



# Deliverable 3.3

# Collection of tools

# developed

QualDeEPC H2020 project

MAIN AUTHOR: CRES

Contributors: WI

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Accelerating Deep Energy Renovation”

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<b>Main Author</b>	Andreas Androutsopoulos (CRES), Effie Korma (CRES), Lena Lampropoulou (CRES),
<b>Contributors</b>	Dr. Stefan Thomas (WI)
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## ABBREVIATIONS

**DHW:** Domestic hot water

**DRNP:** Deep Renovation Network Platform

**EBPD:** Energy performance of buildings directive

**EPC:** Energy performance certificate

**HVAC:** Heating, ventilation, and air conditioning

**MS:** Member State

**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**

**ENERGIACLUB:** Energiaklub Szakpolitikai Intezet Modszertani Kozpont Egyesulet

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

**FEDARENE:** Federation europeenne des agences 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

The Report “*Collection of tools developed*” aims at summarizing the tools and concepts for the support of the policy proposals on seven priorities identified in the *D2.4 Development Strategy Plan* (Kostova et al. 2020) and fully developed in *D3.2 White Paper on good practice in EPC assessment, certification and use* (Veselá et al. 2021) of the QualDeEPC project.

The seven priorities selected for the development of enhanced EPC schemes are:

- A) Improving the recommendations for renovation, which are 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.

The main outcomes at this stage are:

- A text-based list of deep energy renovation recommendations,
- The online QualDeEPC Master tool development,
- The concept for a Deep Renovation Network Platform,
- A universal, enhanced user-friendly EPC template and background on the proposed content,
- Training content for regular training workshops or seminars,
- Concrete advertising guidelines for presenting EPCs in real-estate advertisements during the sale and rental of buildings and a
- List of actions to improve compliance with the mandatory use of EPCs in real estate advertisements by an effective controlling and enforcing mechanism.

The tools and concepts developed are aligned with the Development Strategy Plan. As part of the White paper, they will be the basis for the country-specific adaptation, discussion, and to the extent possible, implementation of the developed proposals in WP5 “Roadmap to convergence and action towards deep renovation”.



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## 1 INTRODUCTION

The QualDeEPC project aims at both improving quality and cross-EU convergence of Energy Performance Certificate schemes, and linking 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.

The Report “*Collection of tools developed*” aims at summarizing the tools and concepts for the support of the policy proposals on seven priorities identified in the *D2.4 Development Strategy Plan* (Kostova et al. 2020) and fully developed in *D3.2 White Paper on good practice in EPC assessment, certification and use* (Veselá et al. 2021) of the QualDeEPC project.

The seven priorities identified 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

Chapter 2 is dedicated to the Priority B and provides information about the scope and the specific technical details on the QualDeEPC Master Tool for comparing EPC recommendations to deep energy renovation recommendations developed by QualDeEPC project. Furthermore, guidance for the use of the Master tool is provided, including figures and pictures of each step that the user needs to follow.

In particular, the Master tool architecture in section 2.2 includes information on the software parameters and the description of the three layers that it consists of, while section 2.3 focuses on the content structure. In section 2.4, the input parameters of the building envelope components and technical systems are described including the values used. Section 2.5 presents thoroughly the produced results and the comparison between current and renovation case.

Chapter 3 summarizes all the practical tools and concepts produced by QualDeEPC corresponding to development needs of the remaining 6 priorities. Detailed description and further information of these concepts and the related policy proposals can be found in *D3.2 White Paper on good practice in EPC assessment, certification and use* (Veselá et al. 2021).

Finally, chapter 4 presents the conclusions and next steps in the adaptation phase of the project.



## 2 ONLINE TOOL FOR COMPARING EPC RECOMMENDATIONS TO DEEP ENERGY RENOVATION

### 2.1 Objective of the QualDeEPC Master tool

In the context of Task 3.3, the QualDeEPC project developed the online QualDeEPC tool that performs building energy performance calculations and provides recommendations towards deep renovation (Master tool). The Master tool version was based on the existing Greek Home Energy Check tool (HEC) enriched with the new features in terms of elements (e.g., further building types), systems and recommendations, as they are thoroughly described in the White Paper (D3.2).

The Master tool developed for QualDeEPC is the general version of a broad user-friendly platform for users, who want to be informed about the energy demand, rating and CO<sub>2</sub> emissions of their residential building, as well as potential energy savings and GHG reductions. It is easy to use, allowing homeowners to simulate their dwellings, through the input of their building's necessary characteristics (typology – selecting one of 10 building types, geographical area, floor area, characteristics of building shell and heating/ cooling systems, etc.) in only 13 steps. In addition, the user can receive recommendations for improving the energy efficiency of their home to high levels (equivalent to deep energy renovation) for the walls, roof, floor, windows, shading, heating, cooling, DHW, and RES, and see the results and the indicative cost of the potential renovation activities. These recommendations could be compared to those of an EPC, or be used to prepare a discussion with an energy consultant or EPC issuer. The tool clearly states that its results are only indicative and for accurate results the user is recommended to obtain an energy audit by an accredited energy auditor/assessor.

In the end, 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 savings (in %), the CO<sub>2</sub> emissions reduction (in %) and an estimation on the investment required for the measures tested.

The QualDeEPC Master tool is available at: [https://www.buildingcert.gr/qualdeepc\\_tools/master\\_tool/](https://www.buildingcert.gr/qualdeepc_tools/master_tool/)

#### 2.1.1 User-friendly approach of the Master tool

At a first step, the energy performance of the building, in the current state, is calculated. In order to do that, the user inserts the required input data by selecting the appropriate option that suits better to his/her case from a set of drop-down menus related to the main components of the building (i.e., building typology, location of the building, building components, technical systems). The input parameters are thoroughly described in section 2.4 of this report. Upon entering the application, a “how to use the tool” guide is provided (Figure 1).



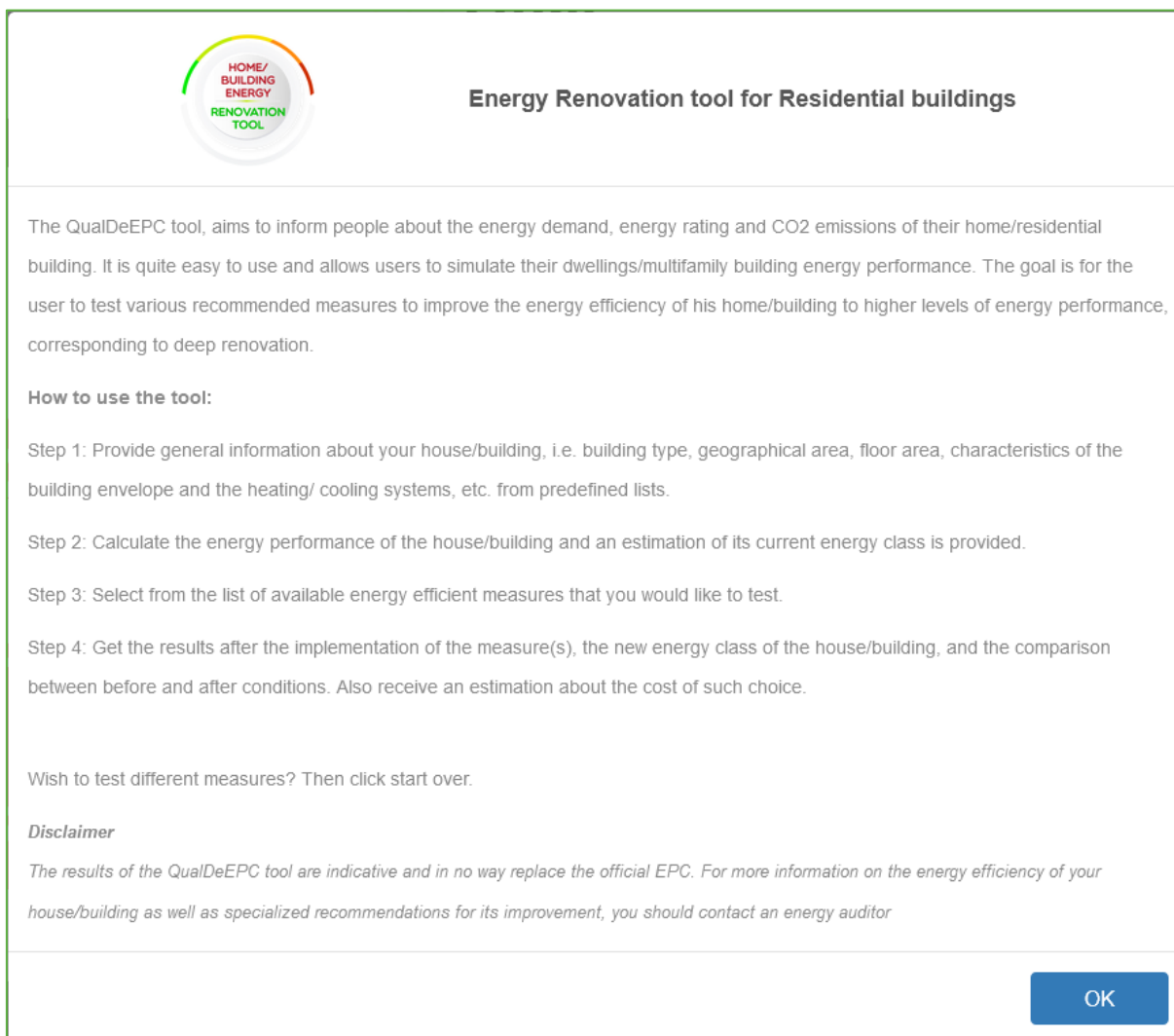


Figure 1: Screen shot of the “how to use the tool” screen

When the input data are inserted, an .xlm file is produced and run by a software calculating the energy performance of a building (see section 2.5.1 Estimation of current energy consumption).

At a following step, the user selects the renovation recommendation that (s)he would like to test in the same way as in the first step (see section 2.5.2 Selecting renovation recommendations). The software runs again to test the selected energy improvement measures. Finally, all results are shown in a “Results” screen. A message states if deep energy renovation criteria have been met when implementing the selected improvement measures. Moreover, the results from the comparison between the current and energy renovated case are provided (see 2.5.3).

## 2.2 Master tool Architecture

The QualDeEPC Master tool consists of three layers depicted in the following figure and described in the following paragraphs.



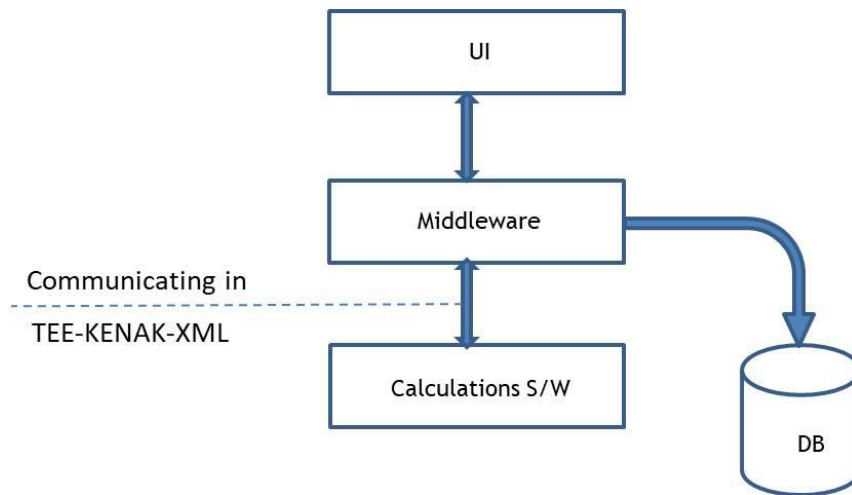


Figure 2: Presentation of the QualDeEPC Master tool architecture

### 2.2.1 Layer 1 – Calculation software

At the heart of the QualDeEPC Master tool lays the calculation software. This is the software that loads all input needed, performs the calculations and returns the results. For this purpose, the Greek national software for the calculation of the energy performance of buildings and building energy classification (TEE-KENAK) was used in the Master tool. The input of TEE-KENAK is an xml file, in a schema (structure), defined by the TEE-KENAK developers and thereafter called TEE-KENAK-XML (not an official name). This file contains all the building related information needed to calculate energy indicators. During the course of the calculations, a series of XML files containing ‘library data’ (e.g. climate data) are loaded, and finally, the software returns the results, again in the form of XML files.

If authorities from another country would like to build up such a tool, the Master tool can be used, but the TEE-KENAK software will need to be replaced by a national or nationally approved calculation software.

### 2.2.2 Layer 2 – Middleware

The Master tool developers have developed a middle layer software in order to create the input xml files for the calculation tool and read the output xml files from it. The procedure to interact with the tool is the following.

First, prototype TEE-KENAK-XML files were created that correspond to certain types of buildings (e.g., one storey house, apartment on ground floor, etc.).

For each run-case, specific parts of the xml files were adjusted through programming, according to the specific examined characteristics of the building. These characteristics are determined by the user through his/her options in the user interface (see below) and are translated by the middleware into something meaningful for the calculation tool. For example, if the user chooses ‘Double glazed aluminum with low-e windows’, the corresponding U-values for this type of windows are written in the right place of the TEE-KENAK-XML file.



When the TEE-KENAK-XML file is completed with all the user entered options, it is sent to the calculation tool, which makes the needed calculations and returns output xml files containing energy indicators and building energy classification.

Finally, the middleware reads the output xml files and populates the UI fields with them, in a user-friendly format.

The middleware was developed by CRES in the form of a REST API. This means that several web service endpoints were implemented, which are called from the user interface and perform the actions described above. More specifically, the user interface sends the input parameters chosen by the user in a JSON format and receives the results also in a JSON format. With this implementation, anyone could develop their own user interface to perform calculations. Depending on the input fields in the user interface and the parameters needed for the national calculation software, the middleware may need to be adapted.

### 2.2.3 Layer 3 – User interface

The user interface of the Master tool is a small web application, designed to provide the users with all the options they need to choose the specific characteristics of the building they want to examine. These options include typology, geographical area, floor area, characteristics of heating/ cooling systems, etc.

After the middleware reads the calculation results as described above, the user interface presents them in an elegant way to the user.

All communications between the different parts of the tool are made through the HTTP protocol.

The user interface is a Single Page Application (SPA). The technology used for the user interface is Vue.js version 2.6.14. In order to make the API calls the library vue-axios was used, version 3.2.4. For the final pdf export, we use the library html2pdf version 0.10.1. Bootstrap was used to create various page elements. The app is bilingual (EN and GR) with the help of vue-i18n library version 8.22.3. The app is responsive (tested with min width 768).

If authorities from another country would like to build up such an online tool, they can either adapt the user interface from Greece, or build a new one.

## 2.3 QualDeEPC Master Tool structure

The Master tool structure was designed to use the necessary information in order to run an appropriate software for energy performance calculations and building energy classification, and is adapted for the purpose of the QualDeEPC project. Special care was given, however, to provide a general result in order not to be interpreted as an official Energy Performance Certificate. The Master tool version, was based on the existing Greek Home Energy check tool (HEC) which was developed in the frame of H2020 project Request2Action in 2016. That tool was mainly developed to get house owners and tenants familiarized with energy conservation techniques in homes and help householders understand how to improve their energy efficiency.

Compared to the Greek Home Energy Check tool, the Master version of the tool for the QualDeEPC project introduces the following additions:



- Additional building typologies;
- Additional technical systems;
- Additional selection options for other building envelope components and technical systems;
- Set of recommendations towards deep renovation; the recommendations presented in hierarchical order based on construction restrictions in order to avoid lock-in effects; Information whether the deep renovation criterion is been met or not<sup>1</sup> after implementing the selected recommendations;
- New user interface available in English and Greek.

The Master tool makes use of the Greek case as an example.

## 2.4 Input parameters

The following sections include detailed information on the input parameters of the QualDeEPC Master tool.

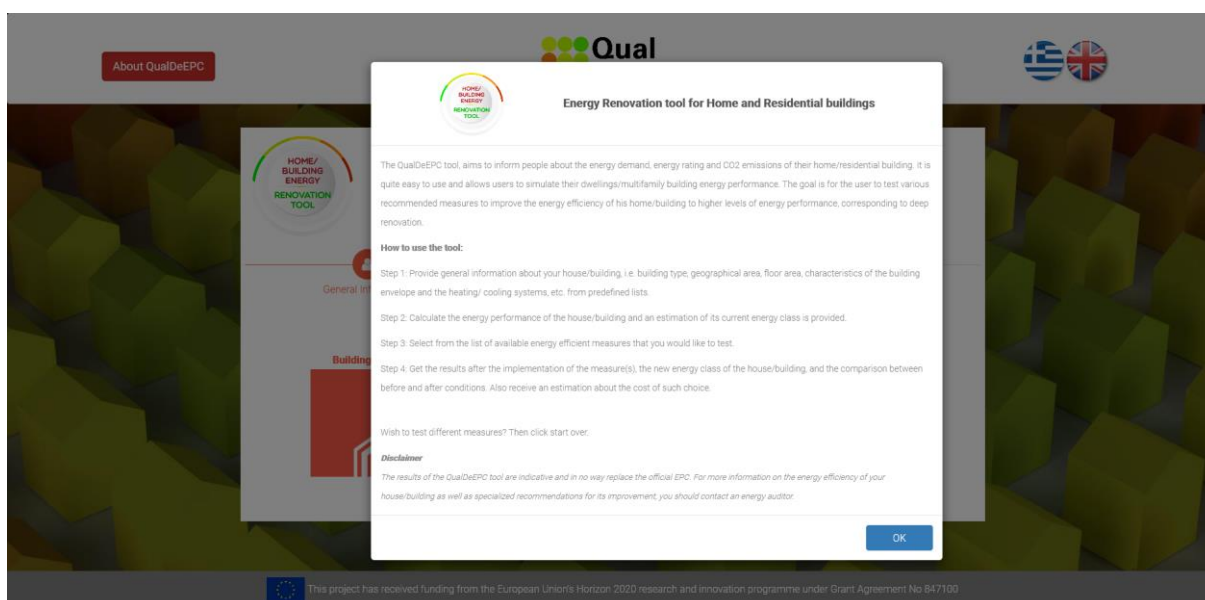


Figure 3 Screenshot of the welcome page of the QualDeEPC Master tool

### 2.4.1 List of building types

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

<sup>1</sup> Based on the concept of QualDeEPC definition of deep energy renovation, and its variants for the partner countries



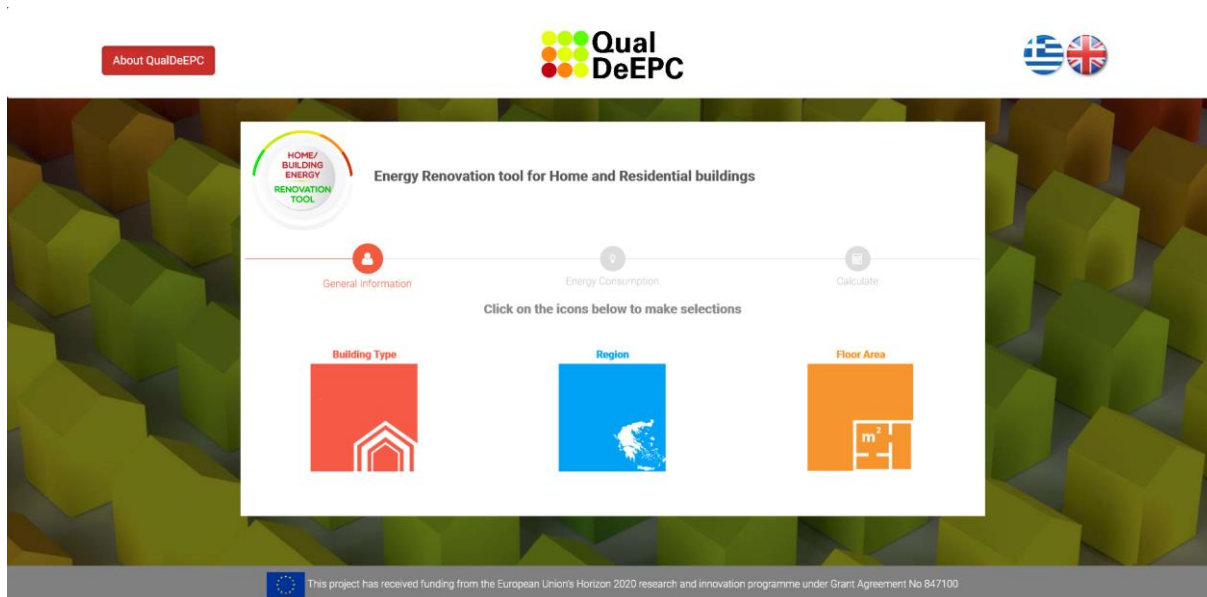


Figure 4: Screenshot of the initial screen of the Master Tool

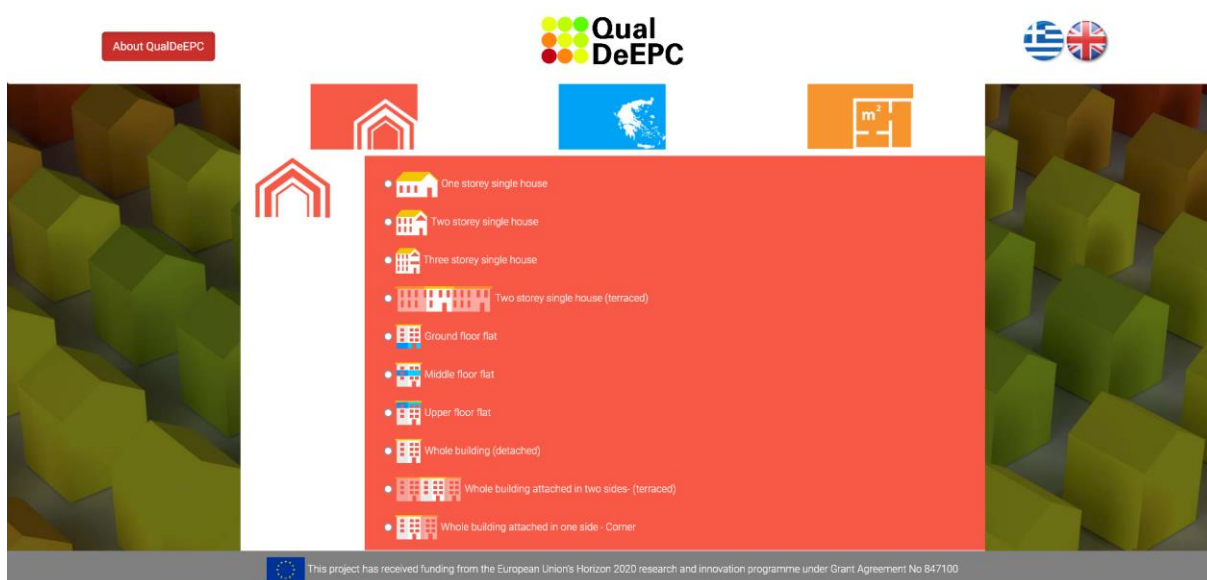


Figure 5: Available building typologies

The four (4) additional building typologies included in the Master tool during the QualDeEPC project are presented in the following table in yellow-greenish coloured rows.

Table 4: List of residential building types available in the QualDeEPC Master tool

	Building Type	Vicinity
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
6	Flat in multifamily building	Upper floor





7	2 storey single house	Terraced
8	Multifamily building	Whole building
9	Multifamily building attached in both side-elevations - Terraced	Whole building - Terraced
10	Multifamily building attached in one side - Corner	Whole building

### 2.4.2 Geographical area/climate zone and floor area of the building

The user is called to select where the building is located, in order for determining the climatic conditions (climatic zones). The climatic zones considered in the Master tool are the ones of the Greek climate zoning classification. The selection in the Master tool comprises data from all regions of Greece related to the 4 climatic zones. The geographical areas are presented at NUTS 3 level for end-users' convenience.

Obviously, this feature of the user interface would need to be adapted for using the Master tool in another country.

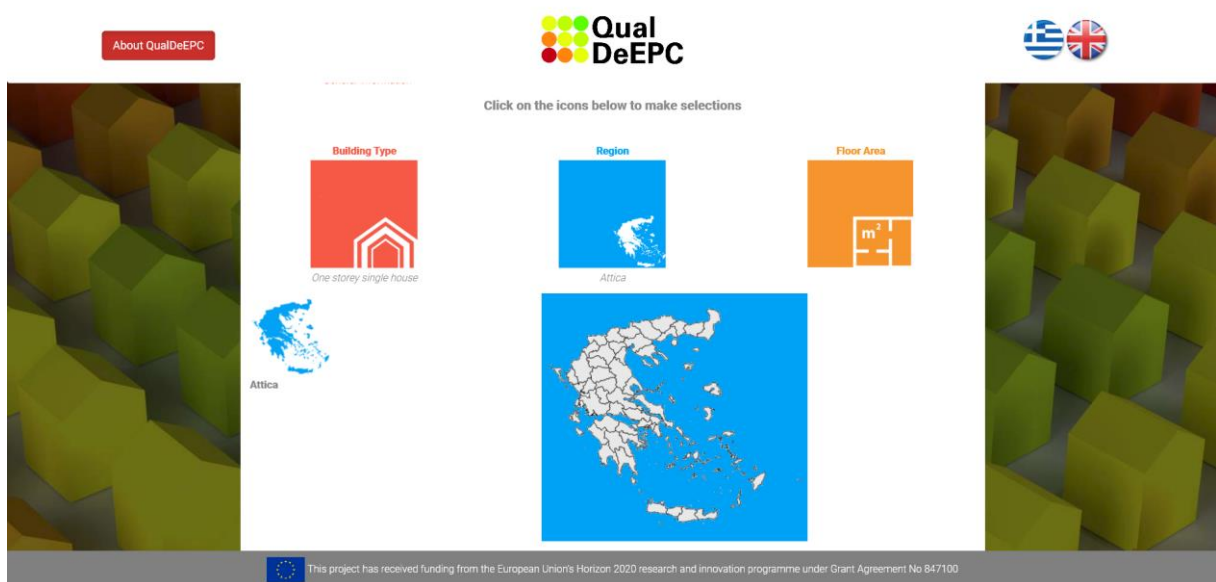


Figure 6: Geographical area/climate zone selection

Furthermore, the user needs to insert or select the total floor area of the house/ building, either by stating the exact floor area (in m<sup>2</sup>) or by selecting the area from 3 choices: < 100 m<sup>2</sup>, between 100 and 150 m<sup>2</sup>, and between 150 and 200 m<sup>2</sup> (see Figure 7). In the case of multifamily building, the number of floors has also to be stated.





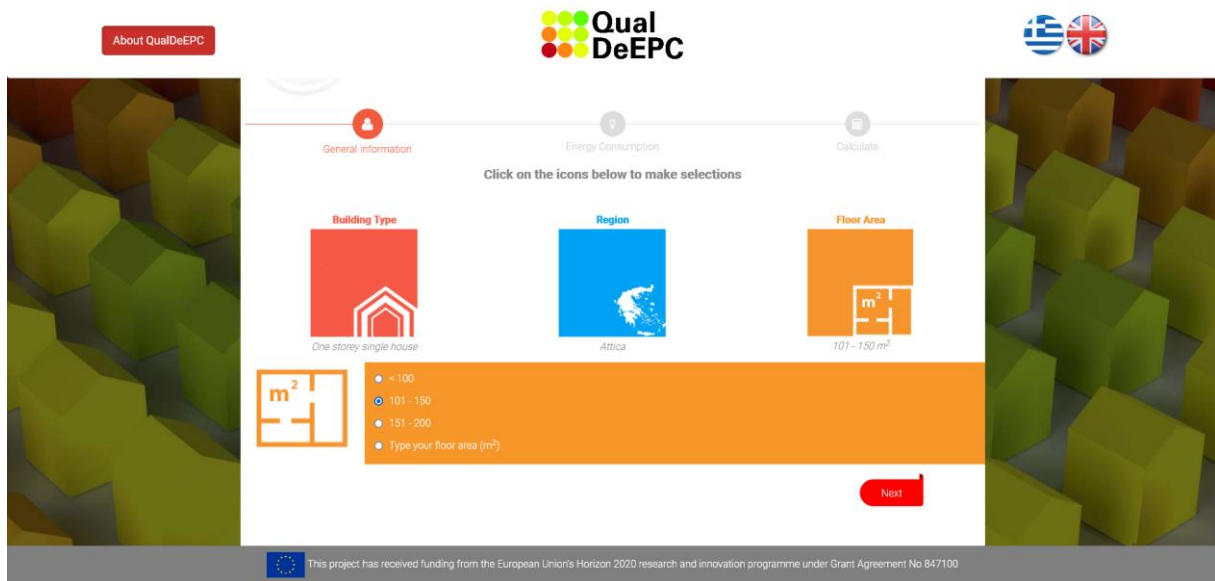


Figure 7: Input parameter- Floor area

### 2.4.3 Selection of building envelope components and technical systems

In order to proceed with the estimation of the current energy consumption and energy classification of the building, the end-user can select the envelope components and technical systems from predefined lists available in each category. It has to be noted that the lists include various components, systems and technologies that are commonly used in the QualDeEPC project partner countries.

The choice is linked to the related U-values or systems' energy efficiency. They reflect characteristics (existing or proposed) of buildings in Greece and may need to be adapted for other countries.

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 automatically taken from the lower values in terms of energy performance in the tool's database.

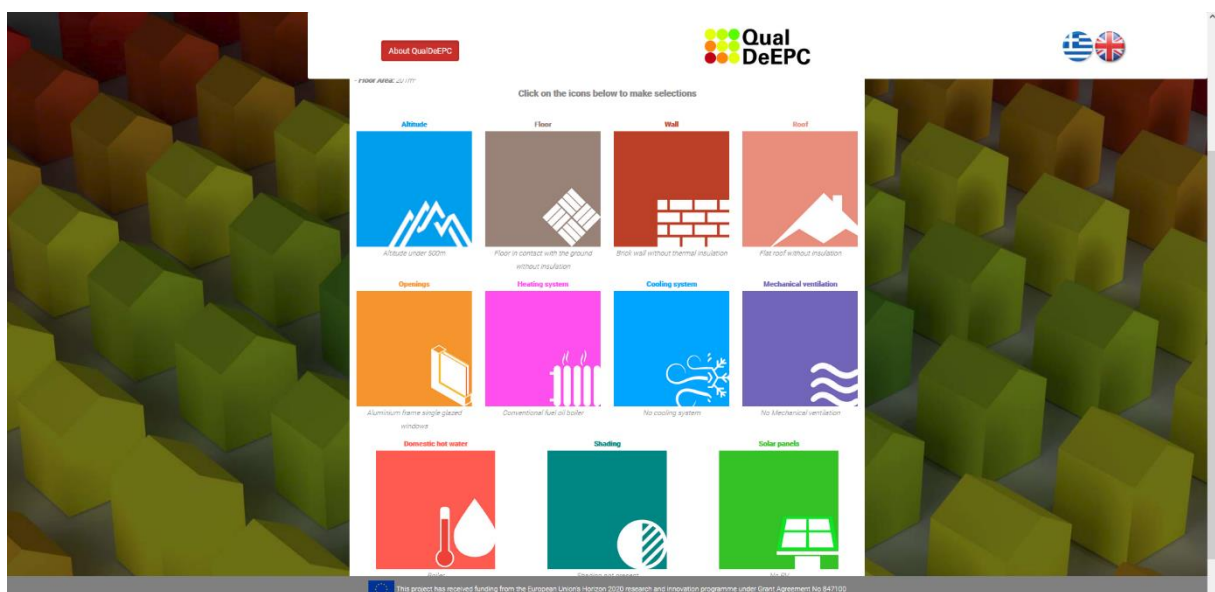


Figure 8: Overview of the building components and technical systems included in QualDeEPC Master tool



Moreover, the user should state whether the building is located at an altitude higher than 500 meters; in such a case the climate data introduced are the ones of the immediately higher (colder) climate zone. It will depend on the country if this feature is relevant.



Figure 9: Selection of altitude where the residential building is located

#### 2.4.4 Specifications of the building components and systems: Floor

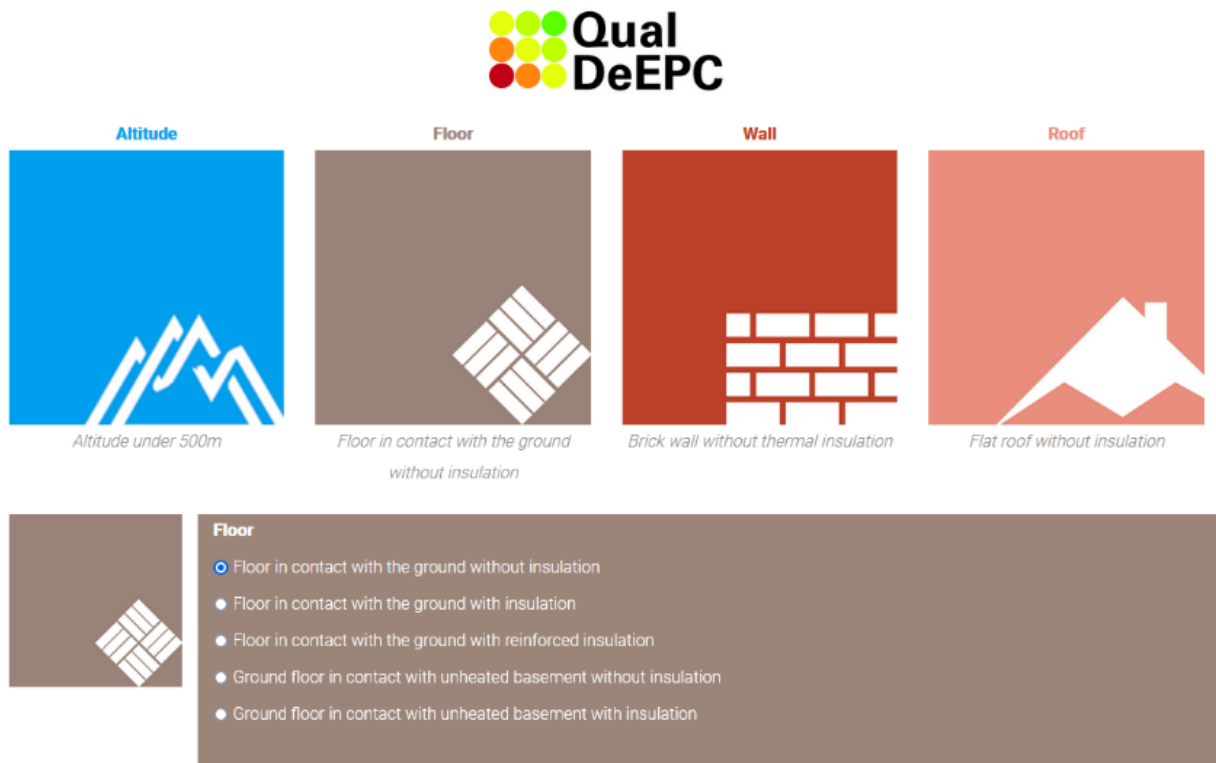


Figure 10: Floor types available in the QualDeEPC Master tool

As regards floor type, five alternative options can be selected as shown in Figure 10 and Table 5.



Table 5 Input selection for heat transmission coefficients in  $W/m^2K$  for insulation of ceiling of an unheated basement (in residential buildings)

Construction type	U-value (examples for Greece)
Floor in contact with the ground without insulation	3.1 $W/(m^2K)$
Floor in contact with the ground with insulation	1.2, 0.9, 0.75 and 0.7 $W/(m^2K)$ , according to the climatic zone
Floor in contact with the ground with reinforced insulation	1.0, 0.8, 0.65 and 0.60 $W/(m^2K)$ , according to the climatic zone (M)
Ground floor in contact with unheated basement without insulation	2.00 $W/(m^2K)$
Ground floor in contact with unheated basement with insulation	1.0, 0.8, 0.65 and 0.60 $W/(m^2K)$ , according to the climatic zone (M)

### 2.4.5 Specifications of the building components and systems: Walls

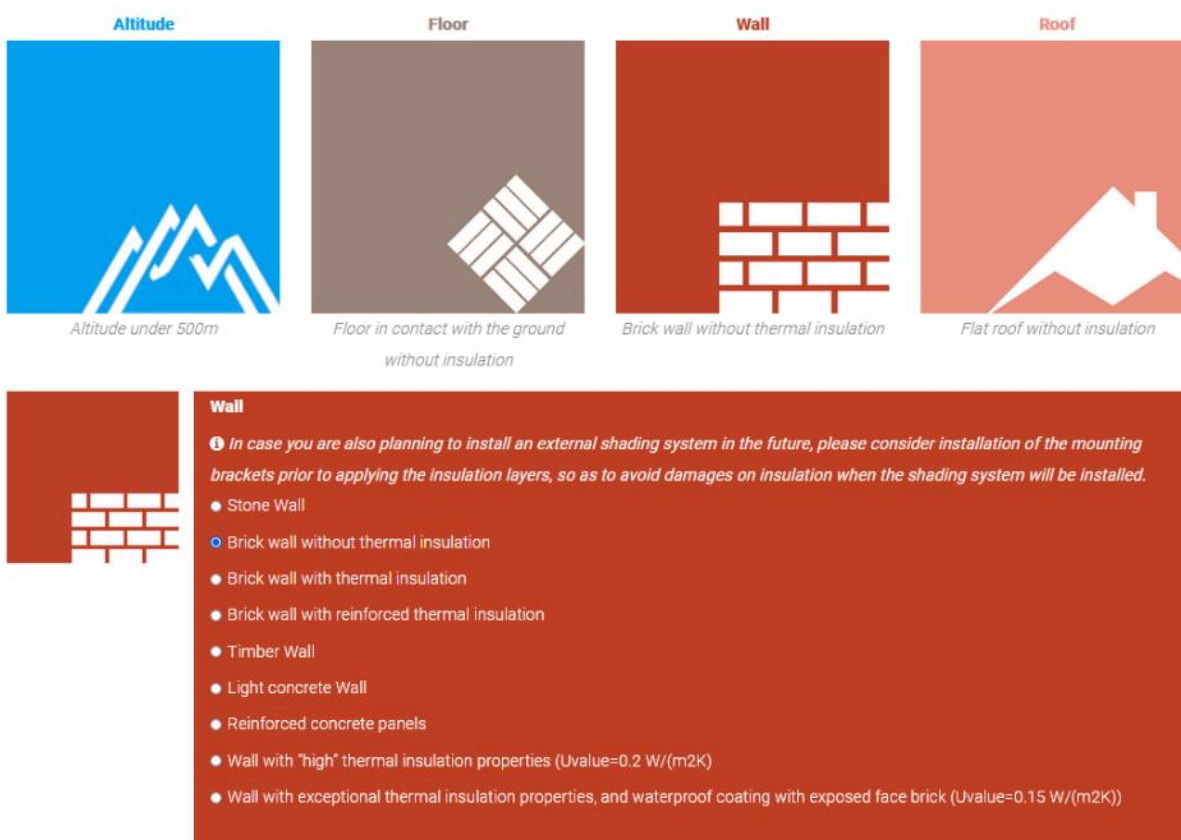


Figure 11: Wall types choices

Regarding the external walls, the user is provided with the following options to select as show in Figure 11 and Table 6.


Table 6 Input selection for external wall

Construction type	U-value (example for Greece)
Stone Wall	4.25 $W/(m^2K)$
Brick wall without thermal insulation	2.2 $W/(m^2K)$

Brick wall with thermal insulation	0.6, 0.5, 0.45 and 0.4 W/(m <sup>2</sup> K) according to the climatic zone where the building is located
Brick wall with reinforced thermal insulation	0.5, 0.4, 0.35 and 0.3 W/(m <sup>2</sup> K) according to the climatic zone where the building is located
Timber Wall	1.0 W/(m <sup>2</sup> K)
Light concrete Wall	1.5 W/(m <sup>2</sup> K)
Reinforced concrete panels	1.8 W/(m <sup>2</sup> K)
Any wall with "high" thermal insulation properties	0,2 W/(m <sup>2</sup> K)
Other type (i.e. exceptional thermal insulation properties, reinforced concrete, waterproof coating with exposed face brick)	0.15 W/(m <sup>2</sup> K)


### 2.4.6 Specifications of the building components and systems: Roof

**Altitude**




Altitude under 500m

**Floor**




Floor in contact with the ground without insulation

**Wall**



Brick wall without thermal insulation

**Roof**



Uninsulated pitched roof

**Roof**

*In case you are planning to install a PV or solar collector in the future, please consider installation of the mounting pillars prior to applying the insulation layers, so as to avoid damages on insulation when the RES system will be installed.*

- Uninsulated pitched roof
- Pitched roof with insulation
- Pitched roof with reinforced insulation
- Flat roof without insulation
- Flat roof with typical insulation
- Flat roof with reinforced insulation
- Roof with exceptional thermal insulation properties (Uvalue=0.25 W/(m<sup>2</sup>K))

Figure 12: Roof type options as presented in the Master tool

The roof type can be selected from a menu of 7 alternative options as shown in Figure 12 and Table 7.

Table 7 Input selection for heat transmission coefficients in W/m<sup>2</sup>K for roof or attic insulation (in residential buildings)

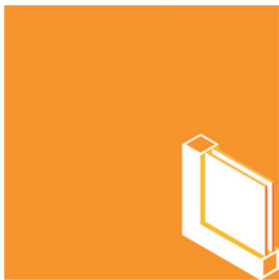
Construction type	U-value (examples for Greece)
Uninsulated Pitched roof	4.25 W/(m <sup>2</sup> K)
Pitched roof with insulation	0.5, 0.45, 0.4 and 0.35 W/(m <sup>2</sup> K) according to the climatic zone



Pitched roof with reinforced insulation	0.45, 0.4, 0.35 and 0.3 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	0.45, 0.4, 0.35 and 0.3 W/(m2K) according to the climatic zone
Other type (i.e. exceptional thermal insulation properties)	0.25 W/(m2K)


## 2.4.7 Specifications of the building components and systems: Windows (Openings)

**Openings**




Aluminium frame single glazed windows

**Heating system**




Conventional fuel oil boiler

**Cooling system**




No cooling system

**Mechanical ventilation**



No Mechanical ventilation



**Openings**

- Wooden frame single glazed windows
- Wooden frame double glazed windows
- Wooden frame double glazed low-e (low-emissivity) windows
- Aluminium frame single glazed windows
- Aluminium frame double glazed window
- Aluminium frame with double low-e glazing
- Aluminium frame with thermal break and double glazing
- Aluminium frame with thermal break and double low-e glazing
- Synthetic frame single glazed windows
- Synthetic frame double glazed windows
- Aluminium frame double glazed equipped with thick argon or krypton thermal break and low-e glass (Uvalue=1.5 W/(m2K))
- Synthetic or wooden frame double glazed with thick argon or krypton thermal break and low-e glass (Uvalue=1.25 W/(m2K))
- Synthetic or wooden frame triple glazed, vacium and low-e glass ( Uvalue=0.9 W/(m2K))

Figure 13: List of Window systems included in the QualDeEPC tool

Regarding the windows, the user can find 11 choices as shown in Figure 13 and Table 8.

In the Greek Regulation and the respective calculation tool, windows and doors are considered in the same group as ‘openings’

Table 8 Input selection for heat transmission coefficients in W/m<sup>2</sup>K for standard windows (in residential buildings)

Construction type	U-Value (examples for Greece)
Wooden frame single glazed windows	5 W/(m <sup>2</sup> K)

Construction type	U-Value (examples for Greece)
Wooden frame double glazed windows	2.9 W/(m <sup>2</sup> K)
Wooden frame double glazed low-e (low-emissivity) windows	2.1 W/(m <sup>2</sup> K)
Aluminium frame single glazed windows	6 W/(m <sup>2</sup> K)
Aluminium frame double glazed window	3.7 W/(m <sup>2</sup> K)
Aluminium frame with double low-e glazing	3 W/(m <sup>2</sup> K)
Aluminium frame with thermal break and double glazing	3 W/(m <sup>2</sup> K)
Aluminium frame with thermal break and double low-e glazing	2.3 W/(m <sup>2</sup> K)
Synthetic frame single glazed windows	5.0 W/(m <sup>2</sup> K)
Synthetic frame double glazed windows	3.0 W/(m <sup>2</sup> K)
Aluminium frame double glazed equipped with thick argon or krypton thermal break and low-e glass	1.5 W/(m <sup>2</sup> K)
Synthetic or wooden frame double glazed with thick argon or krypton thermal break and low-e glass	1.25 W/(m <sup>2</sup> K)
Other window type with very low U-value (e.g. triple glazed, vacuum gap)	0.9 W/(m <sup>2</sup> K)



## 2.4.8 Specifications of the building components and systems: Heating systems

For heating systems, the user can find 17 choices as shown in Figure 14 and Table 9



Figure 14: Screenshot- Selection of heating systems

Table 9: Input selection for heating systems (in residential buildings)

Heating system type	Efficiency (examples for Greece)
Conventional fuel oil boiler	0.84
Condensing fuel oil boiler	0.99
Conventional gas boiler	0.90
Condensing gas boiler	0.99
Conventional air conditioning unit – (old technology)	2.20
Air conditioning unit (with inverter)	4.20
Local electrical units	1.00
Biomass boiler	0.9



Biomass pellet boiler	0.9
Geothermal heat pump	4.80
Air-to-water heat pump	4
Air-to-air heat pump	4
Exhaust air heat pump	4.2
Stove	0.25
District heating	3
Small-scale CHP unit	0.8

### 2.4.9 Specifications of the building components and systems: Cooling systems

For cooling systems, the user can find 17 choices as shown in Figure 15 and Table 10.

without insulation

**Openings**



Aluminium frame single glazed windows

**Heating system**



Conventional fuel oil boiler

**Cooling system**



No cooling system

**Mechanical ventilation**



No Mechanical ventilation

**Cooling system**

**ⓘ** In case you are planning to install wall insulation or replace windows in the future, please consider that prior installation or replacement of the air conditioning system will result in over-dimensioning and consequent costs.

- No cooling system
- AC units with inverter driven technology (VRF/VRV)
- Local air conditioning units – (old tech)
- Local air conditioning units – ( with inverter)
- Geothermal heat pump
- District cooling system
- Central cooling system

Figure 15: Cooling systems selection

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

Cooling system type	Efficiency (examples for Greece)
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)	3.8
Geothermal heat pump	4





District cooling system	3
Central cooling system	3.5

### 2.4.10 Specifications of the building components and systems: Ventilation

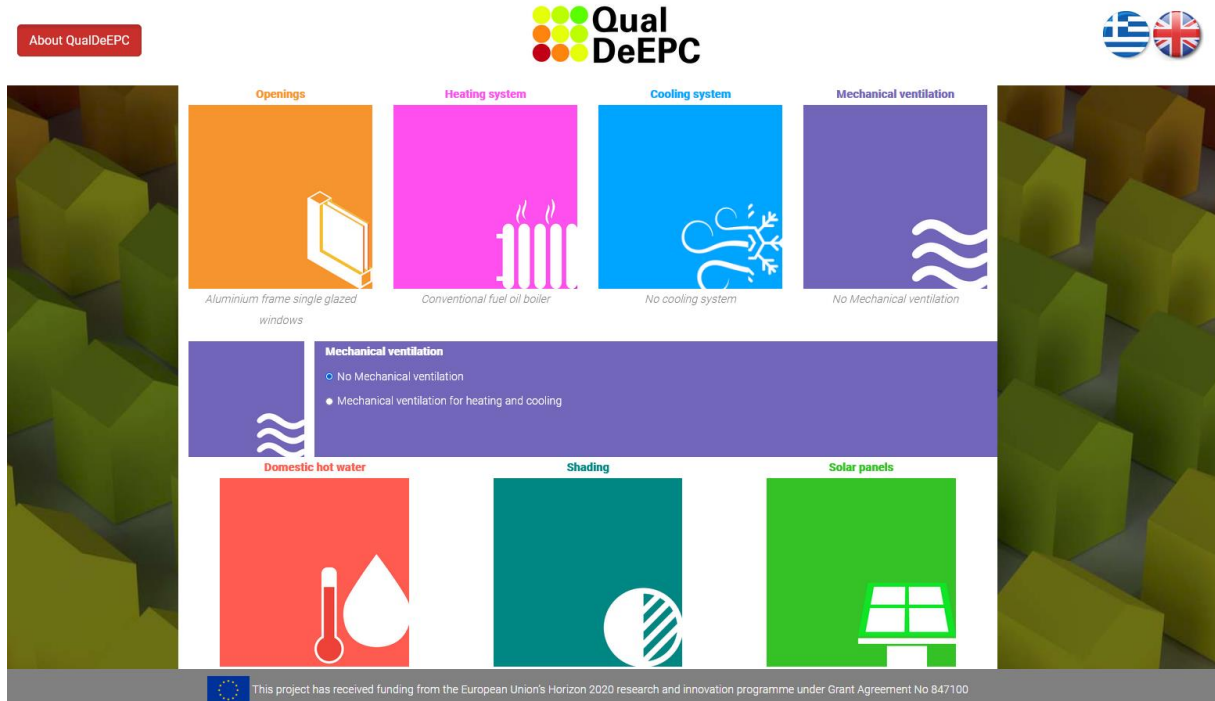


Figure 16: Available selections regarding the ventilation system

Table 11 Mechanical Ventilation system options for heating and cooling systems

System Type	Mechanical Ventilation
Heating System	<input type="checkbox"/> or <input checked="" type="checkbox"/>
Cooling System	<input type="checkbox"/> or <input checked="" type="checkbox"/>

When the mechanical ventilation system is active, it is used for both heating and cooling purposes (default), and the air recirculation is fixed value 0.6 while the heat recovery is taken 0.5 for both needs (heating/cooling).



### 2.4.11 Specifications of the building components and systems: DHW

For domestic hot water (DHW) systems, the user can select between 9 choices as shown in Figure 17 and Table 12.

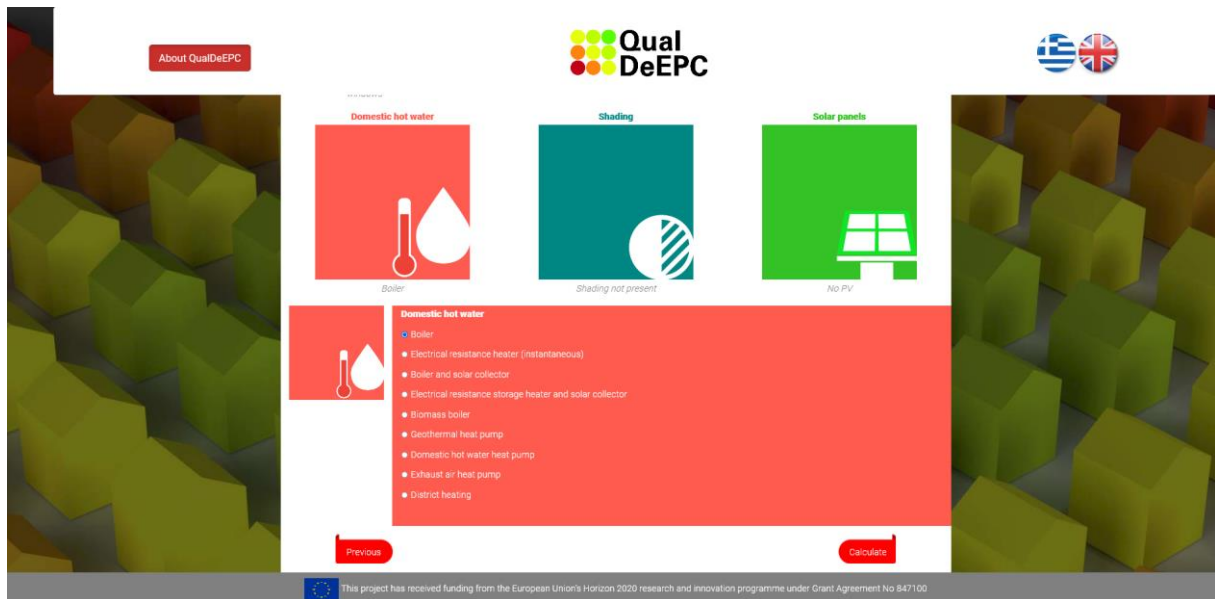


Figure 17: Hot water production systems selection.

Table 12 Selection input for DHW systems (in residential buildings)

Hot water system type	Efficiency (examples for Greece)
Boiler	0.88, 0.9/0.99 according to the boiler type
Electrical resistance heater (instantaneous)	1
Electrical resistance storage heater	1
Boiler and solar collector	0.88, 0.9, 0.99 according to the boiler type (flat solar collector)
Electrical resistance storage heater and solar collector	1 (flat solar collector)
Geothermal heat pump	4
Domestic hot water heat pump	3.3
Exhaust air heat pump	3.3n/a
District heating	3



## 2.4.12 Specifications of the building components and systems: Shading

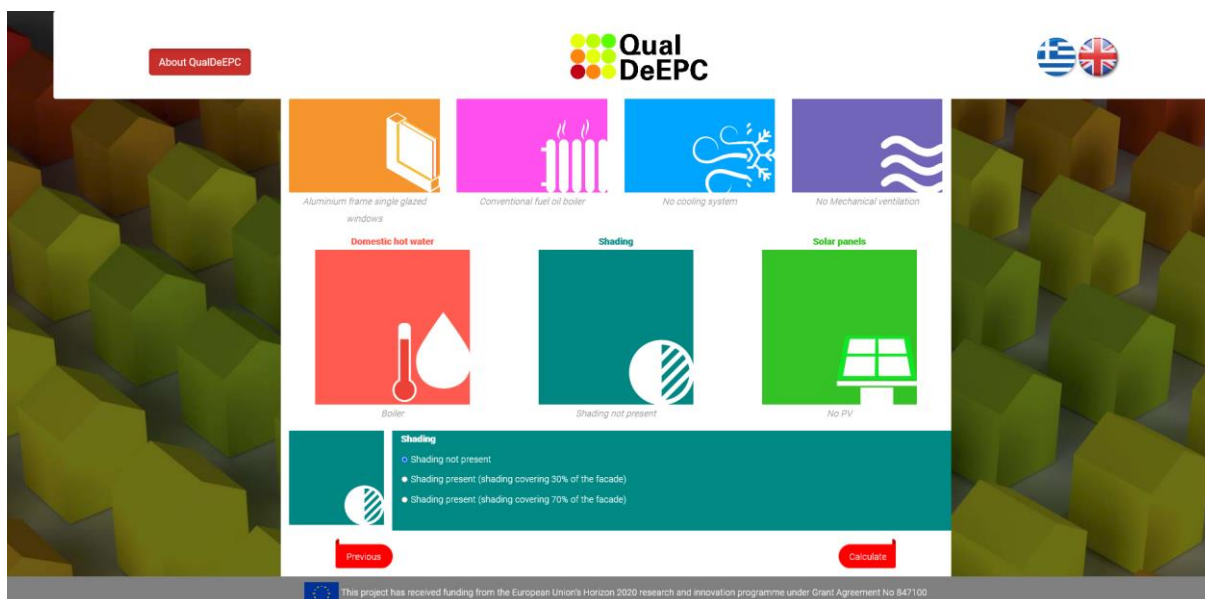


Figure 18 Shading choices

There are three choices for shading.

Table 13 Input selection for shading (in residential buildings)

Shading type	Value
Shading not present	Shading coefficients 1
Shading present (shading covering 30% of the facade)	Shading coefficients: $F_{hoT}=0.91, F_{on}=0.93, F_{fin}=0.46$
Shading present (shading covering 70% of the facade)	Shading coefficients: $F_{hoT}=0.86, F_{on}=0.73, F_{fin}=0.28$



### 2.4.13 Specifications of the building systems: RES

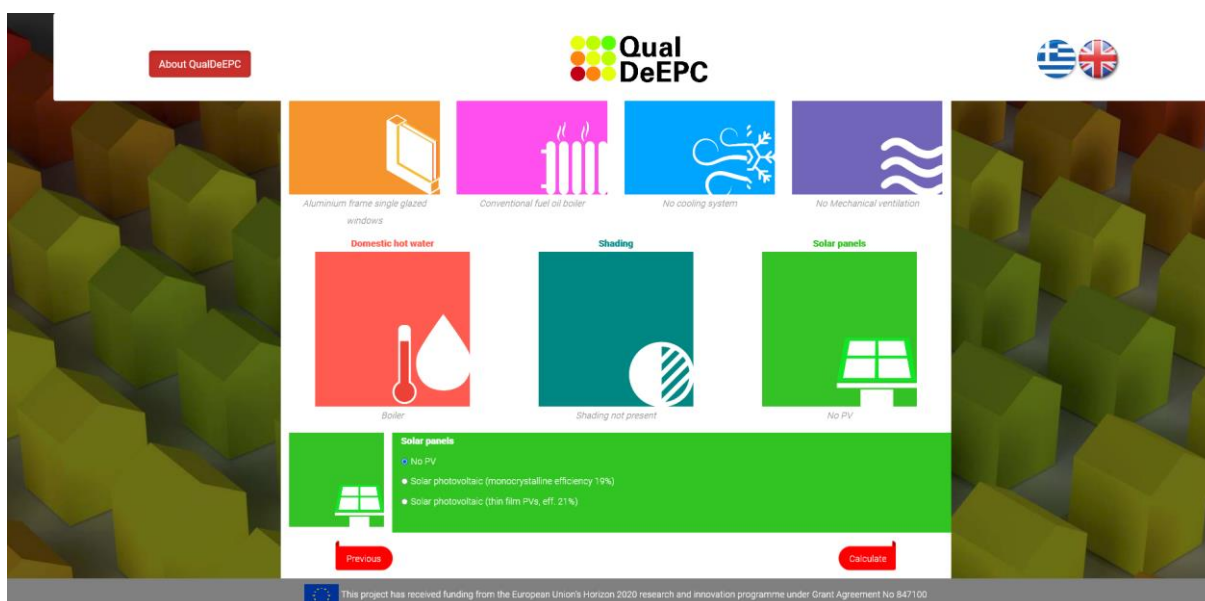


Figure 19 Renewable energy sources selection

In case of the Renewable Energy (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 selections for heating systems, i.e. biomass boiler, geothermal heat pump, combined solar collectors and boiler are included in the heating systems component. The solar collector (for DHW) is a conventional flat type one with a utilization factor of 0.332 (for the Greek case). The PV systems consist of two different PV cells panels.

Table 14 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)	0.9
Solar photovoltaic (monocrystalline efficiency 16%)	efficiency 19%
Solar thermal collector for space heating	0.9
Solar photovoltaic (Polycrystalline and thin film PVs)	efficiency 23%



## 2.5 Results

### 2.5.1 Estimation of current energy consumption

All inputs provided by the user are used to run the software tool, which provides an estimate of the current energy consumption of the building in energy figures as well as an estimate of the energy class which is indicated on the energy classification scale shown on screen. The results are provided for the yearly final energy consumption for heating, cooling and domestic hot water production (Figure 20).

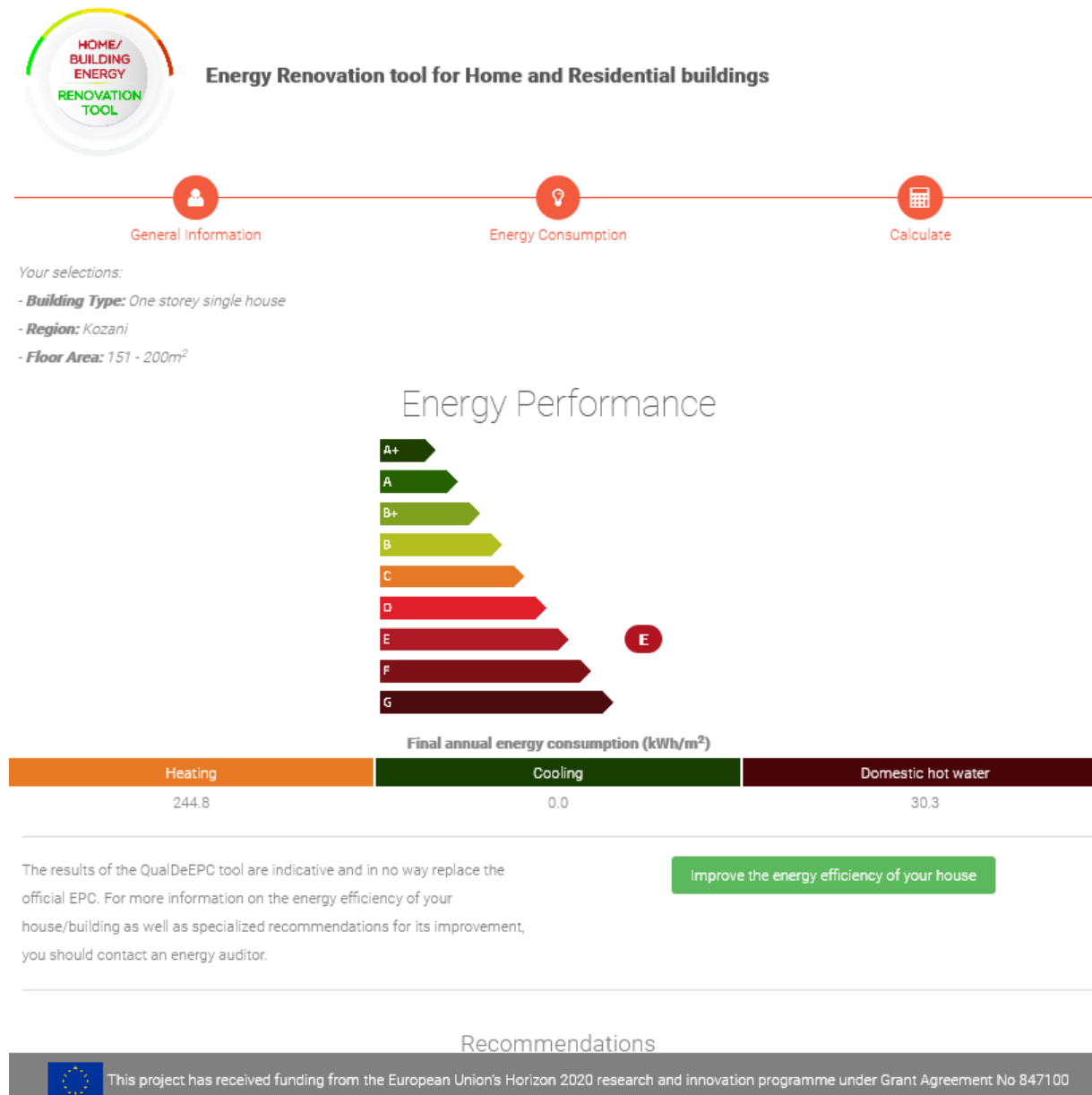


Figure 20: Screenshot of the estimated current energy consumption of the residential building

### 2.5.2 Selecting renovation recommendations

The user can select the renovation measures, which will be tested by clicking on the “Improve the energy efficiency of your house” button. Then, the user has the possibility to apply energy efficient



solutions for building systems and components (see Figure 21). In order to proceed, the user should select at least one improvement of the building components or systems.

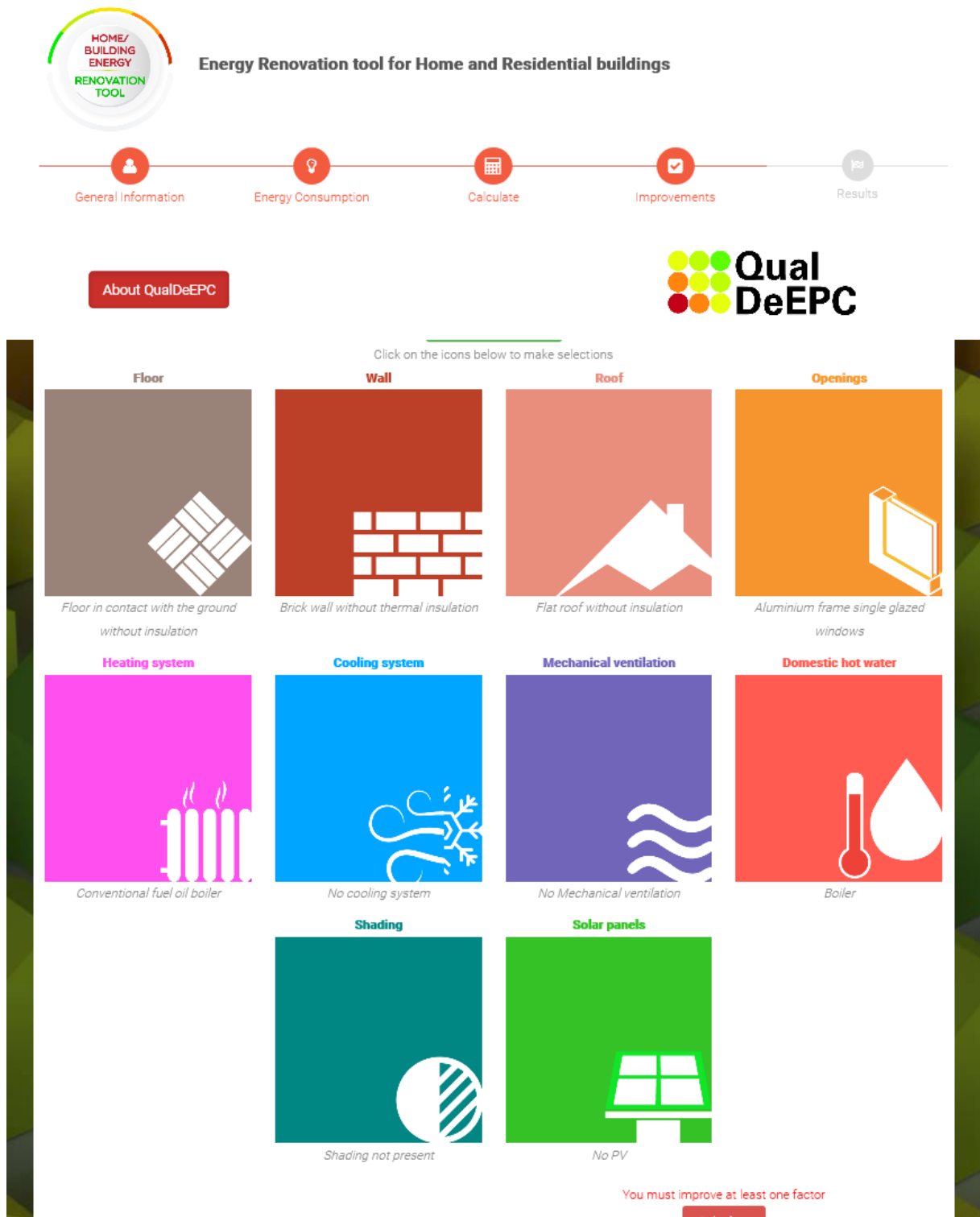


Figure 21: Improvements selection

The same screen includes information about the QualDeEPC proposed set (see Table 15) of renovation recommendations consistent with the “deep energy renovation”. The proposed recommendations are presented in a prioritized manner and included in the relevant lists for improving energy efficiency, so



as the user to get familiar with the typical order of implementing such measures avoiding any damages of the systems in the future or lock-in effects.

Table 15: QualDeEPC Master tool recommendations towards deep renovation

#	Type	Action
1	Roof Insulation	Roof with exceptional thermal insulation properties
2	Window replacement	Window with enhanced insulation properties which fulfil nZEB requirements
3	Installation of shading	Fixed horizontal/vertical shading devices or Venetian, shutters or awning to decrease cooling needs
4	External wall insulation	Wall with enhanced thermal insulation properties which fulfils nZEB requirements
5	Floor insulation	Floor area with enhanced thermal insulation properties which fulfils nZEB requirements
6	Replacement/ modernization of the heating system	Energy efficient devices i.e. heat pumps, condensing boilers with A energy category label
7	Replacement/ modernization of the cooling system	Use of efficient cooling systems (A energy label), geothermal heat pump, reversible inverter air-air heat pump, etc.
8	Utilization of renewable energy sources	Use of solar collectors, biomass boiler, PVs for heating and electricity production purposes
9	Energy efficient DHW production	Use of solar thermal collectors or energy category A heat pumps
10	Mechanical ventilation	Utilisation of energy efficient mechanical ventilation equipment (fans, controls, etc.)

Furthermore, information about the engineering approach (see 2.5.3.1, Pillar 1) when considering the improvement of the envelope performance is provided in the selection lists of the systems and components (see Figure 22).

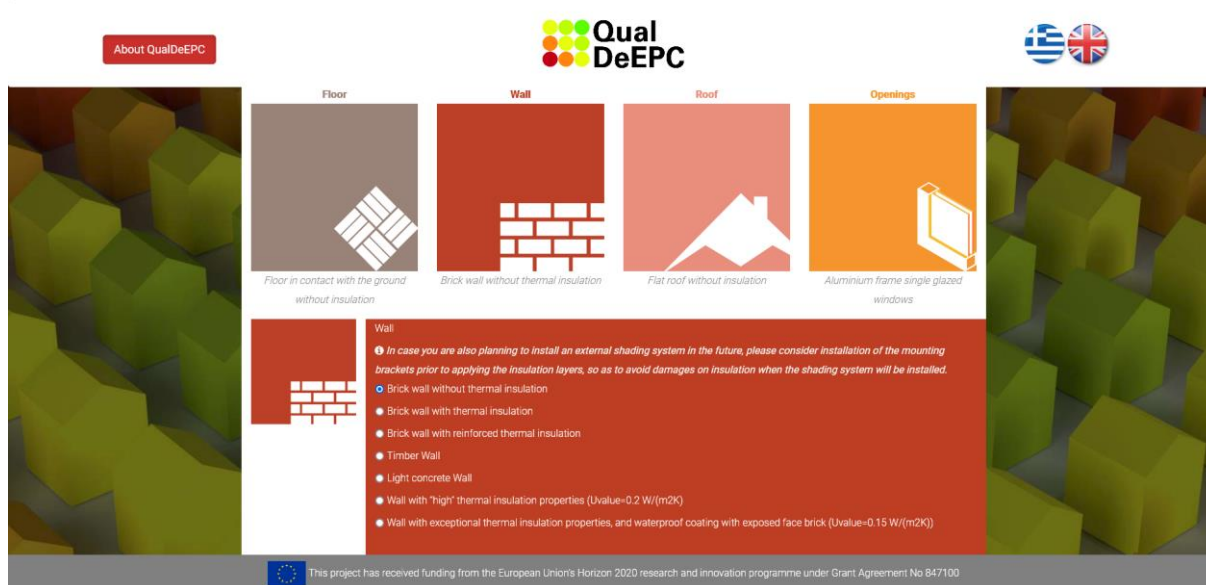


Figure 22: Info about the rationale of the measures (example for Walls)



It has to be noted that the improvement measure or measures can be compared with the current energy figures of the house only once. In case the user wishes to check more options, (s)he has to re-enter all the input values from the beginning.

### 2.5.3 Comparison between existing and renovation case; and deep energy renovation checkmark

Finally, the results from the comparison between the current and energy renovated case are given. Additionally, the new energy class of the house is given together with the achieved energy savings (in %), the CO<sub>2</sub> emissions reduction (in %) and an estimate of the investment required for the improvement measures tested (see Figure 23).

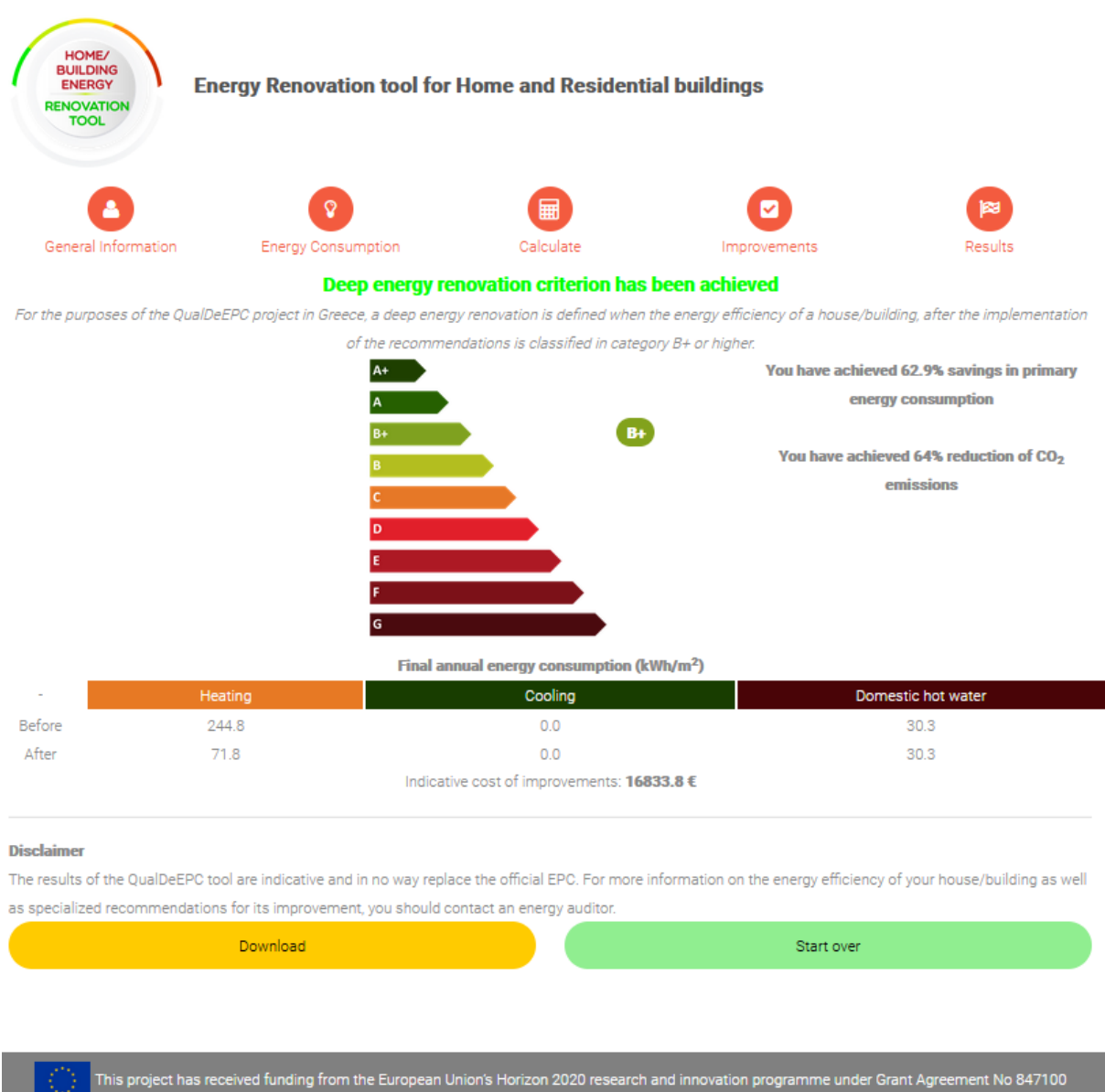


Figure 23: Results comparison



An additional message states if Deep energy Renovation criteria have been achieved (see Figure 23 – sentence in green). The criteria may have to be adapted for other countries, but the two cases remain:

- Deep energy renovation of the house/building has been achieved when fully implementing the recommendations or
- Deep energy renovation of the house/building has not been achieved when fully implementing the recommendations.

### *2.5.3.1 Output of recommendations*

The user has the option to download the report for the current test. In the report (in pdf format) for the test conducted by the user, the following information is available:

#### *Page 1*

- Building general information
- Selected building envelope components and technical systems



# Energy Renovation tool for Residential buildings

Results sheet

## Building General Info

**Building Type:** One storey single house

**Region:** Drama

**Floor Area:** < 100m<sup>2</sup>

**Altitude:** Altitude under 500m

## Selected building envelope elements and technical systems:

Floor	Floor in contact with the ground without insulation
Wall	Brick wall without thermal insulation
Roof	Flat roof without insulation
Openings	Aluminium frame single glazed windows
Heating system	Conventional fuel oil boiler
Cooling system	No cooling system
Mechanical ventilation	No Mechanical ventilation
Domestic hot water	Boiler
Shading	Shading not present
Solar panels	No PV

Figure 24: QualDeEPC tool results report layout (page1)

### Page 2

- Selected renovation recommendations listed in a prioritized manner regarding which energy efficiency technology should take place first and in what order (see Figure 25).
- Estimated energy classification before and after the improvements.



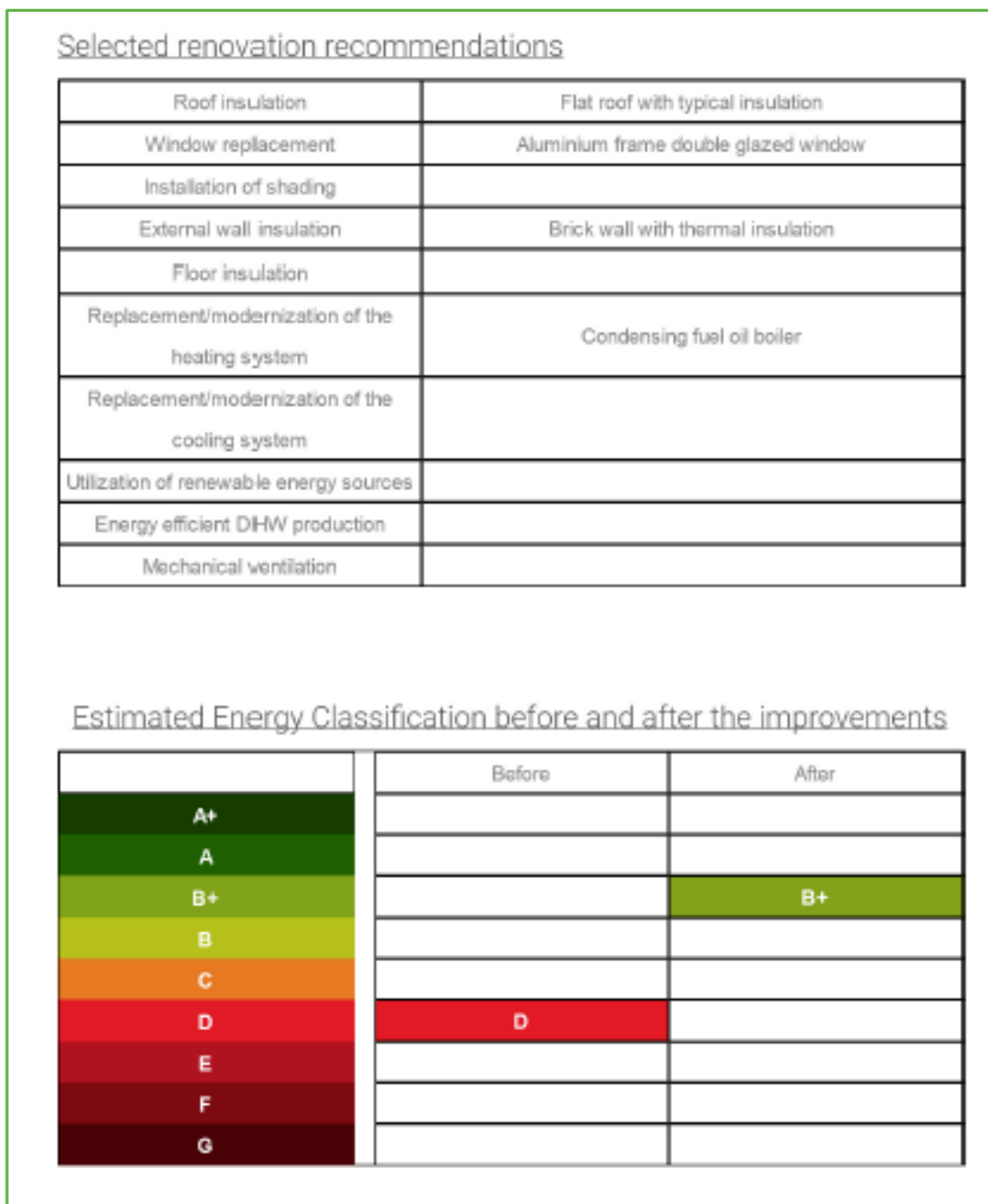


Figure 25: QualDeEPC tool results report layout (page 2)

The rationale behind the prioritization of measures towards deep renovation is based on the following pillars:

**Pillar I: the commonly accepted engineering / scientific approach**

1<sup>st</sup> : improve the performance of the envelope components so as **to reduce the energy demand of the building**

2<sup>nd</sup> : **improve the efficiency of the Technical Systems**, the dimensioning of which will be based on the ‘reduced energy demand’, after implementation of Step 1

3<sup>rd</sup> : **install Renewable energy technologies**, which are meant to cover a % of the energy demand resulting after the implementation of Steps 1 and 2.



## Pillar II: Implementation of energy retrofit measures towards Deep Renovation

When considering the improvement of the envelope performance, attention should be paid to the order of measures to be implemented so as to avoid either **lock-in effects** or **damages** on previously implemented technologies/materials

### Page 3

- Estimated final energy consumption before and after energy renovation (kWh/m<sup>2</sup>) for space heating and cooling as well as domestic hot water.
- Indicative cost of the selected renovation recommendations – improvements
- Estimated savings in primary energy consumption and CO<sub>2</sub> emissions
- Statement if the deep energy renovation criterion has been achieved.

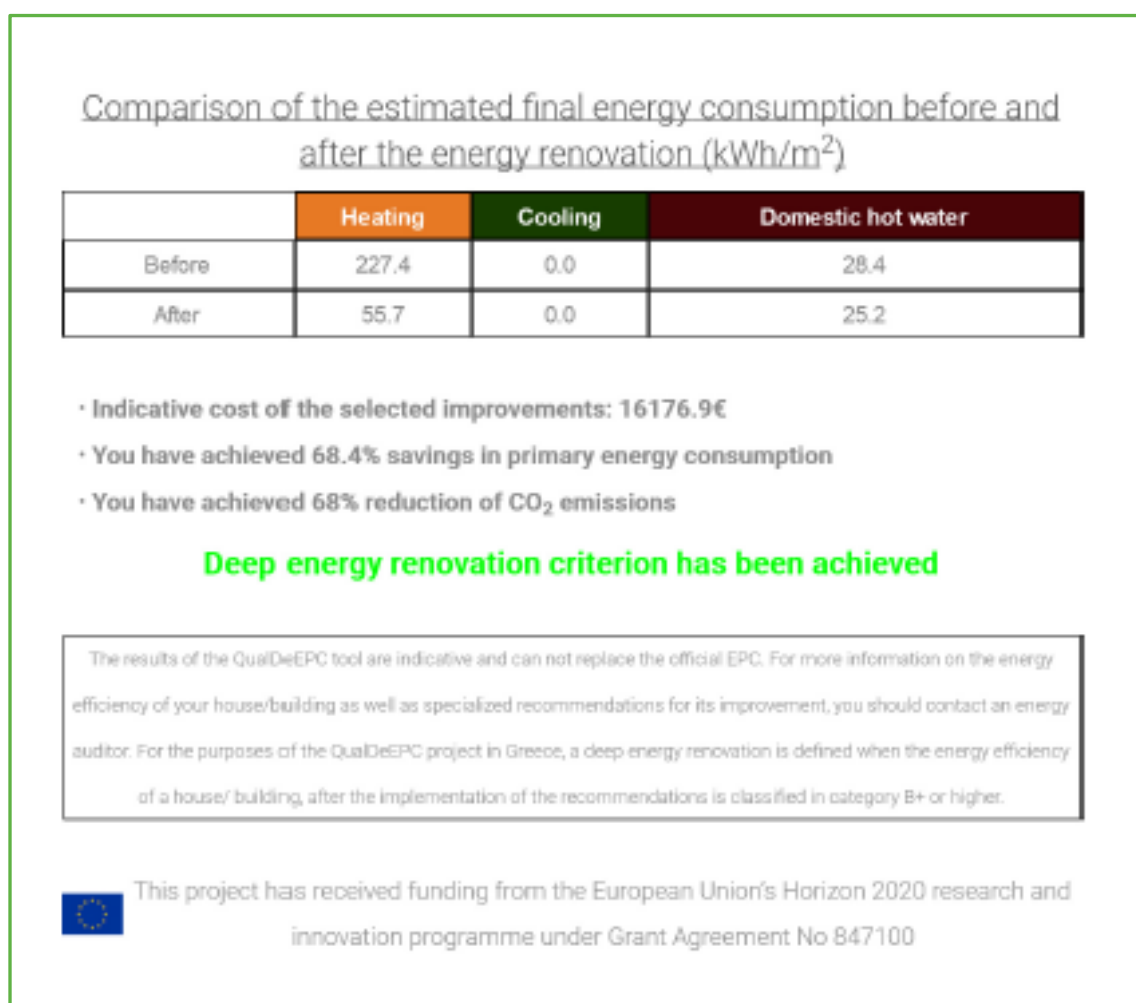


Figure 26: QualDeEPC tool results report layout (page 3)

Moreover, the final page of the report includes information on the definition of “Deep Energy Renovation” (example for Greece) and the following disclaimer: *The results of the QualDeEPC tool are indicative and in no way replace the official EPC. For more information on the energy efficiency of your house/building as well as specialized recommendations for its improvement, you should contact an energy auditor.*



### 3 OTHER TOOLS DEVELOPED

Taking into account the strategy plan of the QualDeEPC project (D2.4), a set of concepts and policy proposals has been developed aiming to improve the quality and the cross-EU convergence of Energy Performance Certificate schemes, and the link between EPCs and deep renovation. In the following sections, the technical proposals and tools that further support the adaptation and implementation of the selected project’s priorities, developed in the framework of WP3 (D3.2 White paper, Veselá et al. 2021) are presented.

#### 3.1 Improving the recommendations for renovation provided on the EPCs towards deep energy renovation

**Development Need:** Definition of ‘deep energy renovation’, guidance on (1) which renovation actions should usually be recommended on EPCs, and (2) energy efficiency or rating levels of these recommendations in consistency with ‘deep energy renovation’, considering that these could be implemented according to an individual renovation roadmap. [QualDeEPC D3.2 White paper]

**Output 1:** Set of deep energy renovation recommendations by QualDeEPC

Building element/technical system	Specific recommendation
External wall insulation	Wall with enhanced thermal insulation properties (nZEB for renovation standard or similar)
	Wall with exceptional thermal insulation properties (nZEB for new buildings standard or similar)
Roof insulation	Roof with enhanced insulation
	Roof with exceptional thermal insulation properties
Insulation of ceiling of an unheated basement/ ground floor	Floor connected to the unheated basement or ground floor with reinforced insulation
Window replacement	Window with enhanced insulation properties: e.g. Double glazed window equipped with thick argon or krypton thermal break and low-emissivity glass
	Window with exceptional insulation properties, e.g. triple glazed window
Door replacement	Door with enhanced insulation properties
	Door with exceptional insulation properties
Replacement/ Installation of shading	External blinds (Venetian, shutters or awning)
	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
	Ventilation system with heat recovery of min. 80% and very low electrical power consumption
	Ventilation system with heat recovery of min. 90% and low electrical power consumption



Building element/technical system	Specific recommendation
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
	Reversible inverter air-air heat pump
	District heating
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;
	<i>alternatively</i> , 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 <sup>-1</sup> or lower at 50 Pa pressure difference
	OR Air tightness according to new building standard
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

More information on the proposed deep energy renovation recommendations by QualDeEPC can be found in the White Paper of QualDeEPC project (<https://qualdeepc.eu/public-project-deliverables>).

The exact values of each recommendation adapted to country-specific context are a subject of WP5 and in particular of D5.1 Report on the 7 nationally adapted enhanced assessment and certification schemes. They can be considered a tool for implementation of enhanced EPC schemes.



## 3.2 Creating Deep Renovation Network Platforms (DRNP)

**Development Need:** Creation of Deep Renovation Network Platforms, which are one-stop-shops (OSS) for deep renovation linked to EPCs plus a Networking Platform for renovation supply-side actors and their joint communication/marketing, and in this way are addressing the needs of various stakeholders and end-users. Based on the analysis and development strategy plan created in WP2, two versions – basic and extended – were outlined, defined by the type of services offered, and five potential sub-types, 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 (D3.2 White paper, Veselá et al. 2021).

**Output 1:** The **basic platform concept** includes seven services/products, which are mainly offering an information OSS plus active marketing and networking of actors, and can be adapted by other EU MS. The structure, the description of services as well as the users addressed are illustrated in the following table. They can serve as a tool for those who wish to implement a Deep Renovation Network Platform according to the basic concept.



Table 16 Basic version of the DRNP

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
<b>1. Information on renovation actions</b> <b>1.1 General information</b>	<ul style="list-style-type: none"> <li>Providing general information and other benefits due to renovation</li> <li>Providing information on principles of insulation, heating, cooling, and ventilation systems, renewable energies</li> <li>descriptive texts and graphics on the website with information</li> <li>text and graphic documents downloadable as pdf-documents</li> </ul>	<p>General information on renovation actions</p> <ul style="list-style-type: none"> <li>energy consulting/advice</li> <li>deep (full) renovation</li> <li>building insulation</li> <li>air tightness</li> <li>windows</li> <li>shading</li> <li>ventilation</li> <li>heating system</li> <li>cooling system</li> <li>domestic hot water</li> <li>lighting</li> <li>renewables</li> <li>monitoring</li> <li>best practice</li> <li>quality management</li> </ul> <ul style="list-style-type: none"> <li>The information should be in line with the concrete proposal by QualDeEPC for Improving the EPC recommendations towards deep energy renovation</li> <li>The above list should be made consistent with the renovation actions, for which we develop the improved recommendations</li> </ul>	<ul style="list-style-type: none"> <li>Building owners</li> <li>Prospective buyers</li> <li>Tenants</li> <li>Possibly EPC assessors</li> </ul>	<p><a href="https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsani-erung.html">https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsani-erung.html</a></p> <ul style="list-style-type: none"> <li>Roof renovation: measures at a glance</li> <li>Which technical measures are part of the roof renovation?</li> <li>Which advantages and disadvantages do they bring?</li> <li>When is a roof renovation worthwhile?</li> <li>When does it make sense to combine different renovation measures for the roof?</li> </ul> <p><a href="https://www.energiesparen.be/bouwen-en-verbouwen">https://www.energiesparen.be/bouwen-en-verbouwen</a></p> <p><a href="http://translate.google.com/translate?sl=nl&amp;tl=en&amp;u=https%3A%2F%2Fwww.energiesparen.be%2FEPB-burgers">http://translate.google.com/translate?sl=nl&amp;tl=en&amp;u=https%3A%2F%2Fwww.energiesparen.be%2FEPB-burgers</a></p> <ul style="list-style-type: none"> <li>Insulation and airtightness</li> <li>Glazing and windows</li> <li>Heating</li> <li>Domestic hot water</li> <li>Ventilation</li> <li>Lighting</li> <li>Electrical devices</li> <li>Green energy</li> </ul> <p><a href="https://www.greenmatch.co.uk/">https://www.greenmatch.co.uk/</a></p>	<p>General information on:</p> <ul style="list-style-type: none"> <li>building insulation</li> <li>windows</li> <li>ventilation</li> <li>heating system</li> <li>renewables</li> <li>deep renovation</li> </ul>





Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
1.2 Information on potential savings, costs and other benefits	Providing general information on costs of renovation for deep renovations, building components, building services, renewable energy, potential energy savings, cost savings and co-benefits	<p>Information on renovation costs and savings, benefits</p> <ul style="list-style-type: none"> <li>energy consulting/advice</li> <li>deep (full) renovation</li> <li>building insulation</li> <li>windows</li> <li>ventilation</li> <li>heating system</li> <li>renewables</li> <li>monitoring</li> <li>best practice</li> <li>quality management</li> <li>energy prices</li> <li>co-benefits (e.g. comfort, noise reduction, air improvement, image, value enhancement, external appearance)</li> </ul> <p>Same list as for 1.1</p> <p>Link to the calculator for energy cost savings, possibly included in the tool (1.3)</p>	<ul style="list-style-type: none"> <li>Building owners</li> <li>Prospective buyers</li> <li>Tenants</li> <li>Possibly EPC assessors</li> </ul>	<p><a href="https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsani-erung/kosten.html">https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsani-erung/kosten.html</a></p> <p>Roof renovation: measures and costs at a glance</p> <ul style="list-style-type: none"> <li>What does it cost?</li> <li>Energy savings?</li> </ul> <p><a href="https://www.energiesparen.be/ener-giewinst">https://www.energiesparen.be/ener-giewinst</a></p> <p>Calculation of the profit for the replacement of an old boiler (&gt; 20 years old) with a condensing boiler in 5 steps</p> <p>Good practice examples with feedback from homeowners on realised energy-efficient renovation projects to motivate undecided people.</p>	<p>Information on renovation typical costs and savings for:</p> <ul style="list-style-type: none"> <li>building insulation</li> <li>windows</li> <li>ventilation</li> <li>heating system</li> <li>renewables</li> </ul>
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)	<p>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 recommenda-</p>	<ul style="list-style-type: none"> <li>Building owners</li> <li>Prospective buyers</li> <li>Tenants</li> <li>EPC assessors</li> </ul>	<p><a href="https://www.energiesparen.be/ener-giewinst">https://www.energiesparen.be/ener-giewinst</a></p>	<p>Integration to renovation tools or linking of existing tools in QualDeEPC partner countries.</p> <p>This would be the online tool for comparing EPC recommendations to deep energy renovation</p>

Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		<p>tions developed in Task 3.3 or information will be provided, how these existing tools can be expanded in this regard.</p>			<p>recommendations developed in Task 3.3</p>
<p><b>2.1 Linking with Energy Performance Certificates</b></p>	<ul style="list-style-type: none"> <li>• Providing detailed information on EPC assessment purposes/uses, procedure, tools and assessors</li> <li>• Comprehensive information on EPCs, including EPC obligations, registry of EPC assessors (with a link), explaining EPCs in terms of nZEB and national energy targets</li> </ul>	<p>Information on EPCs answering the following questions:</p> <ul style="list-style-type: none"> <li>• Who needs an EPC and for which purpose?</li> <li>• When is an EPC required?</li> <li>• How long is an EPC valid?</li> <li>• Read &amp; understand the EPC.</li> <li>• Who can issue EPCs, where can I find issuer?</li> <li>• What types of EPCs existing?</li> <li>• Where EPCs are regulated?</li> <li>• Content of EPCs and for what it is useful.</li> <li>• Content of the renovation recommendations, incl improved recommendations (T.3.1)</li> <li>• Samples of EPCs</li> <li>• Linking to EPC-assessor and energy expert databases, regulations etc.</li> <li>• What to present in advertisements</li> </ul> <p>Links to</p> <ul style="list-style-type: none"> <li>• The online renovation calculator tool (1.3)</li> <li>• The deep renovation recommendations (1.1)</li> </ul>	<ul style="list-style-type: none"> <li>• Building owners</li> <li>• Prospective buyers or tenants</li> <li>• EPC assessors</li> <li>• Citizens</li> <li>• Public authorities</li> </ul>	<p>Information on EPCs – FAQs:</p> <ul style="list-style-type: none"> <li>• What is an EPC?</li> <li>• Which energy efficiency classes are there?</li> <li>• What does an EPC cost?</li> <li>• Consumption &amp; demanded based EPC what is the difference?</li> <li>• Where can I apply for an energy certificate?</li> <li>• When is an EPC required?</li> <li>• How long is an EPC valid?</li> <li>• Read &amp; understand the EPC.</li> <li>• <a href="https://www.co2online.de/modernisiert-und-bauen/energieausweis">https://www.co2online.de/modernisiert-und-bauen/energieausweis</a></li> <li>• The EPC guide will help you on your way!</li> <li>• <a href="#">An EPC tailored to your building</a></li> <li>• Questions about the EPC?</li> <li>• Investigations into the EPC</li> </ul> <p><a href="https://www.energiesparen.be/energieprestatiecertificaten">https://www.energiesparen.be/energieprestatiecertificaten</a></p>	<p>Detailed information on</p> <ul style="list-style-type: none"> <li>• EPC in general and purposes/uses/duties</li> <li>• EPC assessment procedure</li> <li>• EPC forms and types</li> <li>• Renovation recommendations</li> <li>• issue energy certificates and where this is regulated</li> <li>• Links to</li> <li>• The online renovation calculator tool (1.3)</li> <li>• The deep renovation recommendations (1.1)</li> <li>• Advertising guidelines for EPCs</li> </ul>



Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
<b>2.2 Linking with building deep renovation roadmap and possibly a passport</b>	<ul style="list-style-type: none"> <li>Linking EPC information to detailed analysis to upgrade it to a Building deep renovation roadmap</li> <li>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)</li> </ul>	<ul style="list-style-type: none"> <li>Advertising guidelines for EPCs</li> </ul> <p>Information on building renovation roadmap and passport</p> <ul style="list-style-type: none"> <li>What is it?</li> <li>How can the EPC be a starting point?</li> <li>Benefit of the renovation roadmap and passport: why is it useful?</li> <li>The methodology of the building renovation roadmap and passport</li> <li>Energy efficiency of buildings (link to 1.1)</li> <li>costs of the roadmap or passport and existing subsidy measures</li> </ul> <p>Links to</p> <ul style="list-style-type: none"> <li>A list of energy consultants who can develop a Building deep renovation roadmap, and link to grants offered for it (if available)</li> <li>If available, a list of energy consultants entitled to issue a Building Passport, and/or link to a software for creating such a passport</li> <li>Links to further information about the roadmap/passport</li> <li>Links to subsidy programmes</li> </ul>	<ul style="list-style-type: none"> <li>Building owners</li> <li>Prospective buyers or tenants</li> <li>EPC assessors</li> <li>Public authorities</li> </ul>	<p><a href="http://translate.google.com/translate?sl=de&amp;tl=en&amp;u=https%3A%2F%2Fwww.febs.de%2Fberaten-finanzieren%2Fisfp">http://translate.google.com/translate?sl=de&amp;tl=en&amp;u=https%3A%2F%2Fwww.febs.de%2Fberaten-finanzieren%2Fisfp</a></p> <ul style="list-style-type: none"> <li>Woningpas <ul style="list-style-type: none"> <li><a href="https://woningpas.vlaanderen.be/over-woningpas">https://woningpas.vlaanderen.be/over-woningpas</a></li> </ul> </li> <li>Passeport Efficacité Énergétique <ul style="list-style-type: none"> <li><a href="https://theshiftproject.org/en/experience-p2e-2">https://theshiftproject.org/en/experience-p2e-2</a></li> </ul> </li> <li>Individueller Sanierungsfahrplan <ul style="list-style-type: none"> <li><a href="https://www.febs.de/beraten-finanzieren/isfp">https://www.febs.de/beraten-finanzieren/isfp</a></li> </ul> </li> </ul>	<p>Information on building renovation roadmap and passport</p> <ul style="list-style-type: none"> <li>What is it?</li> <li>How can the EPC be a starting point?</li> <li>Benefit of the renovation roadmap and passport: why is it useful?</li> <li>Methodology of the building renovation roadmap and passport</li> <li>Links to further information about the roadmap/passport</li> <li>Energy efficiency of buildings (link to 1.1)</li> </ul> <p>Links to</p> <ul style="list-style-type: none"> <li>Links to subsidy programmes</li> <li>The online renovation calculator tool (1.3)</li> </ul>



Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		<ul style="list-style-type: none"> <li>The online renovation calculator tool (1.3)</li> </ul>			
<b>3. Information on building contractors/ technicians and energy-efficient-experts</b> <b>Support with finding experts and building contractors/ technicians</b>	<ul style="list-style-type: none"> <li>Providing information regarding energy-efficient-experts, building contractors/ technicians/ installers</li> <li>Providing a search engine or a databases of energy-efficiency experts/ contractors / technicians/ installers/ technical supervisors</li> <li>Requesting various renovation offers/quotes from contractors/ technicians and comparing them so that the end-user can make an informed choice</li> </ul>	<ul style="list-style-type: none"> <li>Information provided regarding:</li> <li>Consultation of qualified experts and companies in the building sector</li> <li>Instructions on how to find and recognize reputable and well-qualified companies and what to watch out for.</li> <li>List of companies with authorised consultants</li> <li>Link to the database of energy-efficient-experts and EPC assessors</li> <li>How to use the service for requesting offers/quotas</li> <li>Which EPC data could be the basis for requesting an offer</li> </ul>	<ul style="list-style-type: none"> <li>Building owners</li> </ul>	<p>Find your professional</p> <p><a href="https://www.energiesparen.be/bouwen-en-verbouwen">https://www.energiesparen.be/bouwen-en-verbouwen</a></p> <p>→ find your professional</p> <p><a href="https://translate.googleusercontent.com/translate_c?depth=1&amp;pto=aue&amp;rurl=translate.google.com&amp;sl=nl&amp;sp=nmt4&amp;tl=en&amp;u=https://www.buildyourhome.be/nl&amp;usg=ALkJrhgJFfgnCyt-O6mQmbSSkrR3BBw0Q">https://translate.googleusercontent.com/translate_c?depth=1&amp;pto=aue&amp;rurl=translate.google.com&amp;sl=nl&amp;sp=nmt4&amp;tl=en&amp;u=https://www.buildyourhome.be/nl&amp;usg=ALkJrhgJFfgnCyt-O6mQmbSSkrR3BBw0Q</a></p> <p>→ find your contractor</p> <p><a href="https://translate.googleusercontent.com/translate_c?depth=1&amp;pto=aue&amp;rurl=translate.google.com&amp;sl=nl&amp;sp=nmt4&amp;tl=en&amp;u=https://www.vinduwaanne-mer.be/&amp;usg=ALKJrhVoCwKqhc3GzZer2sipL8U5PVo5g">https://translate.googleusercontent.com/translate_c?depth=1&amp;pto=aue&amp;rurl=translate.google.com&amp;sl=nl&amp;sp=nmt4&amp;tl=en&amp;u=https://www.vinduwaanne-mer.be/&amp;usg=ALKJrhVoCwKqhc3GzZer2sipL8U5PVo5g</a></p> <p>Find your energy-expert:</p> <p><a href="https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsani-erung/kosten.html#c18593">https://www.energie-experten.org/bauen-und-sanieren/altbausanierung/dachsani-erung/kosten.html#c18593</a></p>	<ul style="list-style-type: none"> <li>Information regarding energy-efficient-experts, building contractors/ technicians/ installers</li> <li>Instructions on how to find and recognise reputable and well-qualified companies (contractors/ craftsman) and what to watch out for.</li> </ul>



Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
<b>4. Information on material or product manufacturers/suppliers</b>	<ul style="list-style-type: none"> <li>Provides information on product manufacturers /suppliers required for deep renovation</li> <li>Alternatively or in addition, could also link to information provided by associations of manufacturers or distributors e.g. of insulation materials, with appropriate indication that this may be commercial information</li> </ul>	<p>Information on the currently most frequently used materials and technologies and their manufacturers and suppliers</p> <ul style="list-style-type: none"> <li>building insulation</li> <li>windows</li> <li>HVAC systems</li> <li>renewables</li> <li>etc.</li> </ul> <p>Links to further independent lists and databases for materials, products, manufacturers, suppliers</p>	<ul style="list-style-type: none"> <li>Building owners</li> <li>Building contractors/ technicians/ installers</li> </ul>	<p>Compare insulation prices from independent providers for free!</p> <p><a href="https://www.daemmen-und-sani-eren.de/daemmung/hersteller">https://www.daemmen-und-sani-eren.de/daemmung/hersteller</a></p> <p>Lists of manufacturers:</p> <p><a href="https://www.energie-experten.org/bauen-und-sani-eren/daemmung/daemmstoffe/hersteller.html">https://www.energie-experten.org/bauen-und-sani-eren/daemmung/daemmstoffe/hersteller.html</a></p> <p><a href="https://www.carmen-ev.de/in-fothek/branchenadressen/301-adresslisten-aus-datenbank/933-hersteller-von-natur-daemmstoffen">https://www.carmen-ev.de/in-fothek/branchenadressen/301-adresslisten-aus-datenbank/933-hersteller-von-natur-daemmstoffen</a></p> <p><a href="https://aislaconpoliuretano.com/normativa/">https://aislaconpoliuretano.com/normativa/</a></p> <p>Database of products:</p> <p><a href="https://www.greenbuildingproducts.eu/?lang=en">https://www.greenbuildingproducts.eu/?lang=en</a></p> <p><a href="http://reecf.org/en/eligible-installers">http://reecf.org/en/eligible-installers</a></p>	
<b>5. Information on financing opportunities for deep renovation</b>	<ul style="list-style-type: none"> <li>Provide information about financial incentives, loans, and subsidies or third party financing</li> </ul>	<p>Information on funding programmes for energy-efficient buildings</p> <ul style="list-style-type: none"> <li>overview of programs for energy-efficient renovations</li> </ul>	<p>Building owners</p>	<p>Loans &amp; credits: <a href="https://www.energiesparen.be/leningen">https://www.energiesparen.be/leningen</a></p> <p>Information on Support programs and database for experts:</p>	<p>Information on existing support programs for energy-efficient buildings</p> <ul style="list-style-type: none"> <li>Links to subsidy programmes</li> </ul>



Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		<ul style="list-style-type: none"> <li>• database of programmes for energy-efficient renovations, with links to programme websites</li> <li>• link to the database of energy-efficient-experts</li> <li>• How to use the service for help with applying for funding</li> <li>• Which EPC data could be the basis for applying for funding</li> <li>• Links to funding programmes</li> </ul>		<p><a href="https://www.deutschland-machts-effizient.de/KAE-NEF/Redaktion/DE/Standardartikel/foerderprogramme-hauseigentuemmer.html">https://www.deutschland-machts-effizient.de/KAE-NEF/Redaktion/DE/Standardartikel/foerderprogramme-hauseigentuemmer.html</a></p> <p><a href="https://www.energie-effizienz-experten.de/">https://www.energie-effizienz-experten.de/</a></p>	
<b>6. Active marketing of deep renovation and its benefits and costs</b>	<ul style="list-style-type: none"> <li>• 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</li> <li>• Using demonstration projects to show enhanced „quality of life through insulation and energy-saving“ by bringing together various stakeholders listed in the next column</li> </ul>	<p>Marketing instruments:</p> <ul style="list-style-type: none"> <li>• Media releases</li> <li>• Events for the public</li> <li>• Events for stakeholders and experts</li> </ul> <p>Content for the marketing: e.g.,</p> <p>Showing advantages of different energy renovation measures and co-benefits</p> <ul style="list-style-type: none"> <li>• Showing potential savings of energy and costs → linking to 1.2 Information on potential savings and costs</li> <li>• Promotion of deep renovation network platform</li> <li>• Showing Best Practice and Pilot projects</li> </ul>	<ul style="list-style-type: none"> <li>• Building owners</li> <li>• Citizens</li> <li>• Building contractors/ technicians/ installers</li> <li>• City/Municipality</li> <li>• local housing companies</li> <li>• the social credit agencies</li> <li>• Professional buildings and developers</li> <li>• Architects</li> </ul>	<p><a href="https://translate.googleusercontent.com/translate_c?depth=1&amp;pto=aue&amp;rurl=translate.google.com&amp;sl=nl&amp;sp=nmt4&amp;tl=en&amp;u=https://www.energiesparen.be/ikBENOver/10reasons-to-BENOver-now">https://translate.googleusercontent.com/translate_c?depth=1&amp;pto=aue&amp;rurl=translate.google.com&amp;sl=nl&amp;sp=nmt4&amp;tl=en&amp;u=https://www.energiesparen.be/ikBENOver/10reasons-to-BENOver-now</a></p> <ul style="list-style-type: none"> <li>• 10 reasons to BENOver now</li> <li>• Download the 'I BENOver' campaign material</li> </ul> <p>dena Database of efficient homes:</p> <p><a href="https://effizienzhaus.zukunft-haus.info/effizienzhaeuser/">https://effizienzhaus.zukunft-haus.info/effizienzhaeuser/</a></p> <ul style="list-style-type: none"> <li>• <a href="https://www.greenmatch.co.uk/">https://www.greenmatch.co.uk/</a></li> </ul>	<ul style="list-style-type: none"> <li>• Showing advantages of energy renovation measures and co-benefits</li> <li>• Promotion of deep renovation network platform</li> </ul> <p>through media releases and in own events (which may be organised anyway for other purposes)</p>



Services/products	Description of services	Details of Services offered	Users addressed (examples)	Examples	Minimum version
		<ul style="list-style-type: none"> <li>• Linking to a database of efficient homes/ buildings</li> <li>• Providing information material of benefits of various renovation measures on the building envelope as well as of various efficient heating and hot water technologies</li> <li>• Linking to 1. Information on renovation actions</li> </ul>			
<b>7. Network (platform) for learning, exchange and cooperation (local/regional/ national)</b>	<ul style="list-style-type: none"> <li>• Discussing active marketing activities and involving supply-side actors, city administration, energy companies, financial institutions etc., in the media work, events, and funding</li> <li>• Discussing training needs and the organizing of training</li> </ul>	<p>Information and activities provided:</p> <ul style="list-style-type: none"> <li>• List or database of training providers</li> <li>• List of network partners</li> <li>• Workshops on cross-disciplinary topics and/ or cooperation with workshop providers</li> <li>• Creation and maintenance of a training calendar with events, seminars, workshops in cooperation with training providers, consumer organisations and energy agencies etc.</li> <li>• (Online) Platform for exchange between professionals, e.g. EPC issuers</li> </ul>	<ul style="list-style-type: none"> <li>• Building contractors/ technicians/ installers</li> <li>• City/Municipality</li> <li>• local housing companies</li> <li>• the social credit agencies</li> <li>• Professional buildings and developers</li> <li>• Architects</li> <li>• Financial institutions</li> <li>• Energy companies</li> </ul>	<p>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.--&gt; <a href="https://www.fortbildungskalender.de/termine">https://www.fortbildungskalender.de/termine</a></p> <p><a href="https://www.energieagentur.nrw/veranstaltungen">https://www.energieagentur.nrw/veranstaltungen</a></p>	<ul style="list-style-type: none"> <li>• List of existing renovation platforms, involving supply-side actors, city administration, energy companies, financial institutions etc.,</li> <li>• List of training providers for EPC assessors</li> <li>• Link to lists of workshops and seminars</li> </ul>



**Output 2:** Further to the basic platform, QualDeEPC proposes an **enhanced version of the DRNP**, which could be a platform for suppliers to organize one-stop supply offers for renovation. The additional services suggested, which are included in the extended part of the platform, as well as examples, are presented in the following table.

The choice of services to be offered will depend on who operates the platform, and what are its main objectives (e.g., guidance of investors through the whole deep renovation journey – services 10 and possibly 12; or even providing the renovation as a package – service 13; support for policy-makers through additional networking – service 8 –, capacity building – service 9 – or monitoring – service 11 – functions). This may also depend on the regional or national situation of building renovation markets and policies.





Table 17 Extended part of the DRNP

Services/products	Description of services	Users addressed (examples)	Examples of organisations that could act as providers
<b>8. Network (platform) for learning, exchange and cooperation (interregional/ transnational)</b>	<ul style="list-style-type: none"> <li>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</li> <li>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.</li> <li><b>Examples:</b> 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 as 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.</li> </ul>	<ul style="list-style-type: none"> <li>Construction and financial sector including sector federations, contractors, builders, renovation consultants, banks, financial institutions</li> <li>All cities</li> </ul>	<ul style="list-style-type: none"> <li>Platform facilitator itself</li> <li>Energy Agency</li> <li>Professional associations/ federations of energy assessors</li> </ul>
<b>9. Capacity building and training</b>	<ul style="list-style-type: none"> <li>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.</li> <li>Training and learning platform to obtain expertise and sector capacity</li> <li>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</li> </ul>	<ul style="list-style-type: none"> <li>Sector/professional federations</li> <li>Training organizations</li> <li>Professional buildings</li> <li>Architects</li> <li>Contractors</li> </ul>	<ul style="list-style-type: none"> <li>Platform facilitator itself</li> <li>Energy Agency</li> <li>Other third parties</li> </ul>
<b>10. Step-by-step guidance for renovation project from start to end</b>	<ul style="list-style-type: none"> <li>Offering step-by-step guidance documents including monitoring of renovation project from start to end</li> <li>Possibly: Requesting various renovation offers/quotes from contractors/technicians and comparing them so that the end user can make an informed choice</li> <li>Full inspection of home and proposal for a renovation plan and quality control after renovation works</li> <li>Possibly: Hotline in case of questions during decision-making and implementation of works</li> <li>Drawing up a measurement report with an overview of costs and energy savings</li> </ul>	<ul style="list-style-type: none"> <li>Building owners</li> <li>Prospective buyers</li> </ul>	<ul style="list-style-type: none"> <li>Platform facilitator itself</li> <li>Energy Agency</li> <li>Third party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)</li> </ul>



Services/products	Description of services	Users addressed (examples)	Examples of organisations that could act as providers
<b>11. Monitoring the implementation of the renovation project(s)</b>	<ul style="list-style-type: none"> <li>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</li> <li>Follow-up of the renovation works</li> <li>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.</li> </ul>	<ul style="list-style-type: none"> <li>Owners</li> <li>Trustees</li> <li>Building professionals</li> <li>EPC assessors</li> <li>Communities</li> <li>Social landlords</li> <li>Third-party investors               <ul style="list-style-type: none"> <li>Renewable energy professionals</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>City/Municipality</li> <li>Platform facilitator itself</li> <li>Energy Agency</li> <li>Financial institution</li> <li>Third-party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)</li> </ul>
<b>12. Operating a physical network hub and information centre</b>	<ul style="list-style-type: none"> <li>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</li> </ul>	<ul style="list-style-type: none"> <li>Building owners and/or investors</li> <li>Building professionals</li> <li>All end-user groups</li> </ul>	<ul style="list-style-type: none"> <li>Platform facilitator itself</li> </ul>
<b>13. Carrying out renovation project(s)</b>	<ul style="list-style-type: none"> <li>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</li> <li>Possibly providing the finance for the works</li> </ul>	<ul style="list-style-type: none"> <li>Building owners and/or investors</li> </ul>	<ul style="list-style-type: none"> <li>Financial institution</li> <li>Third-party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)</li> <li>Platform facilitator itself (if it is a construction company or similar)</li> </ul>
<b>14. Initiation and coordinating deep renovation demonstration project(s)</b>	<ul style="list-style-type: none"> <li>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“</li> </ul>	<ul style="list-style-type: none"> <li>Building professionals</li> <li>Building owners and/or investors</li> <li>Third-party investors</li> </ul>	<ul style="list-style-type: none"> <li>City/ Municipality</li> <li>Platform facilitator itself</li> <li>Energy Agency</li> <li>Financial institution</li> <li>Third-party (Network partners from the platform with a network of companies of craftsmen, planners and constructions workers)</li> </ul>



Services/products	Description of services	Users addressed (examples)	Examples of organisations that could act as providers
<b>15. Aggregation of building renovation projects</b>	<ul style="list-style-type: none"> <li>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).</li> </ul>	<ul style="list-style-type: none"> <li>Building owners and/or investors</li> </ul>	<ul style="list-style-type: none"> <li>Platform facilitator itself</li> <li>Energy Agency</li> <li>Third party (Network partners from the platform)</li> </ul>



Taking into account the various subtypes of platforms recognized in D3.2 White paper, QualDeEPC project outlines the potential service provider, description of services and end-users addressed for each subtype and service/product that each EU Member State could operate.



Table 18 Relevant content by Subtype of platform

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 1.1 Energy Performance Certificates					
Linking with 1.2 Building deep renovation roadmap and possibly a passport					
				link to local providers	link to local providers
3. Information on building contrac- tors/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
4. Information on material or product man- ufacturers/ suppliers					



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
<b>5. Information on financing opportunities for deep renovation</b>					
<b>Help with applying for loan and grant programmes or third party financing</b>					
		online		in person	in person
<b>6. Active marketing of deep renovation and its benefits and costs</b>					
	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
<b>7. Network (platform) for learning, exchange and cooperation (local/regional/national)</b>					
	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 coordinating deep renovation demonstration project(s)					
15. Aggregation of building renovation projects					
Explanation	Relevant for the subtype	Comments	Not relevant		



Further information on the Deep Renovation Network Platforms concept can be found in the *Deliverable 3.2, White Paper on good practice in EPC assessment, certification, and use*<sup>2</sup>.

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<sup>2</sup> <https://qualdeepc.eu/public-project-deliverables>



### 3.3 Regular mandatory EPC assessor training

**Development Need:** Mandatory training on assessment and recommendations is required for initial certification and registration in some countries, while in others there are no such requirements. The development work of the QualDeEPC project focuses on training regarding the renovation recommendations and deep renovation, particularly using results on priority A (see chapter 3.1). High-quality energy assessment and certification demands enhancement of knowledge on the recent developments, therefore the QualDeEPC project proposes a regular, mandatory training for EPC assessors to maintain a high quality of issued EPCs, or at least a regular, mandatory examination based on voluntary training.

**Output 1:** Training content for regular training workshops or seminars

The training content for regular training workshops or seminars proposed, is targeting beyond the basic knowledge required for the EPC issuance and is focused on the following topics:

- recent changes in national or European Building Performance Acts,
- state-of-the-art technologies,
- deep energy renovation recommendations (priority A),
- common mistakes or errors in EPCs,
- funding programs for renovation and their technical requirements,
- *consumer information and communication,*
- *contract design,*
- *further (soft) skills for EPC assessors.*

The QualDeEPC policy proposal suggests as mandatory content of the regular training the information related to the first five topics that are directly linked with the quality of EPC's and the deep energy renovation recommendation, whereas the last three could be optional.

Detailed information about the contents for a regular training of EPC assessors is included in the chapter 6 of D3.2 (Veselá et al., 2021).<sup>3</sup>

### 3.4 High user-friendliness of the EPC

**Development Need:** High user-friendliness of the EPC is valued highly important by stakeholders and QualDeEPC country partners. Even though the EPC forms are designed to meet the EPBD requirements and to include the technical information related to the energy performance of the building, the actual EPC form is utilized in several occasions in EU member states, such as real estate transactions and funding programmes related to building renovation, and by various recipients, i.e. homeowners, potential buyers and tenants. For these reasons, the EPC form should be designed in a user-friendly way so as to provide easily the information needed. In addition, the information and its presentation should provide an incentive for implementing deep renovation of the building.

**Output 1: Template for an enhanced and more user-friendly EPC form**

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<sup>3</sup> <https://qualdeepc.eu/public-project-deliverables>



In the framework of WP3, a policy proposal related to the “High user-friendliness of the EPC” was developed and a template for an enhanced and more user-friendly EPC form has been implemented. The template consists of 4 pages plus 1 containing optional fields and could serve as the first step to the development of an individual deep renovation passport/roadmap for a building.

A detailed description of the form and design of the elements as well as details on how to obtain the needed input data are provided in the “White Paper on good practice in EPC assessment, certification, and use” (Veselá et al.)<sup>4</sup> available online at QualDeEPC project website. The elements of the proposed EPC form can be summarized as follows:

1. General data and building specification (standard requirement)
2. Current picture of building
3. Box and check mark for nZEB standard or smart readiness indicator on the first page of the EPC form template
4. Energy performance and classification (current and after implementation of ‘main option’ for energy renovation: standard requirement)
5. Place for CO<sub>2</sub>/ GHG emissions and savings on the 1st page of EPC form template
6. Past metered or modelled yearly total energy consumption
7. Details on building envelope and building HVAC system
8. Display of improved classifications and energy performance
9. Potential energy savings (in kWh/yr)
10. Detailed renovation recommendations by component
11. Useful combination of renovations and stepwise implementation
12. Link to Deep Renovation Network Platform
13. An (optional) 5th page to the EPC form to include the visualization and further space for national adaptation
14. Footnote to validity date

The design of the proposed template for an enhanced and more user-friendly EPC form developed by QualDeEPC, and the elements included in it, are presented in the figures overleaf.

The template form has also been adapted and translated for the seven EU Member States represented in the project team (Bulgaria, Germany, Greece, Hungary, Latvia, Spain, and Sweden), cf. D5.1 Report on the 7 nationally adapted enhanced assessment and certification schemes. Other countries would need to adapt it in a similar way.

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<sup>4</sup> <https://qualdeepc.eu/public-project-deliverables>



Template for an enhanced and more user-friendly EPC form

## EPC form *for residential buildings*

in accordance with *Building Energy ACT XYZ*

Registry no.: 123456789	Valid until: DD/MM/YYYY# <small>*EPC is valid 10 years from the date of issuance</small>	EPC type: e.g. asset rating
other requirement(s), e.g nZEB standard, calculation method		

### Building data

<b>Type of building</b>	<i>e.g. multi-family home,</i>	<i>Current picture of building</i>
<b>Address</b>		
<b>Additional specification of building</b>	<i>e.g. nine apartments;</i>	
<b>Year of construction</b>		
<b>Area</b>		
<b>Additional value</b>		

### Energy classification and performance

minValue [kWh/m <sup>2</sup> yr]	maxValue [kWh/m <sup>2</sup> yr]	Energy class	1 <sup>st</sup> value, e.g. Primary energy [kWh/m <sup>2</sup> yr]	2 <sup>nd</sup> value, e.g. final energy [kWh/m <sup>2</sup> yr]	"improved value" for Main Option* [kWh/m <sup>2</sup> yr]
		A+			
		A			
		B			234
		C			
		D			
		E			
		F	987		
		G			
		H			
<b>CO<sub>2</sub>-/GHG-emissions [kg CO<sub>2</sub> / (m<sup>2</sup>yr)]:</b>					

\* The underlying renovation recommendations and implementation scheme for the Main option are given on p. 3 & 4.

Potential final energy savings for renovation according to the Main Option:	XYZ kWh/yr
Potential savings of CO <sub>2</sub> -/ GHG-emissions according to the Main Option:	ABC kg CO <sub>2</sub> / yr

<b>Issuer</b> <i>e.g. address, telephone no., registry no.</i>	<b>Date</b>
	<b>Signature</b>

1



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Figure 27 First page of the enhanced EPC form template



## EPC form *for residential buildings*

in accordance with *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							

2

\*\*measured energy consumption depends on the use of heating, cooling, ventilation system (inkl. windows) and domestic hot water system of building occupants, as well as the number of occupants. Also, the 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 [m <sup>2</sup> ]	Description or Avg. U-value [W/m <sup>2</sup> K]	Energy rating##
Roof or ceiling to attic			
External walls			
Windows			
Doors/Gates			
Ground floor or floor to unheated 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			

## Meaning of energy rating:

-  Exceeds significantly the minimum standards of Building Energy Act (e.g. as suggested by funding programs)
-  Reaches or minimally exceeds the minimum standards of Building Energy Act (e.g. current regulations/ laws)
-  Lower than standards of Building Energy Act



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Figure 28 Second page of the enhanced EPC form template



## EPC form *for residential buildings*

in accordance with *Building Energy ACT XYZ*

### Renovation recommendations – component evaluation

Building envelope	Recommendation	"new" avg. U-value [W/m <sup>2</sup> K]	New Energy rating <sup>#</sup>	Cost effectiveness (e.g. pay-back time)	Included in Main option?
Roof or attic					<input type="checkbox"/>
External walls					<input type="checkbox"/>
Windows					<input type="checkbox"/>
Doors/Gates					<input type="checkbox"/>
Ground floor or floor to unheated basement					<input type="checkbox"/>

3

Technical systems	Recommendation	Energy source, provided power, EU energy label	New Energy rating <sup>#</sup>	Cost effectiveness (e.g. pay-back time)	Included in Main option?
Heating system					<input type="checkbox"/>
Domestic hot water					<input type="checkbox"/>
Ventilation system					<input type="checkbox"/>
Cooling system					<input type="checkbox"/>
Renewable energies (outside of other systems)					<input type="checkbox"/>
Other: e.g. Lighting					<input type="checkbox"/>

Potential final energy savings for renovation according to the Main Option: XYZ kWh/yr

Potential savings of CO<sub>2</sub>-/ GHG-emissions according to the Main Option: ABC kg CO<sub>2</sub>/ yr



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Figure 29 Third page of the enhanced EPC form template

## EPC form *for residential buildings*

in accordance with *Building Energy ACT XZY*

### Renovation recommendations – renovation concepts

Description of useful combination of renovations and stepwise implementation for the Main option:

4

Economic result (e.g. payback time, *optional*):

Main option meets requirements for:

<i>Nearly zero energy buildings in case of renovation:</i>	<input type="checkbox"/>
<i>Air tightness:</i>	<input type="checkbox"/>
<i>Reduced thermal bridging:</i>	<input type="checkbox"/>
<i>Min. 50% RES or equivalent measures:</i>	<input type="checkbox"/>

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

### 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*



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Figure 30 Fourth page of the enhanced EPC form template

## EPC form *for residential buildings*

in accordance with *Building Energy ACT XYZ*

### Graphical visualisation of energy performance *(optional)*

*Placeholder for visualisation of energy performance*

5

### Further information *(optional)*

*Here any further information can be presented which might be required or interesting on a national level, e.g. comparison to energy demand/ consumption of similar buildings, explanation of terms, ...*



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Figure 31 Fifth page of the enhanced EPC form template





## Output 2: Energy Rating Indicator

An indicator has been included in page 2 of the proposed EPC form. The indicator is referred as “energy rating”<sup>5</sup> and provides information about the energy performance of the building envelop components and technical systems by using three coloured symbols (green, yellow, red).

The same rating and indicator values are also applied to the state of energy efficiency that a building component would achieve after implementing the energy renovation recommendations on p.3 of the enhanced EPC form. The three coloured symbols (green, yellow, red) are linked to the following levels of energy rating:

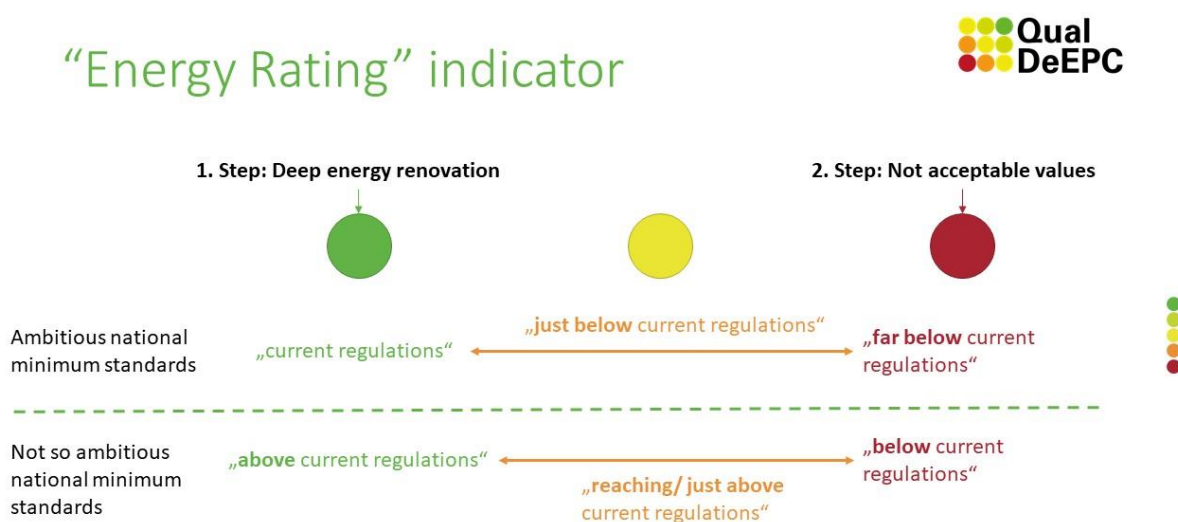


Figure 32: Energy rating indicator as defined by the QualDeEPC project

**A.** In case of ambitious national minimum standards already in force, the energy rating indicator and values could stand as follows:

- **Green:** Reaches the minimum standards set by the national the regulation/ legislation
- **Yellow:** Just below the minimum standards set by the national the regulation/ legislation
- **Red:** Significantly below the minimum standards set by the national the regulation/legislation

**B.** In case of less ambitious national minimum standards in force, the energy rating indicator and values could stand as follows:

- **Green:** Exceeds the minimum standards set by the national the regulation/ legislation
- **Yellow:** Reaching or slightly exceeding the minimum standards set by the national the regulation/ legislation

<sup>5</sup> D3.2 “White Paper on good practice in EPC assessment, certification, and use”, section 7.3.4





- **Red:** Below the minimum standards set by the national the regulation/legislation

Obviously, the threshold values for defining if a building or system component would be rated as green, yellow, or red, will need to be defined at national level. The idea is that green is closely related to the deep renovation recommendations (priority A).

### 3.5 Voluntary/mandatory advertising guidelines for EPCs and other potential measures for improving compliance with the mandatory use of EPCs in real estate advertisements

#### Development Need 1:

The [EPBD](#) requires that **the energy performance indicator of the energy performance certificate of the building or the building unit, as applicable, is stated in the advertisements in commercial media** when are offered for sale or rent (DIRECTIVE 2010/31/EU, recast 2018, art.12).

QualDeEPC recognized that the level of compliance with this provision varies among the Member States as well as in the represented countries in the project. One reason may be a difficulty for building owners to understand how to comply with the legal requirement. Therefore, a set of concrete advertising guidelines presenting EPCs in real-estate advertisements was developed. Further information can be found in [White Paper on good practice in EPC assessment, certification and use](#).

**Output 1: Concrete advertising guidelines** for presenting EPCs in real-estate advertisements during the sale and rental of buildings.

#### Proposal for voluntary guidelines for displaying EPCs (or its contents) in real estate advertisements

Content-related guidelines	Publication -related guidelines
<ul style="list-style-type: none"> <li>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<sub>2</sub> emissions</li> <li>Specify medium-specific EPC content that should be displayed in various mediums, such as print (especially small text in newspapers and magazines; potential limitations in printed media should be considered, e.g. less content requirement in printed media), digital and internet, audio-visual.</li> <li>URL to the EPC or EPC number should be provided, when possible, especially if EPCs are in public domain</li> <li>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</li> </ul>	<ul style="list-style-type: none"> <li>Provide publication parameters for displaying the EPC content such as size, colours, background, pixels, and typography.</li> <li>Provide softcopies of the EPC content, especially for digital media</li> <li>Provide graphical and text examples of advertisements for various media</li> </ul>

#### Output 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.”

**Output 3: Direct measures for ensuring compliance** with the mandatory use of EPCs in real estate advertisements by effectively controlling and enforcing: Policy proposal

**List of actions 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.	<ul style="list-style-type: none"> <li>Ministry of Economy - market inspectorate in Croatia</li> <li>The National Board of Housing, Building and Planning in Sweden</li> <li>Ministry of Energy, Commerce, Industry and Tourism (MECIT) in Cyprus</li> </ul>
Resources and competences	Adequate human and financial resources 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	<p>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:</p> <ul style="list-style-type: none"> <li>Marketing and advertising departments of real-estate portals, newspapers and magazines etc. to not accept advertisements that do not adhere to mandatory guidelines</li> <li>Housing finance companies, banks etc.</li> <li>Real-estate companies, letting agencies, property management firms etc.</li> <li>Building owner associations etc.</li> </ul>	
Methods of enforcement (active): penal provisions	<p>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.</p> <p>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.</p>	<ul style="list-style-type: none"> <li>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</li> <li>In Cyprus, Non-compliance has led to penalties in 22 cases. This has led to a</li> </ul>



Way to improve compliance	Description	Good practice examples
		<p>higher rate of EPC display in advertisements</p> <ul style="list-style-type: none"> <li>In Ireland, non-compliance of the regulations is liable on summary conviction to a class A fine</li> </ul>



## 4 CONCLUSIONS

The Report “*Collection of tools developed*” aims at summarizing the tools and concepts in order to support the policy proposals on seven priorities identified in the *D2.4 Development Strategy Plan* (Kostova et al. 2020) and fully developed in *D3.2 White Paper on good practice in EPC assessment, certification and use* (Veselá et al. 2021) of the QualDeEPC project.

The seven priorities selected for the development of enhanced EPC schemes are:

- A) Improving the recommendations for renovation, which are 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

The main outcomes are:

- A text-based list of deep energy renovation recommendations,
- 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,
- Training content for regular training workshops or seminars
- Concrete advertising guidelines for presenting EPCs in real-estate advertisements during the sale and rental of buildings and
- List of actions to improve compliance with the mandatory use of EPCs in real estate advertisements by an effective controlling and enforcing.

The tools and concepts developed are aligned to the Development Strategy Plan and as part of the White paper form the basis for the country-specific adaptation discussion, and to the extent possible implementation of the developed policy proposals in WP5. Any further improvements to the concepts and tools included in the final version of the White Paper that are found to be useful in general, also for other countries, are included in the Guidebook for improved EPCs (Deliverable 5.3).



## 5 REFERENCES

Kostova, D., Thomas, S., & Gokarakonda, S. (2020). *D2.4 Development strategy plan for the development of next generation EPC schemes* (p. 148). [https://qualdeepc.eu/wp-content/uploads/2021/11/QualDeEPC\\_D2.4\\_Development-strategy-plan\\_20211111\\_final.pdf](https://qualdeepc.eu/wp-content/uploads/2021/11/QualDeEPC_D2.4_Development-strategy-plan_20211111_final.pdf)

Veselá, Stephanie; Thomas, Stefan; Gokarakonda, Sriraj; Pannier, Peter; Korma, Effie; Lampropoulou, Lena; Androutsopoulos, Andreas (2020): Deliverable 3.1. Green paper on good practice in EPC assessment, certification, and use. QualDeEPC H2020 project. URL: [https://qualdeepc.eu/wp-content/uploads/2020/11/QualDeEPC\\_D3.1\\_Green-paper\\_20201105\\_final-comp.pdf](https://qualdeepc.eu/wp-content/uploads/2020/11/QualDeEPC_D3.1_Green-paper_20201105_final-comp.pdf)

Veselá, S., Thomas, S., Gokarakonda, S., Pannier, P., Korma, E., Lampropoulou, L., & Androutsopoulos, A. (2021). Deliverable 3.2. White paper on good practice in EPC assessment, certification, and use. *QualDeEPC\_D3.2\_White-Paper-on-good-practice-in-EPC-assessment-certification-and-use.pdf*. [https://qualdeepc.eu/wp-content/uploads/2021/11/QualDeEPC\\_D3.2\\_White-Paper-on-good-practice-in-EPC-assessment-certification-and-use.pdf](https://qualdeepc.eu/wp-content/uploads/2021/11/QualDeEPC_D3.2_White-Paper-on-good-practice-in-EPC-assessment-certification-and-use.pdf)

