assessors to maintain a high quality of issued EPCs. The regular training can be based on initial training, which should have a larger workload than the regular training sessions. Moreover, the workload and content of the initial training should depend on the previous qualification (University degree or secondary technical education).

The regular mandatory training might be a combination of training courses, visits to workshops or seminars, and the verification of issued EPCs. In each category, the workload for the EPC assessors should be specified on a national level.

6.2.2 Training content for regular training workshops or seminars

In contrast to the initial training of the EPC issuers, the training content for regular training workshops or seminars should not contain basics on EPC issuance (this should be covered by the initial training), unless there are major changes in the basics. The regular training should rather focus on

information on changes relevant to national or European Building Performance Acts, state-of-the-art technologies and particularly on deep renovation recommendations. Moreover, topics on consumer information, contract design or common mistakes, as well as errors, might be possible. Also, a regular training for specific funding programs for renovation and their technical requirements could be conducted.

6.2.3 Development strategy

The general framework of a mandatory regular training and the specific training content (e.g., a possible curriculum with specific content and timetable) will be discussed in more detail with the country partners and the national stakeholders. For the white paper, the aim is to provide specific details on both topics.

7 HIGH USER-FRIENDLINESS OF THE EPC

7.1 Analysis of EPC forms

The energy performance certification (EPC) forms are the central information element of the EPC process in all partner countries. Ideally, they are the link between the detailed analysis done by the EPC issuers and the building owners as well as potential buyers or tenants. Besides, third parties, such as building financial advisors or administrative officers, need to find relevant information. Thus, the EPC forms have to satisfy three main functions:

1. Verify compliance with legal requirements on the energy performance of the building.
2. Inform the building owner and potential buyers or tenants about the current energy performance of a building and what renovations might be needed to increase the energy efficiency and decrease of CO_2 emissions of the building.
3. Encourage (current or future) building owners to implement energy-efficient renovation options, which should lead to 'deep energy renovation'.

In order to achieve all three functions, the EPC forms require high user-friendliness for experts, building owners and users, and other potential users (e.g. administrative officers, financiers). However, the analysis of QualDeEPC in WP2 showed that user-friendliness is still an issue for most EPC forms in EU- and especially the project's partner countries. To fill this gap, this chapter firstly analyses the current EPC forms of the project's partner countries. Secondly, it includes elements for enhancement that have been analysed and prioritized.

7.1.1 EPC form elements in partner countries

For the most relevant EPC form elements, Table 51 in ANNEX A on pages 140ff. shows if they are implemented on the country-specific EPC form. In the following sections, the data provided is analysed per country.

7.1.1.1 EPC form and general data

Bulgaria

The Bulgarian form of EPC is an integral part of the whole procedure for assessing the energy performances of buildings, including – energy report, Annex 2 Resume and Energy performance certificate.

The Bulgarian form of EPC consist of 5 pages, as each page contains information on the following points:

1. General information about the building, including a photo,
2. Energy class and energy characteristics of the building
3. Description of the enclosing structures and energy conversion systems in the building
4. Distribution of the annual energy consumption in the building
5. Description of the selected energy-saving measures and their ecological impact

Germany

The German EPC form consists of five pages. The first page provides general information about the issued EPC such as legal basis, registry number and date of validity as well as information on the

building. The building data includes the type or usage of the building, the address, a picture ad the year of construction. In addition, the basic information on the HVAC system of the provided at this point (see also section 7.1.1.3). The second page and third page give detailed information about the energy demand (calculated) or consumption (measured), respectively. The forth page summarizes the renovation recommendations and the fifth page is a glossary for most important terms.

Greece

The Greek EPC form consists of two pages. The first page gives an overview of general building data, as well as the primary energy consumption of the building under consideration, the primary energy consumption of the reference building, the CO2 emissions and the energy class. The second page gives detailed information of the calculated energy demand by end-use (both for the building under consideration and the reference building), the calculated consumption by fuel type and end-use, an area dedicated on recommendations for the improvement of energy performance and the issuer's data.

Hungary

The Hungarian EPC form consists of a 1-page summary and a calculation annex. The calculation annex is for professionals only; end users cannot understand it (there are no formal requirements on the annex). The main EPC page itself provides general information about the issued EPC such as legal basis, registry number and date of validity as well as information on the building including the type or usage of the building, the address, a photo and the year of construction. Contact and registry data of the EPC expert and the owner are indicated as well. It includes main indicators and reference values for specific primary energy consumption, specific heat loss coefficient, summer overheating factor, renewable energy share. The energy class is indicated in a graphical format. There is a short part for renovation recommendations and the class that can be achieved if measures would be implemented.

Latvia

The first page of EPC contains the EPC registry number and the date of validity. The first page also contains general information about the building such as total and heated areas, number of floors. In the first page of EPC also the energy classification of the building and energy consumption data is shown. The second page of EPC contains some information on historical measured data as well as some data on heat losses in building envelope and ventilation.

EPC comes with 2 mandatory annexes – list of economically feasible energy efficiency measures and input data used for calculations.

Spain

The EPC form provides data of building identification (address, climatic area, legislation, registry number ….), building typology (new or not new building; residential/tertiary sector), data of EPC issuer, energy classification (primary energy consumption and CO_2 emissions), list of Annexes, and the signature of the EPC issuer. The annex includes the recommendations of energy efficiency and new renewable sources installation that EPC issuer recommends.

Sweden

The first part of the EPC form gives general information about the building (e.g. address and year of construction). It also gives information about the energy class, heating system etc. The second part gives detailed information about energy consumption. The third part includes information about ventilation control and radon etc. The fourth part summarizes the recommendations about energy

efficiency measures. The last pages include other relevant information (e.g. explanation of important terms). It also includes information about the person who has done the energy performance certificate.

7.1.1.2 Energy classification

All EPC forms of the partner countries for residential buildings provide a classification of the building on an energy-related scale. However, the basis for the categories and the specific values vary. In Table 31, details on the type, unit, name and value of all partner countries are shown for residential buildings.

Table 31 Energy classification of residential buildings

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Type	Primary energy demand (normalised) energy, incl. electricity	Final energy demand/ consumption (excl. electricity)	Total primary energy consumption in comparison to a reference building	Non-renewable primary energy demand (excl. lighting)	Energy consumption for space heating	Primary energy consumption and CO2-emissions	The energy class is based on primary energy use with current requirements imposed on new buildings.
Unit	kWh/m²	kWh/m²yr	kWh/m²yr	kWh/m²yr	kWh/m²yr	kWh/m²yr/ $kgCO_2/m^2yr$	kWh/m²yr
Categories: name / values							
1st	A+ / <48	A+ / < 30	A+ / < 0.33 Ref	AA++ / …≤40	A / <40	A / < 37.1 < 8.4	A/ ≤ 50 %
2nd	A / 49 - 95	A / < 50	A / < 0.50 Ref	AA+ / 40<…≤60	B / 40 – 60	B / < 60.1 < 13.6	B/ >50 - ≤ 75 %
3rd	B / 96-190	B / < 75	B+ / < 0.75 Ref	AA / 60<…≤80	C / 60 – 80	C / < 93.2 < 21.1	C/>75- ≤ 100 %
4th	C / 191-240	C / < 100	B / < 1.00 Ref	BB / 80<…≤100	D / 80 – 100	D / < 143.3 < 32.4	D/ >100 - ≤ 135 %
5th	D / 241-290	D / < 130	C / < 1.41 Ref	CC / 100<…≤130	E / 100 – 150	E / < 298.1 < 66.3	E/ >135 - ≤ 180 %
6th	E / 291-363	E / < 160	D / < 1.82 Ref	DD / 130<…≤160	F / >150	F / < 336.8 < 79.6	F/ >180 - ≤ 235 %
7th	F / 364-435	F / < 200	E / < 2.27 Ref	EE / 160<…≤200		G / > 336.8 > 79.6	G/ > 235 %
8th	G / >435	G / < 250	F / < 2.73 Ref	FF / 200<…≤250			
9th		H / > 250	G / > 2.73 Ref	GG / 250<…≤310			
10th				HH /			

				310<…≤400			
11th				II / 400<…≤500			
12th				JJ / 500<…			

Bulgaria

The values in the classification are based on the total specific annual primary energy demand (kWh/m2/y). The calculation of these values does not include any correction factors. The methodology for calculation of the specific total annual primary energy (the energy performance, that define the energy class) includes the climate parameters of the different climate zones. However, the values in the energy class scale are unified for the whole country. Electricity is included in the calculation of the total specific annual primary energy demand.

The scales for the energy classes are different for residential and non-residential buildings. There are different scales for several types of non-residential buildings: administrative buildings; school buildings; universities; kindergartens; healthcare buildings; hotels; shopping centres and restaurants; sports facilities; culture and art facilities.

Germany

For demand-based EPCs, the primary energy demand is marked on the scale. For consumption-based EPCs, the final energy consumption is displayed on the scale. The classification in specific categories is only provided for residential buildings in combination with a Continuous color. The scale is the same for EPCs issued based on demand or consumption. EPCs for non-residential buildings have a Continuous Color Scale. The scale also allows for larger values than the one for residential buildings. Moreover, the EPC of non-residential buildings include electricity.

Since the EPC in Germany aims to provide a comparable value of energy use for all buildings, the calculated or measured energy values are corrected for location and weather conditions. Therefore, the final energy demand is based on one reference climate for all locations in Germany. The final energy consumption for heating is corrected for deviations by the weather conditions in the selected year in comparison to the standard reference year.

Greece

For all EPCs, the calculated primary energy consumption is marked on the scale. The same type of EPC is used for all building types/uses. The calculated primary energy consumption is based on the climate zone data where the building is located. Electricity is included in all building types.

Hungary

For all EPCs, the calculated specific non-renewable primary energy consumption is the basis for classification. The same type of EPC is used for all building types/uses. For the classes BB or better additional requirements are to be met such as minimum share of renewable energy sources or certain requirements on consumption measurement of individual units and control, and applied calculation

methods. Electricity is included in the calculation of all building types except for elevators, domestic appliances and technological purposes.

Latvia

In Latvian EPC, the energy classification of buildings is based on space heat consumption in the building. The space heating energy consumption usually is corrected to a standard heating season (defined by the number of heating days and outdoor air temperature during these heating days). There is a difference in the scale values between residential and non-residential buildings. For instance, a class residential building has to consume less than 40 kWh/m2 per year, but for non-residential buildings A class is defined as space heat consumption under 45 kWh/m2 per year. In the EPC, part of buildings electricity consumption is included (lighting, ventilation, cooling). For residential buildings, lighting electricity consumption has not to be included in EPC. Nevertheless, electricity consumption does not affect the classification of the building because the energy efficiency class is defined based on space heating consumption.

Spain

The EPC is based on primary energy demand. It provides information on the classification of total energy and total CO_2 emissions in $kgCO_2/m^2$ year. There is one classification of the total primary energy demand of the building and four sub classifications:

- Sub-classification 1: Heating demand (kWh/m^2 year) and CO2 emissions ($kgCO_2/m^2$ year)
- Sub-classification 2 Cooling demand (kWh/m^2 year) and CO2 emissions ($kgCO_2/m^2$ year)
- Sub-classification 3 Sanitary Hot Water demand (kWh/m^2 year) and CO2 emissions ($kgCO_2/m^2$ year)
- Sub-classification 4 Lighting (for non-residential buildings)

EPC forms for the non-residential building include lighting classification.

Sweden

Energy efficiency class is based on the primary energy value. The seven classes on the scale are based on the energy consumption requirement imposed on new buildings built today. The requirements are different for different building types (e.g. multifamily buildings, non-residential buildings). Energy class C corresponds to the particular requirement that would apply to the building if it were built today.

The primary energy value expresses the weather normalized energy demand corrected to standard use and geographical location. Moreover, the energy demand is adjusted with weighting factors for different energy carriers.

7.1.1.3 Details on building HVAC[6] system incl. renewable energies

Bulgaria

Specific indicators of energy conversion systems to ensure the microclimate are presented in the EPC, including indicators of technological processes for heating and ventilation, the efficiency of heat and cold generators in the building; installed power, energy source, and annual energy demand.

There is no text description of the HVAC systems, as they are presented in detail in the Annex 2 Summary.

[6] Heating, ventilation and air conditioning

Germany

The German EPC form contains basic information about the building's HVAC system displayed on the first page of the EPC form. The form provides the energy source of the heating and hot water system, the type of cooling and air conditioning system and, for new buildings (demand-based EPC), information on used renewable energy including its coverage for heating and cooling requirements.

Greece

The Greek EPC document contains no information on the HVAC systems. This information is included in the .xml file, which is uploaded in the platform for the calculation of the EPC class and EPC issuance. Information on used RES for all end uses and their share at the building energy balance is presented on the 2nd page of the EPC.

Hungary

The Hungarian EPC document contains no information on the HVAC systems. This information is included in the calculation annex, which is for expert use only.

Latvia

This information has to be included in EPC as annex. In many cases, it is not clearly defined what information should be included and in these cases, the information provided in EPC about HVAC systems is dependent on the energy assessor. In national legislation, it is defined that in some cases the HVAC system has to be inspected in detail. In these cases, it is mandatory to fill in heating system boiler inspection deeds under Annex D to standard LVS EN 15378:2009; heating system inspection deed under Annex K to standard LVS EN 15378:2009 and air conditioning systems shall be inspected in accordance with the standard LVS EN 15240:2009 L "Ventilation for buildings. Energy performance of buildings. Guidelines for inspection of air conditioning systems"(hereinafter - the standard LVS EN 15240:2009). An independent expert shall draw up a deed regarding the inspection of the air conditioning system under Annex G to standard LVS EN 15240:2009. In real life in most cases when these annexes should be filled it is not done.

Spain

The certificate provides the energy source of the heating and warm water system, the type of cooling and air conditioning system, the performance of the generator (i.e. boiler).

Sweden

The Swedish EPC document contains information about energy carrier of the heating, cooling and warm water system. Information regarding solar photovoltaic/solar thermal systems should also be included (area and yearly production) if such systems exist. Moreover, the type of ventilation system for the building and mandatory ventilation inspection (OVK) is included. It also contains information about the nominal power for the heating system and the air conditioning system, and whether inspections of these systems are mandatory.

7.1.1.4 Details on building envelope

Bulgaria

The building envelope information is presented in a table, which includes area and U-value before and after ESM.

More detailed text descriptions of the building envelope are presented in the Annex 2 Summary.

Germany

In the German EPCs form, only the demand-based EPCs give some information on the quality of the building envelope. For residential buildings, the calculated and reference value of the specific transmission heat loss is displayed. For non-residential buildings, a checkmark is given to confirm that the requirement for the average heat transfer coefficient is met. There are no more details given on the building's envelope.

Greece

The Greek EPC document contains no information on envelope components. This information is included in the .xml file, which is uploaded in the platform for the calculation of the EPC class and EPC issuance.

Hungary

The Hungarian EPC document contains no information on the envelope components. This information is included in the calculation annex, which is for expert use only.

Latvia

In the annex of the EPC usually, detailed information on building envelope is shown in a table where the following data is given for each building envelope element: area, U-values, thermal bridges, temperatures, UA values, heat losses through the building envelope element.

Spain

The certificate provides information about the material and the transmission heat loss of the different areas of the envelope.

Sweden

The Swedish EPC document contains no information about the building envelope, except when it is mentioned in the recommendations of energy efficiency measures.

7.1.1.5 Renovation recommendations

Bulgaria

The renovation recommendations are displayed on the last page of the EPC in table form. They are grouped by measures on building envelope and measures on systems.

Information is provided for: investment of the measures, energy conserved, saved CO2 emissions, payback period. Detailed descriptions for the measures are provided in Annex 2 Summary

The owners of public service buildings are obliged to implement the measures for reaching the minimum required class of energy consumption, defined in the energy audit, within three years from the date of acceptance of the EPC.

The EPC provides information on the effect of the renovation measures.

Germany

The renovation recommendations on the German EPC form are presented on a separate page. The form is the same for residential and non-residential buildings as well as for EPCs based on demand and consumption. The focus is set on cost-efficient measures with the option that this kind of measures are not possible (e.g. newly built buildings).

For each renovation recommendation, the EPC issuer has to provide the building element that should be improved, a detailed description, and a recommendation if the renovation should be undertaken as a single measure or within a larger renovation project. Furthermore, there is an option to state the amortisation time and estimated cost per saved kilowatt-hour. There is no calculation on how the energy demand or consumption would be reduced by the implementation of the measures.

As stated in the German EPC form, the renovation recommendations are mainly for information purposes. There is a written recommendation to contact an energy consultant to conduct a detailed energy audit. Hence, the building owners are not obliged to implement any of the recommendations.

Greece

A table with recommendations for the improvement of the energy performance is included in the second page of the EPC document. The 1st part of the table includes the description of the energy improvement measures (one line per measure), and recommended measures are inserted by priority (1-3) that might be implemented, according to energy savings and payback time.

The second part of the table provides information on the estimates of initial investment cost, primary energy savings in [kWh/m²] - [%] - [€kWh], simple payback period (y), CO2 emissions reduction [kg/m²] and the energy class expected upgrade.

Implementation of the recommendations is obligatory in the following cases:

In new buildings, when the building 'as built' does not meet the requirements of the regulation and is not in line with the Energy study submitted (together with all other required studies) when applying for a building permit.

In existing buildings, when the owner applies for a subsidy in national incentive programmes for the improvement of energy efficiency.

In all other cases (EPC issuance for sale or rental), there is no obligation for implementation of the recommendations included in the EPC.

Hungary

The recommendation section in the Hungarian EPC is very brief and simple. The expert is free to formulate the advice based on his/her experience. No formal requirements on either giving advice about details, the order of measures, costs, risks, etc. Monumental protection aspects must be respected. The EPC form provides numeric information on the effect of the renovation measures on the energy consumption of the building. Quality checks pointed out that this section of the EPC does not give useful and reliable advice in its current form.

Latvia

The renovation recommendations on the Latvian EPC form are presented on a separate annex. The form of this annex is regulated by Regulations Regarding Energy Certification of Buildings.

Proposals for energy efficiency measures shall be filled out in a free form by complying with the following conditions:

1) recommendations regarding measures that are technically feasible for the specific building shall be included;

2) the recommended measure, description thereof and indicator to be achieved shall be indicated by specifying the necessary measurements;

3) the planned saving of delivered energy of the recommended measure, the specific energy-saving per one square metre of the building per year and saving in percentage terms (from the existing calculated energy performance assessment of the building);

4) the planned implementation costs of proposals shall be indicated (the payback period of the measure may be indicated);

5) if the implemented proposal increases or reduces also the consumption of other energy systems, the relevant consumption shall be indicated separately with a positive or negative mark accordingly;

6) proposals shall be numbered. If variants of alternative proposals are offered, they shall be designated accordingly (for example, 1A, 1B, 1C) and, where necessary, explain in order to identify with which other measure or which other measures they are to be compared and interact.

There is no obligation for building owners to implement any of the measures described in the EPC. In the annex of EPC where the energy efficiency measures are described, it is clearly shown what is the existing energy consumption in the building and what it would be after implementing suggested measures.

Spain

The renovation recommendations on the Spanish EPC form are presented in the Annex. The form is the same for residential and non-residential buildings.

For each renovation recommendation, the EPC issuer has to provide the building element that should be improved, a detailed description. There is no minimum or maximum number of recommendations, i.e. the EPC issuer can include as much as he or she considers convenient.

Sweden

The renovation recommendations are presented in the last part of the EPC. There is a list of suggested renovation measures divided into; regulation and control, HVAC (including renewables) and building envelope. Only recommendations that are economically feasible for the specific building shall be included. For each recommended measure, the following shall be included; a description, expected energy savings (kWh/year) and cost about energy savings (SEK/kWh).

7.1.1.6 Additional information

Bulgaria

The EPC certifies the energy performance of a new building before its commissioning, including the level of energy consumption and its corresponding class on the scale of energy consumption classes.

The EPC of a building in operation certifies the energy performance at normalized energy consumption in the existing condition of the building at the time of the energy audit, the projected level of energy consumption after application of a selected package of energy-saving measures and its corresponding energy consumption class of energy consumption.

The requirements for energy performance of buildings are subject to mandatory periodic inspection once every 5 years and, if necessary, are updated to reflect the technological development in the building sector.

When separate parts in a newly constructed building have different purposes and are separated as thermal zones and each of the zones has an air-conditioned volume, less than 90 per cent of the total

air-conditioned volume of the building, a certificate under para. 1 shall be issued separately for each zone on a scale, corresponding to the purpose of the respective zone.

The EPC of a building in operation may be issued based on:

1. the results of the assessment of the economically feasible package of energy-saving measures, which reaches the minimum required energy consumption class on the scale of energy consumption classes for the respective category of buildings, to which the building belongs as intended, or

2. the results of an economically feasible package of measures chosen by the owner among the packages proposed in the survey, requiring higher investments than the investment to achieve a minimum energy efficiency class, but leading to greater energy savings and a higher class of energy consumption.

Germany

The German EPC forms contain several annotations on the calculation methods and difference between energy demand and consumption. Additionally, the last page provides more details on elements of the EPC form. Moreover, the EPC form for residential buildings includes a reference scale where the typical energy demand/ consumption of specific building types are marked for comparison (see also section 7.1.2).

On all types of EPC forms, one to two lines are devoted to the energy value that has to be displayed in the real estate advertisements.

Greece

The EPC presents the energy class of the building (either new or renovated) compared to a reference building. It also contains numerical data on the primary energy demand of the building under examination and of the reference building, as well as the CO2 emissions.

The EPC also contains information on energy demand by end-use as well as the calculated energy consumption by end-use and fuel type.

On the 2nd page of the document, there is an area dedicated to recommendations on the improvement of the energy performance (see also par. 1.1.1.5). At least one recommendation is needed for the EPC issuance. The maximum number of recommendations that can be inserted in the current EPC template is 3.

The validity period of the EPC is 10 years; if a major renovation occurs, a new EPC is issued.

In mix-use buildings, different EPCs are issued for each part of the building with a different use.

Hungary

An overall revision of the Hungarian EPC is under consideration. A draft version is already available. The new EPC draft will be much more informative, particularly, concerning the retrofit recommendations.

Latvia

The EPC form and all other relevant information can be found in the following link: https://likumi.lv/ta/en/en/id/258322-regulations-regarding-energy-certification-of-buildings

Spain

n/a

Sweden

In most cases, an on-site visit is mandatory. If the EPC assessor has not performed an on-site visit, it shall be noted and a reason for the exception shall be given.

Information about radon measurement is also included in the EPC if such measurements have been performed with resulting values.

7.1.2 Best practice examples of EPC elements

Bulgaria

A good visualisation of the annual specific energy consumption share (consumed energy, baseline, and estimated energy consumption after ESM) is presented in the EPC as shown in Figure 17.

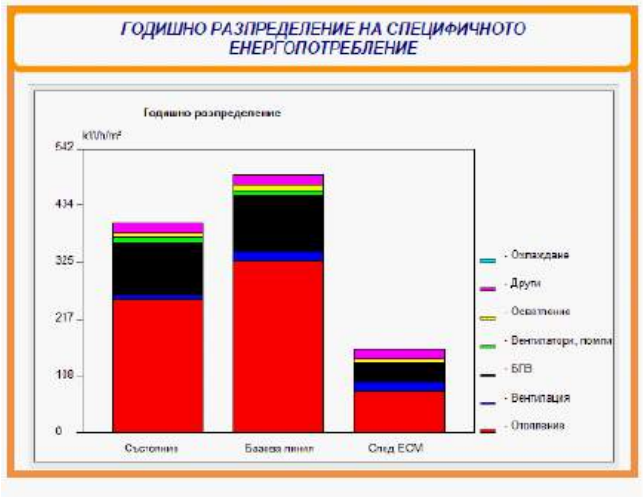


Figure 17 Visualization of annual specific energy consumption share (Bulgaria)

Germany

The final energy usage of typical building types is shown on a reference scale on EPC form for residential buildings (Figure 18).

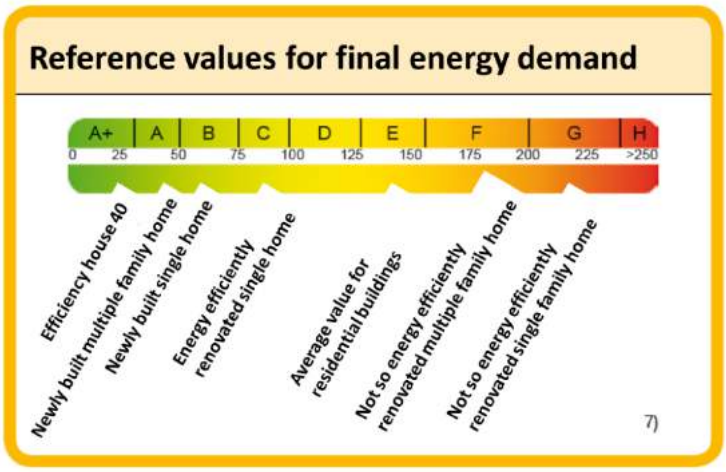
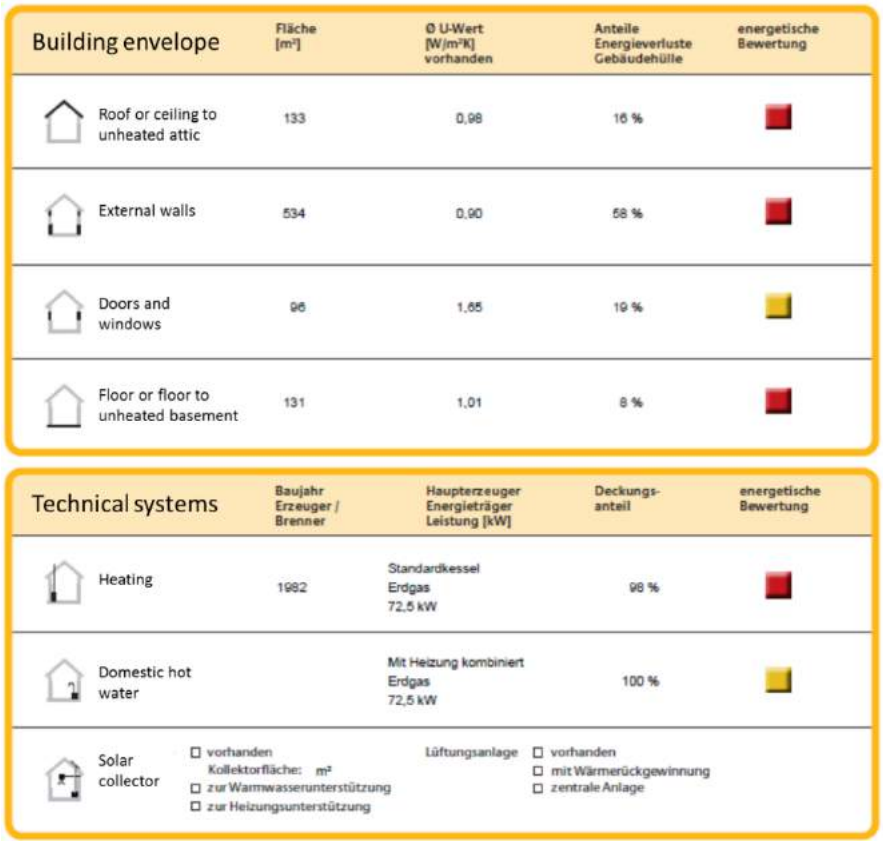


Figure 18 Final energy usage of typical building types in current German EPC

Furthermore, a type of glossary with remarks and description of some EPC form elements is available on the last page of EPC form.

An older proposed EPC-form called „dena Gütesiegel“ includes a detailed evaluation of the most important building elements using a colour-coded system. Furthermore, the recommendations are shown similarly (Figure 19).



Building envelope	Fläche [m²]	Ø U-Wert [W/m²K] vorhanden	Anteile Energieverluste Gebäudehülle	energetische Bewertung
Roof or ceiling to unheated attic	133	0,98	16 %	
External walls	534	0,90	58 %	
Doors and windows	96	1,65	19 %	
Floor or floor to unheated basement	131	1,01	8 %	

Technical systems	Baujahr Erzeuger / Brenner	Haupterzeuger Energieträger Leistung [kW]	Deckungs-anteil	energetische Bewertung
Heating	1982	Standardkessel Erdgas 72,5 kW	98 %	
Domestic hot water		Mit Heizung kombiniert Erdgas 72,5 kW	100 %	
Solar collector	☐ vorhanden Kollektorfläche: m² ☐ zur Warmwasserunterstützung ☐ zur Heizungsunterstützung	Lüftungsanlage	☐ vorhanden ☐ mit Wärmerückgewinnung ☐ zentrale Anlage	

Figure 19 Example of component evaluation in EPC form (proposed for Germany)

Greece

The part of the recommendations of the EPC with the information provided is considered useful and friendly. It contains a short description of the proposed measures, information on the initial investment cost, primary energy savings, simple payback period, CO_2 emissions reduction as well as the expected upgrade in energy class. The improvement needed on this part concerns the possibility to insert more than 3 recommendations, to provide a prioritised list of measures which -implemented step by step- would lead to a deep renovation of the building.

Hungary

Not the current version, but the draft version of the planned EPC has some elements to consider:

- pictograms on building function
- location pictograms of an apartment unit in the building
- Pictograms on renewable energy use
- Final energy table per energy source and purpose
- Evaluation of envelope components integrated with recommendations (Figure 20)
- Evaluation of technical building system components integrated with recommendations (Figure 21)
- Photo documentation page
- Additional information page:
    - Legal references, applied standards
    - Short summary on the rights and obligations of the building owner and EPC experts

- Websites on where to find further information
- Information on where to get further help to design and implement renovation
- Declarations of EPC expert (e.g. about on-site visit, reference to building code, used software, sets of available information, authentication of EPC)

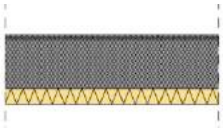
CELLAR CEILING								
	ENERGY PERFORMANCE (U-value, W/m²K)					REMARK		
	poor 0,9<...	low 0,5<..≤0,9	medium 0,26<..≤0,5	good 0,2<..≤0,26	excellent ≤0,2	Added thermal insulation decreases room height.		
	CURRENT VALUE							
	1,3							
	RECOMMENDED THICKNESS OF ADDED INSULATION*					Cost ($$$$)	Savings (****)	Payback time (🕐🕐🕐🕐)
				12 cm		$$	***	🕐🕐
					18 cm	$$$	****	🕐🕐
	*considering λ = 0,039 W/mK insulation material							

Figure 20 Evaluation of envelope components integrated with recommendations (Hungary)

COOLING SYSTEM ENERGY PERFORMANCE								
	CURRENT PERFORMANCE					REMARK		
	poor 125%<...	moderate 110<..≤150 %	normal 95<..≤110 %	good 80<..≤95%	excellent ≤80%			
		X						
	RECOMMENDED MODERNISATION MEASURES					Cost ($$$$)	Savings (****)	Payback time (🕐🕐🕐🕐)
	System component	Remark	Recommended	To be considered	Not recommended			
	Chiller	air to water, SEER > 4,1		X		$$	**	🕐🕐
	Insulation of pipes			X		$	*	🕐🕐🕐
	Hydraulic balancing	according to plan	X			$	**	🕐
	Control				X	-	-	-
	[NEW ELEMENT]							

Figure 21 Evaluation of technical building system components integrated with recommendations

Latvia

On the energy classification scale, also the energy performance references such as an nZEB are depicted (Figure 22).

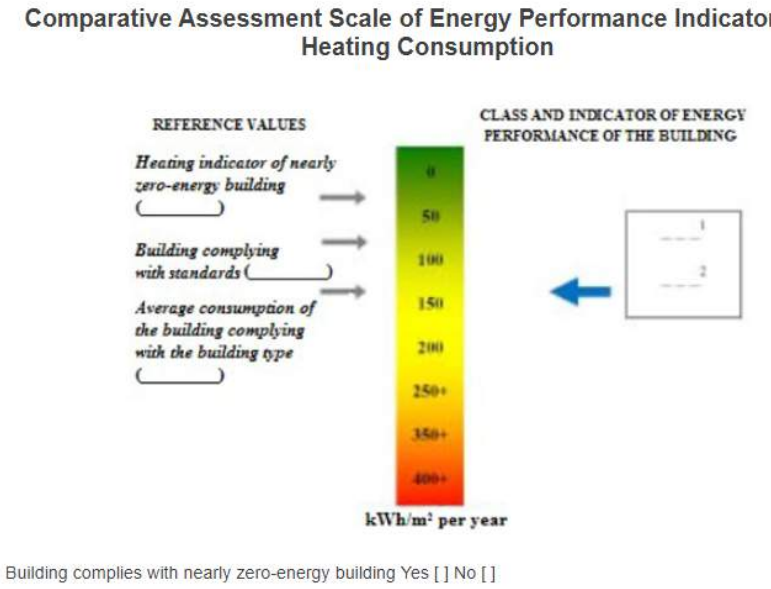


Figure 22 Comparative Assessment Scale of Energy Performance Indicators for Heating Consumption (Latvia)

Spain

n/a

Sweden

The visualisation of the energy class is simple and clear (Figure 23). However, it could be pointed out that Energy class C corresponds to the particular requirement of energy performance that would apply to the building if it were built today.

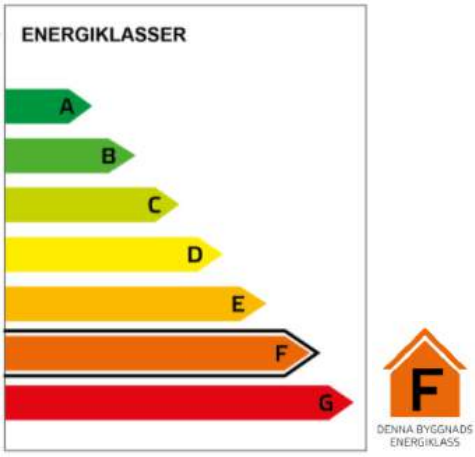


Figure 23 Energy classification scale on Swedish EPC form

7.1.3 Feedback from building owners and stakeholders on EPC forms

7.1.3.1 Building owners

Bulgaria

The general opinion of the homeowners/ building representatives is that the energy performance certificate provides an overview of the strengths and weaknesses in the energy performance of the building. The certificate clearly shows how the annual energy consumption of the building is com-

pared with other buildings of a similar type. The certificate clearly shows what energy efficiency measures must be applied in the building.

Concerning the information in the EPC, that homeowners/ building representatives stated that it is understandable and accessible to experts in this field, but not to the end-user. There should be more explanations and clarifications to the individual parts and the terms.

Another important conclusion is that there is no comment that according to the regulations the building does not meet the requirements for energy efficiency.

A building representative has stated that the deadline for implementation of the measures is not clearly indicated on the certificate.

Regarding the statement "The certificate helps investors make informed decisions about financing energy efficiency measures" a homeowner's opinion is that all actual costs, including those accompanying energy-saving measures, must be indicated in the EPC.

Regarding the category "Assessment of suggested improvements regarding the recommendations for renewal of energy efficiency in the energy certificate": all of the homeowners have indicated it as important.

Germany

Not yet available, due to issues with finding pilot buildings.

Greece

Owners seem to be rather satisfied enough with the current EPC form, probably because they are familiar with, after all this time, thus most answers are positive.
However, they would like to see some improvements and it looks like the priority is given to:

- 'more technical specifications in the recommendations'
- -'explanations of terms and tables'

Also, depending on the professional background of the owner and familiarity with energy terms, it is clearly indicated that consultation is needed with the energy assessor/issuer for the EPC to be understandable and useful.

Regarding 'deep renovation', there is some confusion with 'renovation', because 'deep renovation' is not defined.

Hungary

Not yet available.

Latvia

Not yet available.

Spain

There were eight responses of building owners and building department managers corresponding to 14 buildings in Spain. Less than 28% of the owners understand neither the figures nor the language of the EPC. The public building representatives understand the EPC and small modifications are proposed.

The owners of residential buildings and the Presidents of the building neighbours think the EPC is a document required for the renting or sale of the house and do not follow the energy efficiency recommendations. The scale and colours of EPC are well understandable by them. They think the recommendations for energy saving should be improved. However, they usually change a boiler or air conditioning system, when is not running, and not when the EPC includes a recommendation to do it.

The building department managers, representing public office buildings, schools, etc., responded that they use the EPC recommendations as information data. In some cases, they try to find financing incentives or public budget to perform some of the recommendations. They think that to perform an EPC recommendation, sometimes a more deeply analysis or energy audit of the building should be carried out.

Sweden

The following summary is based on responses from six building owners, most of them with residential buildings (single or multi-family buildings). In general, the opinions regarding the EPC form differ quite a lot among the respondents. To some extent, this is due to different background knowledge and expectations.

In general, the respondents do not think that the EPC gives a clear overview of the strengths and weaknesses of the building's energy performance. However, most of the them stated that they got a fairly good understanding of whether the building is already energy efficient or not.

It was pointed out that although the classification scale is nice and clear, it is difficult to understand whether the energy class is good, okay or bad in comparison to other buildings of the same type. A couple of suggestions in order to make it more useful were given: to include the intervals for the building classes and/or to show statistics of similar buildings (same age, climate zone etc). Moreover, the comparison to similar building types was (in general) not considered to be very useful, since it is not explained how this value is calculated.

Regarding the energy efficiency potential of the building, this is generally not considered to be clear enough. Some of the respondents would find it helpful if the EPC also displayed total energy savings as well as improved energy class, if all of the recommended measures were implemented. One of the building owners thinks that it would be good to show also savings for each measure in primary energy, in order to make it easier to compare to other values in the EPC.

Some of the building owners found it easy to understand what energy efficiency measures to implement, while others did not. In the same way, the opinions differ regarding whether the EPC will be helpful in order to make decisions on energy- and cost-effective measures. A few specifically asked for more details related to the recommended measures. One building owner also questioned why not more recommendations were given in the EPC. This is related to the fact that recommended measures in the EPC form must be cost effective. Instead, additional possibilities to improve the energy performance of the building may therefore be given separately. All of the respondents think that it would be useful if information was given on which of the recommendations that could or should be combined. The respondents do not consider the EPC to encourage deep energy renovation, with one exception.

A couple of the building owners would have liked to see energy consumption from the last few years. Also, it can be difficult to understand the energy consumption values since they are corrected to a normal use of the building.

Today there is link in the EPC to Boverket.se. A couple of the respondents suggested to add a link to a webpage with advice from the Swedish Energy Agency.

7.1.3.2 Stakeholders

Bulgaria

Four stakeholder responses were collected in Bulgaria, including the National EPC Body, EPC training institution and energy consultants. Generally, there is an agreement on the statements for assessment of the **existing certificates** with timidly consent and comments on the following statements:

- The EPC shows if the building reaches the minimum energy efficiency requirements of buildings set in the national legislation. (Stakeholder comment: *"To some extent - the certificate does not inform the consumer that energy class "C" is the minimum that must be achieved in a complete renovation"*)
- The EPC shows clearly how the building's energy consumption or demand compares to other buildings of similar type. (Stakeholder comment: *„This is missing as an element.")*
- The display of energy demand or consumption helps me to make professional decisions regarding the building's energy-efficient measures. (Stakeholder comment*: „Professional decisions are entirely in the field of view of the audit firm. On the other hand, the potential energy savings from the proposed measure may provoke solutions for EE measures")*

All of the targeted stakeholders agree that the information in the EPC is presented in understandable language and figures and the classification used in the EPC helps to convey the level of energy efficiency of the building.

All of the respondents somewhat agree that the EPC form(s) need to be revised to ensure high user-friendliness, still, there are some comments considering that *"the certificate should not be forgotten that this is primarily a technical document. Undoubtedly, it must be able to be understood (to the extent necessary) by the general public, but in essence, it is more important to contain the necessary technical information and to be comprehensible and useful, above all, to the professional community. In this sense, the presence of the colour scale is largely almost entirely aimed at the general public."*. Another suggestion for improving the user-friendliness of the certificate is related to digitalization:

- Effect of measures before and after - for a specific measure
- Detailed breakdown with a digital expression of costs by energy and by items - heating, cooling, DHW, etc.
- Improved graphics
- Proposals for optional measures

Regarding the **Assessment of potential improvements regarding the recommendations for energy-efficient renovation on the EPC** we observe that for the most of options the stakeholders are defined as "Not relevant", or "Already implemented". There is a significant discrepancy in stakeholders opinions about the costs of implementing the recommended energy efficiency measures/actions, as it is already implemented in Bulgarian EPC.

As "very important", but already implemented is evaluated the improvement in energy performance class achievable when implementing the recommended energy efficiency measures/actions.

Germany

There were six stakeholder responses in Germany covering the branches of consumer protection, financing institutes and building association. In general, the current EPC was considered to covey its information understandably. Besides, the overall energetic classification of the building and its status

of energy efficiency was rated to be understandable. However, most experts expressed the need for a more detailed description of the buildings' strength and weaknesses, since the overall classification does not show which components might need improvement. Hence, it might not be the best instrument to make financial decisions. This request was also extended for the renovation recommendation. In contrast, stakeholders pointed out that this information is not intended to be part of the EPC, but of a detailed energy audit by a qualified expert. This concern was also stated for expanding the renovation recommendations and, especially, energy-related costs.

Greece

Following an analysis of responses in the questionnaire distributed to stakeholders, the conclusions drawn are the following:

From the 1st group of questions, on the current EPC form:

- In general, stakeholders believe that the current EPC gives a clear overview of the strengths/weaknesses of the building; It is understandable but this also depends on the background of the target group; it clearly shows if the building is energy efficient or not and the level of efficiency. Improvements through the implementation of EE measures are clearly shown in terms of energy class, costs of measures and energy cost savings. The validity period is shown but the deadline for implementation of recommendations is not shown as implementation is not mandatory.
- But It does not show if the building meets the minimum requirements; it does not provide a comparison with other buildings
- Stakeholders believe that the display of demand/consumption in EPC does not help in making any professional decision on EE measures and they are not convinced it helps in making financial decisions. This is due to:
    - missing information on the envelope and technical systems.
    - missing technical details on proposed measures.
- They also believe that there is not enough space for recommendations

From 2nd set of questions, on potential improvements of EPC form:

- Recommendations should not be on 1st page – better on the 2nd as per current EPC
- Although in the Greek EPC all these are already there, it is considered important for EPCs to show a) energy savings achievable when implementing recommended measures / b) improvement in energy performance class achievable / c) costs of implementing the recommended energy efficiency measures / d) energy cost savings achievable when implementing the recommended measures.
- It is not considered important to show if measures fulfil requirements of incentive programs as incentives are changing over time.
- Stepwise implementation of measures is considered 'somewhat important'.

Links to energy or financial advice are considered 'somewhat important'.

Hungary

Not yet available.

Latvia

Not yet available.

Spain

Escan has invited 9 stakeholders to complete the questionnaire and 4 responses have been collected. The responses come from one Regional Energy Agency, and three EPC issuers. Most of them said the information in the EPC is somewhat understandable -both language and figures-. All responses agree that the EPC is carried based on primary energy and CO2 and not in total annual energy consumption. EPC does not include any information in order to compare to other similar building.

About the energy efficiency recommendations of the EPC, their opinions as very important to include the costs of implementing those recommendations in the EPC. The recommendations of the EPC sometimes are just one line; for example, change the heating boiler and cooling (AC) by heat pumps with XX performance. The inclusion of links with additional information stated as somewhat important. Others are not so important or already done as the inclusion of energy savings in EPC.

Sweden

The Swedish EPC form gives an overview of the energy performance overall and shows what needs to be improved, but it does not show what is already good. Moreover, information related to weaknesses that are not profitable to improve is not included in the EPC. According to the EPC assessors, several building owners request that also not cost-effective measures should be included.

The general opinion among the participating stakeholders is that the language in the EPC form is good and that the performance rating (A-E) is clear (and better than the last rating scale). However, some of the figures can be difficult to understand and explain to the building owners, especially the primary energy indicator (kWh/m2) and "cost per saved kWh" (SEK/kWh). Several stakeholders have expressed that there is a need for a better way to state costs and profitability in the EPC, instead of “cost per saved kWh”.

The data included in the EPC is normally based on metered values of energy consumption, but only normalized values (first adjusted to normal use, and then to normal climate) can be found in the EPC. The general opinion among the stakeholders is that it would be good to also include metered values, to make it clearer and more usable for the present as well as future building owners.

Lastly, some stakeholders have also expressed that it would be good to include, and encourage, combinations of recommendations.

7.1.4 Summary of findings

The EPC forms in the partner countries consist of 1 to 5 pages. The shorter EPCs usually provide a 1 -2 page(s) summary and a supplementary annex with the detailed data on the building and the renovation recommendations. Other countries have a modular approach, i.e. each page is dedicated to a topic such as general building data, energy performance, renovation recommendations, etc. However, this design approach does not necessarily correspond to the amount of content provided.

The general data of the EPC itself (e.g. registry number, date of validity) and the provided building data is mostly the same in all partner countries. Two difference can be found: 1) a checkmark for achieving nearly zero energy building standard and 2) the building area used for calculations and reference. A checkmark for nZEB standard is already provided in the Bulgarian, Hungarian, and Latvian EPC form, but missing in der German, Greek, Swedish and Spanish one. For Greece and Sweden,

the nZEB is indirectly conveyed with an energy class that relates to the nZEB standard. The area of the building is given as total, floor, heated/ cooled or net used area.

The energy classification of a building is provided in all EPCs with colored bars or scales, which have 6 to 12 classes. All countries provide energy usage in kWh/m²yr. However, the basis for the classification is different in every country. The energy usage is given as the final or primary energy demand or consumption or in percent of a reference building. In addition, region and climate-specific correction factors are used in some cases. Some EPCs provide reference values of typical building types, which are given in the best practice examples. Furthermore, the classification chart in some partner countries shows a possible improved class, if a specific set of renovation recommendations are implemented.

The description of the building's envelope and HVAC system varies among the partner countries. Only the main energy source and information on the usage of renewable energies is provided in all EPCs. Detailed information is given in EPC form itself in Spain and Sweden, in an annex in Bulgaria, Greece, Latvia and Hungary. However, the latter might not be generally understandable by the building representatives.

Renovation recommendations are stated in all EPC forms, but with differences in detail. In Germany, Hungary and Sweden the required recommendations consist of a brief description and a cost estimation, which is optional in the German and Hungarian EPC. More detail is provided in the other partner countries. Here, the approach is more systematic.

The stakeholder feedback on the current EPC forms is diverse and in some cases contradictory. The feedback represents the usage of the EPCs and their requirements. For example, financial advisors often would like more details on the renovations needed including costs without having to engage an external advisor. On the other hand, building associations prefer a simple EPC form to fulfil legal requirements. In some countries, the issue arises that there might be a competition between the EPC issuers and energy consultants.

The building representatives mostly state that the language used and presentation of the energy performance of the building is clearly shown in the EPC form. Some building owners would like some explanations on the specific terms used in the EPC form. Moreover, in most countries, there is a need for further explanation or details on the renovation recommendations.

All in all, twelve elements for improvement can be identified as follows. The next section provides an analysis for the selection of priority elements that should be included in the enhanced EPC forms.

1. Checkmark for achieving nZEB standard
2. Inclusion of typical classification of specific building types for reference
3. Inclusion of past (metered) total annual energy consumption
4. Details on the efficiency of building envelope and building HVAC system incl. renewable energies
5. Display of improved classifications and energy performance for a specific set of renovation recommendations
6. No. 5 + energy savings in kWh/year
7. Deep energy renovation recommendations by component and influence on components energy efficiency + cost estimation
8. Information on a useful combination of renovations or possibility for stepwise implementation
9. General information about EPC and their usage (regulatory basis)
10. Link to a deep renovation network platform

11. Glossary of most important terms
12. Link/ information on funding programs

7.2 EPC elements for enhancement and selection

This section firstly defines selection criteria for the EPC elements that should be available in all EPCs and can be developed within QualDeEPC. Secondly, each element is analysed on the possibility of implementation, the availability of data, the benefits for the different target groups, a rating overview and a conclusion. Finally, an overview is presented on the elements that can be implemented within QualDeEPC, that are generally recommended for an advanced EPC form and that are not recommended for implementation on a EPC form.

7.2.1 Selection criteria

The decision on the EPC elements for enhancement is based on a short selection procedure.

Criteria:

- Included in the current EPC forms of the partner countries
  - Yes
  - Partially (yes/no-fraction)
  - No
- Ease of development for an EPC template by QualDeEPC
  - Easy to develop
  - Development possible, but work required
  - Not possible to develop within the scope of QualDeEPC
- Availability of required data/ information
  - available
  - Partially available
  - No data available
- Relevance for existing buildings needing renovation
  - Relevant
  - Somewhat relevant
  - Not relevant
- Workload for EPC issuers (especially the ones working for WP4)
  - High
  - Medium
  - Low
- Development need for a specific target group

  Does the target group benefit from the element and/or marked this element as important in the questionnaires?

  - Target groups:
    - current building owners or associations (or as represented by consumer protection agencies)
    - future building owners or tenants or tenant associations (or as represented by consumer protection agencies)
    - energy consultants and their associations
    - national policymakers or certification body
    - Financial advisors or institutions

7.2.2 Element 1: Checkmark for achieving nZEB standard

Development and data availability

The checkmark or similar notation is already included in 4 out of 7 partner countries. If a building's energy performance meets the nZEB standard, can mostly be concluded by comparing the energetic values from the EPC to the definition of the nZEB standard. Hence, it can easily be developed. From 2021 onwards, all new buildings have to be built as nZEB buildings or better according to the European Building Performance Directive (EBPD). Hence, the checkmark might be obsolete in these cases. For existing buildings, the achievability of nZEB standard depends on the definition and on how ambitious it is. In any case, the information may be provided by a yes or no answer field in the form. An example is given in Figure 24.

Figure 24 Checkmark for the achievement of nZEB standard as provided in the Bulgarian EPC form

Benefits for the target group

If a specific building's energetic performance meets the nZEB requirements, is somewhat important for current and future building owners and financial advisors, since it might be linked to the market value of the building. For national policymakers and certification bodies, a statistic of nZEB buildings in the country can be important concerning national energy-saving goals. Existing buildings usually do not achieve this standard before renovation and might not be achievable. For EPC issuers, the completion of the nZEB checkmark has a low workload, since calculated energetic performance only needs to be compared to a few target values.

Rating

Table 32 Rating of the proposed "Checkmark for achieving nZEB standard" for the improved EPC form

Element	Rating
Included in EPC forms	Partially (4 out of 7)
Ease of development	Easy to develop
Data availability	Available
Relevance for existing buildings	Not relevant
Workload for EPC issuers	Low
Development need for	
current building owners or associations or consumer protection	Somewhat important need
future building owners or tenants or tenant associations (or consumer protection)	Somewhat important need
energy consultants and their associations	Not important
national policymakers or certification body	Important need
Financial advisors or institutions	Somewhat important need

Conclusion

A checkmark for nZEB standard might be generally recommended. However, for new buildings, the checkmark will become obsolete by 2021. Moreover, the nZEB standard might not be achievable by existing buildings. Hence, it does not need to be implemented in an EPC template by this project as a priority.

7.2.3 Element 2: Inclusion of typical classification of specific building types for reference

Development and data availability

In most countries, the typical energy usage of specific building types is available in the literature. Examples might be the nZEB standard to be applied from 2021, the current (2020) minimum requirement for newly built single and multiple family homes, or the average of the entire residential building stock. A disadvantage might be that the values can change over time, due to market development and the revision of standards. They also depend on buildings, due to the reference building approach. Hence, exact numbers should be avoided and replaced by a bandwidth.

The German and Latvian EPC form provide references for the energy usage of typical buildings. The German version is located in a separate information box on the same page as the primary and final energy demand or consumption of the actual building (Figure 18, page 91). On the Latvian EPC, this information is given on the same scale as the energy usage of the evaluated building (Figure 25).

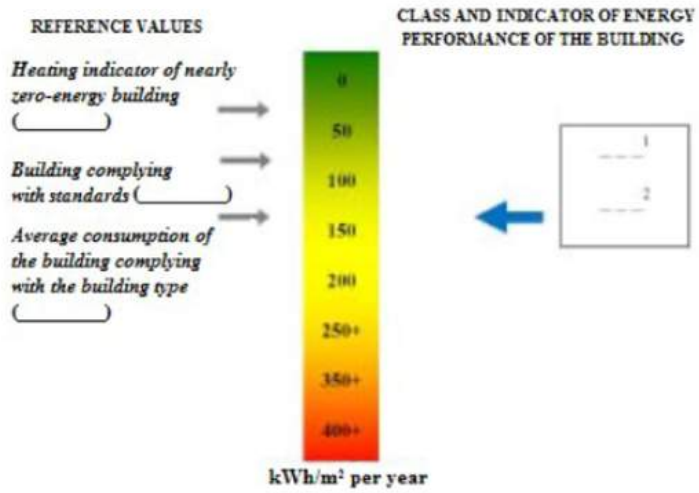


Figure 25 Reference values of building types in current Latvian EPC

Benefits for the target group

Reference values for the energy usage of typical building types help current and future building owners to identify the current energetic state of their building compared to buildings that comply with specific standards. Similarly, it might also be useful to financial advisors in judging the value of the real estate. For energy consultants, this information might be somewhat relevant, when explaining the results to their customers. National policymakers or the certification bodies do not have direct advantages from this element for use in monitoring or statistics, but policymakers will benefit indirectly if it induces renovations.

Since the reference scale would be an informative part of the EPC form, and therefore, not be changed or edited by the EPC issuers, there is no additional workload for the EPC issuers.

Rating

Table 33 Rating of the proposed "Inclusion of typical classification of specific building types for reference" for the improved EPC form

Element	Rating
Included in EPC forms	Partially (2 out of 7)
Ease of development	Development possible
Data availability	Available
Relevance for existing buildings	Relevant
Workload for EPC issuers	Low
Development need for	
current building owners or associations or consumer protection	Important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Somewhat important need
national policymakers or certification body	Not important need
Financial advisors or institutions	Somewhat important need

Conclusion

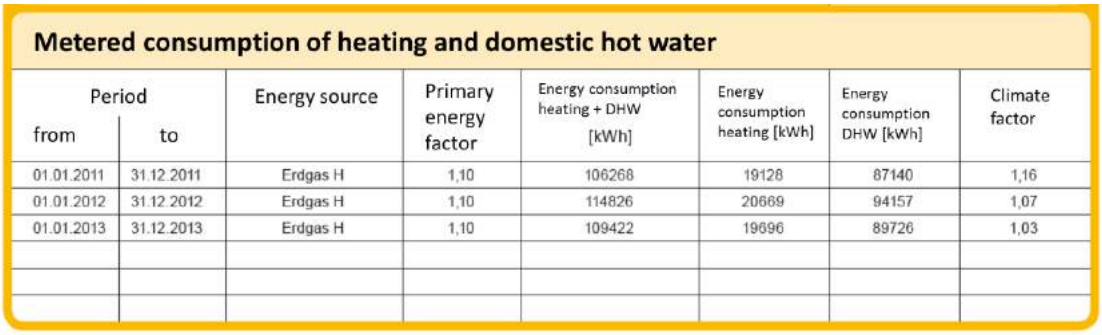
The inclusion of typical energetic classification of specific building types or categories can be beneficial to some target groups. However, the development of a similar scale for all partner countries and the country-specific values might hold some challenges. Moreover, the reference values can change over time, which is a disadvantage for the validity time of up to 10 years of the EPC forms. Hence, an alternative could be to integrate such references in an information platform, where the values can be explained and updated regularly, and to include a link to this platform on the EPC.

7.2.4 Element 3: Inclusion of past metered and/or calculated total annual energy consumption in all EPCs

Development and data availability

The energy performance value in kWh/m^2/yr is not intuitive for potential buyers of tenants of a building, since it will need to be multiplied with the m^2 to find out about the total annual energy consumption as the basis for calculating the energy costs. In modelling-based (asset rating) EPCs, this information is lacking, and mostly no information is provided on the actual real-life annual energy consumption by the current building occupants. In consumption-based (operational rating) EPCs, this information is usually provided in a simple table stating the period, energy source, primary energy factor as well as the metered consumption for heating and DHW for last year up to five years. Annotations should be provided stating that the consumption is dependent on the user profile and weather conditions.

The data availability depends on the metering system installed in the building. For multi-family homes, the actual consumption for a single unit might only be an estimate depending on the floor area. Moreover, in some cases, it might be difficult to differentiate between energy use for heating, cooling, and domestic hot water.



Metered consumption of heating and domestic hot water

Period		Energy source	Primary energy factor	Energy consumption heating + DHW [kWh]	Energy consumption heating [kWh]	Energy consumption DHW [kWh]	Climate factor
from	to						
01.01.2011	31.12.2011	Erdgas H	1,10	106268	19128	87140	1,16
01.01.2012	31.12.2012	Erdgas H	1,10	114826	20669	94157	1,07
01.01.2013	31.12.2013	Erdgas H	1,10	109422	19696	89726	1,03

Figure 26 Example table for noting annual energy consumption (German EPC)

Benefits for the target group

For EPCs based on modelling the building, future building owners and tenants often ask for this information, since it relates to the energy costs that can be expected. Similarly, financial advisors can use this information to estimate energy costs. For current building owners or energy consultants, this information might be somewhat beneficial, when analysing energy saving potentials. No direct benefits are provided for national policy and certification bodies.

Depending on the metering system installed in the building and its accessibility, the workload for EPC issuers might be at a low or medium to a high level.

Rating

Table 34 Rating of the proposed "Inclusion of past metered and/or calculated total annual energy consumption in all EPCs" for the improved EPC form

Element	Rating
Included in EPC forms	Partially / in some countries or types of EPCs
Ease of development	Development possible
Data availability	Somewhat available
Relevance for existing buildings	Relevant
Workload for EPC issuers	Low/Medium to high
Development need for	
current building owners or associations or consumer protection	Somewhat important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Somewhat important need
national policymakers or certification body	Not so important need
Financial advisors or institutions	Somewhat important need

Conclusion

A simple table for the past annual energy consumption and/or the modelled total annual energy consumption will be developed in this project. Exchange with the U-Cert project will be sought.

7.2.5 Element 4: Details on current energy efficiency levels for building envelope and building HVAC system incl. renewable energies

Development and data availability

As mention in section 7.1.4, most EPCs do not include detailed information on the building envelope and HVAC system. For existing buildings, this information is especially relevant to identify the strengths and weaknesses of the building. In some partner countries, this information is included in the annexes to the EPC, which might not be generally understandable. A systematic approach can be found in a past German project called "dena Gütesiegel" (Figure 19, page 92) and in the current EPC renewal process in Hungary. Here, the components of the building envelope and technical system are rated from "bad" to "good" using color-coded information. The availability of boundary values for evaluating several building components varies among the partner countries. A general template and a simple country-specific version of this component evaluation can be done in this project, but all partners need to do some research.

Benefits for the target group

Detailed information on the building components is especially relevant for current and future building owners as well as financial advisors to estimate the value of a real estate and the need for investments. In countries, where the EPC issuers are not necessarily highly qualified energy consultants and no detailed energy audit has been required for issuing an EPC until now, this evaluation might compete a detailed energy audit. However, a first evaluation might also be beneficial for future energy audits.

The detailed evaluation might also be somewhat important for the national policymakers to gain a more precise insight into the building stock.

For EPC issuers, this element can result in a high workload, if details of the building components are not easily available and/or on-site visits are not possible. For example, in consumption-based (operational rating) EPCs, the information needed may not be required and collected for EPC issuance in current schemes.

Rating

Table 35 Rating of the proposed "Details on current energy efficiency levels for building envelope and building HVAC system incl. renewable energies" for the improved EPC form

Element	Rating
Included in EPC forms	Partially
Ease of development	Development possible but work required
Data availability	Partially available
Relevance for existing buildings	Relevant
Workload for EPC issuers	High
Development need for	
current building owners or associations or consumer protection	Somewhat important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Somewhat important need
national policymakers or certification body	Somewhat important need

Financial advisors or institutions	Somewhat important need

Conclusion

This project can develop a simple version of a systematic approach to evaluating building components. This version might then be extended on a national level.

7.2.6 Element 5: Display of improved classifications and energy performance for a specific set of renovation recommendations

Development and data availability

Most EPC issuers use a software to calculate the energy usage of a building, which then translates to the energy class. In the software, the renovation recommendations mostly will be implemented and result in a new value for energy performance and hence, energy class. The set of renovation recommendations should be kept within a cost-effective frame, according to the EPBD.

Benefits for the target group

For current and future building owners and financial advisors, the display of a possibly higher energy class is highly beneficial, since it shows the potential of the building when renovated. Also, the national policymakers could use the information to check if energy saving goals can realistically be reached.

For EPC issuers, the related workload corresponds to the usability of the software, and whether the data for calculating the new classification and energy performance is available.

Rating

Table 36 Rating of the proposed "Display of improved classifications and energy performance for a specific set of renovation recommendations" for the improved EPC form

Element	Rating
Included in EPC forms	Partially
Ease of development	Easy to develop in asset rating EPC schemes, may be more complex in operational rating scheme
Data availability	Available in asset rating EPC schemes may be more difficult in the operational rating scheme
Relevance for existing buildings	Relevant
Workload for EPC issuers	Medium to high
Development need for	
current building owners or associations or consumer protection	Important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Not so important need
national policymakers or certification body	Important need
Financial advisors or institutions	Important need

Conclusion

The project can develop this element.

7.2.7 Element 6: Element 5 + energy savings in kWh/year

Development and data availability

In element 5, improved energy performance is calculated for a set of renovation recommendations. The difference between the original and improved value can be translated into energy saving in kWh/year using the provided area of the building. Since this energy-saving value is an estimation, which also depends on the number and user profile of the building's occupants, a remark on this issue should be added as a footnote or similar.

Benefits for the target group

The display of possible energy savings is especially important for current and future building owners and financial advisors. Similar to element 5, national policymakers could gain a more realistic view of the energy-saving potential of the building stock.

The workload for EPC issuers might be low to medium depending on the developed method, particularly if element 5 is already introduced.

Rating

Table 37 Rating of the proposed "Element 5 + energy savings in kWh/year" for the improved EPC form

Element	Rating
Included in EPC forms	Partially (1 out of 7)
Ease of development	Possible within the scope of QualDeEPC, if element 5 is developed
Data availability	Partially available
Relevance for existing buildings	Relevant
Workload for EPC issuers	Low to medium
Development need for	
current building owners or associations or consumer protection	Important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Not so important need
national policymakers or certification body	Somewhat important need
Financial advisors or institutions	Important need

Conclusion

The information about potential energy savings in kWh per year can be developed within the scope of QualDeEPC.

7.2.8 Element 7: Deep energy renovation recommendations by component and influence on components energy efficiency + cost estimation

Development and data availability

A systematic approach for presenting deep energy renovation recommendations is missing in the EPC forms of the project's partner countries. As these recommendations are already part of this project, also the respective element of the EPC form should be advanced. Similarly to Element 4, examples can be found in a German project called "dena Gütesiegel" and in the EPC renewal process in Hungary. Specific values for the target values of each building component need to be researched and are dependent on the country and climate zone.

An estimation of the costs could be presented as a "category of expense", e.g. ranging from "low" to "moderate" to "expensive" investment. However, this estimation is difficult to obtain.

Benefits for the target group

This element will provide current and future building owners and financial advisors with more detailed information on renovation options with high impact on overall energy usage and an estimation of cost categories.

Depending on the availability of the individual building details, the workload for EPC issuers can be medium to high. If specific target values are generally given, the workload can be kept lower.

Rating

Table 38 Rating of the proposed "Deep energy renovation recommendations by component and influence on components energy efficiency + cost estimation" for the improved EPC form

Element	Rating
Included in EPC forms	No (may soon be introduced in Hungary)
Ease of development	Development possible, but work required
Data availability	Partially available
Relevance for existing buildings	Relevant
Workload for EPC issuers	Medium to high
Development need for	
current building owners or associations or consumer protection	Somewhat important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Not so important need
national policymakers or certification body	Somewhat important need
Financial advisors or institutions	Important need

Conclusion

This project can develop a simple version of a systematic approach for presenting deep renovation recommendations by component.

7.2.9 Element 8: Information on a useful combination of renovations or possibility for stepwise implementation

Development and data availability

On most currently available EPC forms, there is no dedicated space for the information on useful renovation combinations or the stepwise implementation. This information would advance the EPC to a simple form of an individual building renovation roadmap. Since this information will depend on the individual project, an empty field for this purpose will be integrated.

Benefits for the target group

The information on the useful combination of renovations and the possibility for stepwise implementation is an important need for (current and future) building owners and financial advisors. Energy consultants that perform a detailed energy audit might use this information as a basis for their work.

The workload for EPC issuers will be high if the renovation recommendations have to evaluated for the specific building for this element alone. If they are already developed for another element or in the existing schemes, the additional workload for their combination and assessment as to stepwise implementation will be low.

Rating

Table 39 Rating of the proposed "Information on the useful combination of renovations or possibility for stepwise implementation" for the improved EPC form

Element	Rating
Included in EPC forms	Partially
Ease of development	Easy to develop
Data availability	Available
Relevance for existing buildings	Relevant
Workload for EPC issuers	Low or High
Development need for	
current building owners or associations or consumer protection	Important development need
future building owners or tenants or tenant associations (or consumer protection)	Important development need
energy consultants and their associations	Somewhat important need
national policymakers or certification body	Not so important need
Financial advisors or institutions	Important development need

Conclusion

A dedicated field in the EPC form for the information on useful combinations of renovations and the possibility for a stepwise implementation will be developed in this project.

7.2.10 Element 9: General information about EPC and their usage (regulatory basis)

Development and data availability

The description of the EPC process and form is usually provided in national regulation text, which is not generally understandable. The formulation of this information in an easily understandable language might require some work for all partners. The whole glossary can then be issued in an infor-

mation box or on a separate page of the EPC form, or by a link to a Deep Renovation Network Platform.

Benefits for the target group

Current and future building owners and tenants can gain a better understanding of the EPC and its purpose. Energy consultants and other professionals usually obtain this information through their education. For national policymakers, it might be important that the users of EPCs understand the content for high acceptability of EPCs.

Rating

Table 40 Rating of the proposed "General information about EPC and their usage (regulatory basis)" for the improved EPC form

Element	Rating
Included in EPC forms	Partially
Ease of development	Easy to develop
Data availability	Available
Relevance for existing buildings	Somewhat relevant
Workload for EPC issuers	None
Development need for	
current building owners or associations or consumer protection	Important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Not so important need
national policymakers or certification body	Important need
Financial advisors or institutions	Somewhat important need

Conclusion

The implementation of an information box about the EPC in general on the EPC form is recommended. In QualDeEPC, this information will be covered by the link to the Deep Renovation Network Platform, for which this information will be developed.

7.2.11 Element 10: Link to Deep Renovation Network Platform

Development and data availability

In the EPCs of the project's partner countries, there is no link to a deep renovation network platform. If a platform is available, then the link can be easily implemented in the EPC forms using a simple web link or QR-code. However, since the EPCs are usually valid for 10 years, the platform would be required to be maintained in the long term.

Benefits for the target group

For (future) building owners, an official link to validated information is highly beneficial to obtain detailed knowledge building components, their renovation and costs. Besides, for financial advisors, and up-to-date information platform can be important for the same reasons. Building owners and energy consultants can connect more easily via such a platform. National policymakers and the certification body could use the platform to place updates on the regulations.

Rating

Table 41 Rating of the proposed "Link to Deep Renovation Network Platform" for the improved EPC form

Element	Rating
Included in EPC forms	Partially
Ease of development	Easy to develop
Data availability	Partially available
Relevance for existing buildings	Relevant
Workload for EPC issuers	None
Development need for	
current building owners or associations or consumer protection	Somewhat important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Somewhat important need
national policymakers or certification body	Somewhat important need
Financial advisors or institutions	Somewhat important need

Conclusion

An overview of national links to already existing information platforms will be developed in this project and implemented in the enhanced EPC form. At the end of this project, these links might be substituted for the link to the Deep Renovation Network Platforms developed in this project.

7.2.12 Element 11: Glossary of the most important terms

Development and data availability

The terms and definitions used in the EPC form are usually provided in the national regulations and standards. The formulation of this information in an easily understandable language might require some work for all partners. The whole glossary can then be issued on an extra page of the EPC form as is done in Germany.

Benefits for the target group

For (future) building owners, it is important to understand the EPC form and its content to make an informed decision on the necessity and extent of an energy-efficient renovation. Energy consultants and other professionals usually obtain this information through their education. For national policymakers, it might be important that the users of EPCs understand the content for high acceptability of EPCs.

Rating

Table 42 Rating of the proposed "Glossary of most important terms" for the improved EPC form

Element	Rating
Included in EPC forms	Partially (1 out of 7)
Ease of development	Possible, work required
Data availability	Available
Relevance for existing buildings	Somewhat relevant
Workload for EPC issuers	None
Development need for	
current building owners or associations or consumer protection	Important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Not so important need
national policymakers or certification body	Important need
Financial advisors or institutions	Somewhat important need

Conclusion

The implementation of a glossary in the EPC form is generally recommended. In QualDeEPC, this information will be covered by the link to the Deep Renovation Network Platform.

7.2.13 Element 12: Link/ information on funding programs

Development and data availability

Funding programs help building owners to implement energy-efficient measures in a building that might otherwise have long payback times. In most cases, funding programs are promoted on a large scale, hence the data is usually easily available. A link to an official website could be easily implemented on the EPC form via QR-code or similar. However, funding programs change their conditions regularly and are largely depending on the current political goals.

Benefits for the target group

The primary target group for funding programs are (current and future) building owners. Additionally, the information about funding possibilities is also relevant to financial advisors to decide on possible loans and their conditions. For national policymakers, the promotion of funding programs aims to reach the national energy-saving goals. Energy consultants have to stay up-to-date on funding programs, but obtain this knowledge through training or specialized websites.

Rating

Table 43 Rating of the proposed "Link/ information on funding programs" for the improved EPC form

Element	Rating
Included in EPC forms	No
Ease of development	Easy to develop
Data availability	Available
Relevance for existing buildings	Relevant
Workload for EPC issuers	None
Development need for	
current building owners or associations or consumer protection	Somewhat important need
future building owners or tenants or tenant associations (or consumer protection)	Important need
energy consultants and their associations	Somewhat important
national policymakers or certification body	Important need
Financial advisors or institutions	Somewhat important need

Conclusion

Because of the changeability of funding programs, it is not recommended to implement a direct link to national funding programs on the EPC. This information might be rather provided on the Deep Renovation Network Platform, which would be subject to regular maintenance. Moreover, energy consultants (including most EPC issuers) are usually required to obtain knowledge about the latest funding programs.

7.2.14 Conclusion

Table 44 summarizes the conclusions of the detailed analysis of the proposed EPC form elements.

Table 44 Summary of evaluation of proposed EPC form elements

No.	Element	Implementation in enhanced EPC form template to be developed by QualDeEPC	Generally recommended for enhanced EPC form templates	Not recommended on EPC
1	**Checkmark for nZEB standard**			X
2	**References for energy usage of typical building categories**		X*	
3	**Inclusion of past metered and/or modelled total energy consumption per year**	X		
4	**Details on building envelope and building HVAC system**	X		
5	**Display of improved classifications and energy performance**	X		
6	**No. 5 + energy savings in kWh/year**	X		
7	**Detailed renovation recommendations by component + cost estimation**	X	(X)	
8	**Useful combination of renovations and stepwise implementation (as an empty text field)**	X		
9	**General information about EPC**		X*	
10	**Link to Deep Renovation Network Platform**	X	(X)	
11	**Glossary of most important terms**		X*	
12	**Link/ information on funding programs**		(X*)	X

* These elements are indirectly included in the Deep Renovation Network Platform.

() A simplified version can be implemented. More details can be elaborated in the general recommendations.

7.3 Template for EPC form

Based on the analysis in section 7.1 and 7.2, a template for an enhanced and more user-friendly EPC form has been developed. This form will contain the following elements:

1. General data and building specification (standard requirement)
2. Energy performance and classification (standard requirement)
3. Past metered or modelled yearly total energy consumption
4. Details on building envelope and building HVAC system
5. Display of improved classifications and energy performance
6. Potential energy savings (in kWh/yr)

7. Detailed renovation recommendations by component
8. Useful combination of renovations and stepwise implementation
9. Link to Deep Renovation Network Platform

The detailed description of the form and design of the element as well as details on how to acquire the needed input data is given in the following sections. The form is available in

This proposal for a more user-friendly EPC form was developed with a view to include both the data required by the EPBD (nos. 1 and 2) and the additional data that we selected in section 7.2 (nos. 3 to 9). It is thus meant to be universally applicable, but will still need to be adapted to county-specific requirements and needs in WP 5. The information that either needs to be adjusted to the country-specific requirements or needs further input by the EPC issuer is marked with writing in italics.

7.3.1 General data and building specification

As shown in Table 51 on page 143, all EPC forms in the partner countries contain background information on formalities of the EPC, the data of the considered building and information on the EPC issuer including the date and signature. These formalities are included on page 1 of the template as follows:

- A title stating “EPC form” that should be translated into the national language and might be followed by a short subtype of EPC or other description,
- a short reference to the national law that describes the energy performance certification process,
- the registry or serial number of the issued EPC,
- the date of validity,
- the EPC type, if more than one type is issued in the country,
- optional space for other country-specific requirements, e.g. checkmark for nZEB standard, calculation method, etc.
- a space for the address of the EPC issuer, as well as
- a space for the date of issuance and signature of the EPC issuer.

To provide an overview of the considered building, the most important building data is given in the table “Building data” on page 1 of the EPC template. For all partner countries, the type of the building, the address, the year of construction and a building area used for calculation should be included. Two additional descriptions of the building as required by the national law can be integrated.

7.3.2 Energy performance and classification

As a standard requirement, all EPCs need to state the (main) energy class and value(s) of the energetic performance of the building. The table on page 1 of the EPC template can be used by all partner countries based on Table 31. There is also room to add a second or third relevant value as well as the estimated improved energy performance by ‘Option 1’ considering a specific set of renovation recommendations. In the table, the number of lines needs to be adjusted to the corresponding number of energy classed in the national standards.

7.3.3 Past metered or modelled yearly total energy consumption

For the past metered or modelled yearly total energy consumption, a table is provided on page 2 of the EPC form template. The table is designed to contain the energy consumption of the last three years or measuring periods. In addition, the (main) energy source and total consumption for warm water and heating should be provided. If possible, the energy consumption for warm water and heating can be listed separately. Moreover, two additional columns can be used, for example, for the metered electricity (if not mandatory) or climate factors.

This table fulfils two purposes:

1. For consumption-based (operational rating) EPCs, the table can be used to document the relevant data sets.
2. For EPCs based on calculations, this table can provide additional information on the performance of the building under operational conditions.

In case 1, the table is mandatory, since the overall energy rating is based on this data. For the second case, the table might be considered optional, if the national regulations do not include a similar table.

In both cases, obtaining the detailed measured data can prove difficult depending on the system installed. Hence, the data might also be modelled. If the data was measured or modelled can be marked at the element.

7.3.4 Details on building envelope and building HVAC system

The most important parts of the building envelope and the technical system are considered in two tables on page two of the EPC form template. In general, the components should be given a green, yellow or red symbol, to indicate “low”, “medium” or “advanced” energy< performance quality. This indicator is referred to as ‘energy rating’.

For the building envelope, the energy rating should preferably be based on the average U-value of the specific building parts. Thus, for each component, a range of U-values for the three performance options should be prescribed. Since these values might not be possible to determine in all partner countries, a description-based evaluation might be possible.

For the technical components, the preferred evaluation option would be the EU ErP energy label. Since older systems might not be labelled, the label criterion might be complemented with a list of typical technologies.

7.3.5 Display of improved classifications and energy performance and potential energy savings

The improved classification is based on a specific set of renovation recommendations, which are marked in the tables on page 3 of the EPC template (see section 7.3.6). The resulting energy performance is indicated in the table of the energy classification on page 1.

For calculation based EPCs, the improved energy performance can most probably be calculated using the same software as for the original values. In this case, the renovation recommendations are selected before the re-calculation.

In case of operational rating EPCs (based on measured consumption), the EPC issuers may have to rely on average effects of the renovation recommendations on the energy consumption. An official

collection of tables with resulting energy performance values based on typical combinations of recommendations and original values of the energy performance may be useful to support EPC issuers and ensure good quality of the EPCs.

The potential energy savings are calculated as the difference between the original energy performance and the improved energy performance multiplied by the relevant building area. This value might be displayed either on page 1 under the table for energy performance and classification or on page 3 under the tables for the renovation recommendations of the EPC form template. Also, both options may be possible depending on the resulting space available on the adjusted national forms.

7.3.6 Detailed renovation recommendations by component

On page three of the EPC form template, the renovation recommendations by the component are given in two tables. The evaluation of the recommendation is based on the same values or descriptions as for the evaluation of the current component performance in section 7.3.4. In the tables, it is indicated if a recommendation is included in the "Option 1" renovation concept.

An optional column for the evaluation of cost, cost-effectiveness and/ or payback time might be added. At the current stage, no hard criteria for estimating the cost-effectiveness could be identified. The topic will be discussed with the stakeholders in the national workshops.

Overall requirements such as reaching nZEB requirements in case of renovation (for countries, in which these exist), air tightness, reduced thermal bridging and percentage of renewable energies are listed separately since they depend on the combination of selected renovation options. Additionally, it could also be marked if the building reaches or can reach the legal requirements for existing buildings.

7.3.7 Useful combination of renovations and stepwise implementation

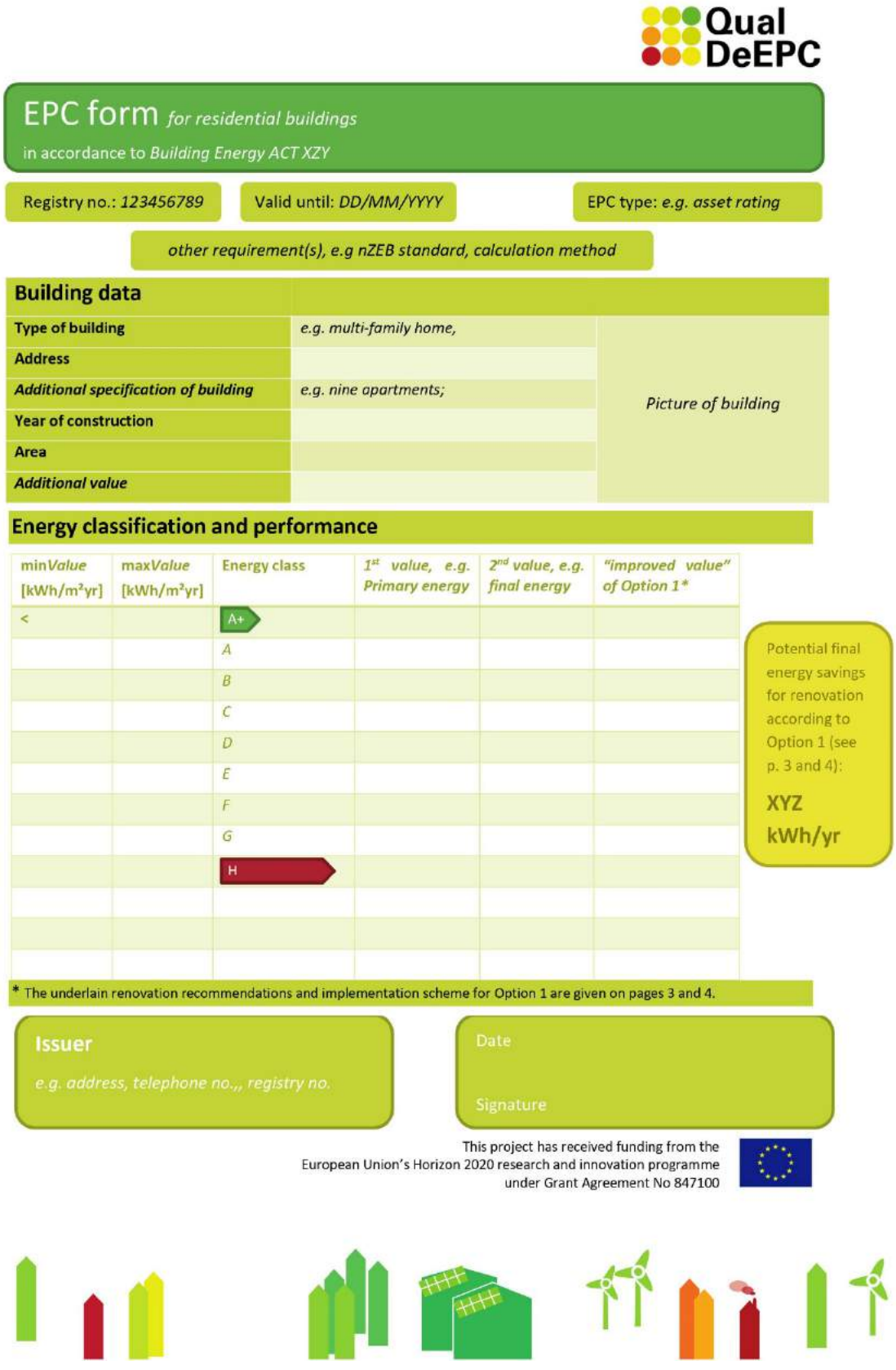
For the description of useful combinations of renovation options and stepwise implementation, two text fields are provided on page 4 of the EPC form template. The first text field is reserved for the detailed description of "Option 1", which is used to calculate the improved performance (classification) and energy savings. Since not all building components are listed in the tables on page 3, additional options might be described. Moreover, an implementation plan might be laid out.

In the second text field, additional renovation options or options that might be implemented later can be described.

7.3.8 Link to Deep Renovation Network Platform

At the end of page 4 of the EPC form template, a text field is reserved to integrate the link to a national Deep Renovation Network Platform, official websites on energy performance certification or other relevant links.

7.3.9 Resulting template for an enhanced and more user-friendly EPC form



EPC form *for residential buildings*

in accordance to *Building Energy ACT XZY*

Registry no.: *123456789* | Valid until: *DD/MM/YYYY* | EPC type: *e.g. asset rating*

other requirement(s), e.g nZEB standard, calculation method

Building data

Type of building	*e.g. multi-family home,*	*Picture of building*
Address		
Additional specification of building	*e.g. nine apartments;*	
Year of construction		
Area		
Additional value		

Energy classification and performance

min*Value* [kWh/m²yr]	max*Value* [kWh/m²yr]	Energy class	*1st value, e.g. Primary energy*	*2nd value, e.g. final energy*	*"improved value" of Option 1**
<		A+			
		A			
		B			
		C			
		D			
		E			
		F			
		G			
		H			

Potential final energy savings for renovation according to Option 1 (see p. 3 and 4):

XYZ kWh/yr

* The underlain renovation recommendations and implementation scheme for Option 1 are given on pages 3 and 4.

Issuer

e.g. address, telephone no.,, registry no.

Date

Signature

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 847100

Figure 27 First page of the enhanced EPC form template

Qual DeEPC

EPC form for residential buildings

in accordance to *Building Energy ACT XZY*

Details on the current energy performance of the building

Energy consumption** measured: ☐ modelled: ☐

No.	Period of measurement (from – to)		Energy source	Energy consumption for space-heating and domestic hot water (DHW) [kWh/yr]			*Electricity [kWh/yr]*	*Other:* _____
				Total	Heating	DHW		
1								
2								
3								

**measured energy consumption depends on the energetic profile of building occupant, the number of occupants and weather conditions during the period of measurement; modelled energy consumption may differ from actual use

Assessment of building envelope and technical system

Building envelope	Area [m²]	*Description or Avg. U-value*	Energy rating
Roof or ceiling to attic			
External walls			
Windows			
Doors			
Ground floor or floor to un-heated basement			

Technical systems	Year of construction/ installation	Energy source, provided power, **EU energy label**	Energy rating
Heating system			
Domestic hot water			
Ventilation system			
Cooling system			
Renewable energies			
Lighting			

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 847100

Figure 28 Second page of the enhanced EPC form template

Qual DeEPC

EPC form for residential buildings

in accordance to *Building Energy ACT XZY*

Renovation recommendations – component evaluation

Building envelope	Recommendation	"new" avg. U-value	New Energy rating	*Cost effectiveness (e.g. payback time)*	Included in Option 1 ?
Roof or attic					☐
External walls					☐
Windows					☐
Doors					☐
Ground floor or floor to unheated basement					☐

Technical systems	Recommendation	Energy source, provided power, EU energy label	New Energy rating	*Cost effectiveness (e.g. payback time)*	Included in Option 1?
Heating system					☐
Domestic hot water					☐
Ventilation system					☐
Cooling system					☐
Renewable energies (outside of other systems)					☐
Other: e.g. Lighting					☐

Potential energy savings when Option 1 is implemented: *XYZ* kWh/yr

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 847100

Figure 29 Third page of the enhanced EPC form template

Qual DeEPC

EPC form for residential buildings

in accordance to *Building Energy ACT XZY*

Renovation recommendations – renovation concepts

Description of useful combination of renovations and stepwise implementation for option 1:

Option 1 meets requirements for:

- *nearly zero energy buildings in case of renovation:* ☐
- *Air tightness:* ☐
- *Reduced thermal bridging:* ☐
- *Min. 50% RES or equivalent measures:* ☐

Description of useful combination of renovations and stepwise implementation for further renovation options not included in option 1:

Further information

The following link(s) provide further information on energy performance certification, use of EPCs and renovations to improve energy performance including financial assistance programmes:

- *Website A*
- *Website B*
- *Website C*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 847100

Figure 30 Fourth page of the enhanced EPC form template

8 VOLUNTARY/MANDATORY ADVERTISING GUIDELINES FOR EPCS

In all EU member states, it should be mandatory to display the energy class of the EPC and/or the energy performance included in the EPC in selling or renting advertisements, since this is required in the EPBD, but the compliance in the markets varies (see Chapter 9 Improving compliance with the mandatory use of EPCs in real estate advertisements).

A potential way to improve compliance is to provide sellers, landlords and letting agencies with concrete and voluntary or even mandatory guidelines for the use and presentation of EPCs and the legally required data in advertisements of sales and rentals of buildings. This will make it easier for these target groups to comply with the advertisement requirements. Such guidelines issued by energy agencies/public authorities are already available in some member states. For example in Ireland, a detailed guideline plus the respective energy class artwork files are available for download and use (SEAI, 2013). Similar guidelines are available in the QualDeEPC partner county Sweden. In France, examples of adverts are available, which comply with the mandate that at least, the energy class label should be presented (Ministère de la Transition écologique et solidaire, 2018).

There are certainly also other ways to improve compliance with the display requirements for EPCs or energy-related EPC data in advertisements for buildings. These are discussed in Chapter 9. They share the same precondition, i.e. the legal requirement to display the energy class of the EPC and/or the energy performance included in the EPC in selling or renting advertisements, with the advertising guidelines discussed in this section.

This chapter, therefore, starts with compiling the legal requirements for the mandatory use of EPCs or energy-related EPC data in real estate advertisements in QualDeEPC partner countries. It continues by looking at whether advertising guidelines for presenting EPCs in real-estate advertisements during sale and rental of buildings exist in the partner countries, followed by Good practice examples of such guidelines. Based on these the section concludes with the QualDeEPC's proposal for the aspects to be covered by such advertising guidelines, and for a legal text to make them mandatory.

8.1 Legal requirements for the mandatory use of EPCs or energy-related EPC data in real estate advertisements in QualDeEPC partner countries

The following table summarizes information on the requirements in the national legislation with regards to mandatory use of EPCs (or its contents) to be published in real estate advertisements in QualDeEPC partner countries, provided by the partners for Deliverables D2.1/D2.4 and this Green paper. Except in Latvia, it is mandatory to use specified content of the EPCs in real estate advertisements in all other QualDeEPC partner countries. However, except in Sweden, there do not appear to be concrete advertising guidelines, such as the format of display of EPCs (or its contents). This lack may make it hard to include or find EPCs related information in the advertisements. Furthermore, the displayed information varies in each country.

Table 45 Existing legal requirements for mandatory use of EPCs in real estate advertisements in QualDeEPC partner countries

QualDeEPC partner country	Existing legal requirements for mandatory use of EPCs in real estate advertisements	Concrete advertising requirements (e.g., which elements of the EPC are to be displayed)
Bulgaria	The Energy Efficiency Act states that the specific annual primary energy consumption indicator - kWh/m^2, indicated in the energy performance certificate, shall be indicated in all advertisements, as per the existing Energy Efficiency Act.	• Specific annual primary energy consumption indicator in kWh/m2
Germany	Due to the implementation of a requirement from the EPBD, sellers and landlords are obliged to include certain information from the energy performance certificate in advertisements in commercial media under § 87 of of the GEG.	• The type of energy certificate ('demand'/asset rating or 'consumption'/operational rating certificate) • The final energy demand/consumption in kWh/m2/year • The essential energy source • For residential buildings only: the year of construction of the building • For residential buildings only: the efficiency class • In the case of non-residential buildings, the energy performance parameter for electricity
Greece	According to the national legislation (L.4122/2013, Transposition of the DIRECTIVE 2010/31/EU on the energy performance of buildings), it is described that it is required to present the energy efficiency index (energy classification) resulting from the energy performance certificate, in case that it is available, in all commercial advertisements and listings when putting up for sale or renting a building or building unit.	• Energy efficiency index (energy classification)
Hungary	In Hungary (decree 176/2008) there is a requirement in the regulation that states *"When a building or apartment unit is offered for sale or rent, the advertisement shall indicate the EPC rating of the building or apartment unit if a certificate is available."*	• EPC rating of the building or apartment unit
Latvia	In the legislation, the mandatory use of EPCs in real estate advertisements is required.	• In the advertisement regarding the sale, rent or lease of the building or building unit shall indicate the energy performance indicators of the building or building unit, if certification of the energy performance of the building has been performed under the procedures specified in Law On the Energy Performance of Buildings • The purchaser, tenant or lessee of an existing building or building unit or the purchaser of a building to be designed is entitled to become acquainted with the energy performance certificate of the building or the temporary energy performance certificate of the building if certification of the energy performance of the building is anticipated for the relevant building or building unit under the requirements of Law On the Energy Performance of Buildings

QualDeEPC partner country	Existing legal requirements for mandatory use of EPCs in real estate advertisements	Concrete advertising requirements (e.g., which elements of the EPC are to be displayed)
Spain	According to the new modifications of RD 235/2013 of 31/07/2019 the article 14, for all advertised buildings for putting for sale or renting, the public information must include information of energy classification according to the energy certification of the building. Also indicating the energy label of the building should be included in the promotion, advertisement and publicity: web, catalogues, press. Information can be available in text, image, visual, audio and audio-visual.	The energy label of the apartment, house, or building: • Energy classification • Coloured arrows • Energy class • Energy consumption primary non-renewable energy (kWh/m2/yr) • CO2 Emissions (kg CO2/m2/yr
Sweden	In advertisements, the energy performance of a building must be symbolised by a house with a colour (green to red) and letter (A to G) that matches the energy classification.	• Energy classification from the EPC

8.2 Summary of country-specific information on the existence of advertising guidelines

Based on information from QualDeEPC deliverable D2.4, the Development Strategy Plan for enhanced EPC schemes, and on further information provided by partners, only Sweden has mandatory advertising guidelines. Germany only has a guide for finding the information in EPCs issued before 1 May 2014. All other countries do not have such guidelines available, see Table 46 below, and the following detailed information.

Table 46 Existing voluntary or mandatory guidelines for use of EPCs in real estate advertisements in QualDeEPC partner countries

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Existence of advertising guidelines							
Voluntary	no	no. Only a guide for finding the information in EPCs issued before 1 May 2014 see details below	no	no	no	no	no
Mandatory	no	no	no	no	no	no	Yes. See details below.

Bulgaria

No detailed advertising guidelines or examples are available in addition to the legal requirement.

Greece

No detailed advertising guidelines or examples are available in addition to the legal requirement.

Germany

There is not a guide on how to present the mandatory advertisement information, but there is a guide for finding this information in EPCs issued before 1 May 2014. It was published in the official journal, but it is unclear whether it is known to many building owners.

Hungary

No detailed advertising guidelines or examples are available in addition to the legal requirement.

In practice advertisements are not checked and - without any legal consequences - in most advertisements, there are no EPC ratings included.

Latvia

No detailed advertising guidelines or examples are available in addition to the legal requirement.

Spain

No detailed advertising guidelines or examples are available in addition to the legal requirement. However, most specialised websites for real estate advertisements show the energy class in the colour of the energy classification, in this example the Energy Performance Class C in green colour:

Figure 31 Example of a simple display of the energy class (here: C) in real estate advertisements in Spain

Other advertisements even include not only the energy class but also energy consumption (kWh/m² per year), arrow background with the colour of classification and emissions, number of $kgCO_2$/year, classification letter and arrow; and the energy label, as in the following example:

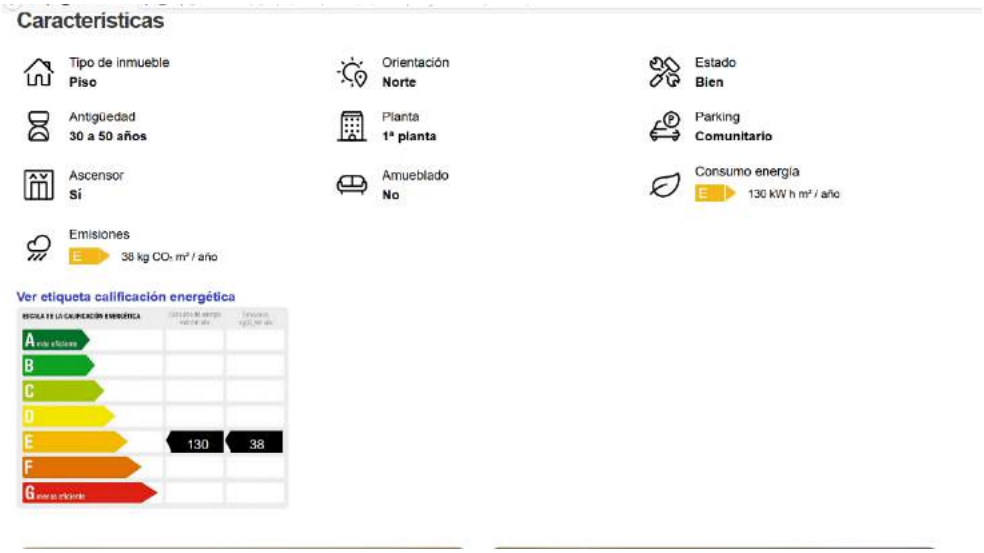


Figure 32 Example of a detailed display of the energy class (here: C) in real estate advertisements in Spain

Sweden

In advertisements, the energy performance of a building must be symbolised by a house with a colour (green to red) and letter (A to G) that matches the energy classification. There are detailed guidelines of what this symbol should look like, e.g. regarding size, colour, background and font. When advertising in commercial printed media, it is enough to use the letter only.

The guidelines are on the homepage of the National Board of Housing Building and Planning and are easy to find by brokers or building owners in Sweden. Brokers are well informed that the EPC is mandatory, and there is nearly always a link to the EPC in each ad on the internet. However, the guide to clearly show the grade (A-F) with a symbol is seldom used in ads.

Also, the EPC is usually distributed at the showing. Normally at the selling, the broker goes through all documents regarding the building, including the EPC, and the buyer should sign that he/she has got this information.

8.3 Good practice examples of advertising guidelines for presenting EPCs in real-estate advertisements during the sale and rental of buildings

8.3.1 BER Advertising Requirements Guidelines: Ireland

In Ireland, the Sustainable Energy Agency of Ireland (SEAI) publishes concrete guidelines for how to comply with the Building Energy Rating (BER) advertising requirement (https://www.seai.ie/publications/BER-Advertising-Guidelines-Issue-2-.pdf). The content that should be provided, depending on the medium of advertisement, includes

BER alphanumeric rating (energy efficiency class) and its motif
BER number
Energy performance indicator that indicates the energy required for space heating and cooling, water heating, ventilation and lighting, and is expressed in kWh/m²/yr.

Detailed guidelines on the requirements for artwork specifying the size, clearance zone, background, colours, and typeface, including samples of softcopy are provided. Besides, exhaustive medium-specific guidelines are provided, such as for advertisements in newspaper and magazines (broad ads with pictures and small text ads), display boards, radio, television, print and electronic mail, estate agent listing and brochure. Furthermore, several example advertisements are also provided.

8.3.2 Decree No. 2010-1662 of 28 December 2010 relating to the mention of the energy classification of buildings in real estate ads: France

In France, Decree No. 2010-1662 by the Ministry of Ecology, of sustainable development, transportation and housing (https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000023317142?r=nJvzIU2BKA) mandates the mention of the energy classification of buildings in real estate announcements. It provides requirements for the content of the EPC to be displayed in various forms of communications, such as print (text), and brochures, electronic. In print, at least the alphabet corresponding to the energy class should be displayed in a font size no less than the remaining text in the advertisement. In electronic and colour brochures, the entire label should be displayed, in specified colours, pixels, and display area. The Ministry for the environment published a few examples of advertisements obeying these requirements (https://www.ecologie.gouv.fr/sites/default/files/DGALN_Exemples_annonces_immobilieres.pdf).

8.3.3 Manual for advertising based on Energy declarations made from 1 January 2014: Sweden

In Sweden, the National Board of Housing and Building Planning provides the guidelines for the use of EPC content in real estate advertisements. The energy class of the building, described by the symbol of a house in colour and with a letter from A to G must be displayed in advertisements. This symbol can be displayed with or without subtitles. Detailed guidelines are provided on the use, placing, position, background and size of the symbol. In text-only ads, the energy class must be displayed.

8.4 QualDeEPC proposal for concrete advertising guidelines for presenting EPCs in real-estate advertisements during the sale and rental of buildings

To improve the use of EPCs and energy-related EPC data for presenting them in real-estate advertisements during sale and rental of buildings, QualDeEPC has developed a proposal for advertising guidelines, and for legislation for making their use mandatory. The drafts for both proposals are presented in the following two subsections.

8.4.1 Proposal for voluntary advertising guidelines and their use

The following table shows aspects that should be considered while framing advertising guidelines for all QualDeEPC partner countries. Depending on the discussion between partners and with stakeholders and building owners, the project team may develop further universally applicable detail or tools (such as graphical and text examples of advertisements for various media) for the upcoming White paper on enhanced EPC schemes.

Table 47 Proposal for guidelines for displaying EPCs (or its contents) in real estate advertisements

Content-related guidelines	Publication -related guidelines
Specify EPC content that should be displayed across all mediums, which includes at least energy classification class, colour, and specific energy consumption (primary or final as displayed on the EPC); in some countries also CO_2 emissions Specify medium-specific EPC content that should be displayed in various mediums, such as print (especially small text in newspapers and magazines), digital and internet, audio-visual. URL to the EPC or EPC number should be provided, when possible, especially if EPCs are in public domain The entire energy label that shows the building's energy class concerning the entire spectrum of energy classification should be shown, when possible, especially in digital media	Provide publication parameters for displaying the EPC content such as size, colours, background, pixels, and typography. Provide softcopies of the EPC content, especially for digital media Provide graphical and text examples of advertisements for various media

8.4.2 Proposal for legislation making their use mandatory

The following text may be included in the national legislation for making the use of concrete guidelines for display of the legally required EPC content in real-estate advertisements during sale and rental of buildings *mandatory*:

"In order to comply with these requirements, the guidelines for advertisements that are provided by the *#name of the national certification body or other authority competent for this task#* must be followed."

9 IMPROVING COMPLIANCE WITH THE MANDATORY USE OF EPCS IN REAL ESTATE ADVERTISEMENTS

By requirement of the EPBD, it is mandatory to present key data from the EPCs in real estate advertisements. However, the level of compliance with this requirement is varying, and data available to us are inconclusive to ascertain how many countries are actively controlling and enforcing this legal requirement. This is also the case for the QualDeEPC partner countries.

Compliance can be improved directly, such as by appointing and providing sufficient resources to designated authorities, so that they can both inform the target groups of their duties and monitor and enforce compliance, and by penal provisions for non-compliance.

In addition, acquiring an EPC for a building is a pre-requisite for its use in real estate advertisements. Increasing the number of existing EPCs is therefore one way to indirectly improve compliance with the advertisement provisions. Only in few member states, such as the Netherlands, for existing buildings, private homeowners receive a provisional EPC (based on information the authorities have about the house) automatically and can convert it online into a definite EPC (low cost). In most other member states, typically, when an EPC is not already present, building owners are only required to procure an EPC when there is a sale or rental of a building. In such cases, legislation and compliance activities regarding the procurement and presentation of an EPC during sale and rental of a building can directly ensure or indirectly nudge the procurement and usage of EPCs in real estate advertisements. One such activity is voluntary or mandatory guidelines for how to present the EPC data in advertisements, which make it easier for building owners to comply. This tool is developed in another priority (see chapter 8). This chapter deals with other instruments and processes to improve compliance.

The following sub-sections describe the level, processes, and instruments of control of implementation of the mandatory use of EPCs in real estate advertisements in QualDeEPC partner countries, as provided by the partners for Deliverable D2.4 and this Green paper. Thereafter, some detail proposed by QualDeEPC on direct compliance measures and good practice is provided. Developing further, indirect compliance measures is beyond the scope of the project.

9.1 Controlling and enforcing the mandatory use of EPCs in real estate advertisements in QualDePC partner countries: direct compliance measures

A direct way of increasing compliance is to appoint and provide sufficient resources to designated authorities and awarding penalties for non-compliance. Section 9.3 below provides more detail on these two potential measures.

Table 48 shows the status of existing nodal authorities, penal provisions and remarks on the existing level, processes, and instruments of control of implementation of the national requirements.

Table 48 Controlling and enforcing the mandatory use of EPCs in real estate advertisements in QualDeEPC partner countries: direct compliance measures

QualDeEPC partner country	Nodal authority	Penal provisions	Remarks on the existing level, processes, and instruments of control of implementation of the national requirements
Bulgaria	Sustainable Energy Development Agency is the EPC control body.	No available information	No available information
Germany	The control and enforcement of the provisions of the Building Energy Act (GEG) is the responsibility of the federal states. The federal states regulate which authorities are responsible for administrative offenses. The competent authorities in the federal states are obliged to investigate any administrative offenses reported.	If the mandatory information is not or not completely included in the real estate advertisement, this constitutes an administrative offense and can be punished under the GEG with a fine of up to 15,000 Euros.	No recent available information
Greece	The body responsible for the monitoring of implementation and compliance control with the regulation in force is the Hellenic Ministry of Environment and Energy	No penal provisions are in force up to date	This provision of the Law is inactive in terms of everyday real estate practice. Furthermore, according to Hellenic NECP submitted to the EC, the enforcement provision mentioned in table 1 will be enforced by 01.01.2021. No specific advertising guidelines are available.
Hungary	There is no nodal body nominated for the task.	No penal provisions are in force up to date	In practice advertisements are not checked and - without any legal consequences - in most advertisements, there are no EPC ratings included.
Latvia	The supervision and control of the performance of duties shall be performed by the Consumer Rights Protection Center (CRPC) in compliance with the regulatory enactments regulating advertising and consumer rights protection	In theory, a monetary fine can be applied.	In the legislation, the mandatory use of EPCs in real estate advertisements is required. In real life, this system does not work at all. Based on information from CRPC there have been no cases when consumers have complained about missing EPCs when renting or buying a property (building or an apartment with individual heat metering). According to CRPC active enforcement of the requirement to show the EPC or energy performance indicator in advertisements will only happen when a complaint from a consumer is received.
Spain	The control of implementation is managed by the Regional Governments. The sanctions are also managed by them.	The legislation at national level states 3 types: high, medium and low according to RD 235/2013 and RD 7/2015 and RD2013. Fines can be 601-1,000 Euros if no information on the label is given in the household sale or renting	The levels of controls are different between the Regional Governments. In general, due to lack of resources very few compliance actions are carried out.

QualDeEPC partner country	Nodal authority	Penal provisions	Remarks on the existing level, processes, and instruments of control of implementation of the national requirements
		advertisement. If the data of the energy class is false or the class there is but the EPC is missing - not done neither registered -this is considered by law as serious and the penalties are 1,001 to 6,000 €.	
Sweden	The National Board of Housing Building and Planning is the surveillance authority.	The National Board of Housing Building and Planning can issue fines if the requirements is not followed.	The most important instrument is the advertisement guidelines. They are on the homepage of the National Board of Housing Building and Planning and are easy to find by brokers or building owners in Sweden. Brokers are well informed that the EPC is mandatory, and there is nearly always a link to the EPC to each ad on the internet, and the EPC is distributed at the showing. Generally, the brokers go through all documents regarding the building, including the EPC, and the buyers should sign that they have received this information.
	Information available		
	Information unavailable		

9.2 Controlling and enforcing the mandatory use EPCs in real estate advertisements in QualDePC partner countries: indirect compliance measures[7]

In most of the EU member states, and all QualDeEPC partner countries, the EPBD has been transposed, so that national law mandates that EPC be displayed in the sale or rental process of a building. This requirement to *possess* an EPC and to *present it* to potential buyers or tenants of a building or parts of it can be seen as measures indirectly supporting the compliance with the requirement to *include EPC data in advertisements*. Furthermore, procedures for verification and sanctions for non-compliance are put in place to ensure the compliance of this provision. The following table shows the current provisions for verification and sanctions for non-compliance for obtaining and showing EPC during the sale and rental of buildings in QualDeEPC countries.

9.2.1 Sanctions for building owners missing to obtain/present an EPC are in place

The use of EPCs in building markets can be improved by placing sanctions for building owners for missing to obtain/present an EPC. This may be combined with rewards for compliance and creating market demand/pressure for presenting an EPC (which should be of high quality), in order to im-

[7] Only direct compliance measures are in the scope for improvement under the QualDeEPC project. Indirect compliance measures are provided only for information purposes, as they are related to the direct measures, and for the attention of the relevant stakeholders. It is generally recommended to provide/improve the unavailable EPC elements and are nor further discussed in sections 1.2.3 and 1.2.4.

prove compliance further, since the control of compliance may not be easy. Regarding market pressure, an example from Austria was found: If no energy certificate is presented and the building does not have an overall energy efficiency corresponding to its age and type, the buyer or tenant can make warranty claims (in the case of rentals this means a reduction in rent). The sanctions for building owners for missing to obtain/present an EPC are often defined in the legislation governing EPCs, but the degree of control and implementation may vary between member states. In most of the member states, there are sanctions for building owners failing to own or present an EPC, when required/on-demand. Among QualDeEPC countries, such sanctions are present at least in Bulgaria and Hungary.

9.2.2 Presenting EPC to official building sales bodies or permit authorities as an obligatory/mandatory measure

Another way to improve compliance with the requirement to own an EPC when selling a property is to make it obligatory/mandatory to present the EPC to official building sales bodies, such as notaries when selling buildings or parts thereof, as practiced in Greece, Hungary and Sweden, as well as several other EU member states, and while applying for a building permit during new construction.

9.2.3 A public database of EPCs

Most EU member states have implemented databases of all issued EPCs. The general public can access many of them, but sometimes the access is limited for special groups like energy advisors etc. The ways to access databases are also different across the countries. Sometimes inserting the street plus housing number is sufficient (like in the UK), sometimes the EPC number has to be inserted (like in Ireland). Furthermore, the amount of data accessible from a public database is different. In some of the countries, a full EPC along with the recommendations can be accessed, while in the others, the publicly available information is limited to key values, such as EPC rating class, energy consumption and the full EPC is only available for the building owner (like in the Netherlands). Among QualDeEPC countries, databases of EPCs exist in all of them except Germany.

9.2.4 Verification of the accuracy of EPCs (quality control of EPCs)

In most countries, accuracy control is based on the sample of EPCs, i.e., a statistically significant percentage of EPCs is verified. However, in few countries such as France and the Czech Republic, control is based on EPC assessors, i.e., a statistically significant percentage of EPC assessors/all EPC assessors are verified, periodically. Either way, practically, in the majority of the member states, both EPCs and assessors are controlled. Quality checks on EPCs include accuracy of the input data and results, calculation methodology used. Quality checks on assessors include their certification, history of errors, and quality of recommendations. However, the basis of quality checks might vary across member states. Among QualDeEPC countries, measures for quality control of both EPCs and assessors are in place in Bulgaria, Greece, Latvia, Spain and Sweden; while measures for quality control of EPCs are in place in Germany and Hungary.

Achieving C or C* level control of EPC assessments for the sample according to EPBD further ensures quality control of EPCs. The C level check includes a full check of input data, calculation results, and recommendations; the C* level includes an additional check through an on−site visit if C level has shown major deviations. The majority of the member states have C level controls. Among QualDeEPC

partner countries, Bulgaria, Germany, Greece, and Hungary have C* level controls, while available information suggests Latvia and Spain have neither C nor C* level controls.

Table 49 Controlling and enforcing the mandatory use EPCs in real estate advertisements in QualDePC partner countries: indirect compliance measures

	Bulgaria	Germany	Greece	Hungary	Latvia	Spain	Sweden
Sanctions for building owners missing to obtain/present an EPC are in place							
Presentation of EPCs to official building sales bodies, such as notaries, is mandatory for sales of buildings							
Existence of a public database of EPCs							
Verification of the accuracy of EPCs (quality control of EPCs)							
	Available						
	Unavailable						

9.3 Direct measures for ensuring compliance with the mandatory use of EPCs in real estate advertisements by effectively controlling and enforcing: Policy proposal and Good practice examples

A direct way of ensuring compliance is to appoint an authority that is responsible for carrying out inspections and control checks of the real estate advertisements, such as in Croatia, Cyprus, Slovakia and Sweden and provide them with sufficient resources. Further, guidelines for compliance checking and methods of enforcement should be laid out including, the measures necessary for raising awareness for compliance and imposing penal sanctions for non-compliance. The following table describes key ways to improve compliance.

Table 50 Ways to improve compliance with the mandatory use of EPCs in real estate advertisements by an effective controlling and enforcing

Way to improve compliance	Description	Good practice examples
Appointment of nodal authorities	In all member states, EPCs are randomly checked for quality control. A pragmatic way could be to appoint the same nodal authorities for compliance verification with the mandatory use of EPCs in real estate advertisements.	Ministry of Economy - market inspectorate in Croatia The National Board of Housing, Building and Planning in Sweden Ministry of Energy, Commerce, Industry and Tourism (MECIT) in Cyprus
Resources and competences	Adequate financial resources and manpower should be provided.	
Check advertisements for compliance	A random checking mechanism, similar to quality control of EPCs, could be adopted. This includes conducting random checks in popular real-estate portals, real-estate advertising columns/sections/pages in registered newspapers and magazines.	
Methods of enforcement (passive): raising awareness	Awareness campaigns should be conducted targeting various stakeholder groups to sensitize them regarding the mandatory use of EPCs in real-estate advertisements and appraise them of the guidelines for advertising, and penal provisions for non-compliance, such as: Marketing and advertising departments of real-estate portals, newspapers and magazines etc. to not accept advertisements that do not adhere to mandatory guidelines Housing finance companies, banks etc. Real-estate companies, letting agencies, property management firms etc. Building owner associations etc.	
Methods of enforcement (active): penal provisions	Levy staged penalties for non-compliance, starting from re-sensitizing, warning, and up to monetary penalties, depending on the relative importance of the stakeholder group and their reach. In most of the member states, including 5 QualDeEPC countries, there are sanctions for building owners missing to obtain/present an EPC during the sale and rental of the building.	In Croatia, penalties are imposed when owners/brokers fail to indicate the energy class in sale advertisements published in the media, in the range of 700 EUR to 4,000 EUR. This obligation is commonly followed and no fines have been issued so far In Cyprus, Non-compliance has led to penalties in 22 cases. This has led to a higher rate of EPC display in advertisements In Ireland, non-compliance of the regulations is liable on summary conviction to a class A fine

10 CONCLUSIONS

The *Green paper on good practice in EPC assessment, certification and use* (D3.1) initiates the discussion with stakeholders and building representatives on specific requirements and tools for enhanced EPC schemes. For the priorities identified in the *D2.4 Development Strategy Plan*, the paper evaluates the country specific situation in all partner countries, shows best practice examples and suggests cross-national measures for improvements. The major outcome at this stage are:

- A text-based list of deep energy renovation recommendations,
- The concept for the online tool development,
- The concept for a Deep Renovation Network Platform,
- A universal, enhanced user-friendly EPC form template and background on the proposed content,
- A general policy proposal for regular mandatory training, and
- A general policy proposal for advertisement guidelines and for actions to improve the compliance with the mandatory use of EPCs in real estate advertisements.

These suggested enhancements are intended to be the basis for both a discussion with stakeholders at national workshops and for their testing in WP 4. For example, the Green paper provides a universal EPC form template, including deep energy renovation recommendations, to be evaluated by the building representatives of the pilot buildings in WP 4. The feedback of the stakeholders will be processed in a feedback report on the national workshops (D3.4), and the results and feedback from the testing will be documented in a transnational comparison report (D4.4) and a summary evaluation report (D4.5). In addition, with testing results and the feedback by the building representatives and stakeholders, and with further developments by the project partners, the Green paper will be enhanced to deliverable D3.2, the *White paper on good practice in EPC assessment, certification, and use*.

Moreover, the Green paper and the White paper will be the basis for the country-specific adaptation, discussion, and to the extent possible, implementation of the developed policy proposals in WP5.

11 REFERENCES

Kostova, D.; Dr. Thomas, S.; Gokarakonda, S. (2020) D2.4 Development Strategy Plan for the development of next generation EPC schemes, QualDeEPC, https://qualdeepc.eu/wp-content/uploads/2020/07/QualDeEPC_D2.4-Development-Strategy-plan_200630_final.pdf

12 ANNEXES

Annex A: Overview of EPC elements in EPC forms of partner countries

12.1 ANNEX A

Element	Bulgaria	Germany	Greece	Hungary[8]	Latvia	Spain	Sweden
General data							
Legal basis	No	Yes	Yes	Yes		Yes	Yes
Registry/ Serial number/ ID number	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reason for issuance	No	Yes	Yes	Yes	Yes	No	No
Type of EPC (demand or consumption)	Yes	Yes	Yes	Yes	Yes	Not relevant	Yes
Date of validity	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Checkmark for compatibility with nZEB requirements	Yes	No	No, but there is an NZEB energy class	Yes	Yes	No	No, but there is an nZEB energy class
General building data							
Address	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Picture of building	Yes	yes	Yes	Yes	Yes	Yes	No
Type of building (residential/ non- residential)	Yes	yes	Yes	Yes	Yes	Yes	Yes
Number of apartments (in case of residential buildings)	No	Yes	No	No	No		Yes
Year of construction	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Building area							
Total area		No	Yes	No	Yes	No	
Floor area/ Living space	Yes	No	Yes (as 'useful area')	No (only in calculation annex)	Yes	Yes	Yes
Heated area	Yes	No		Yes	No	No	Yes
Cooled area	Yes, cooled volume	No	Yes (as 'useful area')	No (only in calculation annex)	No	No	Yes
Net used area	No	Yes, might be calculated from the floor area		No	No	No	No

[8] In Hungary, an improved EPC is under legal procedure. The new form possibly contains all asked information of Table 1. However, no publication date is known.

Element	Bulgaria	Germany	Greece	Hungary[8]	Latvia	Spain	Sweden
Energy classification							
Calculation method for energy demand	Yes	Yes	Yes	Yes (Software)		Yes	Yes
Total primary energy demand/ consumption [kWh/m²yr]	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total final energy demand/ consumption [kWh/m²yr]	Yes	Yes	Yes	No	Yes	No	Yes
Primary energy demand/ consumption for heating and warm water [kWh/m²yr]	Yes	separate value only for non-residential buildings	Yes	No (only in calculation annex)	No	Yes it is separated one data for heating and one data for warm water	No
Primary energy demand/consumption for electricity [kWh/m²yr]	Yes		Yes	No (only in calculation annex)	No	Yes	No
Final energy demand/ consumption for heating and warm water [kWh/m²yr]	Yes		Yes	No	Yes	No	Yes
Final energy demand/consumption for electricity [kWh/m²yr]	No		Yes	No	Yes (lighting, ventilation, cooling)	No	Yes
Energy class							
Based on primary energy	Yes	No	Yes	Yes	No	Yes	Yes
Based on final energy	No	Yes		No	Yes (space heating only)		No
Based on a reference building	No (Yes, only for a new building)	No	Yes	Partly (other buildings)	No		No
CO2-Emissions	Yes	Optional, required by October	Yes	No	Yes	Yes, with classification	No
References for comparing energy demand/ consumption/ class	No	Yes, for final energy demand/ consumption	No	Yes	Yes (for apartment buildings, offices and educational buildings)	No	Yes with new regulations (n-zeb requirements) and similar buildings.

Element	Bulgaria	Germany	Greece	Hungary[8]	Latvia	Spain	Sweden
Past energy consumption							
Details on past energy consumption	Only for the selected base year	Yes, if EPC is based on consumption; last 36 months	Included in the EPC but not mandatory to fill-in	No	Yes (if data available)		No
Building HVAC[9] system incl. renewable energies							
Installation year of heating systems/ boiler	Only in Annex 2 Summary	Yes	Not in the EPC form[10]	No	Yes (in annex of EPC)	No	No
Energy sources	Yes	Yes	Yes	No	Yes	Yes	Yes
Usage of renewable energy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alternative measures instead of renewable energy	Yes	Yes	Yes (included as 'other source'	No			
Type of ventilation system	Only in Annex 2 Summary	Yes	Not in the EPC form	No	Yes (in annex of EPC)	Yes	Yes
Type of heating system	Only in Annex 2 Summary	Yes	Not in the EPC form	No	Yes (in annex of EPC)	Yes	Yes
Type of cooling system	Only in Annex 2 Summary	Yes	Not in the EPC form	No	Yes (in annex of EPC)	Yes	Yes
Technical details on a ventilation system	Only in Annex 2 Summary	No	Not in the EPC form	No	Yes (in annex of EPC)	Yes	Yes
Technical details on a heating system	Only in Annex 2 Summary	No	Not in the EPC form	No	Yes (in annex of EPC)	Yes	Yes
Technical details on a cooling system	Only in Annex 2 Summary	No	Not in the EPC form	No	Yes (in annex of EPC)	Yes	Yes
Building envelop							
Checkmark or similar for met energy efficient requirements	No	Yes	No	No	Yes		No
Technical details on components of building envelop	Yes – Area, U-value	No	Not in the EPC form	No	Yes (in annex of EPC)	Yes	No

[9] Heating, ventilation and air conditioning

[10] "Not in the EPC form": This information is included in a xml file which is uploaded in the platform for the calculation of the EPC class and EPC issuance.

Element	Bulgaria	Germany	Greece	Hungary[8]	Latvia	Spain	Sweden
Conducted measures							
Information on conducted measures since last issued EPC	No Only in Annex 2 Summary	No	Not in the EPC form	No	No (energy assessor has to show what measures have been done in the building since it was built)		Yes
Renovation recommendations							
Type/ Description of measure	Yes, only the name	yes	Yes	Yes	Yes	Yes	Yes
Amortisation time	No	optional	Yes	No	No	No	No
Estimate of cost	Yes	optional	Yes	No	Yes		Yes
Primary energy demand/ consumption after renovation	Yes, the total value for all the measures	No, new EPC required	No, only 'potential energy class improvement'	Yes	Yes	No, new EPC required	Yes
Final energy demand/ consumption after renovation	Yes	No, new EPC required	Not in the EPC	No	Yes	No, new EPC required	Yes
Additional information							
General information about EPC and their usage	No	Yes	Yes	No		No	No
Glossary	No	Yes	No	No		No	No
Links to the (online) platform or tools for further information	No	No	No	No	No	No	No, Link to the National Board of Housing Building and Planning
Links to detailed energy audits	The certificate is an integral part of the energy audit	No, but remark to contact energy consultant for renovation purposes	No	No	The certificate is an integral part of the energy audit.	No	No, Link to the National Board of Housing Building and Planning
Link/ information for real estate advertisements	No	Yes	No	No	No	No	Yes, Link to the National Board of Housing Building and Planning

Table 51 Overview of EPC elements in EPC forms of partner countries