iBRoad

Individual Building Renovation Roadmaps

Country-specific adoption of elements within the national version of iBRoad

Bulgaria, Poland, Portugal, Belgium/Flanders, Germany

ifeu – Institut für Energie- und Umweltforschung Heidelberg

February 2019

www.ibroad-project.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 754045

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Published in February 2019 by iBRoad.

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EXECUTIVE SUMMARY

This report considers the national adaptation of the iBRoad concept in Bulgaria, Poland, Portugal, Flanders and Germany. It analyses specific country characteristics like the existing availability and structure of EPCs, the energetic status of the building stock and common national renovation standards, the required content of the EPC and qualifications required to issue an EPC, barriers to and owners´ motivation for deep renovation, as well as existing energy audits and funding programmes.

All countries considered offer a high potential for a growing renovation market. A consultation tool like the individual Building Renovation Roadmap is very likely to raise the renovation rates as well as the level of indoor comfort. The general approach to energy renovation differs significantly among the considered Member States; however, the implementation of the iBRoad has to enable a common procedure. To this end, the basic added values and benefits arising from the necessary energy audit/consultancy activity and energy renovation need to be stressed throughout the whole communication process.

EPC data can be used as starting point for the iBRoad Roadmap creation. In general, the iBRoad Roadmap is based on building data derived from the EPCs. Energy auditors in the pilot countries all use country specific calculation software to create EPCs and therefore, the iBRoad Roadmap needs to be designed in a way that it can also be created using national calculation software. The iBRoad elements which are relevant for each national situation vary from country to country and, therefore, there is a need to either apply a more general solution or to take over the country specific solution.

At the moment, data export from the respective country specific software is limited or not possible at all. Consequently, data has to be entered manually into the iBRoad tools. In terms of manageability of the iBRoad tools, data export from national EPC software tools should be made available, as far as possible, in the future. The same applies for the data exchange with national EPC databases. In most of the countries considered, EPCs display the overall energy performance of buildings in the form of an energy class. An overall classification of the energetic state of the building is similarly possible in the iBRoad tools. However, such a classification needs to be based on country specific scales and thresholds, and be adapted to the specific display method. For example, the rating can be displayed either with capital letter classes or just with the colour related to the energy demand, to reflect the exact same rating and energy class as displayed in the EPC. Discrepancies between the energy classes would lead to confusion and reduce faith in the energy calculation in its totality.

In all countries considered, EPCs contain recommendations for energy renovation. EPC issuers and building owners are used to energy related renovation advices. The depth of renovation advices in the EPCs, however, varies significantly among the examined countries. Though in some countries, the EPCs also recommend renovation steps in the further future, there is no EPC that offers an individual renovation roadmap. The recommendations in the EPC should be used to advise the building owners to order both an iBRoad Logbook and Roadmap, and acknowledge the added value of these tools. Building owners should be informed that the iBRoad complements the EPC.

In all countries considered, a major barrier to renovation is the lack of information for building owners on how to properly plan, finance and implement their renovation. Therefore, building owners have a strong interest in getting a standardised long-term renovation plan. However, the auditors and auditing products need to become trustworthy to the homeowners. Another important barrier to renovation lies in the fact that building owners cannot afford the renovation cost or the costs are higher than the expected energy savings. In addition, many building owners seek for an improvement of comfort when renovating a building.

It has been shown that, especially in Bulgaria and Poland, renovation measures are often carried out by the building owners themselves or by not specially trained persons. This bears high technical risks in regards to deep renovation. It is therefore important to ensure homeowners´ acceptance of and trust in the iBRoad tools. In particular, it is important to highlight the advantages that arise from the iBRoad tools and the fact that qualified experts, namely energy auditors, elaborate these tools. These factors should awaken the desire to get a renovation roadmap. The iBRoad products should be designed in a way which communicates high quality and reliability. Thus, it is essential to ensure that energy auditors, who issue an iBRoad Roadmap, are adequately trained. In particular, the developed training courses and material should reflect the respective situations in the relevant country.

Building owners perceive energy audits as too technical and difficult to understand. Integrating graphical/text elements of iBRoad into the national software tools and making the results of the audit understandable, will make iBRoad user-friendly and help overcome this barrier. Accordingly, a simple assessment approach is favoured to display overall efficiency, component efficiency, comfort and co-benefits. The integration, in the iBRoad Logbook, of a "market place" would help to overcome the barrier that homeowners do not know where to find craftsmen and who to refer to for a renovation measure. Craftsmen and other suppliers could show their offers and contact data in such a function. The Logbook could offer a filter function to display only the branches needed. The market place could also be used to link homeowners to funding programmes or loans.

The markets for energy audits are very divers in the examined countries. In some countries, the audits rather target single-family buildings, whereas in others almost only multi-family buildings. In some countries, the requirements to EPCs and EPC issuers are much stricter than the requirements to energy audits, and vice versa. Despite these differences, there are common features to base the iBRoad upon. Experienced auditors are available. These are professionals that deal with energy renovations and who are used to think ahead of future building standards. They are the ones to provide the iBRoad renovation roadmap to the building owners. Within the iBRoad project, specific training courses will be developed to explain this new audit product to the auditors. Software tools for audits are already available. When developing the iBRoad tools, one needs to bear in mind the required calculation processes and the possible interface for a future automated data transfer. The communication and dissemination of the iBRoad project can build on existing auditor´s associations and expert lists. Building owners are used to energy audit products. The basic idea of professional audits that deal specifically with energy efficiency is familiar to buildings owners. The iBRoad audit can present itself as a further development of existing consultations. At the same time, it is important to avoid any competition between the existing audits and iBRoad audits. Thus, the differences need to be communicated very clearly. The iBRoad audits should complement existing audits in a way that building owners can choose which kind of audit suits them best.

The calculation methods, standards and norms differ between the examined countries. Accordingly, all energy calculations will be carried out using the specific national calculation software tools. Neither the iBRoad Roadmap Assistant nor the iBRoad Logbook are intended to carry out calculations of the buildings´ energy demands or emissions. The calculation results will have to be transferred from the national calculation software to the iBRoad tools. Ideally, an interface could provide data exchange between the iBRoad tools and the national calculation software. Most of the national calculation software tools are not prepared to calculate staged renovation processes. However, many tools are capable of calculating different building states, as this is an already built-in feature for comparing different renovation scenarios. This would be a sufficient basis to enable auditors to work with the iBRoad tools.

It is foreseen that at least 30 energy auditors within Bulgaria, Poland and Portugal (10 in each country) will be specially trained in face-to-face training courses. An additional training toolkit should accompany the trainings with a handbook, presentation and telephone hotline.

For the implementation of the iBRoad audits, it would be very helpful if existing national incentives could support the iBRoad. This refers to both incentives for energy audits and incentives for energy renovation.

For Bulgaria, the existing National Programme for Energy Efficiency in Multi-family Residential Buildings does not offer incentives for energy audits. Renovation measures recommended by the iBRoad Roadmap can receive support from two programmes, the `Residential Energy Efficiency Credit Line´ (REECL) and the ` Energy Efficiency and Renewable Sources Fund´ (EERSF). REECL proposes specific renovation types with a list of measures to implement and a list of installers. An energy audit is not required. The iBRoad concept does not contradict that, as long as the recommended measures meet the requirements in REECL and owners want to use and apply for the scheme.

The iBRoad audit could become very popular in Poland through the Thermal Modernisation and Refurbishment Fund which requires an energy audit. However, this is mainly used for multi-family buildings at the moment, which are not the main focus of the iBRoad project at this stage. On the other hand, the announced Clean Air programme could provide basic support to the iBRoad as it refers to private building owners.

In Portugal, the iBRoad Roadmap integrates very well with the existing funding schemes. Portugal has a well-developed Energy Performance Certification (EPC) scheme, which is based on the use of a central database and can establish the foundations for a larger building logbook. Energy audits under the EPC scheme are also common and carried out by experts with a robust knowledge and qualification.

In Flanders, the iBRoad renovation roadmap could be used very well as a reference to grant energy premiums. In that way, it would not be necessary to subsidise the roadmap itself. The combination of having an iBRoad renovation roadmap and carrying out two or three of the proposed measures in an early stage can become an effective way to stimulate deeper renovations.

In Germany, the iBRoad Logbook could become a helpful complement to the existing renovation roadmap. The comprehensive incentive programmes for both audits and renovations provide support to the implementation.

There are several country specific incentives to support the energy renovation of existing buildings in general and in particular for single-family and small multi-family houses which are at the main focus of iBRoad. In all countries that are described in this report, incentives are seen as an important factor for a successful market penetration of iBRoad products. Incentives would be very helpful for both the implementation of renovation measures and the issuing of the renovation roadmap. Thus, incentives should be integrated into the iBRoad products in two ways:

- As incentives for the implementation of renovation measures, they should be part of the main iBRoad documents, be displayed in overview pages of the Roadmap and also be explained in pages that give technical and economic details.
- In the iBRoad Logbook there should be general information about the specific incentives of the respective country.

I. INTRODUCTION

The Energy Performance of Buildings Directive (EPBD) requires a transformation of the majority of buildings towards a 'highly efficient and decarbonised building stock by 2050'. The iBRoad project works on supporting this process by developing an Individual Building Renovation Roadmap and a building logbook for single-family houses and small multi-family houses. These tools provide an individual renovation perspective over a long-term period of time that takes the long life cycles of building components into account. The iBRoad Logbook is a repository where all the building's related information can be stored and continuously updated.

Subject to this report are the specific conditions in the pilot countries of the project. The countries examined, either have already implemented a similar tool, i.e., Flanders and Germany (the so-called level 1 countries), or will attend a field testing of the iBRoad tools during the project, i.e., Bulgaria, Poland and Portugal (the so-called level 2 countries).

This report provides guidance on essential decisions concerning the adaptation of the tools to the existing specific framing in the considered countries. The report defines the corner stones by balancing the consistency of the iBRoad tools with the required flexibility to adapt to various conditions.

Based on country factsheets developed earlier in the project, the report analyses the individual building stock and common renovation standards to gain a deeper understanding of the actors and their motives. The report shows similarities and differences in the national EPCs and derives concrete solutions for the developed tools. These also refer to renovation recommendations, and qualifications and training for EPC issuers, as basic starting points for the iBRoad audits.

Barriers to deep renovations and prevailing motives and interests of the building owners are analysed based on a previous iBRoad report on potential user needs. This chapter shows the barriers and motives for energy renovation in the considered countries.

The iBRoad project aims at supporting the evolution of energy audit products in order to trigger deep renovations. Therefore, an identification and evaluation of the current market situation for energy audit products is essential to analyse whether there are substantial differences. The same applies to existing incentives for energy renovation or energy audits.

II. OBJECTIVES OF THIS REPORT

The adaptation of newly developed auditing tools in specific member states requires detailed knowledge of the existing framing. The aim is on the one hand to develop the tools as unified as possible, and on the other hand to be sufficiently flexible to be able to adapt to different conditions.

As part of the iBRoad project, strategies to adopt the concept of the individual Building Renovation Roadmap and the iBRoad Logbook need to be developed for

- *level 1 countries: Belgium/Flanders and Germany and*
- *level 2 countries: Bulgaria, Poland and Portugal.*

Level 1 countries have already adopted a concept similar to that of an individual Building Renovation Roadmap to support building owners with personalised advice to renovation options. Germany introduced the "Sanierungsfahrplan" in the federal state of Baden-Württemberg in 2015 and then transferred the concept to the federal level in 2017. Hence, for Germany, only strategies to adopt the iBRoad Logbook are highlighted in this report. Flanders launched in December 2018 a first version of the "Woningpas", a digital passport for relevant building and environment related data, whereas a series of upgrades will follow subsequently. Furthermore, the "EPC+" which includes renovation advice and outlines a renovation plan is launched in January 2019. For Flanders, this report illustrates strategies to link the "Woningpas" and the "EPC+" to the iBRoad tools.

The concept of individual Building Renovation Roadmaps and the iBRoad Logbook will be field-tested in pilot countries Bulgaria, Poland and Portugal.

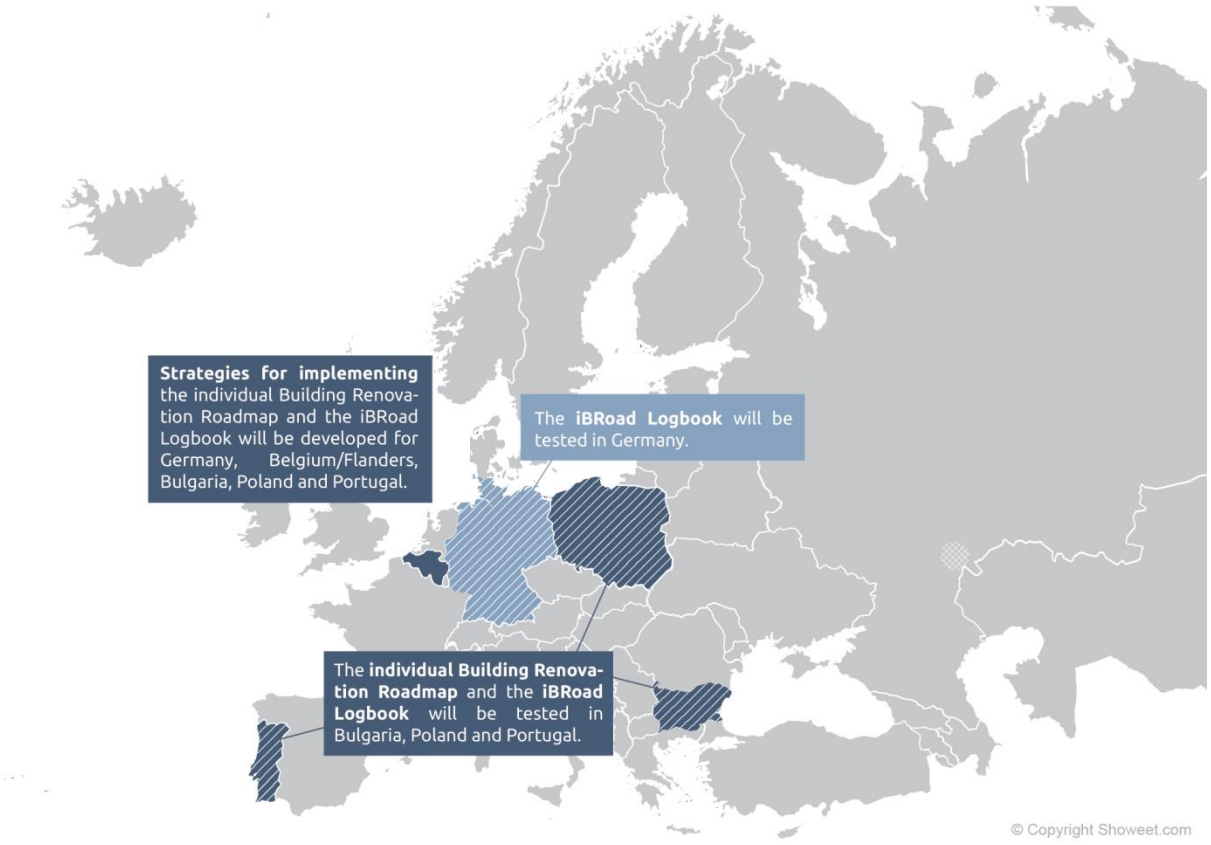


Figure 1: Pilot countries within the iBRoad project

However, the framework conditions under which the individual Building Renovation Roadmap and the iBRoad Logbook will be tested and applied differ significantly. Such conditions include, for example, differing national legislation, energetic status of the existing building stock, renovation rate, common renovation standards, the existing market situation for energy audit products and availability of qualified and experienced energy auditors as well as prevailing motives, and barriers and interests of the building owners in the respective countries.

To ensure that the iBRoad Renovation Roadmap and the iBRoad Logbook have the greatest possible impact, the underlying concept of the tools needs to be adopted and the tools need to be tailored to the specific market. This report examines the country specific situation with regard to the above-mentioned aspects, highlights strategies to adopt the iBRoad concept and, eventually, highlights the country specific adoption of elements within the iBRoad tools. Thereby it ties up with and pursues previous project outcomes under work packages 2 (exploring the principles of Individual Building Renovation Roadmaps) and 3 (developing modules and key approaches) and also, is the basis for the field tests.[1]

Methodology

Strategies to adopt the concept of the iBRoad Renovation Roadmap and the iBRoad Logbook are developed in close cooperation with the specific iBRoad country partners through questionnaires and interviews. Also, the choice for and national adaptation of the various elements to be included in the iBRoad Renovation Roadmap and iBRoad Logbook is conducted in the same way.

[1] e.g. BPIE (2018). Country Factsheets. Current use of Energy Performance Certificates and potential links to iBRoad. http://ibroad-project.eu/news/8-country-factsheets/.

III. ENERGETIC STATUS OF THE EXISTING BUILDING STOCK AND COMMON RENOVATION STANDARDS

Knowledge about the energetic status of the specific building stocks as well as the common renovation standards is essential for the adaptation of the iBRoad tools to the country needs. These indicators define the scope of actions and the flexibility required.

i. Overview

Common to all countries considered in this context is the fact that larger parts of the residential building stock consist of old and energy inefficient houses. The majority of residential buildings are either insulated only at sub-optimal levels or not at all insulated. The (deep) renovation rate is very low and mostly below one per cent.

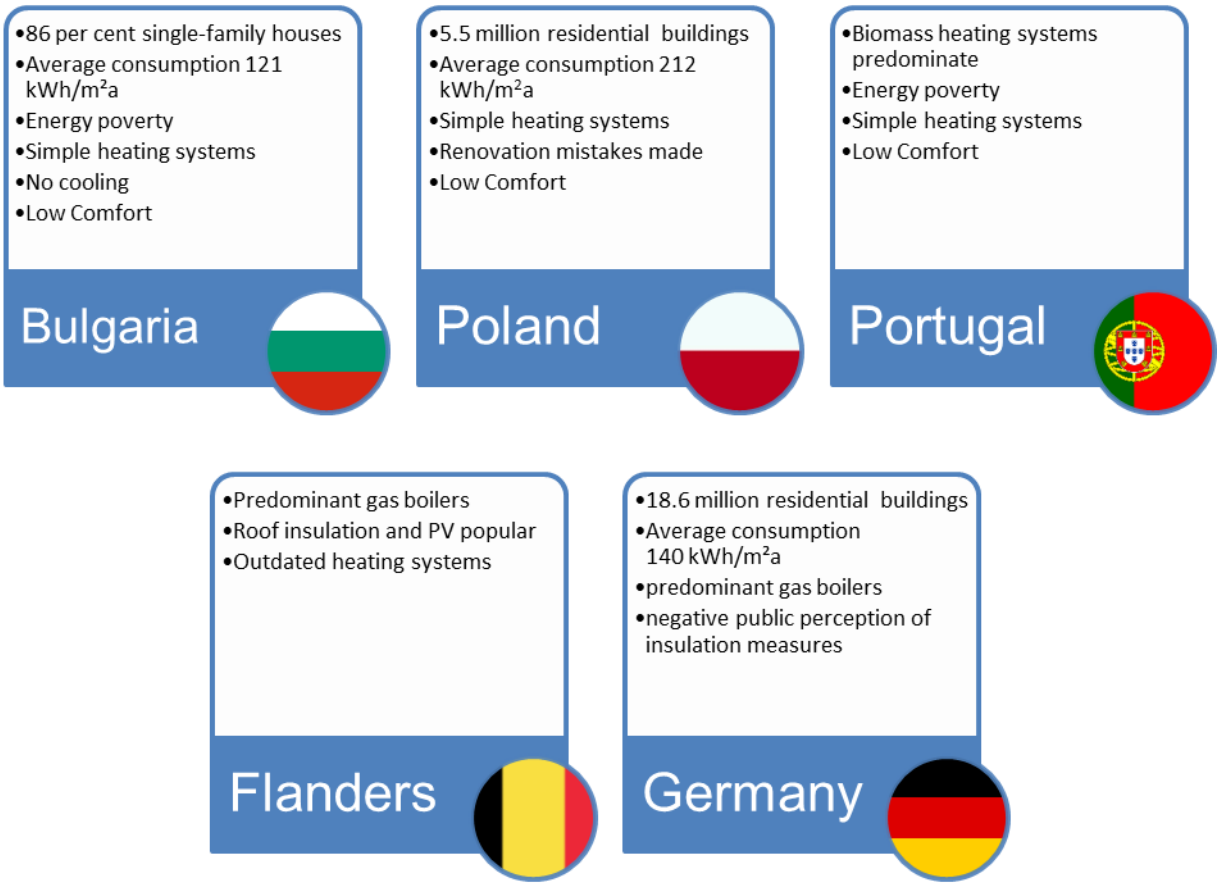


Figure 2*:* Energetic building status and renovation standards in the pilot countries

ii. Situation per country in detail

Bulgaria

In Bulgaria, there are approximately 1.5 million residential buildings: Single-family houses are prevailing (86 per cent), and especially in rural areas their number is significant. Multi-family houses are more common in towns and cities (Census and Dwelling fund 2011).

The calculated energy performance of residential buildings corresponds most often to energy classes D and E (within a range of A+ to G), while the real energy consumption is relatively low (BPIE 2016). The average energy consumption in the Bulgarian building stock is 121 kWh/m²year (BPIE 2018). This discrepancy can be explained by the high level of energy poverty in Bulgaria. Occupants often turn off or turn down heating devices in order to reduce energy costs and only use one or two rooms of the building – other rooms will not be heated. Considering this situation, it is quite obvious that there are often problems with moisture and mould.

The most common heating source in Bulgaria is a mix of wood and coal used in solid fuel burners. The price for these heating sources is still low. In addition, heating subsidies are granted when buying wood or coal. Also electricity is a common heating source.

Furthermore, most of the residential buildings do not have cooling systems, which is a problem for the occupants in summer due to high summer degrees.

Usually, only things that need urgent reparation will be fixed. A renovation measure that homeowners often take into consideration as a first step is changing the old wooden window framework. However, the quality often lacks in terms of the used window glazing or installation. Prices for changing low-standard windows are about 100 – 130 EUR/m². In contrast, the price for triple glazing and good quality windows starts from 200 EUR/m².

Poland

In Poland there are approximately 5.5 million residential buildings. The average residential energy consumption of the Polish building stock is 212 kWh/m²year (BPIE 2018). Table 1 shows the age structure and the energy consumption of the Polish residential building stock.

Building construction year	Buildings		Primary energy consumption	Final energy consumption
	Number (in Thousand)	Percentage (per cent)	(kWh/m²/year)	(kWh/m²/year)
Until 1918	404,7	7.3	> 350	> 300
1918 - 1944	803,9	14.5	300 - 350	260 - 300
1945 - 1970	1363,9	24.6	250 - 300	220 - 260
1971 - 1978	659,8	11.9	210 - 250	190 - 220
1979 - 1988	754,0	13.6	160 - 210	140 - 190
1989 - 2002	670,9	12.1	140 - 180	125 - 160
2003 - 2007	321,6	5.8	100 - 150	90 - 120
2008 - 2011	205,1	3.7	120 - 175	100 - 155
2012 - 2013	27,7	0.5	100 - 175	100 - 155
2014 - 2015	332,7	6.0	105 - 120	85 - 100

Table 1: Age structure and energy consumption of the Polish residential building stock. Source: AHK Poland 2016

The most popular heating sources in single and two-family houses in Poland are coal and wood which are burned in solid fuel boilers. Many households have problems with maintaining proper temperature in used spaces. This is caused by poorly designed installation and insufficient boilers or due to the fact that the building occupants decide to reduce internal thermal comfort to decrease energy costs.

Cooling systems are not common in single-family houses. Consequently, people who live in attics or houses with windows directed to the south encounter overheating problems throughout all warm months.

Problems with moisture or mould are usually seen in old houses where the owner installed new windows. PVC windows are usually airtight and disturb the natural airflow in the building. Further problems with moist and mould are caused by malfunctioning ventilation system and construction mistakes.

The most frequently carried out modernisations are related to the external envelope, as they are said to be easy to carry out and result in high energy savings. The least popular modernisations are those related to ventilation or a renewable energy system. Typical costs of a renovation vary across Poland. For Warsaw, costs are approximately 50 EUR/m² for insulating external walls, 20 EUR/m² – 35 EUR/m² for insulating a roof, 170 EUR/m² for a change of window, and 250 EUR/m² for a change of external doors[2]. The most common mistakes concern installation of very thin insulation layers and mounting windows and doors in a way that causes thermal bridges.

Portugal

The most common energy source for space heating in Portugal is biomass (68 per cent), followed by diesel fuel (14 per cent), electricity (14 per cent), butane gas (2 per cent) and natural gas (2 per cent) (Portuguese National Statistics, 2010). Energy poverty affects the Portuguese population, namely the older ones, and their economic incapacity to heat their houses. In 2016, a study by the Centre for Environmental and Sustainability Research concluded that, in average, 22 per cent respectively 29 per cent of the population is unable to heat their houses during the winter or cool them during the summer months, due to economic issues. Also, in 2017, a survey by Quercus (the Nacional association for the conservation of Nature), reported that 74 per cent of the respondents consider their houses cold during winter, 25 per cent say that they are hot during summer, and only 1 per cent says that their house is thermally comfortable. According to the European Union statistics on income and living conditions, published by Eurostat in 2017, about 25.5 per cent of the Portuguese population reported problems with moisture and mould in their houses.

Renovation measures are carried out by professionals following the relevant legal frame. Usually, envelope renovation (such as replacing windows and roof insulation), or domestic hot water equipment are pursued. Wall insulation, although recommended namely in the EPCs, is usually not adopted. On the opposite side, replacement of windows is usually the most adopted measure since it is easy to implement.

Given the climate and the building stock characteristics, the Portuguese buildings usually have high heating but low cooling needs.

The graphic bellows shows a quick perspective of the renovation measures most often recommended for residential buildings, as identified by the Portuguese scheme.

[2] Cost related to component surface area

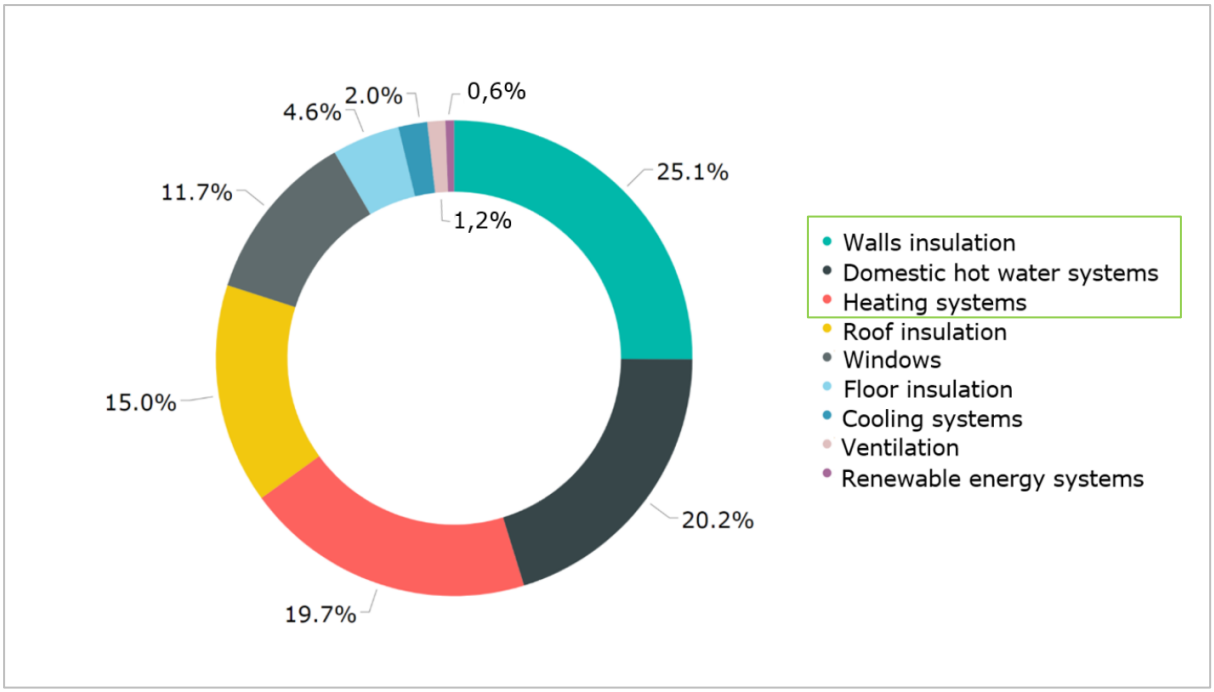


Figure 3: Current status for residential buildings (2019 March) from PT energy certification system (SCE)

Flanders (Belgium)

78 per cent of the Flemish households have an individual central heating system, 6 per cent have a common central heating system and 16 per cent have individual local heaters. Those with individual central heating systems mainly have radiators or convectors (94 per cent)[3].

The majority uses gas as the main energy source for heating (69 per cent), followed by oil (16 per cent), electricity (8 per cent) and wood (4 per cent). In free-standing houses, typically located at more rural locations, the share of gas is only 49 per cent and that of oil is 33 per cent. The opposite is seen in apartments were the share of gas is 81 per cent and that of oil 5 per cent.

The mean temperature in the living rooms is 20,9 °C during the day and 15,8 °C during the night. The hallway and sleeping rooms are rarely heated (74 per cent of the sleeping rooms and 55 per cent of the hallways are never heated, even when someone is at home during the day). 34 per cent of the households with central heating, report to use additional heaters. It is not known whether this is due to insufficient comfort conditions or due to other reasons like extra cosiness.

During summertime, 76 per cent of households experience too high indoor temperatures. Still, only 6 per cent of all households have a cooling system and only 5 per cent of the households without cooling system are planning to install a cooling system in the next 5 years.

Photovoltaic panels are installed in 12 per cent of the residential buildings. Free-standing and semi-terraced houses are more likely to have PV-panels (21 per cent and 16 per cent, respectively) than terraced houses (10 per cent) and apartments.

During the last 10 years, roof insulation has been the most popular insulation measure, followed by replacement of the windows and cavity wall insulation – see table below.

[3] Survey on the energy awareness and behaviour of Flemish households (2017). Flemish Energy Agency

	Percentage of residential buildings in which the insulation measure has been carried out during the last 10 years	Percentage of residential buildings in which the insulation measure has been executed by a professional
Roof insulation	25 per cent	52 per cent
Replacement of windows or glazing	13 per cent (of which 81 per cent concerned total window replacement)	95 per cent
Cavity wall insulation	6 per cent	89 per cent
Floor insulation	5 per cent	47 per cent
Exterior wall insulation	4 per cent	71 per cent
Interior wall insulation	4 per cent	45 per cent
None of the above	67 per cent	/

Table 2: Share of renovation measures in Belgium/Flanders by building component

When asked which energy saving measure the household planned to execute within the next 5 years, roof insulation was again the most popular (12 per cent), followed by the replacement of the boiler by a condensing one (11 per cent) and the installation of PV-panels (10 per cent). Replacement of the boiler by a heat pump or wood pellet boiler (5 per cent and 3 per cent, respectively) and floor insulation (4 per cent) were the least popular.

Germany

The German building stock contains about 21.3 million buildings, 18.6 million of which are residential buildings. 63 per cent of the buildings were built before 1978 when the first German thermal protection regulation came into force. About 15.0 million buildings are single-family and two-family houses. The average final energy consumption for heating in residential buildings has declined from over 200 kWh/m²year in the year 2000 to 140 kWh/m²year. However, greenhouse gas emissions in the building sector have not lowered since 2014. In about 35 per cent of the buildings, insulations of the outer walls were carried out during renovations, however, insulation layers do not necessarily meet actual standards (dena 2015).

With 13.3 million, gas boilers are dominating the heating systems, followed by 5.7 million oil boilers, 1.0 million heat pumps and 0.8 million wood ovens or boilers (BDI 2018). Additionally, 0.37 million mostly larger multi-family houses are being heated by heating networks (AGFW 2017). About 12 per cent of the heating systems are older than 25 years, and can thus be considered as outdated (ZIV 2018).

In 2010, ventilation systems were installed in 1.5 per cent of the German buildings, and cooling systems in less than 1 per cent (IWU 2010).

Energy renovations are usually carried out by craftsmen as required by the funding schemes. The number of outer wall insulations, however, has declined by about 30 per cent since 2012 caused by a broad media reporting about flammable insulation materials.

	Buildings		Flats	
	in Thousand	in per cent	in Million	in per cent
Until 1859	533	3	0,81	2
1860 – 1918	1929	11	4,5	12
1919 – 1948	2236	12	4,3	11
1949 - 1957	1679	9	9,3	10
1958 – 1968	2762	15	6,9	17
1969 – 1978	2580	14	6,3	16
1979 – 1983	1200	7	2,5	6
1984 – 1994	2150	12	4,6	12
1995 – 2001	1919	11	3,7	9
2002 - 2009	1251	7	1,9	5
Total	18239	100	39,2	100

Table 3: German building stock by year of construction in May 2011 (TABULA, "Residential Building Typology - Germany", Available: http://episcope.eu/building-typology/country/de/)

iii. Consequences for iBRoad

The key question to answer in this section is: what are the consequences from the energetic status of the existing building stock and the common renovation standards in the pilot countries, as set out above, for the iBRoad project?

All countries considered above offer a high potential for a growing renovation market. A consultation tool like the individual Building Renovation Roadmap is very likely to raise the renovation rates and the level of indoor comfort as well. Thus, buildings that are still in the original energetic state of the year of construction get a clear path to high-level energy renovations, in line with the climate targets. Especially buildings with more simple system technologies are given the opportunity to avoid technical detours and point directly to renewable energies from the start. Buildings that are already in a lock-in-situation get a long-term perspective to reach higher energy performance while avoiding extreme efforts for doing so at the same time.

The general approach to energy renovation differs significantly between the considered member states. Still, the implementation of the iBRoad has to enable a common procedure. To this end, the basic added values of energy renovation and consultancy need to be stressed throughout the whole communication process.

The individual Building Renovation Roadmap and the Logbook have to take into consideration the scope of existing technical standards, construction types and building technologies in the specific countries. Furthermore, a certain flexibility is required while developing the tools for the future adaptation to other countries with yet unknown requirements.

IV. IMPLEMENTATION OF ENERGY PERFORMANCE CERTIFICATES

i. Overview

The iBRoad project aims at extending Energy Performance Certificates (EPCs) in order to trigger deep renovations. EPCs reflect the energetic status of the buildings and intend to show that there is room for improvement. However, the impact of the EPCs on the rate and depth of renovations is very limited (European Commission 2015). Depending on the national implementation, EPCs will be used as starting points to create an individual Building Renovation Roadmap and the iBRoad Logbook. To this end, the EPCs of the pilot countries are analysed concerning their compatibility with the iBRoad products.

Note

The Energy Performance of Buildings Directive (EPBD) introduced the instrument of Energy Performance Certificates (EPCs) with the aim to create more transparency about the energy performance of individual buildings. To date, the implementation of this instrument by member states varies significantly in terms of scope, information, comparability and user-friendliness, limiting its acceptance by the users and its market penetration.

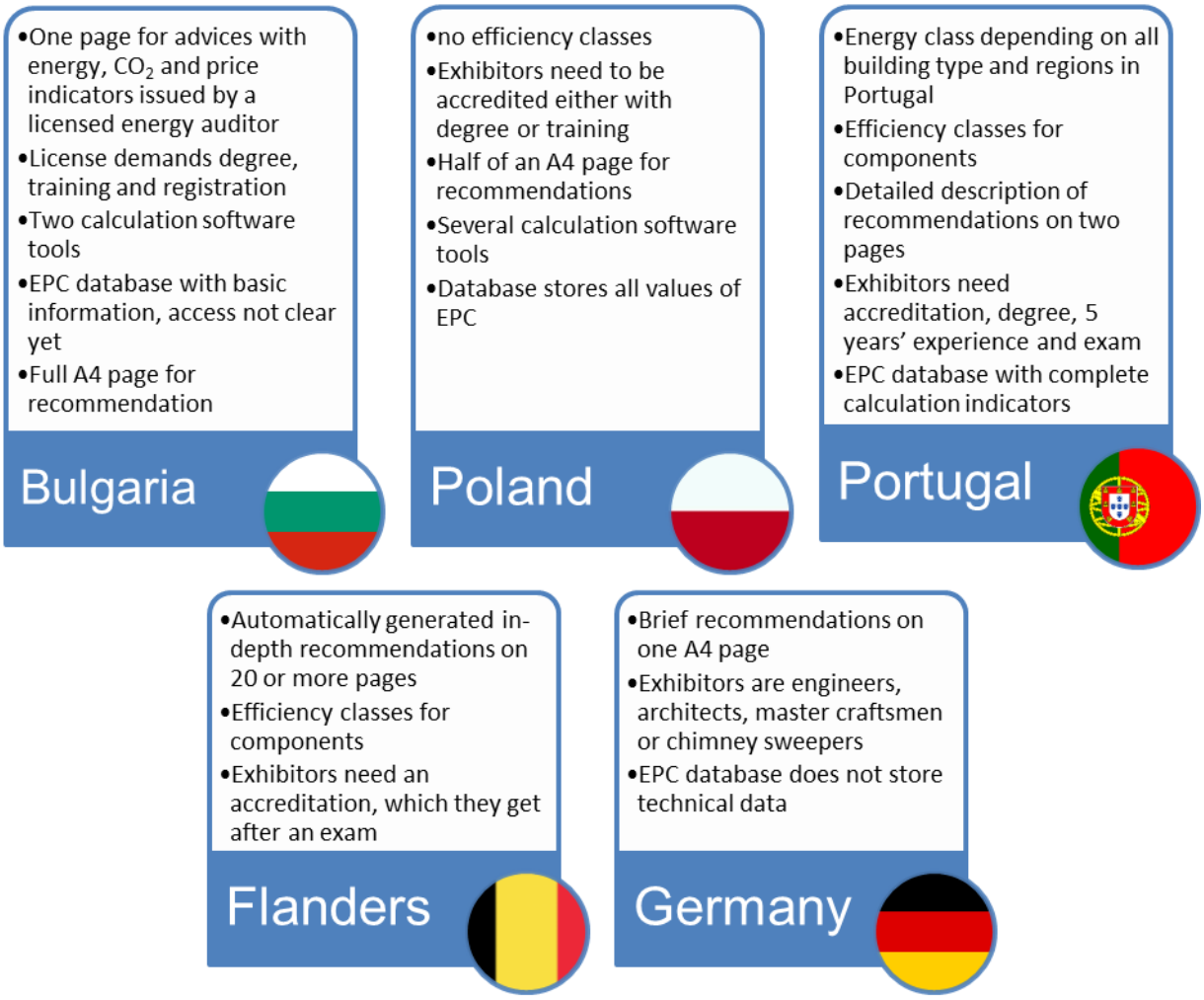


Figure 4: Energetic building status and renovation standards in the pilot countries

ii. Situation per country in detail

Bulgaria

In Bulgaria there are two different kinds of EPCs for residential buildings: one for new buildings and one for existing buildings. In general, both EPCs are very similar to each other but differ in their information content.

The existing building's EPC is an MS Word file with macros. The file has six pages in total; five of them are relevant for the homeowner and are mandatory. The remaining page contains instructions with regard to the creation of the EPC.

СЕРТИФИКАТ

за енергийни характеристики на сграда в експлоатация

Номер	СГРАДА С БЛИЗКО ДО НУЛАТА ПОТРЕБЛЕНИЕ НА ЕНЕРГИЯ	ДА ☐ НЕ ☒	СГРАДА ВЪВЕДЕНА В ЕКСПЛОАТАЦИЯ ЗА ПЪРВИ ПЪТ ПРЕЗ: 1966 г.
Валиден до:			

Сграда/Част	Адрес:
Идентификатор	(по смисъла на ЗКИР)

Разгъната застроена площ		m^2
Отопляема площ		m^2
Площ на охлаждания обем		m^2

Актуална снимка на сградата към момента на обследването за енергийна ефективност

EP_{min} kWh/m²	EP_{max} kWh/m²	Скала на енергопотребление по първична енергия kWh/m²	Преди ЕСМ kWh/m²	След ЕСМ kWh/m²
<	48	A+		
48	96	A		
96	190	B		150
191	240	C		
241	290	D		
291	363	E	320	
364	435	F		
>	435	G		

Енергийни характеристики на сградата	
Специфичен разход на потребна енергия	... kWh/m²
Специфичен разход на потребна енергия за отопление, вентилация и БГВ	... kWh/m²
Общ годишен разход на първична енергия	... MWh
Генерирани емисии CO_2	... тона/год.

РАЗПРЕДЕЛЕНИЕ НА ГОДИШНИЯ РАЗХОД НА ПОТРЕБНА ЕНЕРГИЯ

Общ годишен разход на потребна енергия ....., MWh

Отопление	Вентилация	Охлаждане	Гореща вода	Осветление	Други	Дял на енергията от ВИ
...%	...%	...%	...%	...%	...%	....%

Срок на освобождаване от данък сгради по ЗМДТ
от xx.xx.xxxx г. до xx.xx.xxxx г.

Издаден от
(наименование на юридическото лице) (име, фамилия на упълномощеното лице)

Регистрационен номер
№ ..... / ..... г.

Подпис, печат

Издаден на

2

ЕНЕРГИЙНИ ХАРАКТЕРИСТИКИ НА СГРАДАТА

ОГРАЖДАЩИ КОНСТРУКЦИИ И ЕЛЕМЕНТИ

Наименование	Площ	[2] Коефициент на топлопреминаване		
		Референтен	Преди ЕСМ	След ЕСМ
-	m^2	$W/m^2.K$	$W/m^2.K$	$W/m^2.K$
Стени (външни)				
Прозорци (външни)				
Прозорци на покрива				
Врати (външни)				
Покрив				
Под				

ПОКАЗАТЕЛИ НА ЕНЕРГОПРЕОБРАЗУВАЩИТЕ СИСТЕМИ В СГРАДАТА

1. Показатели за технологичните процеси на отопление и вентилация			2. Ефективност на генератора на топлина, %		
Показател	Преди ЕСМ	След ЕСМ	Преди ЕСМ	След ЕСМ	[1] Норма
Инсталирана мощност за отопление, kW	...	...	...	...	...
	...	...	...	...	...
Ефективност на рекуперацията на топлина при вентилация, %			...	...	$\eta_{r,min} \geq$ ... %
			...	...	$\eta_{r,min} \geq$ ... %

3. Ефективност на генератора на студ (включително термопомпа с приложение за отопление)			
Показател	Преди ЕСМ	След ЕСМ	[3] Норма за възобновяема енергия
Коефициент на трансформация при генерирането на топлина	...	...	...
	...	...	...
Коефициент на трансформация при генерирането на студ	...	...	
	...	...	
4. Енергия от възобновяеми източници	..... MWh	..... MWh	

Издаден на

Издаден от

3

РАЗПРЕДЕЛЕНИЕ НА ГОДИШНИЯ РАЗХОД НА ПОТРЕБНА ЕНЕРГИЯ

АКТУАЛНО СЪСТОЯНИЕ КЪМ МОМЕНТА НА ОБСЛЕДВАНЕТО

Система	Енергиен ресурс	Генератор	Годишен разход на потребна енергия	
			Специфичен	Общ
Вид	Вид	Вид	kWh/m²	kWh
Отопление			...	...
Вентилация			...	...
Охлаждане			...	...
Гореща вода			...	...
Осветление			...	...
Други - уреди, потребяващи енергия			...	...

Отоплителни денградуси	.....
Общ годишен специфичен разход на енергия за отопление и вентилация	....., kWh/m³DD

Препоръки:

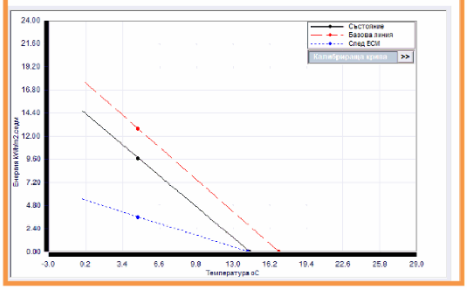
Информация относно възможностите за финансиране на ЕСМ и друга актуална информация за състоянието на енергийната ефективност в България може да бъде намерена на електронната страница на Агенция за устойчиво енергийно развитие: http://www.seea.government.bg

Издаден на

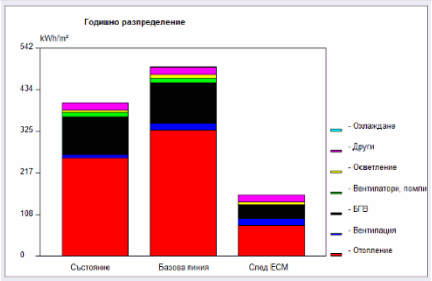
Издаден от

4

БАЗОВА ЛИНИЯ НА ЕНЕРГОПОТРЕБЛЕНИЕТО

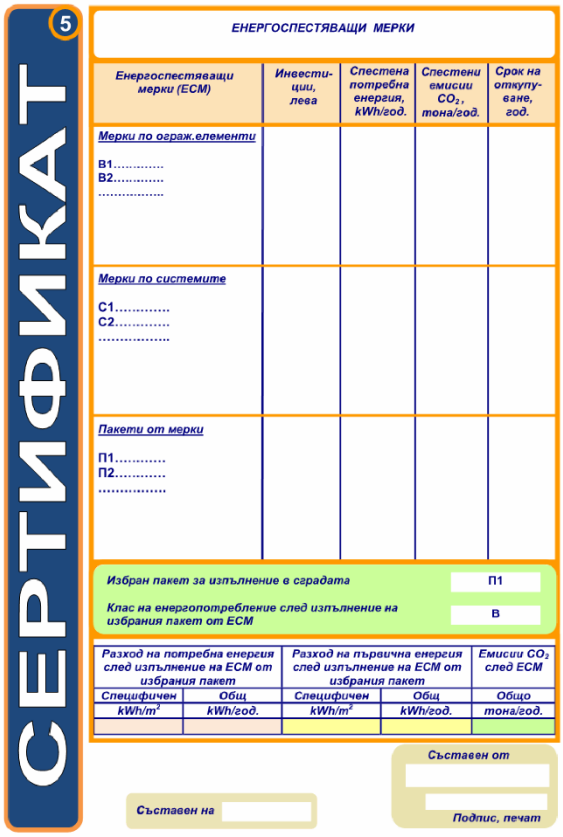


ГОДИШНО РАЗПРЕДЕЛЕНИЕ НА СПЕЦИФИЧНОТО ЕНЕРГОПОТРЕБЛЕНИЕ



Издаден на

Издаден от



5

СЕРТИФИКАТ

ЕНЕРГОСПЕСТЯВАЩИ МЕРКИ

Енергоспестяващи мерки (ECM)	Инвести-ции, лева	Спестена потребна енергия, kWh/год.	Спестени емисии CO_2, тона/год.	Срок на откупу-ване, год.
Мерки по ограж.елементи В1..... В2.....				
Мерки по системите С1..... С2.....				
Пакети от мерки П1..... П2.....				

Избран пакет за изпълнение в сградата	П1
Клас на енергопотребление след изпълнение на избрания пакет от ECM	В

Разход на потребна енергия след изпълнение на ECM от избрания пакет		Разход на първична енергия след изпълнение на ECM от избрания пакет		Емисии CO_2 след ECM
Специфичен	Общ	Специфичен	Общ	Общо
kWh/m^2	kWh/год.	kWh/m^2	kWh/год.	тона/год.

Съставен от

Подпис, печат

Съставен на

Figure 5: Bulgarian standard EPC form for existing residential buildings (Ministry of Regional Development and Public Works) [4]

The first page of the EPC provides an overview of the energetic status of the building. The Information contained includes: general certificates' and issuance information (e. g. issuing number and data of issue and expiration), general building information (such as address, gross floor area, year of construction, heating and cooling area), an energetic classification of the building, the primary energy consumption at actual state and after implementing the recommended energy saving measures, Information about energy consumption at the current state including specific energy needs (kWh/m²year) for heating, ventilation and domestic hot water, primary energy (MWh/year) and tonnes of CO_2, the percentage of energy consumption per section and the share of renewables, information about the period of building tax exemptions, if it is available, and indication whether the building achieves NZEB criteria or not. The class boundaries refer to the primary energy demand. They are valid for all building types and all regions in Bulgaria. There are no efficiency classes for components of the building envelop or technical systems.

The second page contains more detailed information with regard to the building envelope and building systems: living space (m²), heat transfer coefficient (W/m²K) before and after implementing the recommended energy savings measures, information about heating, ventilation and cooling before and after measures (power, kW), coefficient of performance and efficiency of heat recovery (per cent) and the share of renewable energy before and after measures (MWh/year).

The third page contains detailed information about the energy consumption (kWh/year): e. g. energy source, types of generator and energy use for heating, ventilation, cooling, domestic hot water, lighting

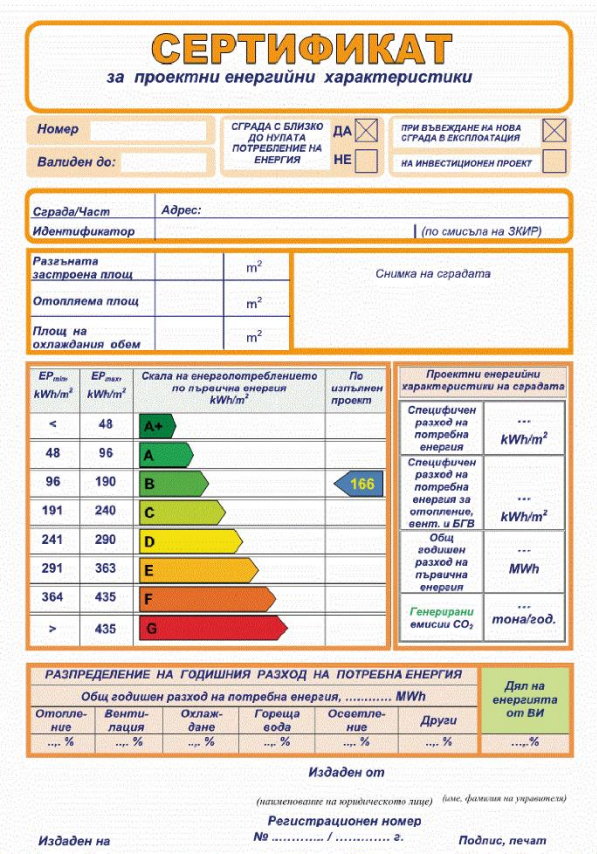
[4] Ministry of Regional Development and Public Works: Ordinance № Е-РД-04-1 from January 22nd 2016 for energy efficiency audits, certification and assessment of energy savings of buildings, 2016

and others, heating degree days and overall annual specific consumption per heat and ventilation (kWh/m³degree day). There is also space for additional recommendations.

Page 4 contains two graphics showing the energy consumption of the building depending on the outside temperature and showing the shares of specific energy consumption divided into heating, ventilation, domestic hot water, lighting, cooling and others (usually appliances). Both of the graphics have to be imported from the national energy software.

The fifth page of the EPC contains information about energy saving measures and presents recommended packages of energy measures including investment, saved energy (kWh), saved CO_2 emissions (tCO_2/year) and payback period.

The Bulgarian EPC for new buildings consists of three pages similar to the existing building's EPC (pages one to three).



СЕРТИФИКАТ

за проектни енергийни характеристики

Номер

Валиден до:

СГРАДА С БЛИЗКО ДО НУЛАТА ПОТРЕБЛЕНИЕ НА ЕНЕРГИЯ — ДА ☒ НЕ ☐

ПРИ ВЪВЕЖДАНЕ НА НОВА СГРАДА В ЕКСПЛОАТАЦИЯ ☒

НА ИНВЕСТИЦИОНЕН ПРОЕКТ ☐

Сграда/Част

Адрес:

Идентификатор (по смисъла на ЗКИР)

Разгъната застроена площ		m²
Отопляема площ		m²
Площ на охлаждания обем		m²

Снимка на сградата

EP_{min} kWh/m²	EP_{max} kWh/m²	Скала на енергопотреблението по първична енергия kWh/m²	По изпълнен проект
<	48	A+	
48	96	A	
96	190	B	166
191	240	C	
241	290	D	
291	363	E	
364	435	F	
>	435	G	

Проектни енергийни характеристики на сградата

Специфичен разход на потребна енергия	--- kWh/m²
Специфичен разход на потребна енергия за отопление, вент. и БГВ	--- kWh/m²
Общ годишен разход на първична енергия	--- MWh
Генерирани емисии CO_2	--- тона/год.

РАЗПРЕДЕЛЕНИЕ НА ГОДИШНИЯ РАЗХОД НА ПОТРЕБНА ЕНЕРГИЯ

Общ годишен разход на потребна енергия, ... MWh

Отопление	Вентилация	Охлаждане	Гореща вода	Осветление	Други	Дял на енергията от ВИ
... %	... %	... %	... %	... %	... %	...%

Издаден от

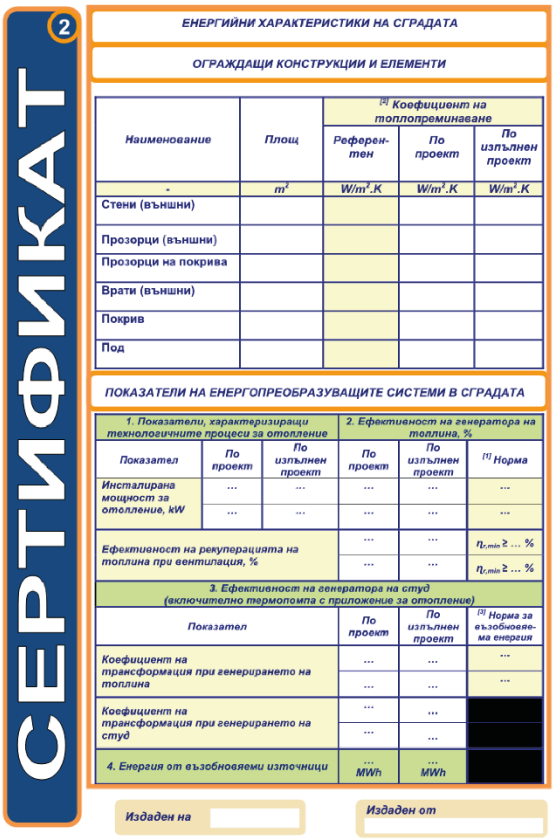
(наименование на юридическото лице) (име, фамилия на управителя)

Регистрационен номер

№ ..... / ..... г.

Издаден на

Подпис, печат



СЕРТИФИКАТ 2

ЕНЕРГИЙНИ ХАРАКТЕРИСТИКИ НА СГРАДАТА

ОГРАЖДАЩИ КОНСТРУКЦИИ И ЕЛЕМЕНТИ

Наименование	Площ	[2] Коефициент на топлопреминаване		
		Референтен	По проект	По изпълнен проект
-	m²	W/m².K	W/m².K	W/m².K
Стени (външни)				
Прозорци (външни)				
Прозорци на покрива				
Врати (външни)				
Покрив				
Под				

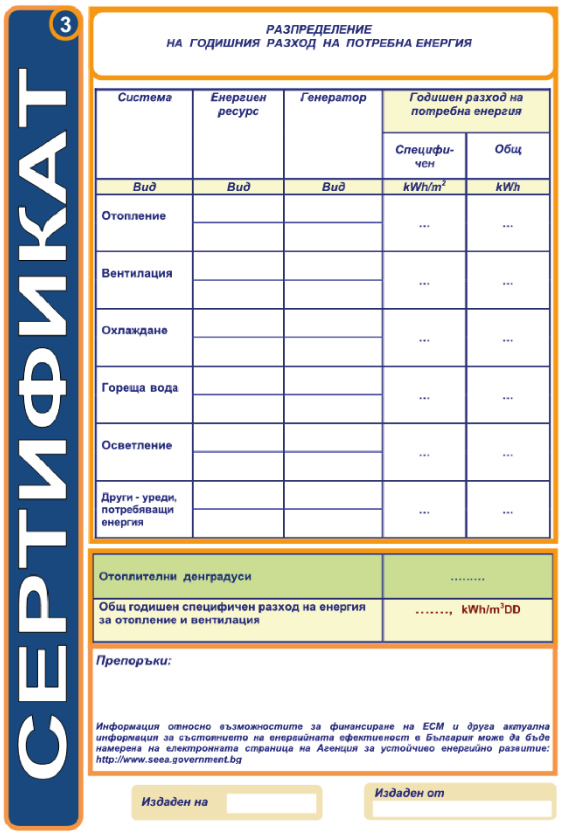
ПОКАЗАТЕЛИ НА ЕНЕРГОПРЕОБРАЗУВАЩИТЕ СИСТЕМИ В СГРАДАТА

1. Показатели, характеризиращи технологичните процеси за отопление			2. Ефективност на генератора на топлина, %		
Показател	По проект	По изпълнен проект	По проект	По изпълнен проект	[1] Норма
Инсталирана мощност за отопление, kW	...	...	...	...	...
	...	...	...	...	...
Ефективност на рекуперацията на топлина при вентилация, %			...	...	$\eta_{r,min} \geq$ ... %
			...	...	$\eta_{r,min} \geq$ ... %

3. Ефективност на генератора на студ (включително термопомпата с приложение за отопление)			
Показател	По проект	По изпълнен проект	[1] Норма за възобновяема енергия
Коефициент на трансформация при генерирането на топлина	...	...	...
	...	...	...
Коефициент на трансформация при генерирането на студ	...	...	
	...	...	
4. Енергия от възобновяеми източници	... MWh	... MWh	

Издаден на

Издаден от



СЕРТИФИКАТ 3

РАЗПРЕДЕЛЕНИЕ
НА ГОДИШНИЯ РАЗХОД НА ПОТРЕБНА ЕНЕРГИЯ

Система	Енергиен ресурс	Генератор	Годишен разход на потребна енергия	
			Специфи-чен	Общ
Вид	Вид	Вид	kWh/m²	kWh
Отопление			...	...
Вентилация			...	...
Охлаждане			...	...
Гореща вода			...	...
Осветление			...	...
Други - уреди, потребяващи енергия			...	...

Отоплителни денградуси	.....
Общ годишен специфичен разход на енергия за отопление и вентилация	....., kWh/m³DD

Препоръки:

Информация относно възможностите за финансиране на ЕСМ и друга актуална информация за състоянието на енергийната ефективност в България може да бъде намерена на електронната страница на Агенция за устойчиво енергийно развитие: http://www.seea.government.bg

Издаден на

Издаден от

Figure 6: Bulgarian standard EPC form for new residential buildings (Ministry of Regional Development and Public Works)

Both kinds of EPCs have to be issued by a licensed energy consultant or a licensed energy auditing company. According to the Energy Efficiency Act, energy consultants can issue certificates for buildings in category 5 (for residential buildings this applies to buildings with less than 1000 m² gross floor area) and capacity for less than 100 visitors). Auditors are either HVAC, electrical or civil engineers or architects who have passed a training course for energy auditing and are registered in the SEDA (Sustainable Energy Development Agency). Energy auditing companies have teams of minimum three experts – HVAC engineer, electrical engineer and architect or civil engineer. All members of the team have to possess a degree, follow the course and successfully pass the exam for energy auditing. In this case, only the company is registered in the SEDA. Licensed energy consultants or consulting companies would be suited to issue the iBRoad.

The certification scheme for a new building is based on the design project. It is issued after construction but before the property act. It is issued by a licensed energy consultant (only for buildings with less than 500 m² gross floor area) or an energy auditing company based on the calculation of the designer for the Energy Efficiency part of the design project (most commonly it's the same person that has designed the HVAC). In some cases, the auditor needs to add additional calculations before certification.

The certification scheme for an existing building is based on an energy audit and it is an indivisible part of the energy audit of the building. In order to issue a certificate for an existing building, an energy auditor or consultant should first do an energy audit and issue an energy audit report, a summary, an EPC and - in the case the boiler or air-conditioning systems are large enough – a report on system efficiency. The energy audit ends up with several documents: a report of the energy audit, a summary of the report (for the regulation authority SEDA) and EPC, and in particular cases also a report for boiler or air-condition system efficiency. All these documents are issued together and sent to the building

owner who is obliged to submit a summary and copy of the EPC to the SEDA. Building owners can find an EPC issuer on a list of certified auditors on the SEDA's web site or by internet research. iBRoad issuers could be listed on the web pages of the Bulgarian energy agency, EnEffect.

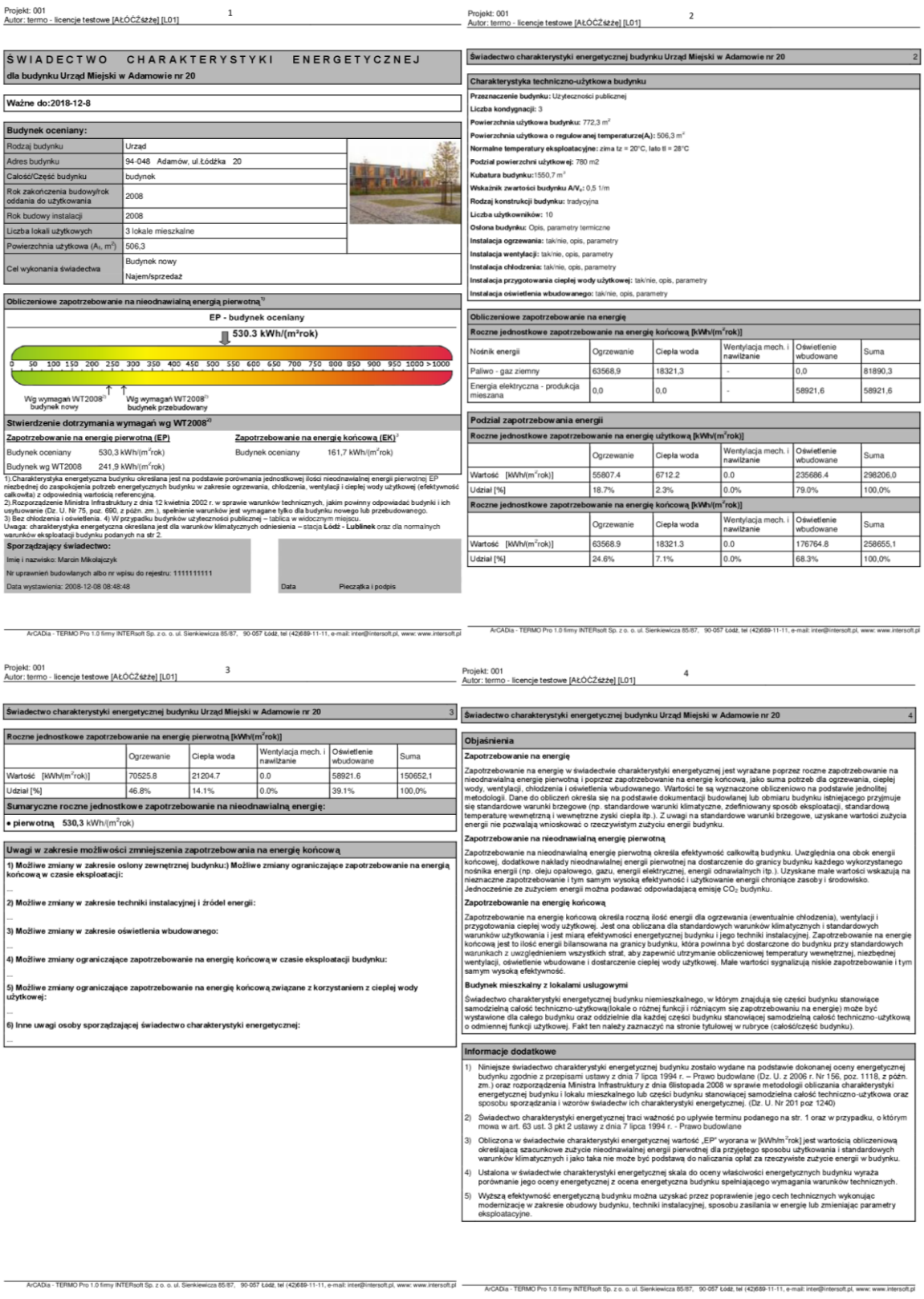
In Bulgaria, the software most often used for calculation, modelling and simulation of the buildings' energy performance and consumption is the EAB Software. Its calculation method is based on ISO 13790:2008.

There is an EPC database in the SEDA. It contains the following information: building name and settlement, type, treated floor area, issuing date of the EPC, energy class, current energy consumption and savings. Access to the data can only be granted in consideration of the law on access to public information. It is not clear yet if the iBRoad project would meet the requirements of this law.

Poland

The Polish EPC for residential buildings consists of four pages:

- The first page contains general building information at the top. Beneath, there is an overview over energetic parameters of the building in its actual state. Also, the applicable primary energy value for new buildings is indicated for reference purposes. In contrast to other EU countries, Poland introduced no efficiency scale based on classes but instead, the primary energy demand is represented by a coloured number scale. The green colour represents lower values of primary energy consumption whereas the red colour represents buildings with higher primary energy consumption. Furthermore, the Polish scale is divided into two bars. The top bar points to the primary energy of the analysed building; the bottom bar points to the primary energy value which is currently required by polish law for new buildings. In addition to this information, the Polish EPC contains parameters of building systems (e. g. the type of energy source) and issuing data on the first page.
- The second page contains technical information about the analysed building (e. g. u-values of particular elements of the external envelope and detailed efficiency indicators for technical systems with descriptions).
- The third page contains energy indicators (e. g. useful, final and primary energy demand related to particular systems in building) and is about renovation recommendations. For the elaboration of renovation recommendation about half an A4 page of space is foreseen. Accordingly, recommendations can only be very short key points. However, recommendations are not mandatory in the EPC.
- The fourth page contains explanatory notes like definitions, simplified instructions on how to fill in the EPC and references to Polish regulations.



Projekt: 001
Autor: termo - licencje testowe [AŁÓĆŻśżże] [L01] 1

ŚWIADECTWO CHARAKTERYSTYKI ENERGETYCZNEJ
dla budynku Urząd Miejski w Adamowie nr 20

Ważne do:2018-12-8

Budynek oceniany:

Rodzaj budynku	Urząd
Adres budynku	94-048 Adamów, ul.Łódźka 20
Całość/Część budynku	budynek
Rok zakończenia budowy/rok oddania do użytkowania	2008
Rok budowy instalacji	2008
Liczba lokali użytkowych	3 lokale mieszkalne
Powierzchnia użytkowa (A_k, m^2)	506,3
Cel wykonania świadectwa	Budynek nowy Najem/sprzedaż

Obliczeniowe zapotrzebowanie na nieodnawialną energią pierwotną[1]

EP - budynek oceniany

530.3 kWh/(m²rok)

0 50 100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 >1000

Wg wymagań WT2008[2] budynek nowy | Wg wymagań WT2008[2] budynek przebudowany

Stwierdzenie dotrzymania wymagań wg WT2008[2]

Zapotrzebowanie na energię pierwotną (EP)		Zapotrzebowanie na energię końcową (EK)[3]	
Budynek oceniany	530,3 kWh/(m²rok)	Budynek oceniany	161,7 kWh/(m²rok)
Budynek wg WT2008	241,9 kWh/(m²rok)		

1) Charakterystyka energetyczna budynku określana jest na podstawie porównania jednostkowej ilości nieodnawialnej energii pierwotnej EP niezbędnej do zaspokojenia potrzeb energetycznych budynku w zakresie ogrzewania, chłodzenia, wentylacji i ciepłej wody użytkowej (efektywność całkowita) z odpowiednią wartością referencyjną.
2) Rozporządzenie Ministra Infrastruktury z dnia 12 kwietnia 2002 r. w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie (Dz. U. Nr 75, poz. 690, z późn. zm.), spełnienie warunków jest wymagane tylko dla budynku nowego lub przebudowanego.
3) Bez chłodzenia i oświetlenia. 4) W przypadku budynków użyteczności publicznej – tablica w widocznym miejscu.
Uwaga: charakterystyka energetyczna określana jest dla warunków klimatycznych odniesienia – stacja **Łódź - Lublinek** oraz dla normalnych warunków eksploatacji budynku podanych na str. 2.

Sporządzający świadectwo:
Imię i nazwisko: Marcin Mikołajczyk
Nr uprawnień budowlanych albo nr wpisu do rejestru: 1111111111
Data wystawienia: 2008-12-08 08:48:48

Data Pieczątka i podpis

Projekt: 001
Autor: termo - licencje testowe [AŁÓĆŻśżże] [L01] 2

Świadectwo charakterystyki energetycznej budynku Urząd Miejski w Adamowie nr 20 2

Charakterystyka techniczno-użytkowa budynku

Przeznaczenie budynku: Użyteczności publicznej
Liczba kondygnacji: 3
Powierzchnia użytkowa budynku: 772,3 m^2
Powierzchnia użytkowa o regulowanej temperaturze(A_k): 506,3 m^2
Normalne temperatury eksploatacyjne: zima tz = 20°C, lato tl = 28°C
Podział powierzchni użytkowej: 780 m2
Kubatura budynku:1550,7 m^3
Wskaźnik zwartości budynku A/V_e: 0,5 1/m
Rodzaj konstrukcji budynku: tradycyjna
Liczba użytkowników: 10
Osłona budynku: Opis, parametry termiczne
Instalacja ogrzewania: tak/nie, opis, parametry
Instalacja wentylacji: tak/nie, opis, parametry
Instalacja chłodzenia: tak/nie, opis, parametry
Instalacja przygotowania ciepłej wody użytkowej: tak/nie, opis, parametry
Instalacja oświetlenia wbudowanego: tak/nie, opis, parametry

Obliczeniowe zapotrzebowanie na energię

Roczne jednostkowe zapotrzebowanie na energię końcową [kWh/(m²rok)]

Nośnik energii	Ogrzewanie	Ciepła woda	Wentylacja mech. i nawilżanie	Oświetlenie wbudowane	Suma
Paliwo - gaz ziemny	63568,9	18321,3	-	0,0	81890,3
Energia elektryczna - produkcja mieszana	0,0	0,0	-	58921,6	58921,6

Podział zapotrzebowania energii

Roczne jednostkowe zapotrzebowanie na energię użytkową [kWh/(m²rok)]

	Ogrzewanie	Ciepła woda	Wentylacja mech. i nawilżanie	Oświetlenie wbudowane	Suma
Wartość [kWh/(m²rok)]	55807.4	6712.2	0.0	235686.4	298206.0
Udział [%]	18.7%	2.3%	0.0%	79.0%	100,0%

Roczne jednostkowe zapotrzebowanie na energię końcową [kWh/(m²rok)]

	Ogrzewanie	Ciepła woda	Wentylacja mech. i nawilżanie	Oświetlenie wbudowane	Suma
Wartość [kWh/(m²rok)]	63568.9	18321.3	0.0	176764.8	258655.1
Udział [%]	24.6%	7.1%	0.0%	68.3%	100,0%

Projekt: 001
Autor: termo - licencje testowe [AŁÓĆŻśżże] [L01] 3

Świadectwo charakterystyki energetycznej budynku Urząd Miejski w Adamowie nr 20 3

Roczne jednostkowe zapotrzebowanie na energię pierwotną [kWh/(m²rok)]

	Ogrzewanie	Ciepła woda	Wentylacja mech. i nawilżanie	Oświetlenie wbudowane	Suma
Wartość [kWh/(m²rok)]	70525.8	21204.7	0.0	58921.6	150652.1
Udział [%]	46.8%	14.1%	0.0%	39.1%	100,0%

Sumaryczne roczne jednostkowe zapotrzebowanie na nieodnawialną energię:

- **pierwotną 530,3** kWh/(m²rok)

Uwagi w zakresie możliwości zmniejszenia zapotrzebowania na energię końcową

1) Możliwe zmiany w zakresie osłony zewnętrznej budynku:) Możliwe zmiany ograniczające zapotrzebowanie na energią końcową w czasie eksploatacji:
...
2) Możliwe zmiany w zakresie techniki instalacyjnej i źródeł energii:
...
3) Możliwe zmiany w zakresie oświetlenia wbudowanego:
...
4) Możliwe zmiany ograniczające zapotrzebowanie na energię końcową w czasie eksploatacji budynku:
...
5) Możliwe zmiany ograniczające zapotrzebowanie na energię końcową związane z korzystaniem z ciepłej wody użytkowej:
...
6) Inne uwagi osoby sporządzającej świadectwo charakterystyki energetycznej:
...

Projekt: 001
Autor: termo - licencje testowe [AŁÓĆŻśżże] [L01] 4

Świadectwo charakterystyki energetycznej budynku Urząd Miejski w Adamowie nr 20 4

Objaśnienia

Zapotrzebowanie na energię

Zapotrzebowanie na energię w świadectwie charakterystyki energetycznej jest wyrażane poprzez roczne zapotrzebowanie na nieodnawialną energię pierwotną i poprzez zapotrzebowanie na energię końcową, jako suma potrzeb dla ogrzewania, ciepłej wody, wentylacji, chłodzenia i oświetlenia wbudowanego. Wartości te są wyznaczone obliczeniowo na podstawie jednolitej metodologii. Dane do obliczeń określa się na podstawie dokumentacji budowlanej lub obmiaru budynku istniejącego przyjmuje się standardowe warunki brzegowe (np. standardowe warunki klimatyczne, zdefiniowany sposób eksploatacji, standardową temperaturę wewnętrzną i wewnętrzne zyski ciepła itp.). Z uwagi na standardowe warunki brzegowe, uzyskane wartości zużycia energii nie pozwalają wnioskować o rzeczywistym zużyciu energii budynku.

Zapotrzebowanie na nieodnawialną energię pierwotną

Zapotrzebowanie na nieodnawialną energię pierwotną określa efektywność całkowitą budynku. Uwzględnia ona obok energii końcowej, dodatkowe nakłady nieodnawialnej energii pierwotnej na dostarczenie do granicy budynku każdego wykorzystanego nośnika energii (np. oleju opałowego, gazu, energii elektrycznej, energii odnawialnych itp.). Uzyskane małe wartości wskazują na nieznaczne zapotrzebowanie i tym samym wysoką efektywność i użytkowanie energii chroniące zasoby i środowisko. Jednocześnie ze zużyciem energii można podawać odpowiadającą emisję CO_2 budynku.

Zapotrzebowanie na energię końcową

Zapotrzebowanie na energię końcową określa roczną ilość energii dla ogrzewania (ewentualnie chłodzenia), wentylacji i przygotowania ciepłej wody użytkowej. Jest ona obliczana dla standardowych warunków klimatycznych i standardowych warunków użytkowania i jest miarą efektywności energetycznej budynku i jego techniki instalacyjnej. Zapotrzebowanie na energię końcową jest to ilość energii bilansowana na granicy budynku, która powinna być dostarczone do budynku przy standardowych warunkach z uwzględnieniem wszystkich strat, aby zapewnić utrzymanie obliczeniowej temperatury wewnętrznej, niezbędnej wentylacji, oświetlenie wbudowane i dostarczenie ciepłej wody użytkowej. Małe wartości sygnalizują niskie zapotrzebowanie i tym samym wysoką efektywność.

Budynek mieszkalny z lokalami usługowymi

Świadectwo charakterystyki energetycznej budynku niemieszkalnego, w którym znajdują się części budynku stanowiące samodzielną całość techniczno-użytkową(lokale o różnej funkcji i różniącym się zapotrzebowaniu na energię) może być wystawione dla całego budynku oraz oddzielnie dla każdej części budynku stanowiącej samodzielną całość techniczno-użytkową o odmiennej funkcji użytkowej. Fakt ten należy zaznaczyć na stronie tytułowej w rubryce (całość/część budynku).

Informacje dodatkowe

1) Niniejsze świadectwo charakterystyki energetycznej budynku zostało wydane na podstawie dokonanej oceny energetycznej budynku zgodnie z przepisami ustawy z dnia 7 lipca 1994 r. – Prawo budowlane (Dz. U. z 2006 r. Nr 156, poz. 1118, z późn. zm.) oraz rozporządzenia Ministra Infrastruktury z dnia 6listopada 2008 w sprawie metodologii obliczania charakterystyki energetycznej budynku i lokalu mieszkalnego lub części budynku stanowiącej samodzielna całość techniczno-użytkowa oraz sposobu sporządzania i wzorów świadectw ich charakterystyki energetycznej. (Dz. U. Nr 201 poz 1240)
2) Świadectwo charakterystyki energetycznej traci ważność po upływie terminu podanego na str. 1 oraz w przypadku, o którym mowa w art. 63 ust. 3 pkt 2 ustawy z dnia 7 lipca 1994 r. - Prawo budowlane
3) Obliczona w świadectwie charakterystyki energetycznej wartość „EP" wyorana w [kWh/m²rok] jest wartością obliczeniową określającą szacunkowe zużycie nieodnawialnej energii pierwotnej dla przyjętego sposobu użytkowania i standardowych warunków klimatycznych i jako taka nie może być podstawą do naliczania opłat za rzeczywiste zużycie energii w budynku.
4) Ustalona w świadectwie charakterystyki energetycznej skala do oceny właściwości energetycznych budynku wyraża porównanie jego oceny energetycznej z ocena energetyczna budynku spełniającego wymagania warunków technicznych.
5) Wyższą efektywność energetyczną budynku można uzyskać przez poprawienie jego cech technicznych wykonując modernizację w zakresie obudowy budynku, techniki instalacyjnej, sposobu zasilania w energię lub zmieniając parametry eksploatacyjne.

Figure 7: Polish standard EPC form for new residential buildings (Arcadiasoft: Certyfiklat energetyczny 2018) [5]

EPC issuers need to be accredited by the Ministry of Investments and Development. To acquire qualification, one has to be an engineer or complete a special training course. An official list of EPC

issuers is available on the ministry's website. To contact one of them, it is suggested to find their private websites on which they advertise their services, as the list does not provide the contact address.

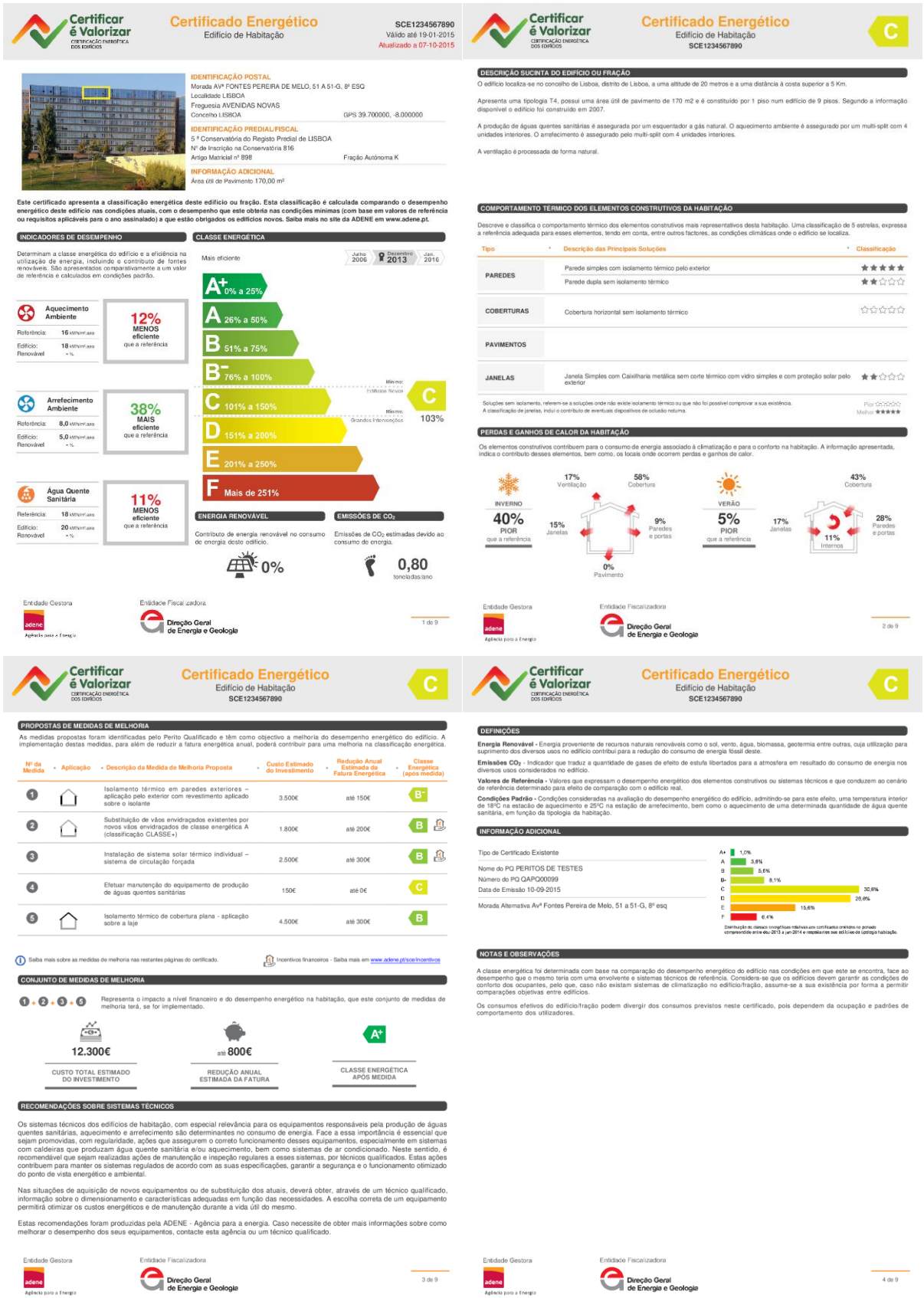
Energy auditors do not need any qualifications to perform energy audits. There is not an official (governmental) list of energy auditors. However, the association of auditors - called ZAE - has a list of all registered members with their contact data. Nearly every auditor is signed to this organisation. KAPE have already contacted them and they are involved in the iBRoad project. Energy auditors who are allowed to issue the EPC and possess the required knowledge could issue the iBRoad.

In Poland `Audytor OZC´ and `ArCADia Thermo BuildDesk Energy Certificate´ are the most commonly used tools to calculate EPCs. The software is based on Polish regulation prepared for the purpose of calculating EPCs. In Poland there is an EPC database operated by the Ministry of Investments and Development. Only employees of the ministry have access to the complete database. The database stores all values and data, which EPCs contain.

Portugal

The Portuguese EPC for residential buildings consists of the following components: the energy class, information on the building components and their performance, proposal of improvement measures to reduce the energy consumption and improve the comfort, and information on fiscal benefits and access to financing.

[5] Arcadiasoft: Certyfiklat energetyczny 2018, URL: http://www.arcadiasoft.pl/pdf/Certyfikat_energetyczny_ArCADia-TERMO.pdf, accessed January 31st 2019



Certificar é Valorizar — Certificação Energética dos Edifícios

Certificado Energético
Edifício de Habitação
SCE1234567890
Válido até 19-01-2015
Atualizado a 07-10-2015

IDENTIFICAÇÃO POSTAL
Morada AV.ª FONTES PEREIRA DE MELO, 51 A 51-G, 8.º ESQ
Localidade LISBOA
Freguesia AVENIDAS NOVAS
Concelho LISBOA — GPS 39.700000, -8.000000

IDENTIFICAÇÃO PREDIAL/FISCAL
5.ª Conservatória do Registo Predial de LISBOA
N.º de Inscrição na Conservatória 816
Artigo Matricial n.º 898 — Fração Autónoma K

INFORMAÇÃO ADICIONAL
Área útil de Pavimento 170,00 m²

Este certificado apresenta a classificação energética deste edifício ou fração. Esta classificação é calculada comparando o desempenho energético deste edifício nas condições atuais, com o desempenho que este obteria nas condições mínimas (com base em valores de referência ou requisitos aplicáveis para o ano assinalado) a que estão obrigados os edifícios novos. Saiba mais no site da ADENE em www.adene.pt.

INDICADORES DE DESEMPENHO

Determinam a classe energética do edifício e a eficiência na utilização de energia, incluindo o contributo de fontes renováveis. São apresentados comparativamente a um valor de referência e calculados em condições padrão.

	Referência	Edifício		
Aquecimento Ambiente	16 kWh/m².ano	18 kWh/m².ano	12% MENOS eficiente	que a referência
Arrefecimento Ambiente	8,0 kWh/m².ano	5,0 kWh/m².ano	38% MAIS eficiente	que a referência
Água Quente Sanitária	18 kWh/m².ano	20 kWh/m².ano	11% MENOS eficiente	que a referência

CLASSE ENERGÉTICA

Mais eficiente

Julho 2006 | Dezembro 2013 | Jan. 2016

A+ 0% a 25%
A 26% a 50%
B 51% a 75%
B- 76% a 100%
C 101% a 150%
D 151% a 200%
E 201% a 250%
F Mais de 251%

Mínimo: Novos Edifícios Novos
Mínimo: Grandes Intervenções
C 103%

ENERGIA RENOVÁVEL

Contributo de energia renovável no consumo de energia deste edifício.

0%

EMISSÕES DE CO_2

Emissões de CO_2 estimadas devido ao consumo de energia.

0,80 toneladas/ano

Entidade Gestora: adene — Agência para a Energia
Entidade Fiscalizadora: Direção Geral de Energia e Geologia

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Certificar é Valorizar — Certificação Energética dos Edifícios

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Edifício de Habitação
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DESCRIÇÃO SUCINTA DO EDIFÍCIO OU FRAÇÃO

O edifício localiza-se no concelho de Lisboa, distrito de Lisboa, a uma altitude de 20 metros e a uma distância à costa superior a 5 Km.

Apresenta uma tipologia T4, possui uma área útil de pavimento de 170 m2 e é constituído por 1 piso num edifício de 9 pisos. Segundo a informação disponível o edifício foi construído em 2007.

A produção de águas quentes sanitárias é assegurada por um esquentador a gás natural. O aquecimento ambiente é assegurado por um multi-split com 4 unidades interiores. O arrefecimento é assegurado pelo multi-split com 4 unidades interiores.

A ventilação é processada de forma natural.

COMPORTAMENTO TÉRMICO DOS ELEMENTOS CONSTRUTIVOS DA HABITAÇÃO

Descreve e classifica o comportamento térmico dos elementos construtivos mais representativos desta habitação. Uma classificação de 5 estrelas, expressa a referência adequada para esses elementos, tendo em conta, entre outros factores, as condições climáticas onde o edifício se localiza.

Tipo	Descrição das Principais Soluções	Classificação
PAREDES	Parede simples com isolamento térmico pelo exterior	★★★★★
	Parede dupla sem isolamento térmico	★★☆☆☆
COBERTURAS	Cobertura horizontal sem isolamento térmico	☆☆☆☆☆
PAVIMENTOS		
JANELAS	Janela Simples com Caixilharia metálica sem corte térmico com vidro simples e com proteção solar pelo exterior	★★☆☆☆

Soluções sem isolamento, referem-se a soluções onde não existe isolamento térmico ou que não foi possível comprovar a sua existência.
A classificação de janelas, inclui o contributo de eventuais dispositivos de oclusão noturna.

Pior ☆☆☆☆☆ Melhor ★★★★★

PERDAS E GANHOS DE CALOR DA HABITAÇÃO

Os elementos construtivos contribuem para o consumo de energia associado à climatização e para o conforto na habitação. A informação apresentada, indica o contributo desses elementos, bem como, os locais onde ocorrem perdas e ganhos de calor.

INVERNO
40% PIOR que a referência
17% Ventilação
58% Cobertura
15% Janelas
9% Paredes e portas
0% Pavimento

VERÃO
5% PIOR que a referência
17% Janelas
43% Cobertura
28% Paredes e portas
11% Internos

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Certificar é Valorizar — Certificação Energética dos Edifícios

Certificado Energético
Edifício de Habitação
SCE1234567890
C

PROPOSTAS DE MEDIDAS DE MELHORIA

As medidas propostas foram identificadas pelo Perito Qualificado e têm como objectivo a melhoria do desempenho energético do edifício. A implementação destas medidas, para além de reduzir a fatura energética anual, poderá contribuir para uma melhoria na classificação energética.

Nº da Medida	Aplicação	Descrição da Medida de Melhoria Proposta	Custo Estimado do Investimento	Redução Anual Estimada da Fatura Energética	Classe Energética (após medida)
1		Isolamento térmico em paredes exteriores – aplicação pelo exterior com revestimento aplicado sobre o isolante	3.500€	até 150€	B-
2		Substituição de vãos envidraçados existentes por novos vãos envidraçados de classe energética A (classificação CLASSE+)	1.800€	até 200€	B
3		Instalação de sistema solar térmico individual – sistema de circulação forçada	2.500€	até 300€	B
4		Efetuar manutenção do equipamento de produção de águas quentes sanitárias	150€	até 0€	C
5		Isolamento térmico de cobertura plana - aplicação sobre a laje	4.500€	até 300€	B

Saiba mais sobre as medidas de melhoria nas restantes páginas do certificado.
Incentivos financeiros - Saiba mais em www.adene.pt/sce/incentivos

CONJUNTO DE MEDIDAS DE MELHORIA

1 + 2 + 3 + 5

Representa o impacto a nível financeiro e do desempenho energético na habitação, que este conjunto de medidas de melhoria terá, se for implementado.

12.300€ — CUSTO TOTAL ESTIMADO DO INVESTIMENTO
até 800€ — REDUÇÃO ANUAL ESTIMADA DA FATURA
A+ — CLASSE ENERGÉTICA APÓS MEDIDA

RECOMENDAÇÕES SOBRE SISTEMAS TÉCNICOS

Os sistemas técnicos dos edifícios de habitação, com especial relevância para os equipamentos responsáveis pela produção de águas quentes sanitárias, aquecimento e arrefecimento são determinantes no consumo de energia. Face a essa importância é essencial que sejam promovidas, com regularidade, ações que assegurem o correto funcionamento desses equipamentos, especialmente em sistemas com caldeiras que produzam água quente sanitária e/ou aquecimento, bem como sistemas de ar condicionado. Neste sentido, é recomendável que sejam realizadas ações de manutenção e inspeção regulares a esses sistemas, por técnicos qualificados. Estas ações contribuem para manter os sistemas regulados de acordo com as suas especificações, garantir a segurança e o funcionamento otimizado do ponto de vista energético e ambiental.

Nas situações de aquisição de novos equipamentos ou de substituição dos atuais, deverá obter, através de um técnico qualificado, informação sobre o dimensionamento e características adequadas em função das necessidades. A escolha correta de um equipamento permitirá otimizar os custos energéticos e de manutenção durante a vida útil do mesmo.

Estas recomendações foram produzidas pela ADENE - Agência para a energia. Caso necessite de obter mais informações sobre como melhorar o desempenho dos seus equipamentos, contacte esta agência ou um técnico qualificado.

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Entidade Fiscalizadora: Direção Geral de Energia e Geologia

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Certificar é Valorizar — Certificação Energética dos Edifícios

Certificado Energético
Edifício de Habitação
SCE1234567890
C

DEFINIÇÕES

Energia Renovável - Energia proveniente de recursos naturais renováveis como o sol, vento, água, biomassa, geotermia entre outras, cuja utilização para suprimento dos diversos usos no edifício contribui para a redução do consumo de energia fóssil deste.

Emissões CO_2 - Indicador que traduz a quantidade de gases de efeito de estufa libertados para a atmosfera em resultado do consumo de energia nos diversos usos considerados no edifício.

Valores de Referência - Valores que expressam o desempenho energético dos elementos construtivos ou sistemas técnicos e que conduzem ao cenário de referência determinado para efeito de comparação com o edifício real.

Condições Padrão - Condições consideradas na avaliação do desempenho energético do edifício, admitindo-se para este efeito, uma temperatura interior de 18ºC na estação de aquecimento e 25ºC na estação de arrefecimento, bem como o aquecimento de uma determinada quantidade de água quente sanitária, em função da tipologia da habitação.

INFORMAÇÃO ADICIONAL

Tipo de Certificado Existente	
Nome do PQ PERITOS DE TESTES	
Número do PQ QAPQ00099	
Data de Emissão 10-09-2015	
Morada Alternativa Av.ª Fontes Pereira de Melo, 51 a 51-G, 8º esq	

A+ 1,0%
A 3,8%
B 5,6%
B- 8,1%
C 30,8%
D 28,6%
E 15,6%
F 6,4%

Distribuição das classes energéticas relativas aos certificados emitidos no período compreendido entre dez-2013 a jun-2014 e respetivas aos edifícios de tipologia habitação.

NOTAS E OBSERVAÇÕES

A classe energética foi determinada com base na comparação do desempenho energético do edifício nas condições em que este se encontra, face ao desempenho que o mesmo teria com uma envolvente e sistemas técnicos de referência. Considera-se que os edifícios devem garantir as condições de conforto dos ocupantes, pelo que, caso não existam sistemas de climatização no edifício/fração, assume-se a sua existência por forma a permitir comparações objetivas entre edifícios.

Os consumos efetivos do edifício/fração podem divergir dos consumos previstos neste certificado, pois dependem da ocupação e padrões de comportamento dos utilizadores.

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Figure 8: Portuguese standard EPC form for residential buildings (ADENE – Agencia para a Energia: Certificado Energético) [6]

The EPC provides the following information to the building owner:

- Energy class of the building
- Performance indicators for space heating, cooling and domestic hot water, and comparison with the reference values of other buildings
- Renewable energy contribution
- CO2 emissions
- Short description of the building
- Thermal performance of all construction elements of the building, with a rating from 1 star (poor) to 5 stars (high)
- Heat gains and losses, and comparison to the reference building
- Improvement measures proposal, with investment cost estimation, expected energy bills saving and improvement regarding the energy class, for each measure and for the overall 'package' of measures
- Recommendations on technical systems
- Summary of the main indicators considered in the ECP (energy needs, climate data, envelope description and U-values considered
- Detailed description of the impact that each improvement measure will have on heating, cooling and domestic hot water needs as well as the co-benefits expected.

The class boundaries refer to the primary energy demand. There is a dynamic reference for the boundaries depending on all building types and regions (climatic zones) in Portugal.

Renovation recommendations are mandatory in Portuguese EPCs. The Qualified Experts (QE) have to indicate improvement measures; however, the adoption by the building owner is not mandatory. The recommendations measures must first focus and respect the following order:

1) Correction of constructive pathologies

2) Reduction of useful energy needs by the envelope of the building

3) Improving the efficiency of technical systems

4) Implementation of RES (renewable energy systems)

About 50 per cent of the document´s space is foreseen for recommendations. The renovation recommendations are generally very detailed. They do not only refer to the next renovation step but also to steps further in the future. Despite the very detailed recommendations and the form they are presented to the owner in the EPC, other (or more) information will most likely be welcome.

EPC issuers (QE) in Portugal need an accreditation. To issue EPCs for residential buildings and small commercial buildings, it is necessary to have a graduation in architecture or engineering recognised by the professional order and minimum work experience in the construction sector of five years. To issue EPCs for commercial buildings, it is necessary to have a graduation in engineering recognised by the professional order with a work experience of five years in the construction sector. Additionally, all

[6] ADENE – Agencia para a Energia: Certificado Energético, https://www.sce.pt/wp-content/uploads/2018/06/ADENE_certificado_energper%20centC3per%20centA9tico_habitaper%20centC3per%20centA7per%20centC3per%20centA3o.pdf, accessed January 31st 2019

issuers need to attend the qualification exams provided by the Portuguese energy agency in order to be able to issue EPCs.

The requirements to energy auditors´ qualifications are the same as to EPC issuers. EPC issuers and energy auditors have to prove their qualification to the Portuguese Energy Agency. There is an official internet list of EPC issuers available in the website of the Portuguese Energy Agency[7]. This would also be suitable for building owners who look for an iBRoad issuer.

The ANPQ (Associação Nacional de Peritos Qualificados) is the Portuguese association of Qualified Experts or energy auditors. They already joined the project as stakeholders available to support the iBRoad´s development and implementation.

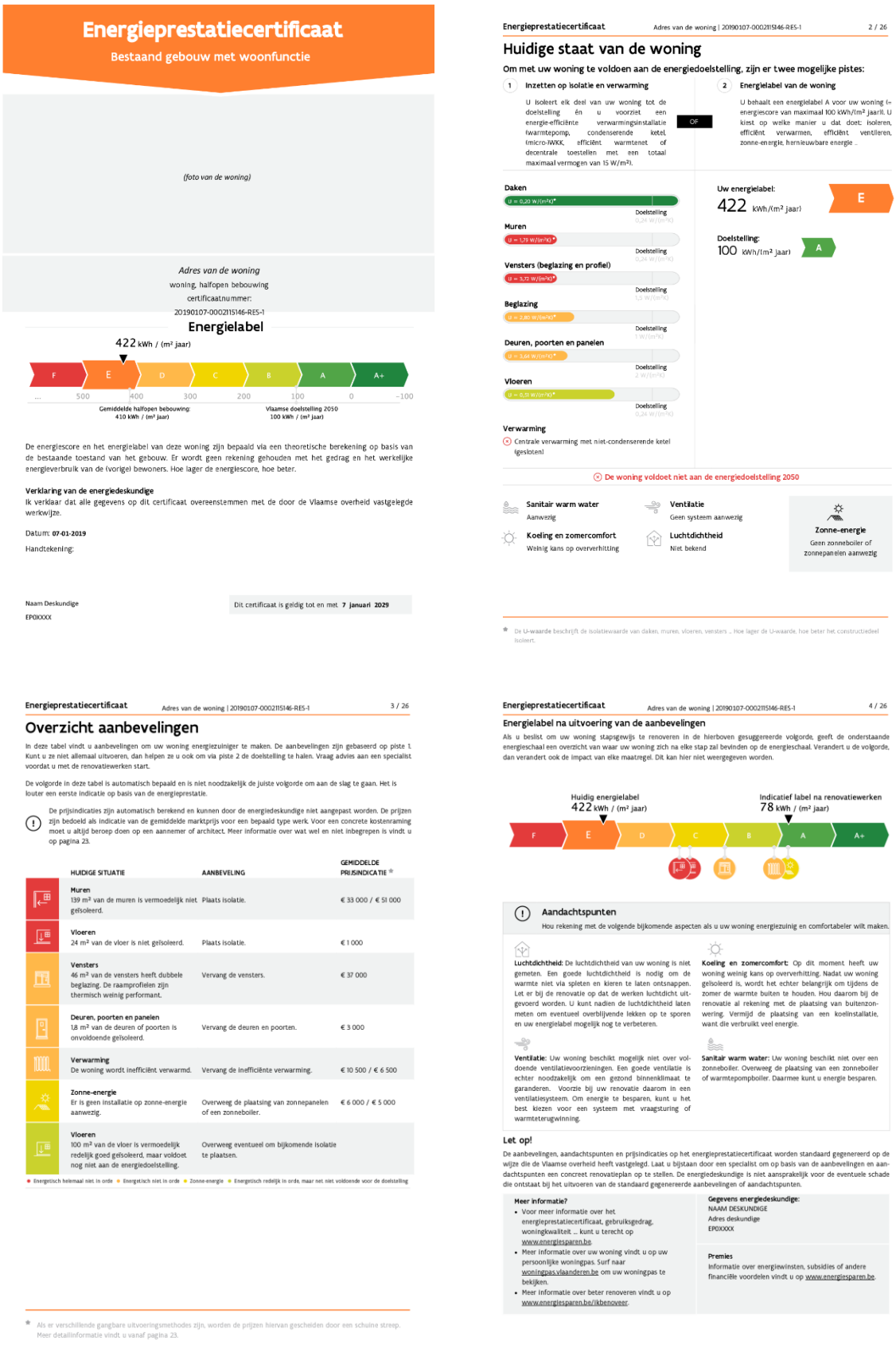
In Portugal, open source software is most often used. The calculation procedure is based on a seasonal quasi-steady state method like prescribed on EN ISO 13790.

Flanders (Belgium)

In January 2019, the current Flemish EPC was replaced by an updated version – the EPC+. The following description will focus on that updated version. However, for best communication purposes, the term 'EPC' has been kept, in order to not give citizens the wrong impression that a new certificate is mandatory.

In general, the EPC+ consists of four parts: First, it displays general building and issuing data (e. g. building address, construction year, EPC issuer) and the buildings' energy label. Second, a short visual overview of the current state of the building is illustrated and compared to the long-term 2050 target on energy performance of buildings. Third, the EPC displays renovation recommendations for the building envelope and heating system(s), including an indication of priority and estimated costs. The impact of each recommendation is shown on an energy scale. For recommendations with regard to hot water, ventilation, risk of overheating and airtightness no prioritisation or costs are indicated. Forth, the EPC contains in-depth information, e. g. detailed technical information with regard to renovation measures. In addition, advice is given to avoid lock-in effects.

[7] https://www.sce.pt/pesquisa-de-tecnicos/



Energieprestatiecertificaat

Bestaand gebouw met woonfunctie

(foto van de woning)

Adres van de woning
woning, halfopen bebouwing
certificaatnummer:
20190107-0002115146-RES-1

Energielabel

422 kWh / (m² jaar)

F | E | D | C | B | A | A+

... 500 400 300 200 100 0 -100

Gemiddelde halfopen bebouwing: 410 kWh / (m² jaar)

Vlaamse doelstelling 2050 100 kWh / (m² jaar)

De energiescore en het energielabel van deze woning zijn bepaald via een theoretische berekening op basis van de bestaande toestand van het gebouw. Er wordt geen rekening gehouden met het gedrag en het werkelijke energieverbruik van de (vorige) bewoners. Hoe lager de energiescore, hoe beter.

Verklaring van de energiedeskundige
Ik verklaar dat alle gegevens op dit certificaat overeenstemmen met de door de Vlaamse overheid vastgelegde werkwijze.

Datum: **07-01-2019**

Handtekening:

Naam Deskundige
EP0XXXX

Dit certificaat is geldig tot en met **7 januari 2029**

Energieprestatiecertificaat Adres van de woning | 20190107-0002115146-RES-1 2 / 26

Huidige staat van de woning

Om met uw woning te voldoen aan de energiedoelstelling, zijn er twee mogelijke pistes:

1 **Inzetten op isolatie en verwarming**
U isoleert elk deel van uw woning tot de doelstelling én u voorziet een energie-efficiënte verwarmingsinstallatie (warmtepomp, condenserende ketel, (micro-)WKK, efficiënt warmtenet of decentrale toestellen met een totaal maximaal vermogen van 15 W/m²).

OF

2 **Energielabel van de woning**
U behaalt een energielabel A voor uw woning (= energiescore van maximaal 100 kWh/(m² jaar)). U kiest op welke manier u dat doet: isoleren, efficiënt verwarmen, efficiënt ventileren, zonne-energie, hernieuwbare energie ...

Daken U = 0,20 W/(m²K)* — Doelstelling 0,24 W/(m²K)

Muren U = 1,79 W/(m²K)* — Doelstelling 0,24 W/(m²K)

Vensters (beglazing en profiel) U = 3,72 W/(m²K)* — Doelstelling 1,5 W/(m²K)

Beglazing U = 2,80 W/(m²K)* — Doelstelling 1 W/(m²K)

Deuren, poorten en panelen U = 3,64 W/(m²K)* — Doelstelling 2 W/(m²K)

Vloeren U = 0,31 W/(m²K)* — Doelstelling 0,24 W/(m²K)

Verwarming
Centrale verwarming met niet-condenserende ketel (gesloten)

Uw energielabel: 422 kWh/(m² jaar) — E

Doelstelling: 100 kWh/(m² jaar) — A

De woning voldoet niet aan de energiedoelstelling 2050

Sanitair warm water
Aanwezig

Ventilatie
Geen systeem aanwezig

Koeling en zomercomfort
Weinig kans op oververhitting

Luchtdichtheid
Niet bekend

Zonne-energie
Geen zonneboiler of zonnepanelen aanwezig

* De U-waarde beschrijft de isolatiewaarde van daken, muren, vloeren, vensters ... Hoe lager de U-waarde, hoe beter het constructiedeel isoleert.

Energieprestatiecertificaat Adres van de woning | 20190107-0002115146-RES-1 3 / 26

Overzicht aanbevelingen

In deze tabel vindt u aanbevelingen om uw woning energiezuiniger te maken. De aanbevelingen zijn gebaseerd op piste 1. Kunt u ze niet allemaal uitvoeren, dan helpen ze u ook om via piste 2 de doelstelling te halen. Vraag advies aan een specialist voordat u met de renovatiewerken start.

De volgorde in deze tabel is automatisch bepaald en is niet noodzakelijk de juiste volgorde om aan de slag te gaan. Het is louter een eerste indicatie op basis van de energieprestatie.

De prijsindicaties zijn automatisch berekend en kunnen door de energiedeskundige niet aangepast worden. De prijzen zijn bedoeld als indicatie van de gemiddelde marktprijs voor een bepaald type werk. Voor een concrete kostenraming moet u altijd beroep doen op een aannemer of architect. Meer informatie over wat wel en niet inbegrepen is vindt u op pagina 23.

	HUIDIGE SITUATIE	AANBEVELING	GEMIDDELDE PRIJSINDICATIE *
	Muren 139 m² van de muren is vermoedelijk niet geïsoleerd.	Plaats isolatie.	€ 33 000 / € 51 000
	Vloeren 24 m² van de vloer is niet geïsoleerd.	Plaats isolatie.	€ 1 000
	Vensters 46 m² van de vensters heeft dubbele beglazing. De raamprofielen zijn thermisch weinig performant.	Vervang de vensters.	€ 37 000
	Deuren, poorten en panelen 1,8 m² van de deuren of poorten is onvoldoende geïsoleerd.	Vervang de deuren en poorten.	€ 3 000
	Verwarming De woning wordt inefficiënt verwarmd.	Vervang de inefficiënte verwarming.	€ 10 500 / € 6 500
	Zonne-energie Er is geen installatie op zonne-energie aanwezig.	Overweeg de plaatsing van zonnepanelen of een zonneboiler.	€ 6 000 / € 5 000
	Vloeren 100 m² van de vloer is vermoedelijk redelijk goed geïsoleerd, maar voldoet nog niet aan de energiedoelstelling.	Overweeg eventueel om bijkomende isolatie te plaatsen.	

Energetisch helemaal niet in orde · Energetisch niet in orde · Zonne-energie · Energetisch redelijk in orde, maar net niet voldoende voor de doelstelling

* Als er verschillende gangbare uitvoeringsmethodes zijn, worden de prijzen hiervan gescheiden door een schuine streep. Meer detailinformatie vindt u vanaf pagina 23.

Energieprestatiecertificaat Adres van de woning | 20190107-0002115146-RES-1 4 / 26

Energielabel na uitvoering van de aanbevelingen

Als u beslist om uw woning stapsgewijs te renoveren in de hierboven gesuggereerde volgorde, geeft de onderstaande energieschaal een overzicht van waar uw woning zich na elke stap zal bevinden op de energieschaal. Verandert u de volgorde, dan verandert ook de impact van elke maatregel. Dit kan hier niet weergegeven worden.

Huidig energielabel 422 kWh / (m² jaar)

Indicatief label na renovatiewerken 78 kWh / (m² jaar)

F | E | D | C | B | A | A+

Aandachtspunten

Hou rekening met de volgende bijkomende aspecten als u uw woning energiezuinig en comfortabeler wilt maken.

Luchtdichtheid: De luchtdichtheid van uw woning is niet gemeten. Een goede luchtdichtheid is nodig om de warmte niet via spleten en kieren te laten ontsnappen. Let er bij de renovatie op dat de werken luchtdicht uitgevoerd worden. U kunt nadien de luchtdichtheid laten meten om eventueel overblijvende lekken op te sporen en uw energielabel mogelijk nog te verbeteren.

Koeling en zomercomfort: Op dit moment heeft uw woning weinig kans op oververhitting. Nadat uw woning geïsoleerd is, wordt het echter belangrijk om tijdens de zomer de warmte buiten te houden. Hou daarom bij de renovatie al rekening met de plaatsing van buitenzonwering. Vermijd de plaatsing van een koelinstallatie, want die verbruikt veel energie.

Ventilatie: Uw woning beschikt mogelijk niet over voldoende ventilatievoorzieningen. Een goede ventilatie is echter noodzakelijk om een gezond binnenklimaat te garanderen. Voorzie bij uw renovatie daarom in een ventilatiesysteem. Om energie te besparen, kunt u het best kiezen voor een systeem met vraagsturing of warmteterugwinning.

Sanitair warm water: Uw woning beschikt niet over een zonneboiler. Overweeg de plaatsing van een zonneboiler of warmtepompboiler. Daarmee kunt u energie besparen.

Let op!

De aanbevelingen, aandachtspunten en prijsindicaties op het energieprestatiecertificaat worden standaard gegenereerd op de wijze die de Vlaamse overheid heeft vastgelegd. Laat u bijstaan door een specialist om op basis van de aanbevelingen en aandachtspunten een concreet renovatieplan op te stellen. De energiedeskundige is niet aansprakelijk voor de eventuele schade die ontstaat bij het uitvoeren van de standaard gegenereerde aanbevelingen of aandachtspunten.

Meer informatie?
- Voor meer informatie over het energieprestatiecertificaat, gebruiksgedrag, woningkwaliteit ... kunt u terecht op www.energiesparen.be.
- Meer informatie over uw woning vindt u op uw persoonlijke woningpas. Surf naar woningpas.vlaanderen.be om uw woningpas te bekijken.
- Meer informatie over beter renoveren vindt u op www.energiesparen.be/ikbenoveer.

Gegevens energiedeskundige:
NAAM DESKUNDIGE
Adres deskundige
EP0XXXX

Premies
Informatie over energiewinsten, subsidies of andere financiële voordelen vindt u op www.energiesparen.be.

Figure 9: Flanders EPC+ standard form (Vlaams Energieagentschap) [8]

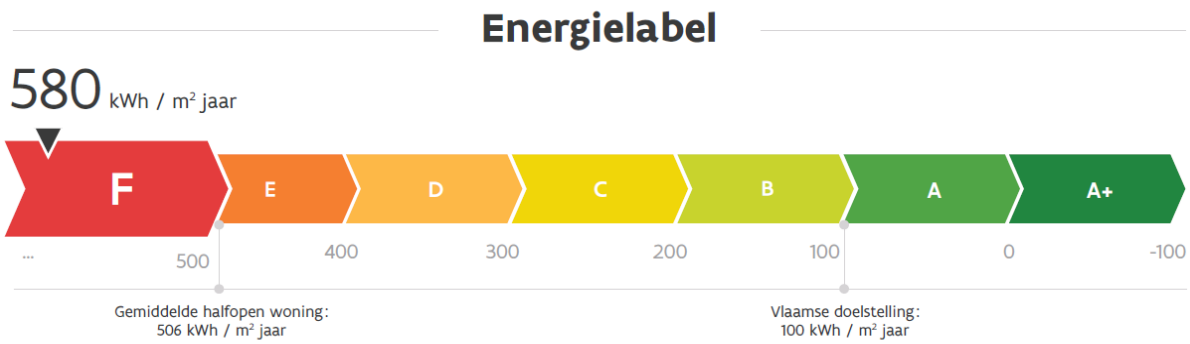


Figure 10: Energy label in Flanders (Vlaams Energieagentschap)

The energy label of the building is based on the energy score, being the yearly-calculated primary energy use, per square meter floor area (kWh/m²/year). The energy label is shown on a horizontal energy scale, on which also the mean value for the buildings with the same typology and the long-term goal for all buildings (= A-label) are shown. The classification levels can be found on this energy scale. The class boundaries refer to the primary energy demand. They are valid for all building types and all regions in Flanders.

The energetic quality of individual components of the building envelope are shown by energy bars. The size and colours of the bars are based on the U-value. E.g. a roof gets a red bar when $U \geq 0.93$ W/m²K, an orange bar when $0.93 > U \geq 0.40$, a light green bar when $0.40 > U \geq 0.24$ and a dark green bar when $U \leq 0.20$. The same classification levels apply for the recommendations: a roof with red bar will get a red recommendation.

[8] Vlaams Energieagentschap (VEA): Energieprestatiecertificaat, 2019, https://energiesparen.login.kanooh.be/sites/default/files/atoms/files/VoorbeeldEPCvanafjanuari2019_nieuw.pdf, accessed January 31st 2019

Figure 11: Assessment of the building envelope in Flanders (Vlaams Energieagentschap)

The recommendations and corresponding cost estimates are automatically generated. Apart from providing correct input data for the energy label and a few extra input parameters, the EPC issuer does not have to bother about the recommendations. He cannot adapt neither remove any of them. Yet he is allowed to give a comment on each of them.

The EPC+ gives a full renovation path in order to get the building in line with the long-term goal. When all EPC+ recommendations would be executed, the building will fulfil the long-term goal. Until now, none of the recommendations are mandatory.

However, in the current draft proposal for the energy policy plan (2021-2030) there is a proposal to make the recommendations mandatory:

In the case of notarial transfer in full ownership of a residential home, three of the following six measures have to be implemented within five years after the transfer.

- Roof insulation (U_{max} = 0.24 W/m²K)
- Wall insulation (U_{max} = 0.24 W/m²K)
- Windows (profiles and glazing) (U_{max} = 1.7 W/m²K and U_{glass} = 1.1 W/m²K)
- Floor insulation (U_{max} = 0.24 W/m²K)
- Condensing boiler no older than 15 years or heat pump
- Renewable energy boiler: heat pump boiler or solar boiler

The recommendations are a major part of the EPC+, certainly because cost estimations are made. Most likely, the cost estimations will influence the house owner. More than the recommendations, the cost estimations reflect the sense of urgency in an intuitive and understandable manner.

As the recommendations are automatically generated and as the EPC is a certificate, which cannot take into account the wishes and desires of the (future) inhabitants, the renovation path will offer only an intermediate level of detail. Refinement will always be needed. For instance, the order of the insulation measures is solely based on the energetic quality (u-value) of the components, regardless of their size. An uninsulated roof, either large or small in size, will always have a red recommendation and appear at the top of the list. Hence, the order given by the EPC+ does not reflect a practical or logical order for

execution. It is up to the house owner, preferably in collaboration with a professional, to further refine the path into the most optimal renovation scheme, given technical and financial constraints.

In Flanders, the EPC-issuer is called the "energy expert" ("energiedeskundige"). Energy experts have to complete specific trainings and successfully pass an exam, after which they are accredited in the official list of energy efficiency experts. No qualifications are required. The list of official energy experts is available on the website of the Flemish Energy Agency. The trainings and exam are organised by educational institutes, who are accredited by the Flemish Energy Agency after having proved their skills and good quality of work. The main bulk of the educational material is provided by the Flemish Energy Agency, but the institutes are free to further extend or adapt it.

The interests of EPC issuers are represented in an association, called OVED.

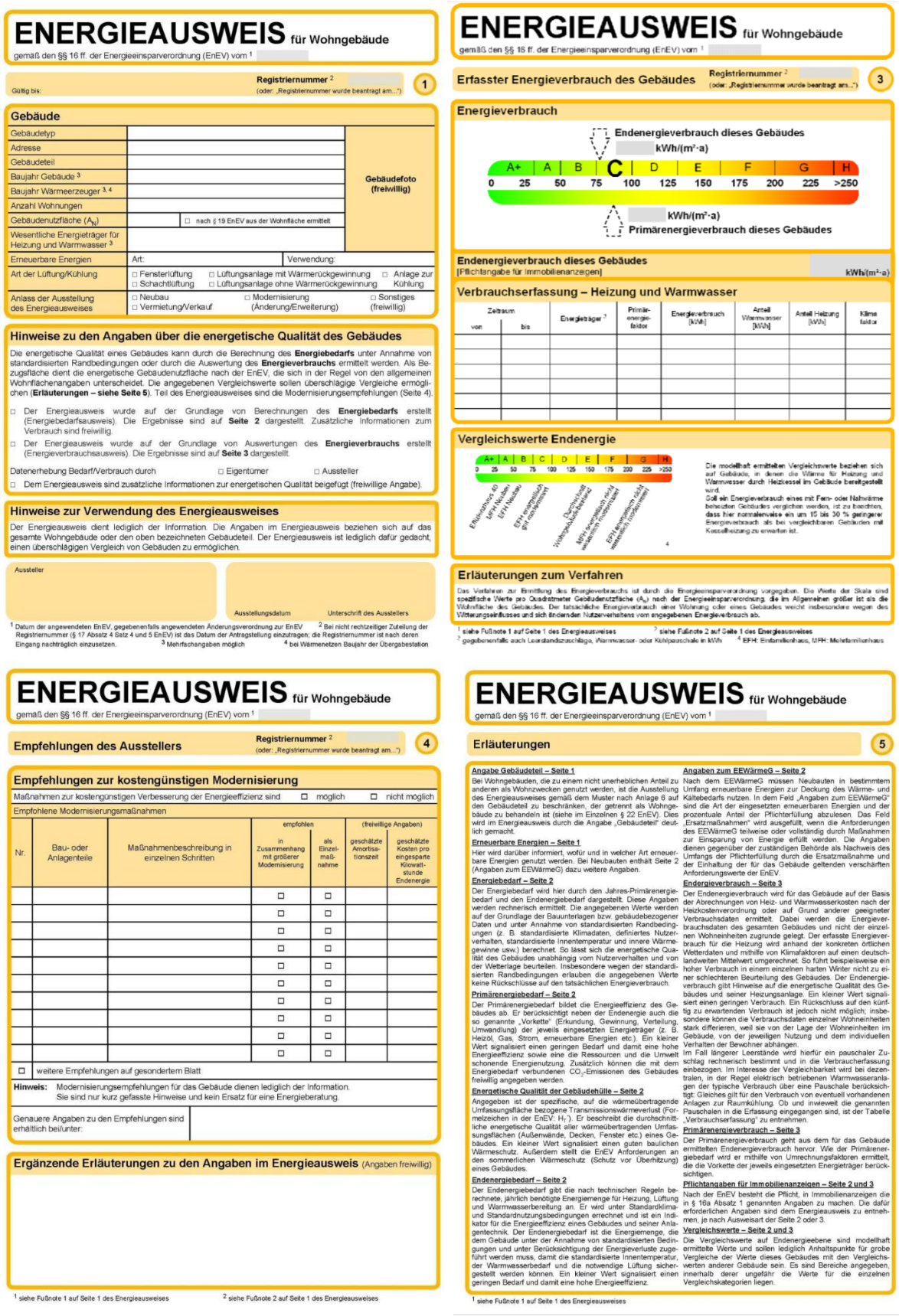
In Flanders, there has been an EPC database since 2009. It stores the technical data from the EPC-calculation and also energy labels and information about the automatically issued roadmap. The Flemish Energy Agency has asked permission to get access to the database in order to display the data in their Woningpas.

Germany

In Germany, two kinds of EPCs for residential buildings exist in parallel: for new buildings, existing buildings undergoing major renovations and old buildings with building application before November 1977 EPCs are based on calculated energy demand. For existing buildings, which comply with energy efficiency standards from 1977 EPCs can be based on the measured energy consumption. Unfortunately, the coexisting of different EPCs complicates comparability and can cause confusion for customers.

In general, the EPC comprises of four parts:

- At first, general building and issue data (e. g. building address, construction year, energy source and number of the document) must be indicated.
- Actual energy consumption (kWh/m²year), indicated as primary energy demand and final energy demand, respectively), the calculated energy demand and a reference value is stated. The German EPC introduced a nine-class labelling scheme with energetic bars starting from A+ and ending with class H. The class boundaries refer to the final energy demand. They are valid for all building types and all regions in Germany. There are no efficiency classes for components of the building envelop or technical systems in the EPC. However, the German "individueller Sanierungsfahrplan, iSFP" comprises such classes.
- According to the German energy savings ordinance, the EPC must also contain renovation recommendations if they are cost effective. Cost effectiveness within this context means that renovation measures must pay for themselves within the normal operation period. Recommendations refer either to the renovation of the whole building or of single components as well as technical systems. In practice, the renovation recommendations only play a minor role. There is very limited space provided in the standard form: only one line per recommendation in the EPC so they must be kept very short. The recommendations usually are very generic and not related to a certain renovation step. A more detailed cost, profitability and action planning as well as a time frame is not foreseen. In fact, they serve as a very basic information for the building owner that certain energy renovations are possible and most likely cost effective.
- Finally, the last part of the EPC contains explanations and definitions for a better understanding (e. g. definitions of primary energy demand and final energy demand).



ENERGIEAUSWEIS für Wohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom [1]

Gültig bis:

Registriernummer [2] (oder: „Registriernummer wurde beantragt am...") 1

Gebäude

Gebäudetyp		Gebäudefoto (freiwillig)
Adresse		
Gebäudeteil		
Baujahr Gebäude [3]		
Baujahr Wärmeerzeuger [3, 4]		
Anzahl Wohnungen		
Gebäudenutzfläche (A_N)	☐ nach § 19 EnEV aus der Wohnfläche ermittelt	
Wesentliche Energieträger für Heizung und Warmwasser [3]		
Erneuerbare Energien	Art:	Verwendung:
Art der Lüftung/Kühlung	☐ Fensterlüftung ☐ Schachtlüftung ☐ Lüftungsanlage mit Wärmerückgewinnung ☐ Lüftungsanlage ohne Wärmerückgewinnung ☐ Anlage zur Kühlung	
Anlass der Ausstellung des Energieausweises	☐ Neubau ☐ Vermietung/Verkauf ☐ Modernisierung (Änderung/Erweiterung) ☐ Sonstiges (freiwillig)	

Hinweise zu den Angaben über die energetische Qualität des Gebäudes

Die energetische Qualität eines Gebäudes kann durch die Berechnung des **Energiebedarfs** unter Annahme von standardisierten Randbedingungen oder durch die Auswertung des **Energieverbrauchs** ermittelt werden. Als Bezugsfläche dient die energetische Gebäudenutzfläche nach der EnEV, die sich in der Regel von den allgemeinen Wohnflächenangaben unterscheidet. Die angegebenen Vergleichswerte sollen überschlägige Vergleiche ermöglichen (**Erläuterungen – siehe Seite 5**). Teil des Energieausweises sind die Modernisierungsempfehlungen (Seite 4).

☐ Der Energieausweis wurde auf der Grundlage von Berechnungen des **Energiebedarfs** erstellt (Energiebedarfsausweis). Die Ergebnisse sind auf **Seite 2** dargestellt. Zusätzliche Informationen zum Verbrauch sind freiwillig.

☐ Der Energieausweis wurde auf der Grundlage von Auswertungen des **Energieverbrauchs** erstellt (Energieverbrauchsausweis). Die Ergebnisse sind auf **Seite 3** dargestellt.

Datenerhebung Bedarf/Verbrauch durch ☐ Eigentümer ☐ Aussteller

☐ Dem Energieausweis sind zusätzliche Informationen zur energetischen Qualität beigefügt (freiwillige Angabe).

Hinweise zur Verwendung des Energieausweises

Der Energieausweis dient lediglich der Information. Die Angaben im Energieausweis beziehen sich auf das gesamte Wohngebäude oder den oben bezeichneten Gebäudeteil. Der Energieausweis ist lediglich dafür gedacht, einen überschlägigen Vergleich von Gebäuden zu ermöglichen.

Aussteller

Ausstellungsdatum Unterschrift des Ausstellers

[1] Datum der angewendeten EnEV, gegebenenfalls angewendeten Änderungsverordnung zur EnEV [2] Bei nicht rechtzeitiger Zuteilung der Registriernummer (§ 17 Absatz 4 Satz 4 und 5 EnEV) ist das Datum der Antragstellung einzutragen; die Registriernummer ist nach deren Eingang nachträglich einzusetzen. [3] Mehrfachangaben möglich [4] bei Wärmenetzen Baujahr der Übergabestation

ENERGIEAUSWEIS für Wohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom [1]

Erfasster Energieverbrauch des Gebäudes

Registriernummer [2] (oder: „Registriernummer wurde beantragt am...") 3

Energieverbrauch

Endenergieverbrauch dieses Gebäudes

kWh/(m²·a)

A+ | A | B | C | D | E | F | G | H

0 25 50 75 100 125 150 175 200 225 >250

kWh/(m²·a)

Primärenergieverbrauch dieses Gebäudes

Endenergieverbrauch dieses Gebäudes kWh/(m²·a)

[Pflichtangabe für Immobilienanzeigen]

Verbrauchserfassung – Heizung und Warmwasser

Zeitraum von	Zeitraum bis	Energieträger [2]	Primärenergiefaktor	Energieverbrauch [kWh]	Anteil Warmwasser [kWh]	Anteil Heizung [kWh]	Klimafaktor

Vergleichswerte Endenergie

A+ | A | B | C | D | E | F | G | H

0 25 50 75 100 125 150 175 200 225 >250

Effizienzhaus 40 – EFH Neubau – EFH Neubau

EFH energetisch gut modernisiert

Durchschnitt Wohngebäude Bestand

MFH Durchschnitt nicht modernisiert modernisiert

EFH durchschnittlich nicht modernisiert (unsaniert)

Die **modellhaft ermittelten** Vergleichswerte beziehen sich auf Gebäude, in denen die Wärme für Heizung und Warmwasser durch Heizkessel im Gebäude bereitgestellt wird.

Soll ein Energieverbrauch eines mit Fern- oder Nahwärme beheizten Gebäudes verglichen werden, ist zu berücksichtigen, dass hier normalerweise ein um 15 bis 30 % geringerer Energieverbrauch als bei vergleichbaren Gebäuden mit Kesselheizung zu erwarten ist.

4

Erläuterungen zum Verfahren

Das Verfahren zur Ermittlung des Energieverbrauchs ist durch die Energieeinsparverordnung vorgegeben. Die Werte der Skala sind spezifische Werte pro Quadratmeter Gebäudenutzfläche (A_N) nach der Energieeinsparverordnung, die im Allgemeinen größer ist als die Wohnfläche des Gebäudes. Der tatsächliche Energieverbrauch einer Wohnung oder eines Gebäudes weicht insbesondere wegen des Witterungseinflusses und sich ändernden Nutzerverhaltens vom angegebenen Energieverbrauch ab.

[1] siehe Fußnote 1 auf Seite 1 des Energieausweises [2] siehe Fußnote 2 auf Seite 1 des Energieausweises
[3] gegebenenfalls auch Leerstandszuschläge, Warmwasser- oder Kühlpauschale in kWh [4] EFH: Einfamilienhaus, MFH: Mehrfamilienhaus

ENERGIEAUSWEIS für Wohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom [1]

Empfehlungen des Ausstellers

Registriernummer [2] (oder: „Registriernummer wurde beantragt am...") 4

Empfehlungen zur kostengünstigen Modernisierung

Maßnahmen zur kostengünstigen Verbesserung der Energieeffizienz sind ☐ möglich ☐ nicht möglich

Empfohlene Modernisierungsmaßnahmen

Nr.	Bau- oder Anlagenteile	Maßnahmenbeschreibung in einzelnen Schritten	empfohlen: in Zusammenhang mit größerer Modernisierung	empfohlen: als Einzelmaßnahme	(freiwillige Angaben): geschätzte Amortisationszeit	(freiwillige Angaben): geschätzte Kosten pro eingesparte Kilowattstunde Endenergie
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		
			☐	☐		

☐ weitere Empfehlungen auf gesondertem Blatt

Hinweis: Modernisierungsempfehlungen für das Gebäude dienen lediglich der Information. Sie sind nur kurz gefasste Hinweise und kein Ersatz für eine Energieberatung.

Genauere Angaben zu den Empfehlungen sind erhältlich bei/unter:

Ergänzende Erläuterungen zu den Angaben im Energieausweis (Angaben freiwillig)

[1] siehe Fußnote 1 auf Seite 1 des Energieausweises [2] siehe Fußnote 2 auf Seite 1 des Energieausweises

ENERGIEAUSWEIS für Wohngebäude

gemäß den §§ 16 ff. der Energieeinsparverordnung (EnEV) vom [1]

Erläuterungen 5

Angabe Gebäudeteil – Seite 1

Bei Wohngebäuden, die zu einem nicht unerheblichen Anteil zu anderen als Wohnzwecken genutzt werden, ist die Ausstellung des Energieausweises gemäß dem Muster nach Anlage 8 auf den Gebäudeteil zu beschränken, der getrennt als Wohngebäude zu behandeln ist (siehe im Einzelnen § 22 EnEV). Dies wird im Energieausweis durch die Angabe „Gebäudeteil" deutlich gemacht.

Erneuerbare Energien – Seite 1

Hier wird darüber informiert, wofür und in welcher Art erneuerbare Energien genutzt werden. Bei Neubauten enthält Seite 2 (Angaben zum EEWärmeG) dazu weitere Angaben.

Energiebedarf – Seite 2

Der Energiebedarf wird hier durch den Jahres-Primärenergiebedarf und den Endenergiebedarf dargestellt. Diese Angaben werden rechnerisch ermittelt. Die angegebenen Werte werden auf der Grundlage der Bauunterlagen bzw. gebäudebezogener Daten und unter Annahme von standardisierten Randbedingungen (z. B. standardisierte Klimadaten, definiertes Nutzerverhalten, standardisierte Innentemperatur und innere Wärmegewinne usw.) berechnet. So lässt sich die energetische Qualität des Gebäudes unabhängig vom Nutzerverhalten und von der Witterung beurteilen. Insbesondere wegen der standardisierten Randbedingungen erlauben die angegebenen Werte keine Rückschlüsse auf den tatsächlichen Energieverbrauch.

Primärenergiebedarf – Seite 2

Der Primärenergiebedarf bildet die Energieeffizienz des Gebäudes ab. Er berücksichtigt neben der Endenergie auch die so genannte „Vorkette" (Erkundung, Gewinnung, Verteilung, Umwandlung) der jeweils eingesetzten Energieträger (z. B. Heizöl, Gas, Strom, erneuerbare Energien etc.). Ein kleiner Wert signalisiert einen geringen Bedarf und damit eine hohe Energieeffizienz sowie eine die Ressourcen und die Umwelt schonende Energienutzung. Zusätzlich können die mit dem Energiebedarf verbundenen CO_2-Emissionen des Gebäudes freiwillig angegeben werden.

Energetische Qualität der Gebäudehülle – Seite 2

Angegeben ist der spezifische, auf die wärmeübertragende Umfassungsfläche bezogene Transmissionswärmeverlust (Formelzeichen in der EnEV: H_T'). Er beschreibt die durchschnittliche energetische Qualität aller wärmeübertragenden Umfassungsflächen (Außenwände, Decken, Fenster etc.) eines Gebäudes. Ein kleiner Wert signalisiert einen guten baulichen Wärmeschutz. Außerdem stellt die EnEV Anforderungen an den sommerlichen Wärmeschutz (Schutz vor Überhitzung) eines Gebäudes.

Endenergiebedarf – Seite 2

Der Endenergiebedarf gibt die nach technischen Regeln berechnete, jährlich benötigte Energiemenge für Heizung, Lüftung und Warmwasserbereitung an. Er wird unter Standardklima- und Standardnutzungsbedingungen errechnet und ist ein Indikator für die Energieeffizienz eines Gebäudes und seiner Anlagentechnik. Der Endenergiebedarf ist die Energiemenge, die dem Gebäude unter der Annahme von standardisierten Bedingungen und unter Berücksichtigung der Energieverluste zugeführt werden muss, damit die standardisierte Innentemperatur, der Warmwasserbedarf und die notwendige Lüftung sichergestellt werden können. Ein kleiner Wert signalisiert einen geringen Bedarf und damit eine hohe Energieeffizienz.

Angaben zum EEWärmeG – Seite 2

Nach dem EEWärmeG müssen Neubauten in bestimmtem Umfang erneuerbare Energien zur Deckung des Wärme- und Kältebedarfs nutzen. In dem Feld „Angaben zum EEWärmeG" sind die Art der eingesetzten erneuerbaren Energien und der prozentuale Anteil der Pflichterfüllung abzulesen. Das Feld „Ersatzmaßnahmen" wird ausgefüllt, wenn die Anforderungen des EEWärmeG teilweise oder vollständig durch Maßnahmen zur Einsparung von Energie erfüllt werden. Die Angaben dienen gegenüber der zuständigen Behörde als Nachweis des Umfangs der Pflichterfüllung durch die Ersatzmaßnahme und der Einhaltung der für das Gebäude geltenden verschärften Anforderungswerte der EnEV.

Endgeräteverbrauch – Seite 3

Der Endenergieverbrauch wird für das Gebäude auf der Basis der Abrechnungen von Heiz- und Warmwasserkosten nach der Heizkostenverordnung oder auf Grund anderer geeigneter Verbrauchsdaten ermittelt. Dabei werden die Energieverbrauchsdaten des gesamten Gebäudes und nicht der einzelnen Wohneinheiten zugrunde gelegt. Der erfasste Energieverbrauch für die Heizung wird anhand der konkreten örtlichen Wetterdaten und mithilfe von Klimafaktoren auf einen deutschlandweiten Mittelwert umgerechnet. So führt beispielsweise ein hoher Verbrauch in einem einzelnen harten Winter nicht zu einer schlechteren Beurteilung des Gebäudes. Der Endenergieverbrauch gibt Hinweise auf die energetische Qualität des Gebäudes und seiner Heizungsanlage. Ein kleiner Wert signalisiert einen geringen Verbrauch. Ein Rückschluss auf den künftig zu erwartenden Verbrauch ist jedoch nicht möglich; insbesondere können die Verbrauchsdaten einzelner Wohneinheiten stark differieren, weil sie von der Lage der Wohneinheiten im Gebäude, von der jeweiligen Nutzung und dem individuellen Verhalten der Bewohner abhängen.

Im Fall längerer Leerstände wird hierfür ein pauschaler Zuschlag rechnerisch bestimmt und in die Verbrauchserfassung einbezogen. Im Interesse der Vergleichbarkeit wird bei dezentralen, in der Regel elektrisch betriebenen Warmwasseranlagen der typische Verbrauch über eine Pauschale berücksichtigt. Gleiches gilt für den Verbrauch von eventuell vorhandenen Anlagen zur Raumkühlung. Ob und inwieweit die genannten Pauschalen in die Erfassung eingegangen sind, ist der Tabelle „Verbrauchserfassung" zu entnehmen.

Primärenergieverbrauch – Seite 3

Der Primärenergieverbrauch geht aus dem für das Gebäude ermittelten Endenergieverbrauch hervor. Wie der Primärenergiebedarf wird er mithilfe von Umrechnungsfaktoren ermittelt, die die Vorkette der jeweils eingesetzten Energieträger berücksichtigen.

Pflichtangaben für Immobilienanzeigen – Seite 2 und 3

Nach der EnEV besteht die Pflicht, in Immobilienanzeigen die in § 16a Absatz 1 genannten Angaben zu machen. Die dafür erforderlichen Angaben sind dem Energieausweis zu entnehmen, je nach Ausweisart der Seite 2 oder 3.

Vergleichswerte – Seite 2 und 3

Die Vergleichswerte auf Endenergieebene sind modellhaft ermittelte Werte und sollen lediglich Anhaltspunkte für grobe Vergleiche der Werte dieses Gebäudes mit den Vergleichswerten anderer Gebäude sein. Es sind Bereiche angegeben, innerhalb derer ungefähr die Werte für die einzelnen Vergleichskategorien liegen.

[1] siehe Fußnote 1 auf Seite 1 des Energieausweises

Figure 12: German standard EPC form based on measured energy consumption (Source: German energy savings ordinance, annex 6)

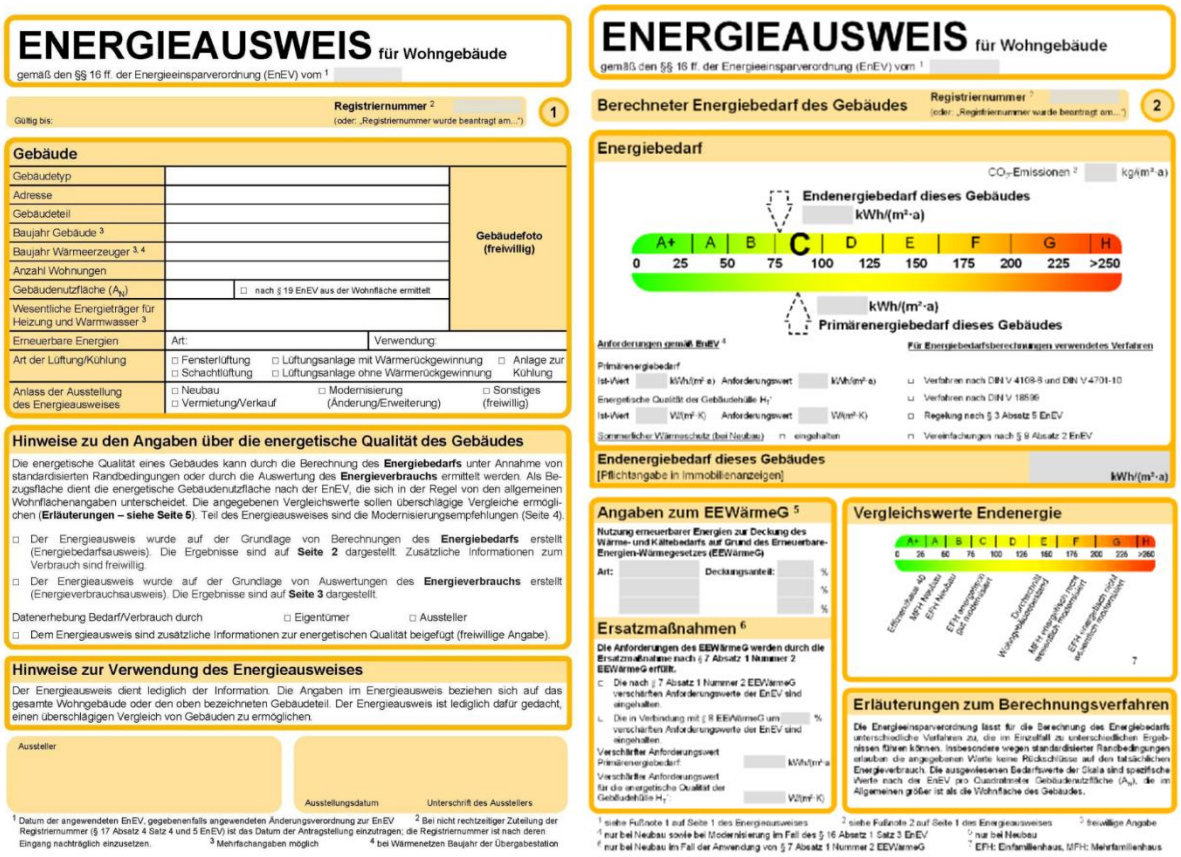


Figure 13: German standard EPC form based on the calculated energy demand (Source: German energy savings ordinance, annex 6)

EPCs may only be issued by persons who have a university degree in a building related field or by master craftsmen and chimney sweepers. The term energy auditor is not protected. Auditors who want to carry out funded audits in a federal programme, however, have to complete specific trainings and must be accredited in the official list of energy efficiency experts.

In Germany, there is no detailed EPC database available. A register run by the German Institut for Structural Engineering (DIBt) gathers all issued EPCs with a unique registration number. Stored is also the type of EPC (demand or consumption based), the building type, postal code, indication of the federal state and the date of issue. Technical data, however, is not stored in the register. Furthermore, the DIBt has the duty to perform random tests from all EPCs. These are validity checks carried out exclusively electronically.

iii. Consequences for iBRoad

The key question to answer in this section is how the different EPCs from different member states can be used to implement the tools developed within the iBRoad project.

EPC data as starting point for the iBRoad Roadmap creation

In general, the iBRoad Roadmap is based on the same building data as the EPCs. Energy auditors in the pilot countries all use country specific calculation software to create EPCs. The iBRoad roadmap needs to be designed in a way that it can be created with national calculation software.

The following EPC content that is related to the iBRoad project is the same or very similar in all considered countries:

- General information on the building and building owner
- Primary energy demand as the main indicator according to the EPBD
- Final energy demand (in Germany either demand or consumption) as additional indicator
- Carbon dioxide emissions
- Main energy sources for heating, domestic hot water and cooling
- Renovation recommendations for energetic improvement measures

The following aspects that are important to the iBRoad project differ in the considered countries:

- Energy classes for the building
- Energy classes for single building components
- Calculation methods
- Calculation software and data connectivity to the EPC data base
- Data stored in EPC databases and access to the databases
- Degree of detail of renovation recommendations for energetic improvement measures
- Consideration of lighting
- Approval for EPC issuers

All aspects that are needed for the iBRoad tools but differ between the countries require either for a more general solution or to take over the country specific solution.
At the moment, data export from the respective country specific software is limited or not possible at all. Consequently, data has to be entered manually into the iBRoad tools. In terms of manageability of the iBRoad tools, data export from national EPC software tools should be provided as far as possible in the future. The same goes for the national EPC database.

The following figure illustrates the creation process of an iBRoad Roadmap.

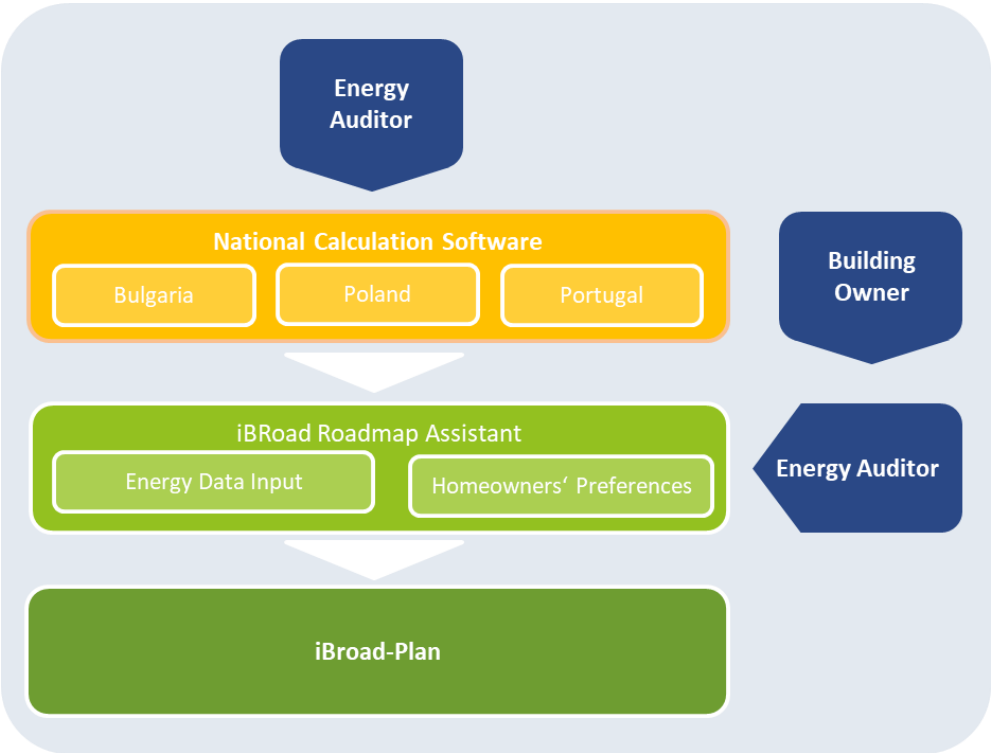


Figure 14: iBRoad Roadmap creation process

EPCs' energetic classification as landmark for the iBRoad Roadmap

In many of the considered countries, EPCs display the overall performance of buildings with energy classes. Usually there is a coloured scale with bars indicating the respective building class:

- Bulgarian EPCs for existing residential buildings have an eight-point energy label scale with energetic bars from A+ to G based on primary energy for the whole building including heating, ventilation, hot water, lighting, pumps, ventilators, appliances and cooling.
- EPCs in Portugal also have an eight-point energy label scale with energetic bars starting from A+ but ending with class F. The scale is based on the ratio between the building primary energy needs and the reference limit primary energy needs expressed as a percentage.
- In Poland, the energetic classification of buildings is different compared to scales in the other considered countries: The Polish scale is built with two colour bars. The green colour on the left end of the bar represents lower values of primary energy consumption whereas the red colour on the right end of the bar represent buildings with high primary energy consumption. The top bar illustrates the primary energy of the analysed building. The bottom bar illustrates the primary energy value, which is currently required by polish law for new buildings.

An overall classification of the energetic state of the building in the iBRoad Logbook is possible. However, it needs to be based on country specific scales and thresholds. If there is a common rating with capital letters classes this can be adapted, otherwise the classification can be displayed with the colour related to the energy demand. The energy class in the iBRoad tools needs to be the same as the one in the EPC. Discrepancies between the energy classes would lead to confusion and reduce faith in energy calculations as a whole.

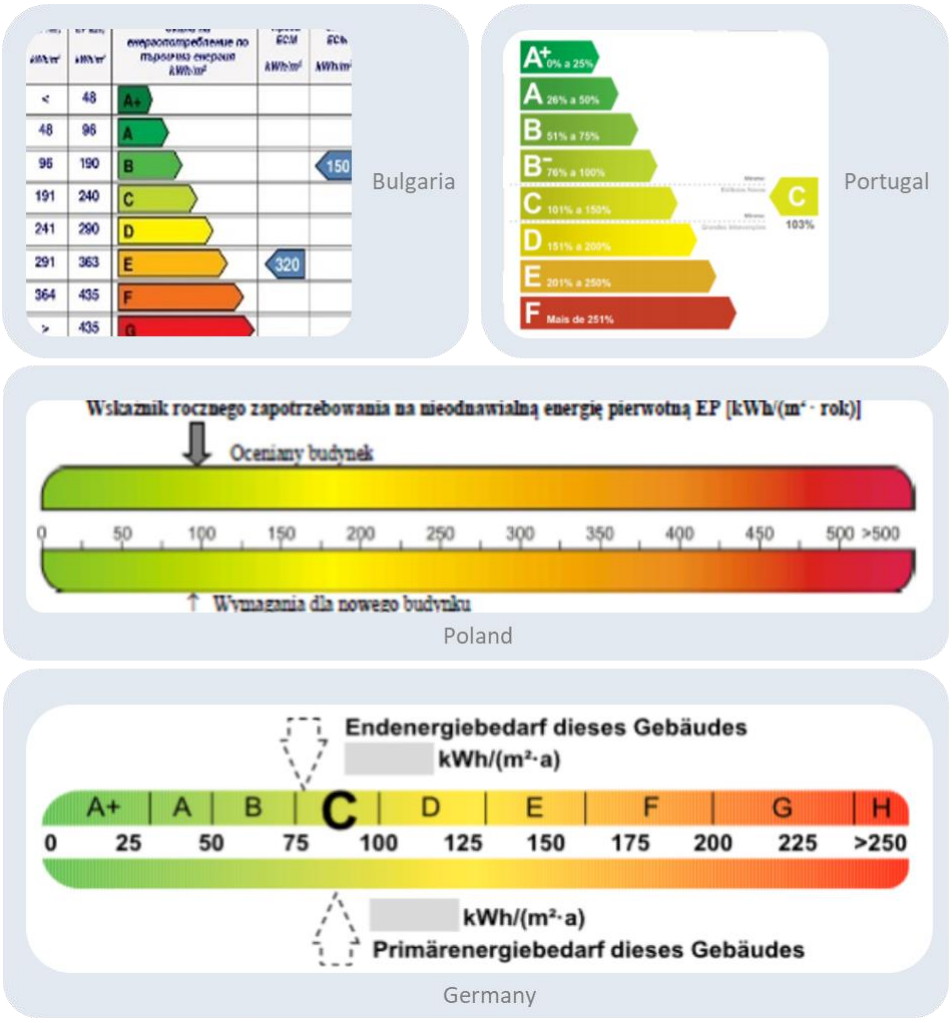


Figure 153: Energetic building classifications in Bulgarian, Portuguese and Polish EPCs

The iBRoad roadmap will display the country specific energy class for the actual building state and also the development of the energy class for future renovation measures.

EPCs' renovation recommendations as starting point for customised renovation packages in the iBRoad Roadmap

In all considered countries, EPCs contain recommendations for energy renovation. EPC issuers and building owners are used to energy related renovation advices. The depth of renovation advices in the EPCs, however, varies significantly between the considered countries. Though in some countries, the EPCs recommend also renovation steps in the further future there is no EPC that offers an individual roadmap. The following typical roadmap features are not part of the EPCs:

- there is no time schedule or order saying when to implement which measure;
- there is no information to which end it makes sense to combine measures;
- renovation recommendations do not take into consideration the preferences of the building owner and the building occupants, e. g., financial capabilities.

As these are core features of the iBRoad approach, the iBRoad tools provides new benefits to all considered countries. The recommendations in the EPC should be used to advise the building owners to order an iBRoad Logbook and Roadmap and acknowledge the added value of the tools. Owners should be informed that the iBRoad complements the EPC.

V. BARRIERS TO DEEP RENOVATIONS AND PREVAILING MOTIVES AND INTERESTS OF THE BUILDING OWNERS

i. Overview

Despite the proven economic and technical feasibility, associated with societal and environmental benefits of building renovation, renovation rates are still low. This is due to a number of barriers along the value chain that go beyond the technical and economic feasibility of renovation. This chapter shows the barriers and motives for energy renovation in the considered countries. In order to prioritise the features of the iBRoad tools, the country partners estimated how buildings owners would rank the added values in their countries.

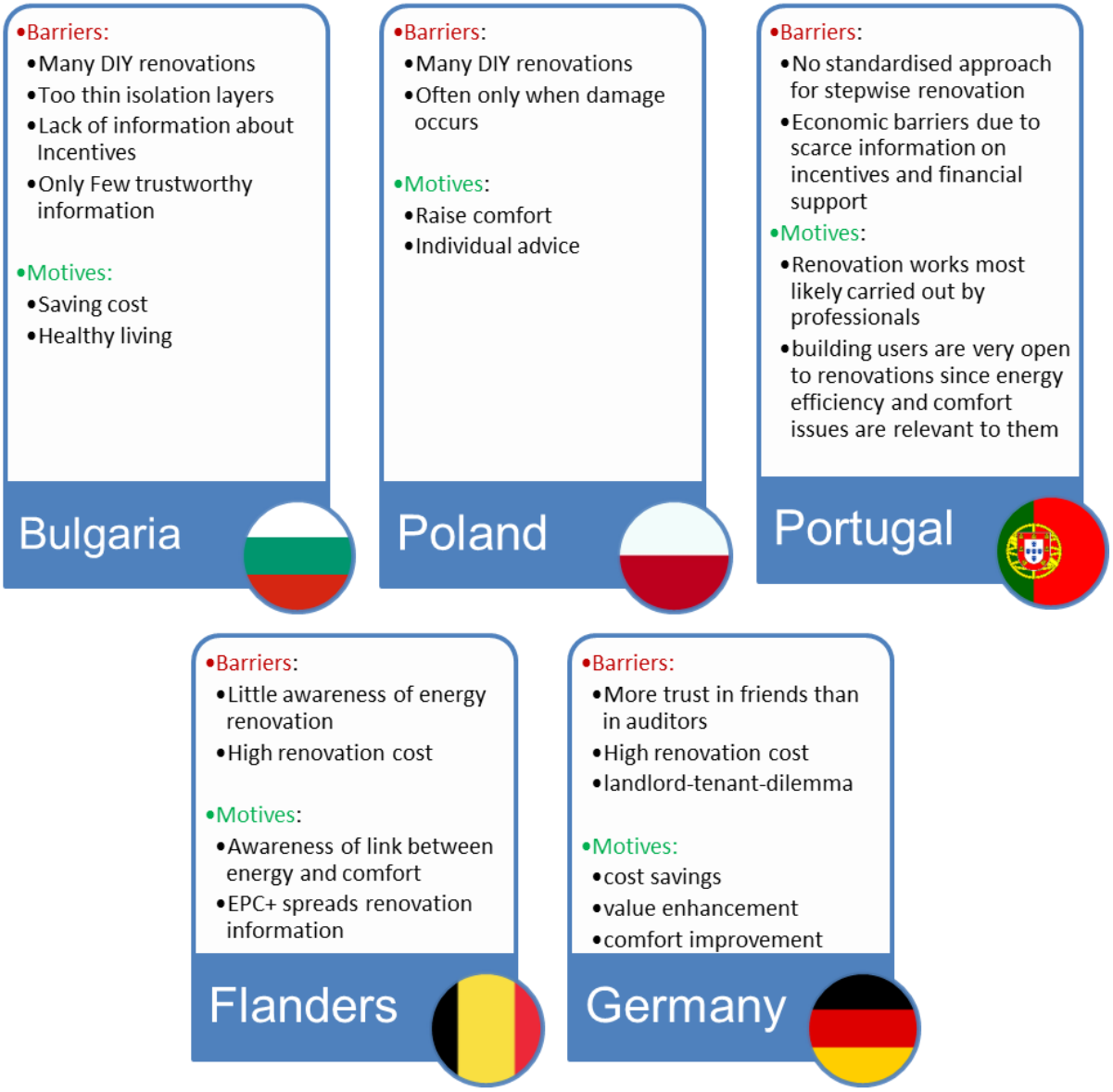


Figure 16: Overview of specific barriers and motives

ii. Situation per country in detail

Bulgaria

Barriers

When renovation measures are carried out in single-family houses, homeowners and homeowners' friends usually take care of the work themselves. Experts and professionals are rather less involved. In general, the capacity of Bulgarian professionals in implementation of energy efficiency measures is not high.

There are no statistics about at what stage(s) of life most renovations take place, but it can be noticed that most of energy efficiency renovations are usually executed after people´s midlife – about the age of 50 to 60 years. Besides the use of poor material and poor installation, a very common mistake is the wrong approach towards the installation of thermal insulation. Usually five centimetres of thickness is considered sufficient by homeowners. In addition, thermal bridges are not adequately avoided.

According to Policy department A – economic and scientific policy (http://www.europarl.europa.eu /RegData/etudes/STUD/2017/607350/IPOL_STU(2017)607350_EN.pdf) the highest level of energy poverty in the EU is in Bulgaria. This results in underheating or undercooling of buildings as well as postponement of renovation measures. Moreover, there is a lack of awareness about available financial support. Building owners who are willing to renovate their homes often are uncertain about which measures to implement. There are a lot of different sources of information, both accessible online and from specialists (from craftsmen to engineers and architects), providing partly contradictory knowledge about reasonable measures and the depth of implementation. None of them are fully trustworthy. Building owners often use the experience of their neighbours or friends that already renovated their homes and they implement the same measures. They are unaware of possible expert help.

Motives

According to the iBRoad "Understanding potential user needs" survey, improving comfort and reducing the amount of money spent for energy is most important for homeowners.

From the experience of the country partner it is expected that the wealthier the building owners are the more crucial comfort and impact on the climate are to them. They are considered to be even more important than saving money. The most substantial comfort aspect related to energy renovation is healthy living. This applies to the main problems in homes in Bulgaria – air pollution, moisture and mould. Other key comfort aspects for building owners are maintenance friendliness and, for urban areas, noise protection.

With regard to homeowners' motives and interests, the country partner was asked to assess Bulgarian people's opinions concerning expected added value of the iBRoad Roadmap and interesting features of the iBRoad Logbook. The profile below illustrates the results.

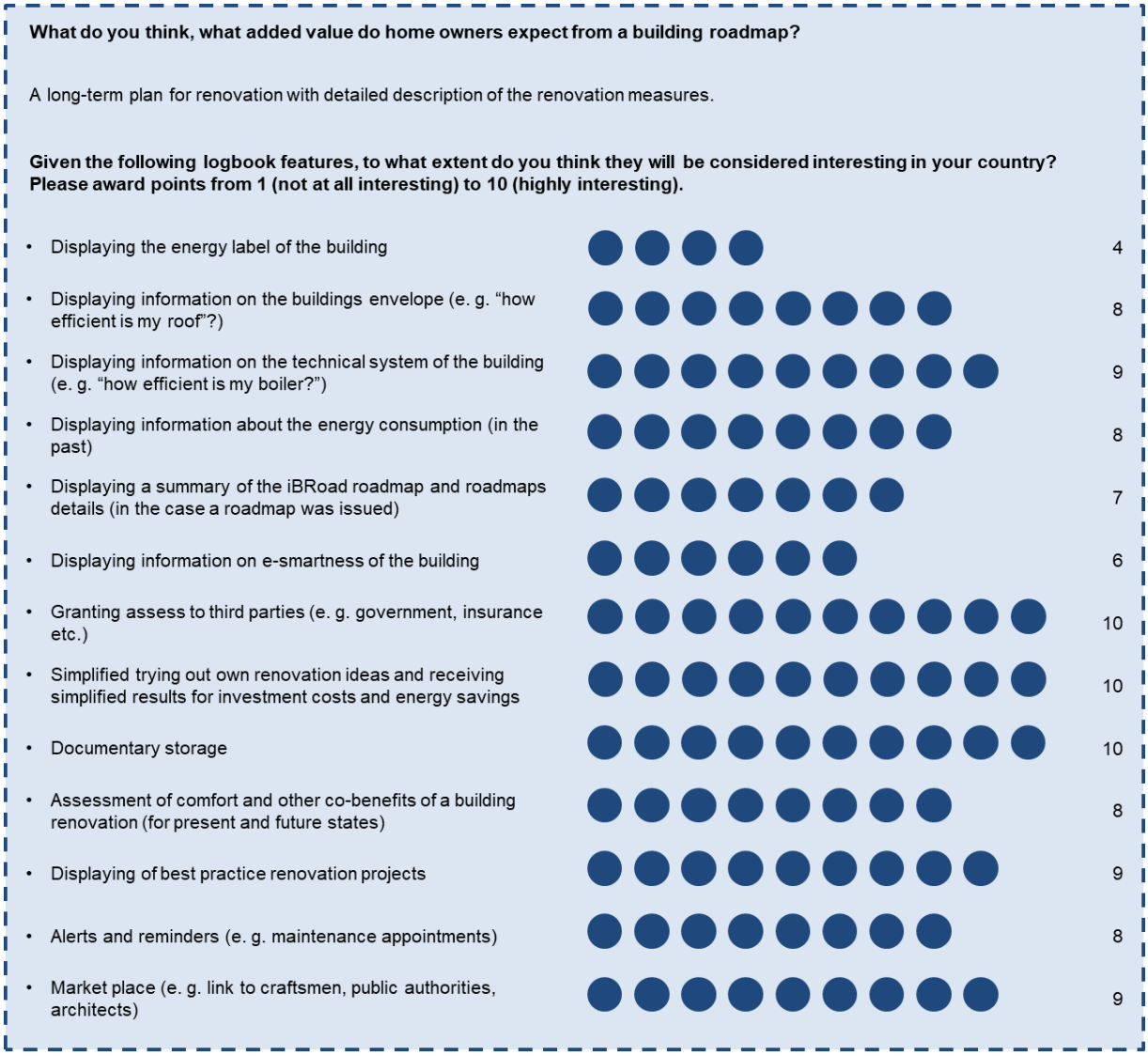


Figure 17: Added value that Bulgarian building owners expect from the iBRoad logbook

All proposed logbook features are supposed to be considered interesting in Bulgaria. Displaying the building´s energy level, however, is rated worst with only four points followed by information on e-smartness of buildings with six points. Many buildings in Bulgaria are underheated. In the poorer communities outside the capital people usually heat only one or two rooms in their buildings. The energy label and e-smartness of the buildings are much less important than creating a comfortable environment in their homes at affordable price and spending less on energy bills after a renovation.

The non-governmental centre for energy efficiency in Bulgaria, EnEffect, anticipates homeowners to expect that the main benefit of the building renovation roadmap is to provide long-term plans for renovation with detailed description of the measures. The main benefit, which homeowners will expect from a building logbook, would be a simplification of the processes. This ranges from simple online tools providing them access to their building documents and access to services offered by the government or the municipality to easy search for energy auditors or maintenance companies.

Poland

Barriers

The homeowner himself most often carries out renovations in Poland. Usually advice is sought from construction workers or friends who went through similar processes in the past. However, as people who were asked are frequently not qualified, advices can be misleading or wrong. Contractors who perform energy renovations are usually highly experienced, but they do not possess the theoretical knowledge on building physics, which sometimes can result in construction faults. Owners who carry out renovation measures usually decide on the most urgent measures that need to be done. Usually, renovation measures are performed one after another, which is dictated by financial matters.

Motives

With regard to homeowners' motives and interests, the country partner was asked to assess Polish people's opinion concerning the expected added value of the iBRoad Roadmap and interesting features of the iBRoad Logbook. The profile below illustrates the results.

Improvements that are associated with internal comfort are installation of a modern boiler, as old kettles require high efforts to operate properly, and changing windows, as the old windows are often leaky and causing draught.

In general, building owners expect that a roadmap would give them specific information about the renovation that they need to perform to reduce operation cost, for their particular building.

The significance of particular advantages of energy renovation depends on actual needs and requirements of homeowners. Owners of houses located in crowded areas would appreciate noise reduction, whereas owners who have to deal with old installation in their building, would appreciate correctly working systems.

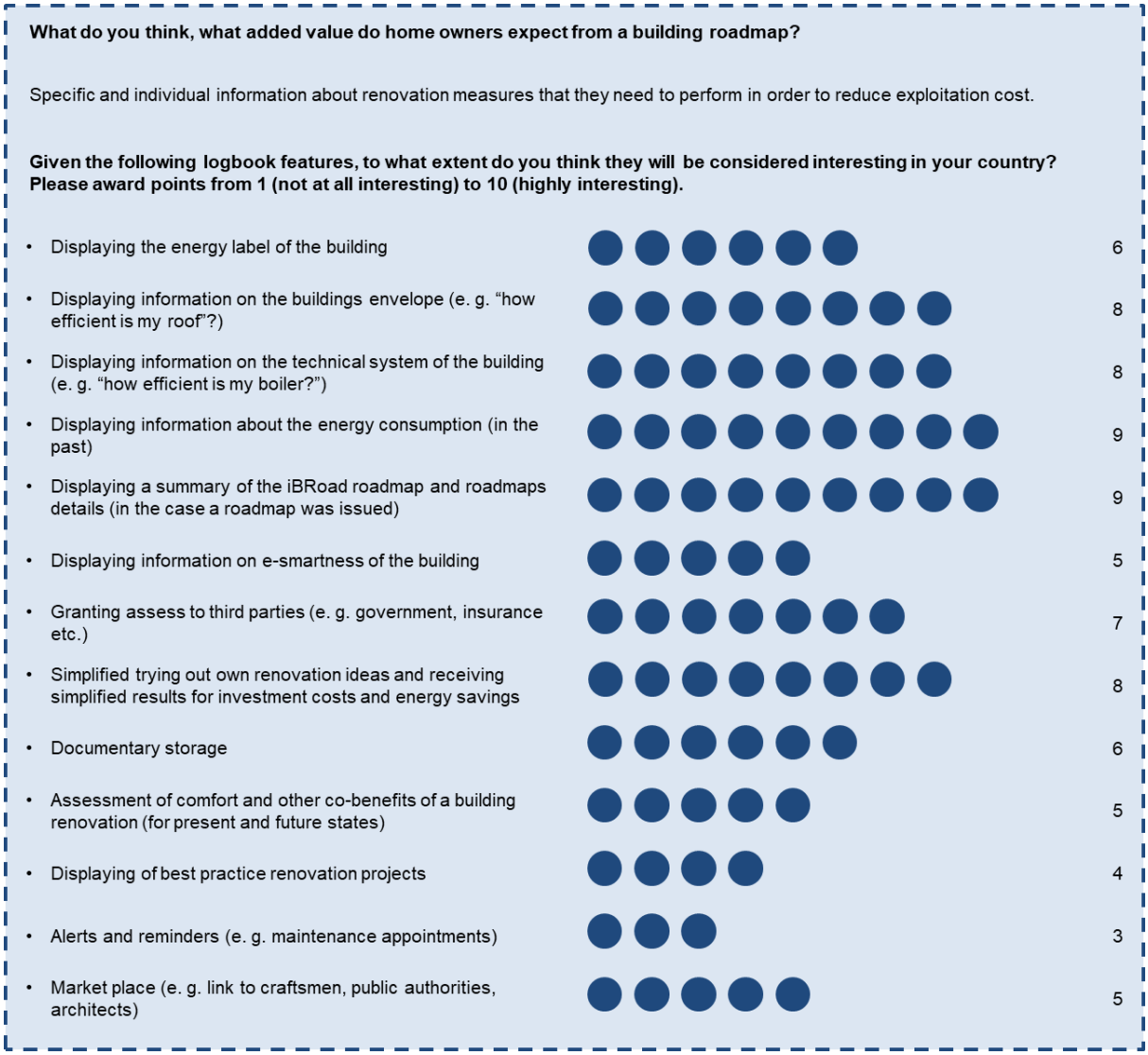


Figure 18: Added value that Polish building owners expect from the iBRoad logbook

For Poland, no logbook feature is rated 10 points. The highest customer interest is expected for technical core information like renovation steps and energy consumption. An alert and reminder feature in the logbook is expected to be the least interesting feature.

Portugal

Barriers

The majority of renovation works are most likely carried out by professionals, since there is a legal frame for it. Accordingly, the implementation standards are generally very high.

There are long-term strategies being pursued with major renovations but there are also small repairs that the owners take along the building lifetime. However, there is no standardised approach for stepwise renovation.

There are no major barriers for the implementation of the iBRoad concept.

Motives

With regard to homeowners' motives and interests, the country partner was asked to assess Portuguese people's opinion concerning the expected added value of the iBRoad Roadmap and interesting features of the iBRoad Logbook. The profile below illustrates the results.

Figure 19: Added value that Portuguese building owners expect from the iBRoad logbook

The Portuguese expectations for the customer´s interest in certain logbook features is highly differentiated. Information about building components, roadmap details and comfort are voted the most interesting to homeowners as well as granting access to building data to third parties. On the other hand, information about the past energy consumption are considered least interesting.

The added value that a building renovation roadmap and a logbook would bring to the building owner would be the access to information about their own building in a unique data repository. Further benefits are expected from the increased awareness regarding their building status and the benefits that improvement measures would have in their building as well as guidance on how to take action on the implementation of renovation works (in a stepwise approach) in their home.

Flanders (Belgium)

Barriers

When households indicated not to plan a certain energy saving measure, the Flemish Energy Agency asked for the reasons. Overall, five main reasons were identified:

- Because I rent the dwelling
- The energy saving measure has already been carried out
- Not necessary/no priority/no time
- I am too old
- Too expensive

Motives

About 45 per cent of the Flemish building owners opt for a profound renovation, in order to modernise their home, increase comfort and energy efficiency; a small minority (4 per cent) opts for smaller renovation works such as embellishment and luxury. No less than 70 per cent are also convinced that an energy-efficient house is also a comfortable home: in a well-insulated house you do not suffer from cold radiation on windows or walls, there is less air coming through slits and a well-insulated house ensures better acoustic comfort.

The personalisation of the EPC+ advice is supposed to become a major added value of a building renovation roadmap. A building renovation roadmap just showing the results of the EPC+, will have no added value. It is estimated that building owners would like to start from the EPC+ recommendations and like to be able to customise these recommendations to their wishes and renovations possibilities, whether or not in collaboration with a professional (energy expert, architect,) Hence, in the roadmap, changes and removals of the EPC+ recommendations would be helpful, e.g., to change the order, to add new measures, to refine the cost estimation (which material, which thickness, which finishing layer, etc.), to see the impact of the changes on the energy label and energy consumption. It could also be an option to make this roadmap changeable in the Woningpas, which is seen as a dynamic instrument consultable by homeowners and others. In addition, the user needs to be able to easily get in touch with architects and building constructors.

In Flanders, the EPC+ was launched in January 2019. During 2019, the Flemish Energy Agency plans to monitor how the EPC+ is received. An important question to be answered is which elements are lacking from the EPC+ for a house owner to start his renovation. The aim is to get an insight into the most important missing features, tools or information, in order to further develop the tools (e.g., the Woningpas and policies needed to motivate citizens towards renovating their homes and to facilitate the renovations process).

The Flemish Energy Agency estimates a provisional ranking of the iBRoad features and linkage to the

Flemish EPC+:

Information that is already in the EPC+ and will be presented in the logbook (Woningpas):

- Energy label of the building
- Information on building envelope
- Information on technical system of the building
- Information on the renovation roadmap: recommendations and costs
- Summary of (personalised) roadmap and roadmaps details

Ranking of the missing features

1. Information about historic energy consumption

2. Simplified trying out own renovation ideas and receiving simplified results for investment costs and energy savings
3. Alerts and reminders (e.g., related to maintenance of a boiler)
4. Grant assess to third parties (government, insurance etc.)
5. Documentary storage
6. Information on e-smartness of the building
7. Best practice renovation projects

By the end of 2019, the following feature will already be made available in the logbook (Woningpas):

- Grant assess to third parties

Furthermore, research, service design and consultation of other parties is currently being carried out in Flanders to investigate the possibility to add the following features in next versions of the logbook (2020 – 2021):

- Information about energy consumption and energy meters (electricity and gas)
- Documentary storage
- Possibility to add personal information on energy-related renovation-works carried out in the past
- Possibility to add information on renovation-works from the renovation roadmap (EPC+) that are already carried out and possibility to re-calculate the energy-label

Germany

Barriers

A majority of building owners in Germany would rather trust their relatives, friends, neighbours or craftsmen when planning a renovation than an energy auditor. The concept of `energy consultation´ itself is not protected so that building owners are partly confused about the content and the objectivity they can expect.

In general, both deep renovation and renewable heating technologies demand higher investments than other alternatives. In addition, even from a life cycle cost point of view, economic measures often do not meet the necessary economic criteria in industrial and commercial environments.

For some building owners, increased investment in energy renovation is unaffordable, even if it pays off in the long term. Often, there is a lack of sufficient equity capital or the ability and willingness to borrow capital is inadequate.

In rented properties, expenses (=costs) and benefits (=energy savings) refer to different parties (landlord-tenant-dilemma), so that there is only little investment motivation for the investor, even if the measures are cost-effective.

Owners lack information about the options for energy renovation. There are deficits in neutral information, for example on the benefits of an insulated building envelope.

Motives

About 25 per cent of the building renovators carry out profound energy renovation measures by conviction to reduce carbon emissions[9]. However, there is not just one single motive for renovation. A market study for the individual renovation roadmap in Germany states that it rather seems to come to an interaction of different motives[10]. However, in many cases the central motive for energetic renovation is energy saving and thus cost savings. This motive can certainly be regarded as a long-term investment basis combined with the desire for value enhancement. Increasing living comfort, beautifying the living environment, providing for old age living or technical interest can also be motives. Although environmental protection plays a role, it is not necessarily a driving motive.

iii. Consequences for iBRoad

There are two key questions to answer in this section: first, how can barriers and obstacles be overcome within the iBRoad project, and second, how can prevailing motives and interests of homeowners be taken into account within the iBRoad project?

In all considered countries, a major barrier to renovation is the lack of information for building owners on how to properly plan, finance and implement renovation strategies. Therefore, building owners have a strong interest in having a standardised long-term renovation plan. However, the auditors and auditing products need to be trustworthy to the homeowners. A second important barrier results from renovation costs that building owners either cannot afford or that are higher than the expected energy savings. In addition, many building owners seek for an improvement of comfort when renovating a building: in particular, this refers to thermal comfort such as less draught, warmer surface temperatures or better cooling in summer time. Another main driver for energy renovations are so-called co-benefits like improved acoustic comfort, security, aesthetics and an increase of the real estate value. Similarly, changes in the use of the building need to be addressed: e.g., when children are born or when they are moving out as well as when the building needs to be suitable for elderly people.

Ensuring the customer´s acceptance

It has been shown that especially in Bulgaria and Poland renovation measures are often carried out by the building owners themselves or by not specially trained persons. This circumstance bears high risks with regard to deep renovation, for example:

- An unsatisfactory renovation result: improper execution of the installation may lead to a renovation result that does not meet the criteria the homeowner imagined or even serious building damage.
- A bad reputation of renovation measures and materials: in many cases the homeowner will not recognise an improper execution of renovation measures. If the renovation result is not as hoped for, homeowners may think that the specific renovation measure was not worth it or that renovation materials are not as good as announced.
- Unnecessary high costs: Due to an improper execution of installation, there is a risk that additional investments will be needed to ensure an acceptable outcome.
- Postponement of further renovation measures/renovation measures that are time-consuming or more difficult to implement: Homeowners might tend to postpone (specific) renovation measures because transaction costs are high.

[9] Stieß et al., 2010
[10] DENEFF, 2017

- Non-implementation of complex renovation measures that cannot be implemented by non-professionals.
- Renovation measures that are planned properly and with regard to further renovation steps and climate targets cause expensive lock-in effects or fail to meet the climate targets.

Within the context of the iBRoad project it should be ensured that homeowners´ acceptance is gained and trust is built in the iBRoad tools: Especially, the desire to get a renovation roadmap should be awakened, because of the advantages that arise from it and because experts, namely energy auditors, elaborate it. The iBRoad products should be designed in a way that communicates high quality and reliability. Consequently, the identified stakeholders in the respective pilot countries should communicate the relevant benefits of the iBRoad tools and the risks that result from self-made and unprofessional implementation of renovation measures.

Also, in the light of the above mentioned, it is essential to ensure that energy auditors, who create an iBRoad Roadmap, will be trained adequately. In particular, training courses and training material should be developed in a way which reflects the respective situation in the relevant country.

Building owners perceive energy audits as too technical and difficult to understand: Integrating graphical/text elements of iBRoad into the software tools and making the results of the audit understandable will make iBRoad user-friendly and overcome this barrier.

Thermal comfort/co-benefits assessment in the iBRoad Roadmap

A main driver for building renovations can be the desire for a reduction of energy costs. However, thermal comfort (e.g., less draught, warmer surface temperatures) and co-benefits (e.g., improved acoustics, safety, aesthetics and an increase of the real estate value of a building renovation) can also be important drivers for renovating a building. Even though the estimated expectations to the added value of the iBRoad tools did not show a clear preference, that does not mean that features are not interesting to building owners. Consequently, thermal comfort and co-benefits of building renovation that were mentioned many times would be addressed within iBRoad.

Within the project context, a simple assessment approach is favoured. It is foreseen that for every defined renovation step an improvement of thermal comfort or co-benefits aspects will be shown. The idea is that comfort and co-benefits of a building renovation will be displayed as icons. Aspects that are improved in the respective renovation step are “switched on” (e. g. from grey to green). In the following steps the “switched on” icons accumulate to show the improvement. The energy auditor will be given assistance on how to assess the comfort aspects in the handbook and the training courses.

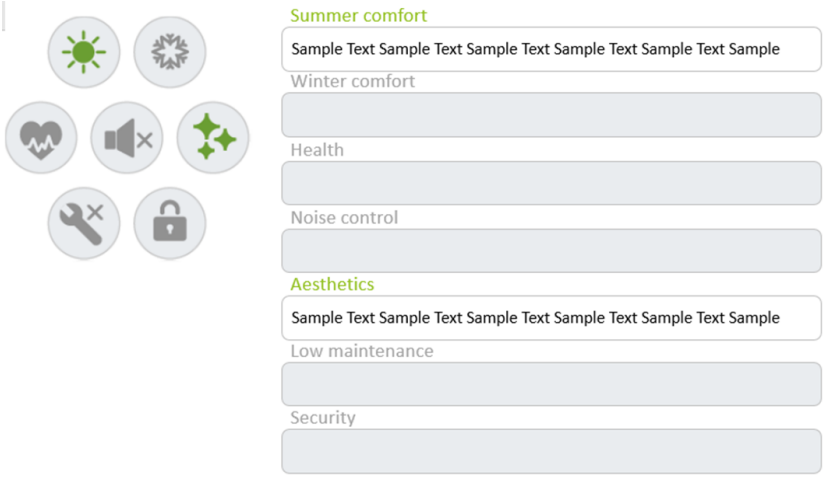


Figure 20: Example for displayed co-benefits that can be turned green if improved in the specific renovation step

Compared to more complex approaches, e.g., a calculated method, this approach offers several advantages, for example:

- less time-consuming and easier to handle for energy auditors
- easy to understand for homeowners
- no calculation needed
- no weighting between co-benefits needed
- assessment without giving the impression that results are more accurate than they really are
- easily adaptable to future developments

In order to overcome the barrier that homeowners do not know who to refer to for a renovation measure or where to find craftsmen, a “market place” tool should be implemented in the iBRoad Logbook. Craftsmen and other suppliers could show their offers and contact data. The Logbook could offer a filter function to display only the branches needed. On the other hand, homeowners might grant limited access to their building data to suppliers. This would be helpful to them in terms of calculating offers or linking their offers to the Roadmap steps. The market place could also be used to link homeowners to funding programmes or loans.

VI. EXISTING MARKET SITUATION FOR ENERGY AUDIT PRODUCTS

i. Overview

The iBRoad project aims at supporting the evolution of energy audit products in order to trigger deep renovations. Therefore, an identification and evaluation of the existing market situation in the considered countries is essential to analyse whether there are substantial differences in terms of the current market situation for energy audit products.

Note

In this context we consider energy audit products as rather broadly defined, so that consequently both on-site energy audits and building software tools are covered.

Figure 21: Overview of energy audit markets

ii. Situation per country in detail

Bulgaria

The Bulgarian market concerning energy audit products for residential buildings is rather limited. The Sustainable Energy Development Agency (SEDA) provides simplified energy calculations for buildings on their website (https://auerportal.seea.government.bg/), which homeowners can use. However, results are of limited use for homeowners as no renovation plan or strategy is offered and all data input comes from non-professionals. Apart from that, there are on-site energy audits, which are quite expensive and obligatory, but there are no controls and no sanctions in the case of an infringement. For a single-family building, the average price varies from 500 to 1000 EUR depending on the complexity and building size. For all renovation measures considered, the auditor has to calculate payback periods, internal rates of return (IRR) and net present values (NPV and NPVq), for which auditors use a specific software – ENSI Profitability. In addition, energy auditors are obliged to compare different packages of renovation measures. In practice, however, it appears that energy auditors fall short of that. Everyone registered in SEDA´s list of energy auditors is allowed to conduct such audits, but the term energy auditor is not protected in any way. Consequently, anyone can call himself an energy auditor.

The existing energy audit in Bulgaria in general is suitable for further development towards deep renovation but not towards step-by-step renovations. The energy audit contains a report template, which can be modified individually. The software that is usually used and almost required for audits is kept simple and allows additional calculations. Given that, experienced and trained auditors can develop also deep renovation analysis but of course at a higher effort than with a software produced especially for deep renovation analyses.

The individual building renovation roadmap (iBRoad) could support Bulgarian building owners and public authorities to strive for renovations that are more comprehensive. A first step could be to visualise the energy performance and the related benefits to generate interest in energy efficiency and deep energy renovations. The iBRoad audits could help solving (by promoting better homes, lower energy bills and mitigation of fossil fuel dependency) two of the most important societal problems in Bulgaria: energy poverty and air pollution.

There are two organisations - “Chamber of energy auditors” and “Association of Bulgarian Energy Agencies, ABEA“ (https://new.abea-bg.org/) that bring together energy efficiency focused companies and auditors.

- The “Chamber of energy auditors”, where it is not obligatory to be registered in order to provide energy audits. Though less than half of the auditors are registered, the chamber influences the work of all energy auditors.
- All regional energy agencies are part of ABEA. Most of them are very active non-profit organisations. ABEA provides opportunities to present the iBRoad in regular meetings.

Poland

In Poland, the market for energy audit products focusses on multi-family buildings. There are subsidies available for energy renovations of multi-family buildings that reach a minimum reduction of energy consumption. To prove that particular renovation measures will contribute to the required energy reduction, it is mandatory to perform an energy audit. Accordingly, energy audits are rarely performed in single-family houses. Energy audits are comparably expensive; however, the audit costs are accepted in the funding programme. Apart from the funding, many building owners do not consider audits as valuable or necessary.

Energy auditors suggest the best solutions to reduce energy consumption to the investor during an on-site visit. For multi-family houses, investors ask specifically for the measures they are most interested in. However, these might not be sufficient to fulfil the requirements of the incentive programme.

Private companies, most of them producers of building materials, offer special online tools to help building owners to find the best solutions for renovation (e.g., calculating u-values of external walls and suggesting the optimum insulation thickness for the investor). Those tools are available free of cost and are easy to understand for building owners.

Energy auditors use a simple payback time method to evaluate economic profitability of particular improvements and whole modernisation. Moreover, the life cycle cost analysis becomes more popular for public procurements.

Portugal

Energy audits are not mandatory for residential buildings in Portugal. However, the Portuguese Energy Agency has a course to qualify energy auditors to perform volunteer energy audits in the residential buildings sector. It resulted from the European project (ENACT) where the goal was to develop a European standard to qualify energy auditors for residential buildings. The main benefit of this qualification is the implementation of the methodology developed under the ENACT project. For the building owner, it is a complement to the EPC, since it is based on calculated energy demand while the energy audit is based on real energy consumption. Thus, the owner is provided with a more realistic diagnosis of the building. Content wise, this energy audit is also suitable for deep renovations. The Portuguese Energy Agency already released five editions of this course, which were well accepted among the sector (energy auditing training course for residential buildings).

The energy auditor sets the price for the audits. There are no incentives for energy audits.

The profession of the 'energy auditor' does not exist in Portugal. Usually audits are performed by qualified experts that can issue EPCs (see chapter IV) or who are graduated in engineering (but without the EPC qualification they can only perform the audit but not issue the EPC).

Auditors are used to considering the investment cost and the energy savings of applying different renovation measures. There is no explicit audit for staged renovation yet

Flanders (Belgium)

In Flanders, there is a well-developed market for energy audit products. There are governmental initiatives at regional, provincial and local level as well as private initiatives.

At regional level, on-site energy audits are offered since 2008. Nevertheless, only 1,500 energy audits have been conducted until now. The on-site energy audit can be considered either unknown or unattractive for homeowners (e.g., due to its price). Also, the existence of the mandatory EPC is considered to be an influencing factor: building owners probably feel less need for a more thorough on-site energy audit.

The on-site energy audit is conducted by a trained energy auditor. Energy auditors in Flanders have to complete specific trainings and succeed in an exam, after which they are accredited in an official list of energy auditors. To conduct an on-site energy audit, other qualifications than that (e.g., education level, experience) are not required – an auditor's type B qualification is sufficient in this context. In fact, Flanders introduced an auditor's ranking system: to issue an EPC you need to be an auditor type A, which is linked to a certain education and experience.

The on-site energy audit is intended for individuals who seek for a voluntary energy advice about their home. The energy auditor provides a full analysis of the energy performance of the house, complemented with advice about how to reduce the energy consumption. A central software, in control by the Flemish Energy Agency, is mandatory for generating a final report, which is intended for the homeowner. The energy auditor is free to set his own price for the service. No subsidies are given.

At provincial level, there are in total five knowledge centres concerning sustainable buildings ("Steunpunten Duurzaam Bouwen")[11]. These centres are local network organisations that help to translate the principles of sustainable living and building into practice. Each of them provides both a digital information desk for short questions and more elaborated products such as renovation advice, whether or not based on an on-site visit. Many of the advice they offer is subsidised. There is no link with the regional energy audit procedure.

At local level, the majority of cities and municipalities offer tailored advice, most often for free and also based on an on-site visit and physical meeting with an expert. Some of the cities and municipalities also offer a digital quick scan (e.g., a digital quick scan tool of the city of Ghent[12]). This allows the house owner to easily assess the energy performance of his house and develop possible renovation measures.

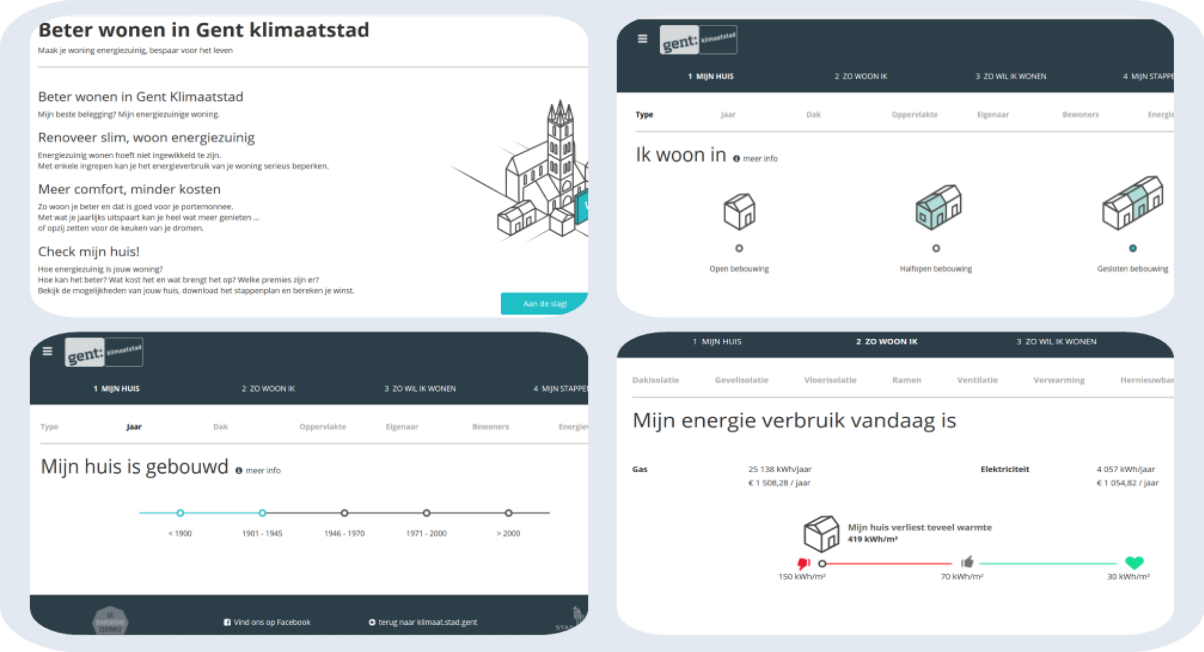


Figure 22: Gent digital quick scan building tool[13]

Private companies, offering energy audit products are scarce: "Cozie", for example, is a digital quick scan and energy advice tool, which is free of charge and can be filled in by the house owner.[14]

[11] E. g. province of Limburg: http://www.eerstehulpbijduurzaambouwen.be/nl/, or province of Antwerp: https://www.kampc.be/duurzaam/persoonlijk-bouwadvies.

[12] https://klimaat.stad.gent/checkjehuis/

[13] Gent: klimaatstadt, URL: https://klimaat.stad.gent/nl/themas/wonen, accessed January 31st 2019

[14] https://www.homefit.be/nl/home

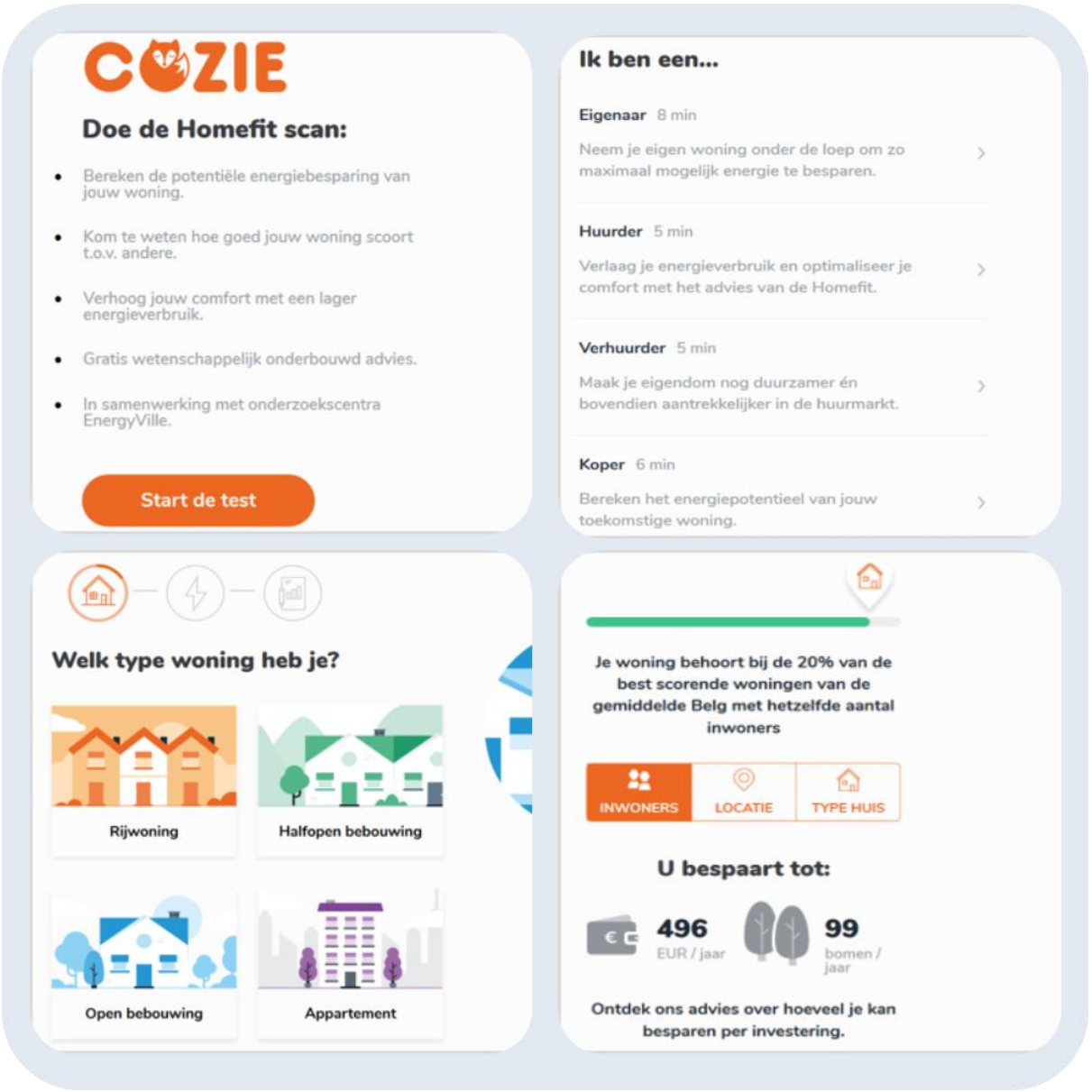


Figure 23: "Cozie" quick scan building tool

Germany

In Germany, there is a well-developed market for building energy audits. There are audits on very different quality levels and depth.

Consumer associations offer stationary energy audits which building owners can visit to put their questions to experts. This offer is subsidised by the Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) respectively the German ministry for economy.

Local energy agencies, auditor associations, local energy initiatives, mortgage providers, banks and other providers also offer stationary audits.

One main on-site audit is the "Energieberatung für Wohngebäude" (energy audit for residential buildings). It is also subsidised by the Bundesamt für Wirtschaft und Ausfuhrkontrolle (BAFA) respectively the German ministry for economy. The programme started in July 1998. Building owners receive a 60 per cent funding of the auditor´s fee (up to a maximum of 800 EUR for single and two-

family houses and 1,100 EUR for residential buildings with three or more residential units). According to the minimum requirements defined in the programme ordinance, the audits must comprise an assessment of the present building state and proposals for energy efficient improvements. Renovations can be envisaged either in one step or stepwise. Auditors need an accreditation. This requires several years of experience and an exam in an accredited training course. Auditors need to sign up to the official auditor´s list.

The "individueller Sanierungfahrplan iSFP" also meets the requirements of the programme "Energieberatung für Wohngebäude". It provides a clear structure and a user-friendly layout to explain even complex relations between numerous renovation steps.

Germany already adopted the concept of an individual Building Renovation Roadmap ("Sanierungsfahrplan") in the federal state of Baden-Württemberg in 2015 and then transferred the concept to the federal level in 2017.

Since 2015, there has been a law in Baden-Württemberg requiring homeowners to use more renewable energy sources to generate heat (EWärmeG). The renovation roadmap serves as a fulfilment option to meet the law's requirements and is a consulting tool for homeowners who are planning renovation measures. Evaluations and analyses show that, in general, the concept is highly appreciated by both, energy auditors and homeowners. However, there is also room for improvement, e.g., renovation measures and their impacts should be described in more detail.

According to the monitoring report of the German market for energy efficiency services, there are 11,500 to 12,500 professional energy auditors available[15]. The total sales in the German market for energy efficiency services accounted for 370 to 400 million EUR in 2017.

In addition, there are numerous online building tools already existing in Germany, e.g.:

- The "Eigenheimmanager" is a tool that is designed to help building owners keep track and to stay on top of things. It provides document storage, and informs about energy consumption, costs, and deadlines. The tool also allows a connection to third parties such as heating installers, energy comparison portals or building societies. The tool is available as an app and free of cost in the basic version.
- The "Sanierungskonfigurator" was developed in 2012 and is a freely available tool. Based on comprehensive data pre-entered by the user, a building's energy assessment is compiled and building renovation recommendations are calculated. The tool has been simplified over time because much of the information needed to calculate was not understood by the customers. A link to craftsmen and energy consultants is also made possible via the tool.
- The "Energiesparkonto" was developed in 2007 and is in its basic version a free tool, which enables the user to enter current energy bills over long periods. The tool calculates the average energy consumption and allows several analyses.
- The "Sanierungsrechner" is a complex online energy-auditing tool offered by the federal ministry for economy. It allows the user to carry out a full calculation according to the German legislation. Based on the present building state, also various options of renovation can be examined.

[15] German Federal Energy Efficiency Center (BfEE), 2019

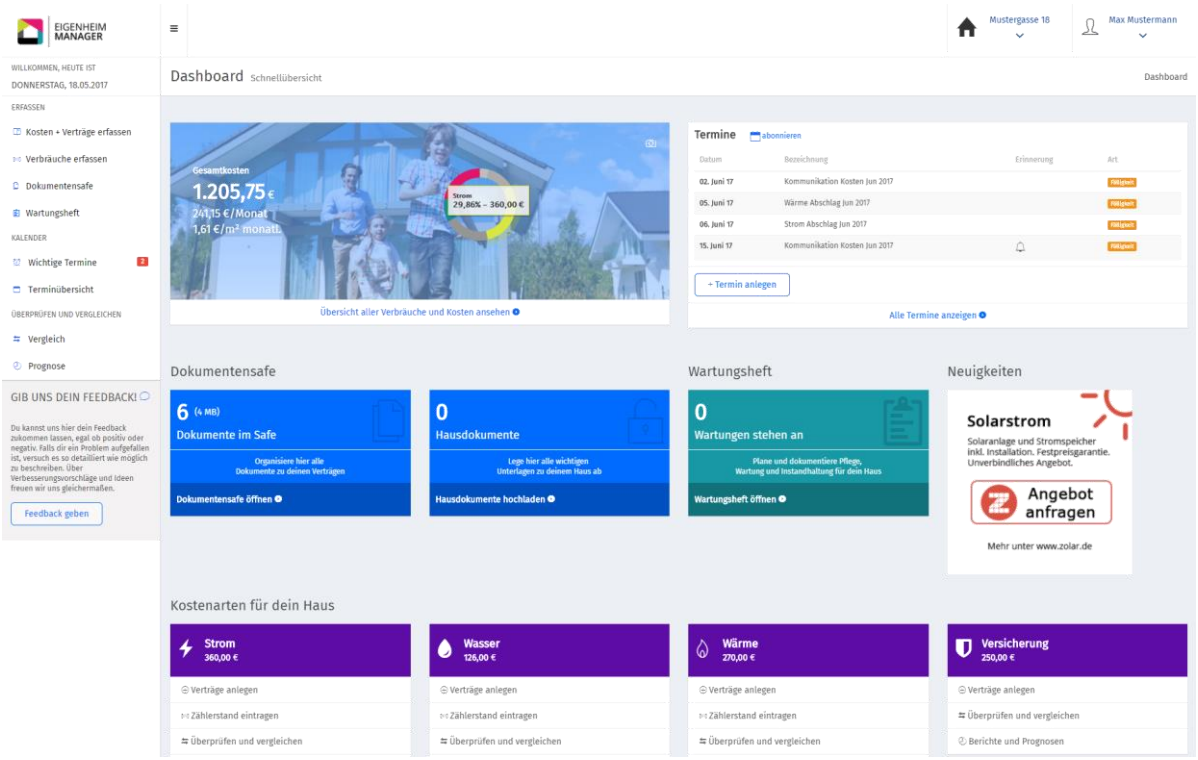


Figure 24: Surface of the "Eigenheimmanager"[16]

[16] Eigenheimmanager, accessed January 31st 2019, https://eigenheim-manager.de

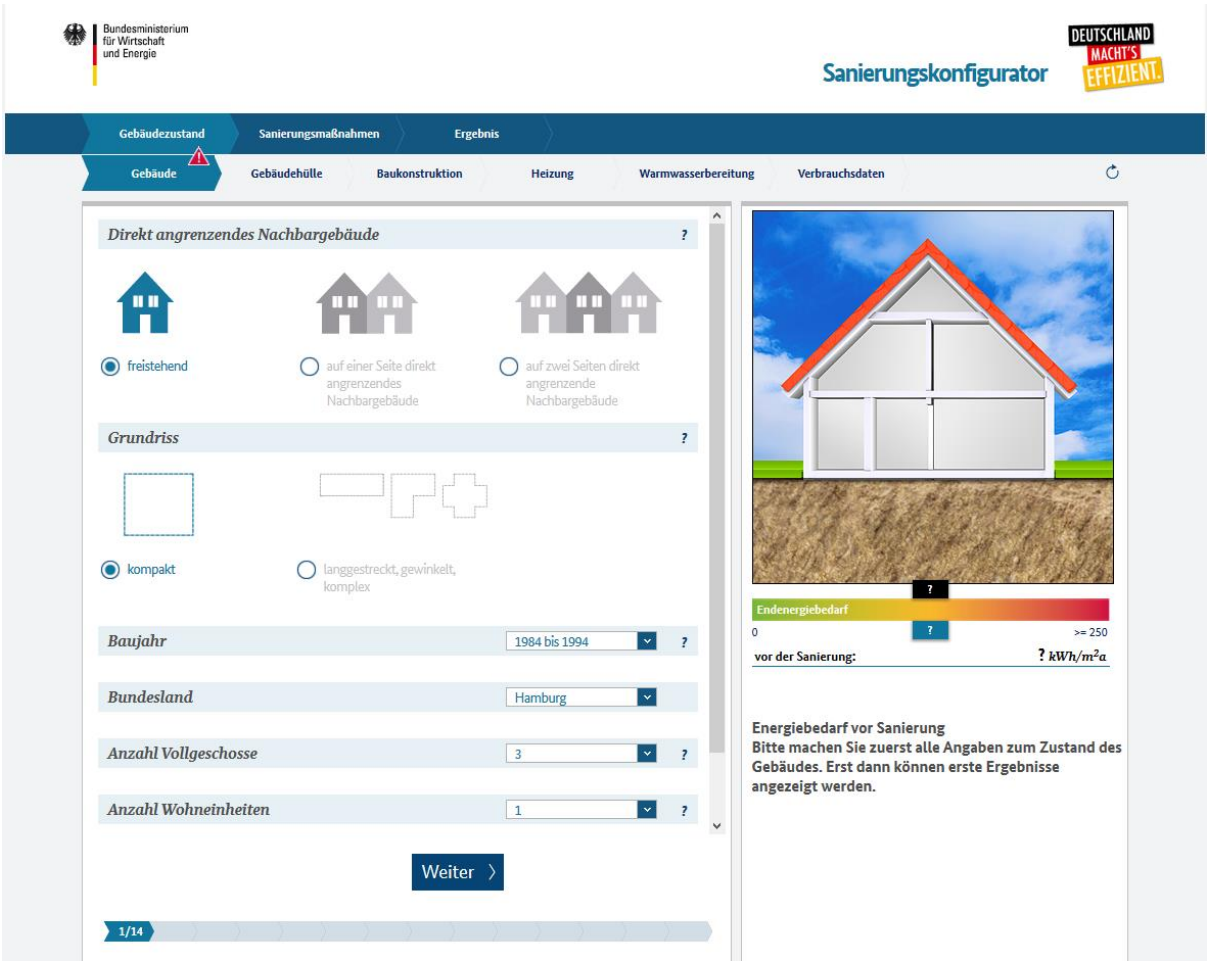


Figure 25: Surface of the "Sanierungskonfigurator"[17]

[17] Federal ministry of economy, Sanierungskonfigurator, accessed January 31st 2019, http://www.sanierungskonfigurator.de/start.php

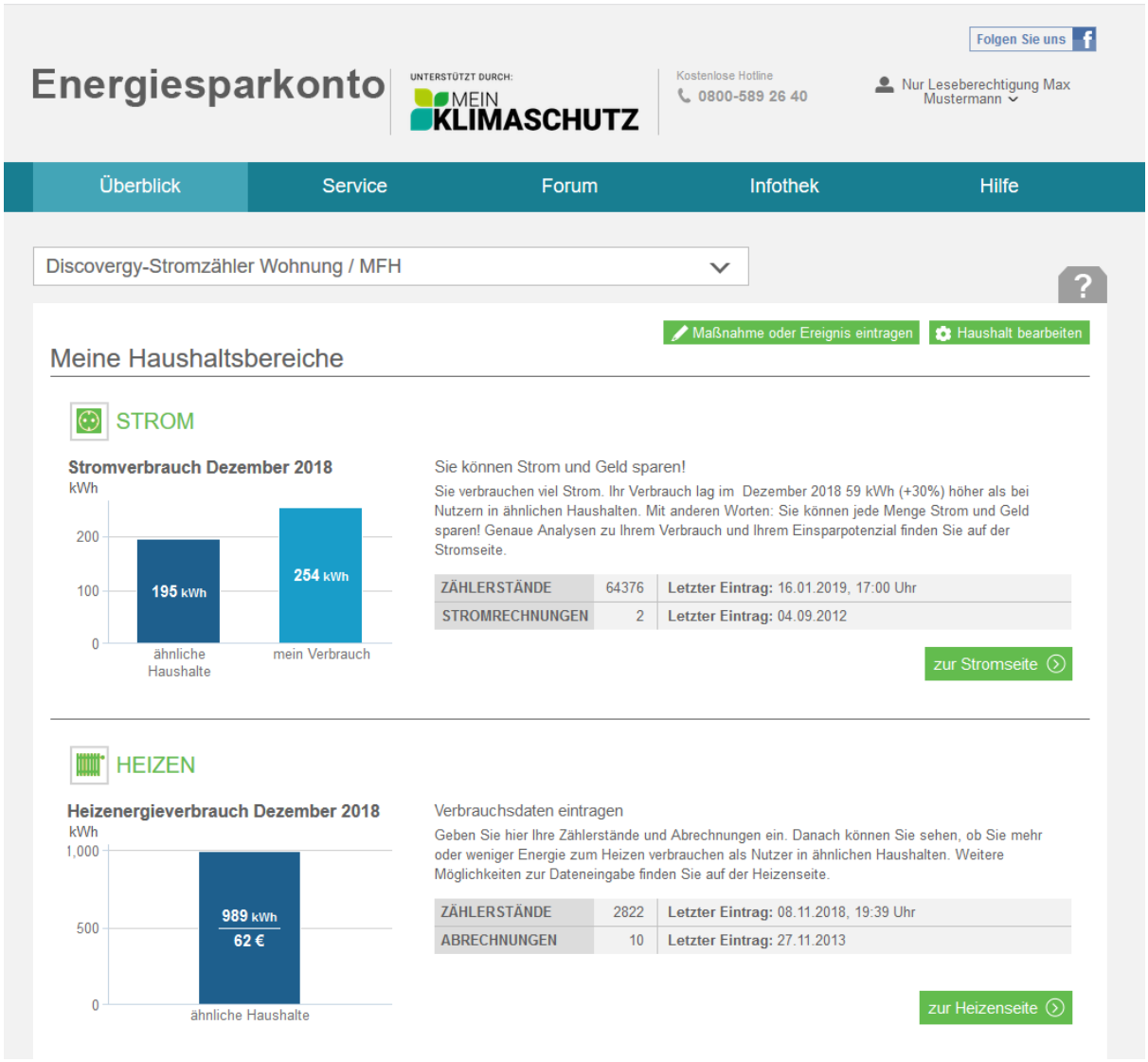


Figure 26: Surface of the "Energiesparkonto"[18]

[18] co2online, SEnerCon, Energiesparkonto, accessed January 31st 2019, https://www.energiesparkonto.de/esk/content/startPage/?portal_id=co2online

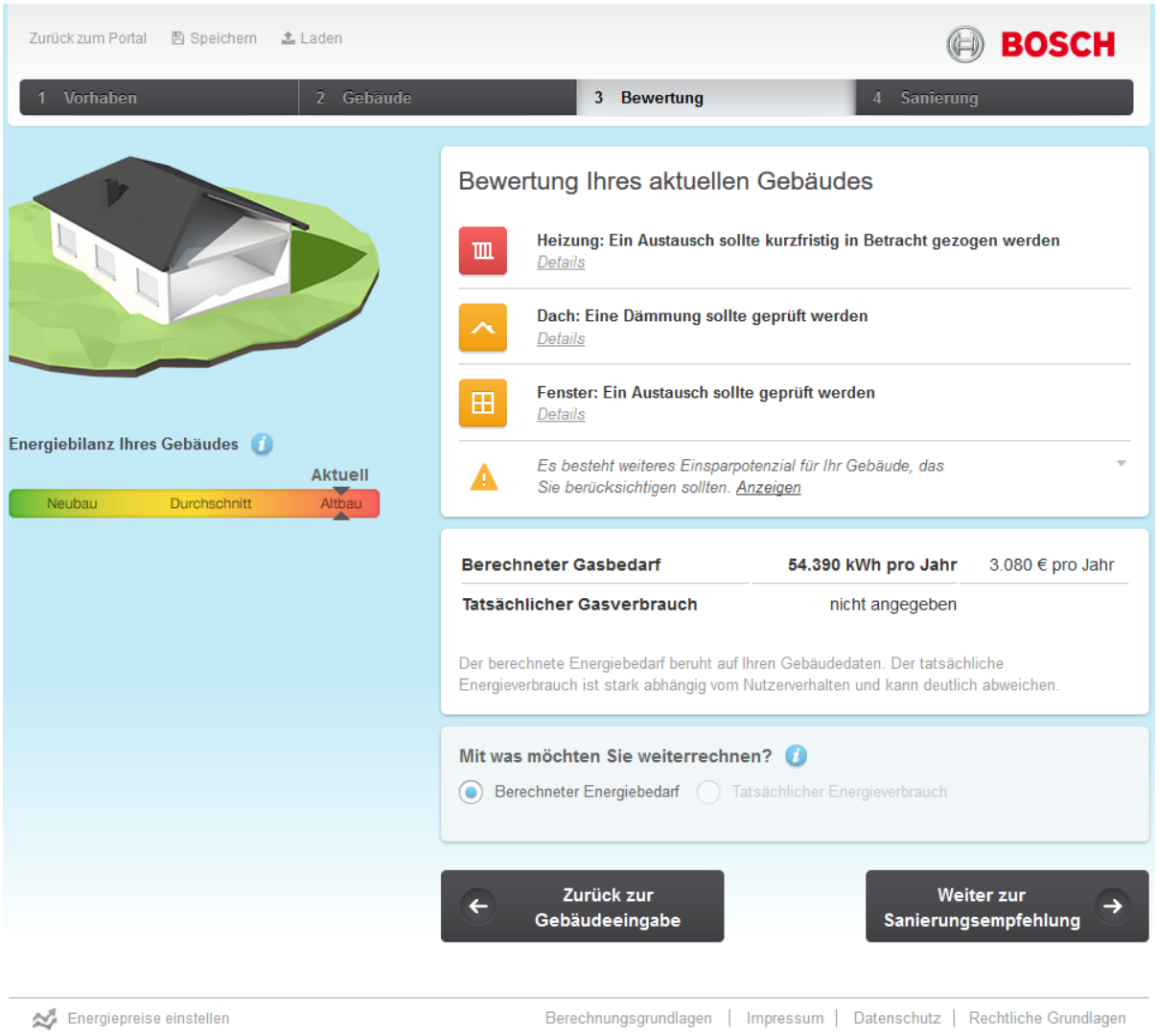


Figure 27: Surface of the "Sanierungsrechner"[19]

iii. Consequences for iBRoad

The key questions in this section are if auditors and software tools in the respective countries are available and adaptable for iBRoad.

The markets for energy audits are very divers in the considered countries. In some countries, the audits target rather to single-family buildings, in others almost only to multi-family buildings. In some countries, the requirements to EPCs and EPC issuers are much higher than the requirements to energy audits and vice versa. Despite these differences, the following can be stated for all considered countries:

- Experienced auditors are available. These are professionals, that deal with energy renovations and who are used to think of future building standards. They are the target group to provide the

[19] Sanierungsrechner, accessed January 31st 2019, https://application.effizienzhaus-online.de/sanierungsrechner/#?state=7

iBRoad renovation roadmap to the building owners. Within the project, specific training courses will be developed to explain this new audit product to the auditors.

- Software tools for audits are available. When developing the iBRoad tools, one needs to bear in mind the required calculation processes and the possible interface for a future automated data transfer.
- An infrastructure for audits is available. The communication and dissemination of the iBRoad concept can build on existing auditor´s associations and expert lists.
- Building owners are used to energy audit products. The basic idea of professional audits that deal specifically with energy efficiency is familiar to buildings owners. The iBRoad audit can present itself as a further development of existing consultations. At the same time, it is important to avoid any competition between the existing audits and iBRoad audits. Thus, the differences need to be communicated very clearly. The iBRoad audits should complement existing audits in a way that building owners can choose which kind of audit suits them best.

Energy calculation software

It is of substantial importance that the results shown in the iBRoad documents are in line with the results of the national EPC. Different results would lead to confusion and mistrust. At the same time, the calculation methods, as well as standards and norms, differ between the examined countries. Accordingly, all energy calculations will be carried out with the official national calculation software tools. Neither the iBRoad Roadmap Assistant nor the iBRoad Logbook are intended to carry out the calculations of the buildings´ energy demands or emissions. The calculation results will have to be transferred from the national calculation software to the iBRoad tools. Ideally, an interface could provide data exchange between the iBRoad tools and the national calculation software. This would enable both import and export of the building data once entered into one of the tools.

Most of the national calculation software tools are not prepared to calculate staged renovation processes. However, many tools are capable of calculating different building states, as this is an already built-in feature for comparing different renovation scenarios. This would be a sufficient basis to enable auditors to work with the iBRoad tools. If the national calculation software was not capable of handling different building states the auditor would have to calculate each renovation step of the Renovation Roadmap separately. This can cause increased effort but is not a substantial obstacle to using the tools.

Auditor´s Training

In the light of the above mentioned, it is essential to ensure that energy auditors, who will attend the field test in Bulgaria, Poland and Portugal and create an iBRoad Roadmap, will be trained adequately. In particular, training courses and training material should be developed in a way that they reflect the respective situation in the relevant country. It is foreseen that at least 30 energy auditors within Bulgaria, Poland and Portugal (10 in each country) will be specially trained in face-to-face training courses, and thus, will be enabled to examine buildings for the purpose of creating an iBRoad Roadmap. Training courses will be conducted in cooperation with the country partners in the national or English language and will last one day. The main focus of these training courses lies on the communication of

- the iBRoad Roadmap principles: some basic principles must be observed when creating the roadmap such as the so-called “best-possible principle” and the customised approach to meet the homeowners’ individual capabilities;
- the procedure for generating the iBRoad Roadmap: starting from an on-site visit of the building up to the roadmap assistant tool that assists the auditor in the creation of the roadmapl;
- the importance of the energy auditors´ acceptance of the iBRoad: creating an iBRoad Roadmap requires that auditors change their practice and adapt to new principles in order to achieve deep

step-by-step renovations. Auditors are asked to adapt their way of working and add several steps to their usual practice to recommend the optimal step-by-step renovation measures;

- aspects that should be observed in the communication with the homeowner and the building occupants: energy auditors are usually trained in technical aspects only. Since they play a key role in motivating the building owner to carry out renovation packages as stated in the defined renovation steps, they must be able to communicate with the home owner, detect their needs and preferences and combine them with technical building knowledge;
- the country specific situations that need to be taken into account: for example, in the light of the precarious financial situation of many homeowners in the pilot countries, energy auditors should be trained to pay special attention to the first step of renovation and efficiency measures to provide high savings at low cost. A special focus should also be on the heating system. When old stoves are replaced, e.g., in Bulgaria or Poland, renewable heating systems should be used as far as possible to avoid the mistakes made in other countries.

Also, within the iBRoad project context, a training toolkit for guiding the consultants is planned: A handbook for energy auditors will clearly explain:

- the fundamental underlying principles of the iBRoad Roadmap: e.g., the best-possible principle and the customised approach to meet the homeowners' individual capabilities (see above);
- the procedure of generating the Roadmap (see above); and
- what should be observed in the communication with the home owner.

It is planned that at least 300 energy auditors in Bulgaria, Poland and Portugal will receive the training material (100 per pilot country). In addition, the handbook for energy auditors will be uploaded to the iBRoad project website, and thus, can be further made accessible and disseminated.

During the field test phase, a telephone hotline in the event of open questions of energy auditors will be set up in cooperation with the country partners.

VII. FUNDING PROGRAMMES

i. Overview

In all pilot countries, there are several funding schemes aiming to improve the energy efficiency of residential buildings. The most important ones are described below.

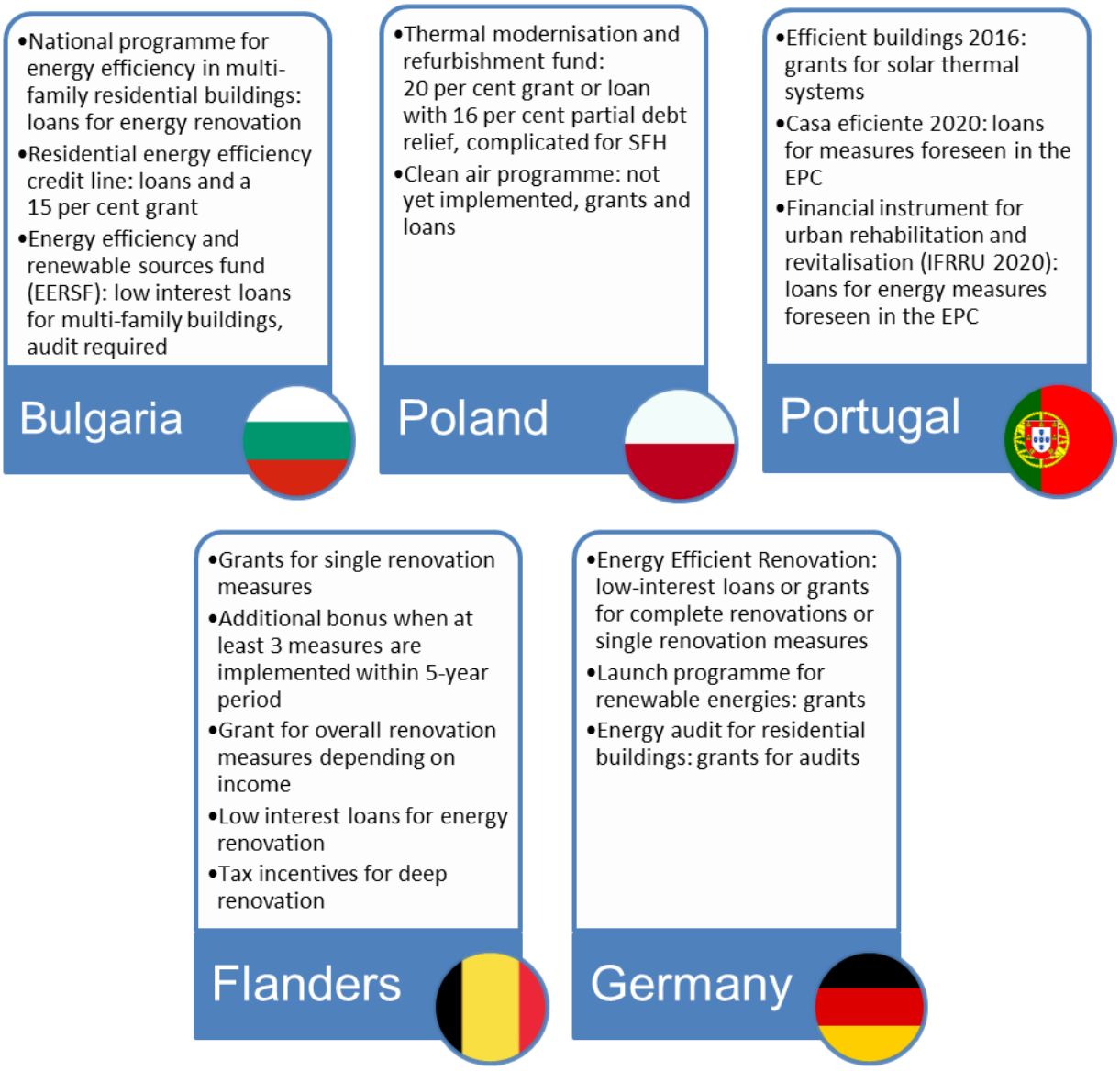


Figure 28: Overview of funding programmes

ii. Situation per country in detail

Bulgaria

In Bulgaria, there are mainly three funding schemes that are available focussing on energy efficiency measures in the residential building sector.

National Programme for Energy Efficiency in Multi-family Residential Buildings	
Programme launch:	▪ 2nd of February 2015
Financial programme volume:	▪ Initially 1 billion BGN, in January 2017 another 1 billion BGN was approved (about 1 billion Euro in Total)
Major objectives:	▪ Improvement of energy efficiency in multi-family residential buildings ▪ Extension of lifetime of apartment buildings and ▪ Contribution to a reduction in local and global air pollution
Eligible persons:	▪ Owners of multi-family residential buildings, (lower limit 3 floors with at least 6 apartments, in the future, it is planned to involve even smaller buildings) ▪ 95 per cent of homeowners must agree to participate in the programme
Funding amount:	▪ 100 per cent grant support to finance measures and related services on a first-come-first-serve basis (all of the unapproved applications remain in the pipeline for future programme phases)
Eligible activities:	▪ Activities on structural reconstruction/strengthening/overhaul depending on damages that occurred during the exploitation of multi-family residential buildings, that have been prescribed as obligatory for the building in the technical audit; ▪ Renovation of common areas of multi-family residential buildings (roof, facade, staircase, etc.) ▪ Implementation of energy efficiency measures, prescribed as required for the building in the energy efficiency audit. ▪ Concurrent construction and assembly works related to the implementation of energy efficiency measures and the relevant rehabilitation of common areas of the building as a result of the implemented measures with energy saving effect. The attendant construction and assembly works are related only with the restoration of the initial state, broken as a consequence of the renovation of the common areas and the change of joinery in the separate site. ▪ Energy efficiency measures to be implemented are expected to bring the renovated buildings to the level of "Class C" of the EPC (i.e., energy use of 191–240 kWh/m²) at the lowest cost.

Table 4: Short description National Programme for Energy Efficiency in Multi-family Residential Buildings

To date, the overall satisfaction with the Programme is very high: As a result of implemented energy efficiency measures, there was a significant improvement in the buildings' energy performance classes[20]. Table 5 shows that 95 per cent of the buildings were rated class C, which was the minimum requirement of the Programme.

[20] Singh et al. 2018

	Class A	Class B	Class C	Class D	Class E	Class F	Class G
Before EE measures	0	2	9	152	819	713	326
After EE measures	1	170	1,848	2	0	0	0

Table 5: Number of buildings in each EPC class before and after implementation of energy efficiency measures in the National Programme for Energy Efficiency in Multi-family Residential Buildings

Residential Energy Efficiency Credit Line (REECL)	
Major objectives:	▪ The programme is designed to provide loans to individuals, associations of apartment owners or service providers (housing management companies, energy service companies, developers and construction companies) to save energy and reduce energy costs by installing new or replacing existing inefficient equipment and appliances with more energy efficient ones.
Eligible buildings:	▪ existing buildings, with one or two dwellings, in which at least two eligible measures for the improvement of the envelope and/or engineering systems of the whole building are implemented; ▪ existing apartment buildings with at least three separate dwellings, in which eligible measures for whole building improvement of the envelope and/or engineering systems are implemented; ▪ houses under construction, with one or two dwellings, that are designed to be energy efficient; ▪ apartment buildings under construction, with one or two dwellings, that are designed to be energy efficient.
Funding amount:	▪ Borrowers are eligible to receive an investment incentive payment of an amount equal to 15 per cent of the lower of either (a) the disbursed amount of the loan, or (b) the eligible investment cost, as determined by the REECL Project Office, for houses with one or two dwellings.
Eligible activities:	▪ The REECL can be applied for several energy saving measures and technologies: e. g. replacing windows, insulation of external envelope, heating pumps, biomass, solar water system, hot water gas boilers, PV in buildings, lifts and balanced ventilation with heat recovery. ▪ For all of them there is a list of installers that can provide the technology.

Table 6: Short description Residential Energy Efficiency Credit Line

Currently, two banks provide the `Residential Energy Efficiency Credit Line´ (REECL). The programme provides loans for measures to save energy by installing new equipment and appliances. Due to high documentation efforts, banks increase the interest rate and do not actively promote the scheme. As a result, homeowners prefer to use their own money, in case they have such, and choose companies offering lower prices compared to those in the REECL lists.

However, to date, the REECL Programme has committed to 1,578 energy efficiency loans totalling 13,478.729 Bulgarian leva and incentive grants amounting to 2,234,767 Bulgarian leva. In addition, to date, the REECL financed projects that have saved 53,820 MWh per year and have brought a reduction in CO_2 emissions in the range of 12,217 tonnes per year[21].

[21] http://reecl.org/en/reecl-statistics/

Energy Efficiency and Renewable Sources Fund (EERSF)	
Programme launch:	▪ 2005
Financial programme volume:	▪ Since it was established the fund has funded projects worth about 87 million leva.
Major objectives:	▪ The Fund provides in general lower interest rate than commercial banks. A necessary condition for a successful application with the EERSF is the presence of a detailed energy audit allowing for an energy analysis and choice of energy saving measures.
Beneficiaries	▪ Project developers, ESCOs, Project contractors, housing corporations, businesses, public entities e. g. municipalities, local authorities, hospitals and universities, residents
Funding amount:	▪ EERSF provides loans within the limits of 27 000 to 2 700 000 leva with preferential interest rates. They also provide loans for homeowners of single-family houses.
Eligible activities:	▪ Activities on structural reconstruction/strengthening/overhaul depending on damages that occurred during the exploitation of multi-family residential buildings, that have been prescribed as obligatory for the building in the technical audit

Table 7: Short description Energy Efficiency and Renewable Sources Fund

Poland

In Poland, two main funding schemes are available or planned focussing on energy efficiency measures in the residential building sector.

Thermal Modernisation and Refurbishment Fund	
Programme launch:	▪ 18th of December 1998
Major objectives:	▪ Providing financial aid for investors engaged in energy modernisation and renovation initiatives as well as providing financial indemnifications for residential building owners. ▪ The Fund offers three types of assistance, namely the energy renovation incentive, the renovation incentive, and the indemnification incentive ▪ The fund requires for 25 per cent drop of energy usage in case of buildings where the heating systems has not been modernised, and 15 per cent for buildings where the heating system had been improved.
Beneficiaries	▪ The fund is a nationwide initiative targeting at housing cooperatives, housing communities, private individuals and local governments.
Funding amount:	▪ Owners of single and multi-family houses can apply for a subsidy or a loan from Energy renovation fund, which covers 20 per cent of the investment spend on energy renovation, or 16 per cent of loan.

Table 8: Short description Thermal Modernisation and Refurbishment Fund

The Thermal Modernisation and Refurbishment Fund is very popular amongst owners of multi-family houses. Owners of single-family houses hardly ever apply for the subsidy, as the procedure is very complicated.

In 2018, the Polish government announced to start a programme called “Clean Air” which will support energy modernisations and the replacement of heat sources. The programme will target individual homeowners and will allocate 103 billion Polish Zloty (about 24 billion EUR) for such activities by 2029.

Two thirds of the fund will be given as grants and the rest as loans. The amount of financing in the case of grants will vary from 30 to 90 per cent of the eligible investment costs, depending on the income per capita in the household[22]. At the beginning of December 2018, more than 16,000 people applied for the `Clean Air´ programme.

Portugal

In Portugal, there are mainly three funding schemes focussing on energy efficiency measures in the residential building sector.

In 2016, the Energy Efficiency Fund (FEE) has provided a financial support, called "Efficient Buildings 2016", for investments in energy efficiency measures to improve the energy performance of existing buildings, including solar thermal heating. "Efficient Buildings 2016" addressed both the residential and service sectors and was opened to receive applications from 8 July until 8 November 2016. For 2017, no additional calls for funding have been launched yet. The last call approved 695 of 2,592 applications. It largely overcame the expectations and the initial fund was not sufficient to cover the demand. The financial support covered the following amounts depending on whether it is addressed to a complete new solar thermal heating installation or a new solar thermal system, which does not include the heater:

- Up to 2,500 EUR for solar thermal systems which do not include the heater
- Up to 3,000 EUR for complete new solar thermal heating installations
- Additional editions have been launched after 2016 addressing the renovation of the building envelope or the replacement of technical systems.

The new "Casa Eficiente2020" Programme aims to grant loans to operations that promote the improvement of the environmental performance of private residential buildings, with a special focus on energy and water efficiency, as well as the management of urban waste.

Casa Eficiente2020	
Programme launch:	▪ 2018
Financial programme volume:	▪ 200 million EUR for the period 2018 – 2021
Major objectives:	▪ Finance investments in energy and water savings as well as the management of urban waste
Eligible persons:	▪ Any individual or collective of private law who is the owner of a property or autonomous area destined for housing
Funding amount:	▪ The financial conditions of the loans granted under the programme are negotiated between the beneficiary and the Commercial Bank.
Eligible activities:	▪ The programme will support interventions on the building's envelope (walls, roofs, windows) and systems (lighting, ventilation, domestic hot water production, sanitary devices, irrigation), but are limited to measures foreseen in the EPC.

Table 9: Short description Casa Eficiente2020

[22] https://www.mos.gov.pl/en/news/details/news/pln-103-billion-for-the-improvement-of-air-quality-in-poland/

The Financial Instrument for Urban Rehabilitation and Revitalisation (IFRRU 2020) is a financial instrument aimed to support investments in urban renewal that covers the entire Portuguese territory. In order to boost investment, IFRRU 2020 brings together various sources of financing, whether European funds of PORTUGAL 2020, whether funds from other entities such as the European Investment Bank and the Development Bank of the Council of Europe, combining them with funds from commercial banking. To support easy-to-access conditions, a single application for funding is required, and there are no restrictions related to the nature of the entity requesting the financing or the future use of the renewed building.

Financial Instrument for Urban Rehabilitation and Revitalisation (IFRRU 2020)	
Programme launch:	▪ 30th of October 2017
Financial programme volume:	▪ EUR 1,400 million
Major objectives:	▪ The complete rehabilitation of buildings with an age equal to or greater than 30 years ▪ The rehabilitation of abandoned spaces and industrial units ▪ The rehabilitation of private fractions inserted in buildings of social housing that are the object of integral rehabilitation
Beneficiaries:	▪ Eligible are natural and legal persons and rehabilitated buildings which can be used for any use, such as housing, economic activities, and equipment for collective use.
Eligible activities:	▪ Energy measures foreseen in the energy certificate

Table 10: Short description Financial Instrument for Urban Rehabilitation and Revitalisation

Since its beginning (November 2017), already 71 projects were approved, reflecting an investment of 265 million EUR.

Figure 29: Portuguese Instrument for Urban Rehabilitation and Revitalisation, Status at December 2018 (Source: IFRRU2020)

Flanders (Belgium)

In Flanders, public funding (premiums) is available for energy upgrading individual measures in relation to roof, floor, basement, wall insulation and exchange of windows as well as installation of heat pumps and solar water heaters. This funding can be assigned by:

- the network operator (imposed by the Flemish government);
- the federal government;
- the Flemish government;
- a local authority; or
- the provincial government.

As from 2017, a total renovation bonus was added on top of the individual premiums for residential buildings which execute at least 3 measures (out of 7) within a 5-year period. A voucher (called BENO pass) can be issued and activated, allowing total renovation bonuses to be added to the individual premiums already paid for these investments. The premium height for single-family houses amounts:

- after the third investment: 1,250 EUR;
- after the fourth investment: 1,750 EUR (+ 500 EUR);
- after the fifth investment and with EPC proof that the home meets the requirements for the first 5 investments: 2,750 euros (+ 1,000 EUR);
- after the sixth investment: 3,750 EUR (+ 1,000 EUR);
- after the seventh investment: 4,750 EUR (+1,000 EUR).

In case of an apartment, the bonuses are half of the above amounts.

Besides specific energy related premiums, the Flemish government also hands out premiums for overall renovation measures ('de renovatiepremie'). This premium is issued for energy-saving works: renovation of windows and glazing, wall insulation, installation of a condensing boiler, roof renewal

(including supporting structure), but is related to the building owner´s income. For renovation of the social housing stock specific financial incentives exist.

Besides this, the Flemish Energy Agency (VEA) also coordinates energy loans financed with public funds for energy saving investments allocated by a network of Energy Houses. Since 2015, more than 11,700 loans were granted. Vulnerable families do not have to pay an interest rate and get intensive guidance during the process.

Next to the energy loans, social loans are also financed with public funds.

In December 2016, several banks such as ING, BNP Paribas Fortis and BPost committed in offering energy loans with interest rates of less than 2 per cent. An energy loan, with low interest rates, enables the home owner to finance energy saving renovation activities, with a limit up to 10,000 EUR (as of October 2017, 15,000 EUR with a longer payback period).

Also, for new dwellings and for existing dwellings who do an 'intensive energetic renovation', when the energy efficiency of the dwelling is below a certain value, there is a discount on the property's taxes. There is also a financial incentive given to buildings that are energetically renovated within 5 years after being donated.

There is a good demand for the existing funding, however, especially the knowledge of the new instruments (e.g., the total renovation bonus) as well as the knowledge of the instruments with a limited target audience is still low.

	known to the public	know by renovators	know by builders
The Flemish energy loan	42 %	51 %	50 %
Individual premiums	57 %	67 %	65 %
Total renovation bonus	26 %	34 %	29 %
Renovation premium	25 %	30 %	29 %
Discount on property tax for existing buildings	20 %	23 %	24 %
Discount on property tax for NZEB buildings	21 %	25 %	27 %

Table 11: Evaluation of the knowledge about Flemish funding programmes

Germany

In Germany, there are three major incentive programmes for the energy renovation of existing residential buildings:

- "Energy Efficient Renovation" is a programme that supports either complete energy renovations or single renovation measures. Building owners can choose between low-interest loans and grants.
- The "Launch Programme for Renewable Energies" focusses on renewable heating systems in new and renovated buildings.
- The "Energy Audit for Residential Buildings" programme awards a grant for sophisticated, standardised audits.

Energy Efficient Renovation - KfW	
Major objectives:	▪ KfW funding bank has developed the `Efficiency House´ building standards (EH 115, EH 100, EH 85, EH 70, EH 55 and EH in listed buildings): an Efficiency House 100 meets the primary energy requirements of a reference building at 100 per cent, an Efficiency House 55 consumes only 55 per cent of the primary energy demand of the reference building. ▪ KfW provides financial grants also for single renovation measures that meet the requirements set in a technical guideline. The requirements refer to u-values of building components or to technical standards of building systems. ▪ Also, defined packages of renovation measures can receive funding called heating package and ventilation package.
Eligible buildings:	▪ existing residential buildings that meet the requirements for an `Efficiency House´ standard after a renovation ▪ single components in residential buildings, which are renovated at least to a defined minimum standard above the legal requirements
Funding amount:	▪ the programme was initiated by the Federal Ministry of Economy. It is managed by the public KfW-bank (Kreditanstalt für Wiederaufbau). The budget for the whole programme – included a programme for new built `Efficiency Houses´ - accounts for 2 billion Euro per year. ▪ Homeowners can choose between low-interest loans and grants. ▪ Interest rates are 0.75 per cent (January 31st 2019), maximum loan amount is 100,000 Euro per unit for `Efficiency House´ renovations or 50,000 Euro per unit for single measures or packages. ▪ Depending on the realised `Efficiency House´ standard a repayment bonus is granted. It ranges from 12.5 per cent (EH 115, listed buildings, packages) to 27.5 per cent (EH 55). Repayment bonus for single measures accounts for 7.5 per cent. ▪ Grants range from 10 per cent for single measures to 30 per cent of the eligible cost for an EH 55 renovation
Eligible activities:	▪ KfW summarises the eligible single measures in a list. In particular, these refer to high standard components of the building envelop and highly efficient system technologies, however not to renewable systems. ▪ Almost all investments related to energy improvements in `Efficiency House´ renovations are eligible included costs for planning and auditing.

Launch Programme for Renewable Energies	
Major objectives:	▪ The programme´s intension is to support renewable heating systems in the building sector. Investors receive grants for installing defined renewable systems.
Eligible buildings:	▪ The programme refers mainly to existing buildings. ▪ There is special funding for new buildings also, when innovative renewable energy sources are installed.
Funding amount:	▪ The programme was initiated by the Federal Ministry of Economy. It is managed by the Federal Office of Economics and Export Control (BAFA). The budget for the whole programme accounts for about 100 million Euro per year. ▪ The grant for automatic biomass boilers ranges from 2,000 to 5,000 Euro ▪ The grant for solar thermal systems ranges from 50 to 140 Euro per square meter ▪ For heat pumps the grant amounts from 1,300 to 4,500 Euro ▪ There are numerous bonuses to add to the basic grant e.g. for highly innovative systems or combinations of renewable systems.

The "Energy Audit for Residential Buildings" programme is described in chapter VII. Furthermore, there are numerous energy related incentives for the building sector, however at a lower extent than the named programmes. They are offered by federal states, municipalities, cities, energy supply companies, banks and other institutions.

iii. Consequences for iBRoad

Subsidising the iBRoad roadmap

For the implementation of the iBRoad audits, it would be very helpful if existing national incentives could support the iBRoad or could be adapted. This refers to both incentives for energy audits and incentives for energy renovation.

For Bulgaria, the existing National Programme for Energy Efficiency in Multi-family Residential Buildings does not offer incentives for energy audits. Renovation measures recommended by the iBRoad Roadmap can receive support from both programs REECL and EERSF. REECL proposes specific renovation types with a list of measures to implement and a list of installers. An energy audit is not required. The iBRoad concept has no contradiction with that, if the recommended measures meet the requirements in REECL and if owners want to use the scheme. Owners can simply apply for the scheme.

The requirements of the next call for Energy Efficiency of Multi-Family Residential Buildings National Programme (EERSF) are not published yet. According to the lower standards in the previous call, it is not likely that deep renovations will be considered in this programme. This would not support the iBRoad targets.

The iBRoad audit could become very popular in Poland where the Thermal Modernisation and Refurbishment Fund requires an energy audit. However, this is mainly used by multi-family buildings at the moment, which are not the target group of the iBRoad project at this stage. On the other hand, the announced Clean Air programme could provide basic support to the iBRoad as it refers to private building owners.

In Portugal, the iBRoad Roadmap integrates very well with the existing funding schemes. Portugal has a well-developed Energy Performance Certification (EPC) Scheme, which is based on the use of a central database that can easily establish the foundations for a larger building logbook. Energy audits under the EPC scheme are also common and carried out by experts with a robust knowledge and qualification.

The Logbook is seen as a powerful tool that will help the Qualified Experts on their energy certification process and will benefit all building users due to its structured collection and possibility of centralising diverse data of their housing.

The acceptance of the iBRoad concept in Portugal depends to a considerable extent on different aspects: first, an alignment with existing and new subsidies or financial programmes to incentivise the renovation of buildings; second, an involvement of several stakeholders, with special relevance to national authorities, also linked with one-stop-shops, and third, the homeowners which should be seen as a special stakeholder and main beneficiary of the concept. An alignment with the existing EPC scheme would be very favourable the more so if the iBRoad could be integrated as an additional tool to promote and monitor the national building renovation strategies.

In Flanders, the iBRoad renovation roadmap could be used very well as a reference to grant energy premiums. In that way, it would not be necessary to subsidise the roadmap itself. The combination of having an iBRoad renovation roadmap and carrying out two or three of the proposed measures in an early stage can become an effective way to deeper renovations.

In Germany, the iBRoad Logbook could become a helpful complement to the existing renovation roadmap. The comprehensive incentive programmes for both audits and renovations provide support to the implementation.

Information about incentives in the iBRoad roadmap

There are several country specific incentives to support the energy renovation of existing buildings in general and for single-family and also for the iBRoad target group of small multi-family houses in

particular. In all countries that are described in this report, incentives are seen as an important factor for a successful market penetration of iBRoad products. Incentives would be very helpful for both the implementation of renovation measures and the issuing of the renovation roadmap. Thus, incentives should be integrated into the iBRoad products in two ways:

- Incentives for the implementation of renovation measures should be part of the main iBRoad documents. They should be displayed in overview pages of the roadmap and explained in pages that give technical and economic details.
- In the iBRoad Logbook there should be general information about the specific incentives of the respective country.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 754045