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Progress on the implementation of Energy Performance Certificates in EU

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Contents

Abstract

Energy performance certificates (EPCs) are a key policy tool to inform about and to foster improvements to the energy performance of the building stock. Since their introduction in 2002 by the Energy Performance of Buildings Directive (EPBD), EPCs have been implemented across Member States (MSs) in different ways, depending on the political and legal context, the available technical capacities, as well as the characteristics of the buildings stock and buildings market in general.

In 2021, in the context of "Fit for 55" legislative package, the European Commission proposed the third revision of the EPBD. The proposal improves the provisions on EPCs, their issuing and display, and their databases. In particular, it pursues harmonisation across MSs through a mandatory template for EPCs and a harmonised scale of energy performance classes.

This report presents the results of a survey conducted by JRC among MSs to collect information on how each MS has implemented the EPC scheme. It highlights differences among MSs regarding the energy uses included in the calculation, the floor area considered, the definition of energy classes, the main indicator(s), the number of EPCs issued, the availability of a national register, the mechanisms in place to ensure the quality of EPCs.

The findings of this study are expected to provide valuable insights to support the process of harmonisation of EPC schemes as per the proposal for a recast EPBD currently under discussion.

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1 Introduction

Energy performance certificates (EPCs) are a key policy tool to inform about and to foster improvements to the energy performance of the building stock. Being issued for all buildings or building units which are sold or rented out to a new tenant, they provide prospective buyers or renters with useful information regarding the building's energy performance rating and recommendations for cost-effective improvements.

Since their introduction in 2002 by the Energy Performance of Buildings Directive (EPBD) (European Commission, 2002), EPCs have been implemented across Member States (MSs) in different ways, depending on the political and legal context, the available technical capacities, as well as the characteristics of the buildings stock and buildings market in general.

In 2021, the European Commission (EC) proposed, in the context of "Fit for 55" legislative package (European Commission, 2021), the third revision of the EPBD (European Commission, 2021), as a key legislative instrument to deliver a zero-emission building stock by 2050, while reducing dependency on fossil fuels, decreasing energy bills and creating local jobs and economic growth.

The proposal improves the provisions on EPCs, their issuing and display, and their databases. In particular, it pursues harmonisation across MSs through a mandatory template for EPCs (presented in Annex V to the proposal) and a harmonised scale of energy performance classes, based on seven classes from A to G, where:

— A represents a zero-emission building;

— G includes the 15% worst performing buildings in the national building stock;

— The other classes (B-F) have an even bandwidth distribution in terms of an indicator of primary energy use in kWh/(m²y).

Other provisions concern:

— the reduced validity of EPCs of classes D to G from 10 to 5 years, to ensure that citizens receive up-to-date information;

— the obligation to issue EPCs in digital format;

— the reliability of certificates, through on-site visits and quality control;

— the obligation to have an EPC issued also for buildings undergoing major renovations, buildings for which a rental contract is renewed and all public buildings, in order to achieve better coverage of the building stock;

— disclosing information on the energy performance class and indicator for all buildings offered for sale or rental and for all public buildings frequently visited by the public;

— setting up national databases of EPCs, whose information shall be transferred to the Building Stock Observatory.

This report presents the results of a survey conducted by JRC among MSs in order to collect information on how each MS has implemented the EPC as well as its verification, monitoring and register. The findings of this study are expected to provide valuable insights to support the process of harmonisation of EPC schemes as per the proposal for a recast EPBD currently under discussion.

The report is organised as follows. First, Section 2 briefly describes the methodological approach. Then, Section 3 presents the main differences among EPC schemes across Member States. Subsequently, Section 4 highlights the advancement in the implementation of national databases (Section 4.1), the progress made in terms of number of EPCs issued (Section 0) as well as the measures in place to ensure the quality of EPCs (Section 4.3). Section 5 presents more detailed information regarding general rules, class boundaries and examples of EPCs in each Member State. Finally, Section 6 draws conclusions.

2 A survey concerning the status of implementation of Energy Performance Certificates of building in the EU Member States

Between July 2022 and February 2023, JRC conducted a survey concerning the status of implementation of Energy Performance Certificates of buildings in the 27 Member States. The survey built on the experience of a previous work carried out in early 2020. The survey was carried out contacting national experts (including those suggested by Concerted Action EPBD coordinator and CINEA - European Climate, Infrastructure and Environment Executive Agency) that in most cases provided updated data. In parallel, desk research was conducted by looking for public data and documents in order to complete the database and clarify some specific aspects of the schemes.

The national experts were asked to fulfil a questionnaire (see Annex 1) organised in three parts: the first one concerning all major evolution occurred in the legislation or in the organisation of EPC system since 2020; the second one concerning an update of the database; the third one including possible synergies between EPC schemes and other instruments (namely Smart Readiness Indicator, LEVEL(s), Building renovation passports and Digital logbooks).

The research was firstly aimed at understanding the general approach adopted in the EPC certification schemes, such as:

- which indicators are chosen to identify energy classes (primary energy, final energy, emissions, etc.);
- how class limits are defined: trough fixed classes or using a reference building;
- whether the class limits are equal or different for specific building categories;
- how the climate zones are taken into account;
- which end-uses are included in the calculations;
- how the floor area is defined;
- how nearly zero-energy building (NZEB) is defined and its relationship with the energy classes.

A second important aspect analysed is the status of implementation of the EPC national register. This includes information on the way data are uploaded, the organisation managing the system, whether data are collected at a regional or a national level, whether data are publicly accessible.

Finally, where available, data were collected concerning the number of EPCs issued and the average energy demand in total and for different building categories and energy classes.

3 Overview of EPC schemes across EU Member States: criteria and assumptions

When Member States implement energy performance certification schemes, various possible options are open:

- which end uses should be included in the calculations
- how to define the floor area to be considered in the specific consumption calculation
- if to define classes and class boundaries or not and, in case, how many classes
- whether to choose fixed values for class boundaries or a reference building method
- whether to choose a common approach for all building categories or different approaches (or different boundaries) for different categories
- whether to include one or more indicators with class boundaries
- whether to take account of different climate zones

In the following paragraphs, the different approaches listed above are presented and discussed.

3.1 End uses included

Regardless of how the energy class is defined, it is necessary to calculate an energy consumption of the building under consideration. The definition of the energy performance of a building introduced by the EPBD (Directive 2010/31/EU) (European Commission, 2010) is "the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting". Member States have adopted different approaches in defining which end uses should be included in the classification. Table 1 and Table 2 show the end uses included in the energy performance calculation by each Member State for residential buildings and non-residential buildings, respectively. This means that the calculation method adopted includes these end uses and that the professional in charge of the calculation must take account of them in the procedure.

Table 1. End-uses included in the calculation in different MSs for residential buildings.

Member States	Heating	Hot Water	Auxiliaries	Ventilation	A/C	Lighting
Belgium - Brussels	YES	YES	YES	YES	YES	NO
Belgium - Flanders	YES	YES	YES	YES	YES	NO
Belgium - Wallonia	YES	YES	YES	YES	YES	NO
Bulgaria	YES	YES	YES	YES	YES	YES
Czechia	YES	YES	YES	YES	YES	YES
Denmark	YES	YES	NO	NO	NO	NO
Germany	YES	YES	YES	NO	NO	NO
Estonia	YES	YES	YES	YES	YES	YES
Ireland	YES	YES	YES	YES	NO	YES
Greece	YES	YES	YES	YES	YES	NO
Spain	YES	YES	YES	YES	YES	NO

Member States	Heating	Hot Water	Auxiliaries	Ventilation	A/C	Lighting
France	YES	YES	YES	YES	YES	YES
Croatia	YES	YES	YES	YES	YES	NO
Italy *	YES	YES	YES	YES	YES	NO
Cyprus	YES	YES	YES	YES	YES	N/A
Latvia	YES	YES	YES	YES	YES	YES
Lithuania	YES	YES	YES	YES	YES	YES
Luxembourg	YES	YES	YES	NO	NO	NO
Hungary	YES	YES	YES	YES	YES	NO
Malta	YES	YES	YES	YES	YES	YES
Netherlands	YES	YES	YES	YES	YES	YES
Austria	YES	YES	YES	NO	NO	NO
Poland	YES	YES	YES	YES	YES	YES*
Portugal	YES	YES	YES	YES	YES	YES
Romania	YES	YES	YES	YES	YES	YES
Slovenia	YES	NO	NO	NO	NO	NO
Slovakia	YES	YES	YES	YES	YES	YES
Finland	YES	YES	YES	YES	YES	YES
Sweden	YES	YES	YES	YES	YES	NO

Note: in Poland only built-in lighting is included.

Source: JRC elaboration, 2023

Table 2. End-uses included in the calculation in different MSs for non-residential buildings.

Member States	Heating	Hot Water	Auxiliaries	Ventilation	A/C	Lighting
Belgium - Brussels	YES	YES	YES	YES	YES	NO
Belgium - Flanders	YES	YES	YES	YES	YES	NO
Belgium - Wallonia	YES	YES	YES	YES	YES	NO
Bulgaria	YES	YES	YES	YES	YES	YES
Czechia	YES	YES	YES	YES	YES	YES

Member States	Heating	Hot Water	Auxiliaries	Ventilation	A/C	Lighting
Denmark	YES	YES	NO	NO	NO	NO
Germany	YES	YES	YES	NO	NO	NO
Estonia	YES	YES	YES	YES	YES	YES
Ireland	YES	YES	YES	YES	NO	YES
Greece	YES	YES	YES	YES	YES	NO
Spain	YES	YES	YES	YES	YES	YES
France	YES	YES	YES	YES	YES	YES
Croatia	YES	YES	YES	YES	YES	YES
Italy *	YES	YES	YES	YES	YES	YES
Cyprus	YES	YES	YES	YES	YES	N/A
Latvia	YES	YES	YES	YES	YES	YES
Lithuania	YES	YES	YES	YES	YES	YES
Luxembourg	YES	YES	YES	YES	YES	YES
Hungary	YES	YES	YES	YES	YES	YES
Malta	YES	YES	YES	YES	YES	YES
Netherlands	YES	YES	YES	YES	YES	YES
Austria	YES	YES	YES	NO	NO	NO
Poland	YES	YES	YES	YES	YES	YES*
Portugal	YES	YES	YES	YES	YES	YES
Romania	YES	YES	YES	YES	YES	YES
Slovenia	YES	NO	NO	NO	NO	NO
Slovakia	YES	YES	YES	YES	YES	YES
Finland	YES	YES	YES	YES	YES	YES
Sweden	YES	YES	YES	YES	YES	NO

Note: in Italy non-residential buildings will include also elevators and escalators consumption; in Poland only built-in lighting is included.

Source: JRC elaboration, 2023

The most common approach includes in the calculation all final uses: space heating, electric auxiliaries, domestic hot water, ventilation, air conditioning and (where relevant) lighting. As expected, all MSs include space heating. Slovenia and Denmark only consider space heating without including auxiliaries and domestic hot water. Luxembourg (for residential buildings), Germany and Austria (for all buildings) do not include ventilation and air conditioning, while Ireland does not include air conditioning for residential buildings. Only eighteen countries include lighting, five of which only for non-residential buildings.

3.2 Floor area considered

For the calculation of the specific energy consumption, total energy consumption is normally divided by the floor area (or, in some cases, by the volume) in order to obtain an index in kWh/(m^2year) (or kWh/(m^3 year)) that can be used for the comparison of buildings with different size. The floor area considered can be different:

— Gross floor area includes the total area of a building, calculated on a floor-by-floor basis, enclosed by the outer building's outer walls;

— Net floor area, or net area, is derived when the outer walls of a building, are deducted from the gross floor area;

— Useful floor area is derived when all the walls of a building (inner and outer), are deducted from the gross floor area[1];

— Heated floor area includes the fraction of the area that is served by the heating system.

Most MSs calculates the specific energy consumption using the heated floor area, as shown in Table 3.

Table 3. Definition of floor area considered in different MSs

Member States	Floor area considered
Belgium - Brussels	Gross floor area
Belgium - Flanders	Gross floor area
Belgium - Wallonia	Heated floor area
Bulgaria	N/A
Czechia	Gross floor area
Denmark	Heated floor area
Germany	Useful floor area
Estonia	Heated floor area
Ireland	Gross floor area
Greece	Useful floor area
Spain	Net floor area
France	Net floor area (Surface habitable)

[1] This definition is what was used in the current practice until now. In the proposal for the revision of the EPBD 'useful floor area' means "the area of the floor of a building needed as parameter to quantify specific conditions of use that are expressed per unit of floor area and for the application of the simplifications and the zoning and (re-)allocation rules, taking into account national, European and international standards".

Croatia	Heated floor area
Italy	Heated floor area
Cyprus	N/A
Latvia	Heated floor area
Lithuania	Heated floor area
Luxembourg	Heated floor area
Hungary	Heated floor area
Malta	Useful floor area
Netherlands	Net floor area
Austria	Gross floor area
Poland	Heated floor area
Portugal	Useful floor area
Romania	Useful floor area
Slovenia	Heated floor area
Slovakia	Gross floor area
Finland	Net floor area
Sweden	Net floor area

Source: JRC elaboration, 2023

3.3 Class boundaries: categories, indicators and climate zones

Several different approaches can be adopted when designing the EPC in a specific Member State. In some cases it can be decided that what matters is the energy consumption in standard conditions or the actual energy consumption, per unit area. It follows that the system will define performance classes by using fixed boundaries (which may be different between different building categories).

In other cases it can be decided that the certification system should only take account of the characteristics of the building that can be changed by the designer, and not of other variables that can influence the energy consumption, such as the surface to volume ratio, the climate, the size. It follows that the system in this case will define the performance classes by comparing the actual building performance with that of an hypothetical building placed under the same climate conditions, with the same size and dimensions but with walls, windows, heating and cooling system defined as standard. In this latter case, for example, a building complying with the current minimum standard, or a NZEB can be chosen as a reference building, and classes' boundaries are defined calculating the ratio between the actual building energy consumption and the reference building calculated consumption.

Considering the different approaches adopted in the MSs, only Poland and Malta did not define energy classes, although Poland has adopted some indicative classes in the Long-Term Renovation Strategy and is expected to introduce class boundaries in the EPCs in 2023. Most countries have introduced between 7 and 9 different classes, normally indicated with a letter between A and G, in some cases with one or more "+" (A+, A++ or from A4 to A1). Only exceptions are Latvia with 6 classes, Italy 10, Hungary 12, Netherland 12 (11 for residential buildings), Ireland 15. In all countries except Netherlands, the number of classes is the same for different building categories.

As shown in Table 4, sixteen MSs have adopted fixed class boundaries (although in Denmark and Finland they may vary depending on the building floor area). Ten MSs (shown in Table 7) have adopted the reference building method. The standard which defines each class may be very different from country to country. For example, the upper limit for class A may range between 0 and almost 300 kWh/(m^{2}year), while the lower limit for class G may range between 200 and 1005 kWh/(m^{2}year). This may depend on the climate and on the end uses included in the calculation. Wallonia and Germany have introduced classes only for residential buildings. Ireland has a fixed boundaries system for residential buildings and uses a reference building approach for non-residential buildings. Table 5 and Table 6 show the limits for each class in single-family houses and in multifamily residential buildings.

Table 4. MSs that have adopted fixed boundaries and number of categories with different boundaries

MSs with fixed boundaries adopted	Categories with different boundaries
Belgium - Brussels	Residential / Non-residential
Belgium - Flanders	2 cat Residential
Belgium - Wallonia	Residential
Bulgaria	Residential / 11 cat Non-residential
* Denmark	Residential / Non-residential
Germany	Residential
Estonia	3 cat Res / 11 Non-residential
Ireland	Only for Residential (reference building for non-residential)
* France	Residential / 3 cat Non-residential
* Croatia	2 cat Residential / 7 Non-residential
Latvia	Residential / Non-residential
Luxembourg	2 cat Residential (no classes for non-residential)
Netherlands	Residential / 10 cat Non-residential
Austria	Same for all
Romania	2 Residential/ 6 Non-residential
Slovenia	Same for all
Slovakia	2 cat Residential / 6 Non-residential
* Finland	2 cat Residential / 7 Non-residential

Note: in Finland (for single houses) and Denmark class boundaries are calculated depending on area of the apartment/building; in Finland the small residential category is divided in 4 subcategories; in France residential sector classes are defined trough two different indicators (primary energy and emissions) and limits for residential buildings are different for two climate zones; in Croatia limits are different for coastal and continental climate zone.

Source: JRC elaboration, 2023

Table 5. MSs that have adopted fixed boundaries and limits for each energy class for single-family houses

	A++++	A+++	A++	A+	A	B	C	D	E	F	G	H	I
	All data in kWh/(m^2 year)												
B - Brussels					45	95	150	210	275	345	> 345		
B - Flanders				0	100	200	300	400	500	> 500			
B - Wallonia			0	45	85	170	255	340	425	510	> 510		
Bulgaria				48	95	190	240	290	363	435	> 435		
Germany				30	50	75	100	125	150	200	250	> 250	
Estonia					120	140	160	210	260	330	400	> 401	
Ireland			25	50	75	150	225	300	380	450	> 450		
Croatia				45	80	115	280	445	560	670	> 670		
Latvia					40	60	80	100	150	> 150			
Luxembourg					45	95	125	145	210	295	395	530	>530
Netherlands	0	50	75	105	160	190	250	290	335	380	> 380		
Austria			10	15	25	50	100	150	200	250	> 250		
Romania				91	129	257	390	544	522	652	> 783		
Slovenia				10	15	35	60	105	150	210	> 210		
Slovakia				54	108	216	324	432	540	648	> 648		

Note: for Estonia households with heated floor area between 120 and 220 m^2 are considered;; for Denmark see Table 26; for France see Table 34; for Finland see Table 54.

Source: JRC elaboration, 2023

Table 6. MSs that have adopted fixed boundaries and limits for each energy class for multi-family buildings

	A++++	A+++	A++	A+	A	B	C	D	E	F	G	H	I
	All data in kWh/(m² year)												
B - Brussels					45	95	150	210	275	345	> 345		
B - Flanders				0	100	200	300	400	500	> 500			
B - Wallonia			0	45	85	170	255	340	425	510	> 510		
Bulgaria				48	95	190	240	290	363	435	> 435		
Germany				30	50	75	100	125	150	200	250	> 250	
Estonia					105	125	150	180	220	280	340	> 340	
Ireland			25	50	75	150	225	300	380	450	> 450		
Croatia				80	100	120	265	410	515	615	> 615		
Latvia					40	60	80	100	150	> 150			
Luxembourg					45	95	125	145	210	295	395	530	> 530
Netherlands	0	50	75	105	160	190	250	290	335	380	> 380		
Austria			10	15	25	50	100	150	200	250	> 250		
Romania				73	101	198	297	396	495	595	> 595		
Slovenia				10	15	35	60	105	150	210	> 210		
Slovakia				32	63	126	189	252	315	378	> 378		
Finland					75	100	130	160	190	240	> 240		

Note: for Denmark see Table 26; for France see Table 34.

Source: JRC elaboration, 2023

MSs that have adopted the reference building approach in most cases define classes using the same boundaries for all categories (Table 7). As already mentioned, class boundaries in this case are defined calculating the ratio between the actual building energy consumption and the reference building calculated consumption (Table 8). The calculated energy consumption of the reference building takes into account the building size, the building category (since they may have different minimum standards) and the climate.

Table 7. MSs that have adopted the reference building approach and number of categories that have different reference buildings

MSs which adopted a reference building approach	Categories type
Czechia	Same for all
Ireland	Only non-residential (fixed classes for residential)
Greece	Same for all
Spain	Two categories (Residential / Non-residential)
Italy	Same for all
Cyprus	Same for all
Lithuania	Same for all
Hungary	Same for all
Portugal	Same for all
Sweden	Same for all

Source: JRC elaboration, 2023

Table 8. MSs that have adopted the reference building approach and limits calculated as ratio between the actual building energy consumption and the reference building calculated consumption.

	A+++	A++	A+	A	B	C	D	E	F	G	H	I
Czechia				0.8	1.2	1.6	2.3	3	3.7	> 3.7		
Greece			0.33	0.5	1	1.41	1.82	2.27		2.73	> 2.73	
Italy	0.4	0.6	0.8	1	1.2	1.5	2	2.6	3.5	> 3.5		
Cyprus				0.5	1	1.5	2	2.5	3	> 3		
Hungary		0.4	0.6	0.8	1	1.3	1.6	2	2.5	3.1	4	5
Portugal			0.25	0.5	0.75	1	1.5	2	2.5	> 2.5		

Sweden				0.5	0.75	1	1.35	1.8	2.35	> 2.35		

Note: Spain (see paragraph 5.9) and Lithuania (see paragraph 5.15) use two different indices.

Source: JRC elaboration, 2023

In most cases EPCs show many different indicators (such as useful energy demand; energy consumption for specific end uses such as heating, DHW, cooling; renewable energy sources that are generated and used on-site; specific CO_2eq emissions) although normally only the primary energy consumption is shown under a class system. Some MSs have adopted a class system also for some other indicators that are shown in the EPC (this means that one building can be a class A building concerning energy consumption and a class C building concerning the CO_2eq emissions: both are shown in the certificate). More detailed information is provided in section 5 where the specimen of EPC of the different MSs are shown, but a first comparison shows a variety of approaches:

— Czechia (see Figure 8): in case of existing building and its refurbishment and NZEB six indicators are shown: (1) primary energy from non-renewable energy sources; (2) total delivered energy; (3) partial delivered energy for the technical systems of heating and cooling, forced ventilation, moisture treatment, hot water and lighting of the interior of the building; (4) average U-value of heat transfer; (5) U-value of heat transfer of individual structures at the system boundary; (6) efficiency of technical systems;

— Spain includes also a class for emissions (see Figure 16);

— Romania includes also classes for GHG emissions (CO_2eq) and classes for each end-use (heating, cooling, ventilation, domestic hot water, and lighting) (see Figure 33);

— France (see Figure 17) includes also a class for emissions (furthermore, for residential building the class depends on both the emissions and the energy consumption);

— Croatia since 2017 includes two different classes in the EPC (see Figure 18): specific annual heat demand for heating ($Q''_{H,nd,ref}$); specific annual primary energy (E_{prim});

— Luxembourg: when the EPC is based on the calculation (and not on the actual consumption) seven classes are shown (see Figure 25): total primary energy consumption; heating primary energy consumption; lighting primary energy consumption; ventilation primary energy consumption; air conditioning primary energy consumption; heat final energy demand; emissions;

— Austria certificates includes four different classes (see Figure 29): heat energy demand (HWB); primary energy demand (PEB); CO_2 emissions; overall energy efficiency factor (fGEE);

— Slovakia (see Figure 36) in the first page includes two main classes (total energy demand and primary energy demand) and in the second page four additional classes (heating demand; hot water demand; lighting demand; air ventilation and cooling demand).

3.4 Possible pathways of integration

In the relatively high number of criteria and assumptions needed to define a certification system, most MSs have chosen similar approaches. Based on our analysis of the different schemes we may suggest that:

— although several different indicators may be shown on the EPC, the main indicator should be based on the calculated primary energy consumption;

— the calculation must include energy used for Heating, Domestic Hot Water preparation, Auxiliaries, Ventilation and Air conditioning (built-in lighting could be included); however, currently some MSs do not include them all;

— in order to calculate the specific consumption per unit area, net conditioned floor area should be taken into account;

— the number of classes may be limited to 7-8 classes, leaving the possibility to MSs to add subclasses introducing one or more “+”;

— some class limits may be defined taking into account (1) reference values relevant to the MS (e.g. NZEB or ZEB classes), (2) legal requirements/obligations (e.g. minimum performance requirements upon renovation, minimum energy performance standard, etc.) (3) the number of building included (e.g. the EPBD proposal suggests that “The letter G shall correspond to the 15% worst-performing buildings in the national building stock at the time of the introduction of the scale”).

What remains to be decided is whether to adopt an approach where class boundaries are defined with absolute figures (that may be different for different building categories) or to adopt a reference building method. Pros and cons of the two approaches are briefly discussed in Box 1 and 2.

BOX 1 - Fixed values for class boundaries

Normally, when fixed class boundaries are decided it is easier to compare the actual energy consumption (or CO_2eq emissions) of different buildings in the same category. The final customer without any technical expertise can easily compare different building by just looking at the class or comparing the figures (kWh/(m^2 year) or kg CO_2eq /(m^2 year)). Two different buildings with the same energy consumption or emissions are in the same class, and this is easy to understand.

MSs that have adopted this approach normally define different limits for different categories, to take account of the fact that the energy consumption may depend on the activity carried out in the building (e.g. commercial buildings or hotels have higher energy consumption compared to residential buildings).

Concerning the climate, only Italy had a fixed system with different values for 6 different climate zones until 2015 and later adopted a reference building method. Currently only Croatia defines different values for different climates (coastal and continental). France has adopted different class boundaries for residential buildings classified E, F and G and located in climatic zones H1b, H1c and H2d and at an altitude of over 800 m. Conversely, in most countries class boundaries do not depend on climate zones. Nevertheless, if a fixed-boundaries approach would be adopted at EU level, given the fact that the climate may be really different in different MSs, it may be advisable to adopt different class boundaries for different climates.

BOX 2 – Reference building approach

The reference building approach leaves room to complexity and flexibility. The reference building may have different characteristics depending on the building category. Furthermore, the building size and the climate influence the consumption or the emissions of the building considered, therefore this approach does not need to define different boundaries for different categories/climate. General rules concerning the complexity and flexibility may be introduced at EU level in order to reduce the risk of confusion.

Main counterarguments against the Reference building approach are the fact that only 10 MSs have adopted it until now (of which one, Ireland, only for non-residential). In addition, this approach could result in buildings with identical energy consumption levels (or equivalent CO_2 emissions) being labelled with distinct energy classes. This discrepancy may arise due to variations in size (or surface-area-to-volume ratio) or geographical location, specifically in different climates. The latter may create some confusion in the final customer without any technical expertise that may wrongly expect that the same energy consumption should lead to the same energy class.

4 Progress in MSs concerning the EPC register, the quality and number of EPC issued

4.1 EPC register implementation status

As shown in Table 9, most of the MSs have already implemented a national EPC register. Most MSs have a national system, managed by a central authority that automatically collects data from the professionals that are developing EPCs. Normally data are collected classifying buildings in different categories. In 9 MSs data are publicly accessible (in some cases upon request). In 5 MSs only limited data are accessible. In 6 MSs data are not accessible and in 3 it depends on the regional authority. Data are missing for Belgium-Flanders, Latvia, Malta and Sweden.

Table 10 shows the web address of the national EPC registers, where available. The type of data collected and the type of building categories may widely vary between different MSs as highlighted by the results in Table 11.

Table 9. EPC register: Implementation status; Upload of EPC data; Management of the registers; Access to EPC data

	Implementation status	Upload of EPC data	Management of the registers	Access to EPC data
Belgium - Brussels	Regional	Automatic	Regional authority	Public access
Belgium - Flanders	N/A	N/A	N/A	N/A
Belgium - Wallonia	Regional	Manual	Regional authority	Access on demand. Access to other organisations and public is planned
Bulgaria	National	Automatic & Manual	Central authority	Public access
Czechia	National	Manual	Central authority	No public Access
Denmark	National	Manual	Central authority	Public access (after request)
Germany	National	Automatic	Central authority	No public access
Estonia	National	Manual	Central authority	Public access
Ireland	National	Automatic	Central authority	Public access to limited data
Greece	National	Automatic	Central authority	No public access
Spain	Implemented at national level. Developed at regional level.	Manual transferring data from regional registries twice a year	Central and Regional authorities	Depends on Regions
France	National	Automatic	Central authority	Public access

	Implementation status	Upload of EPC data	Management of the registers	Access to EPC data
Croatia	National	Automatic	Central authority	N-A
Italy	Implemented at national level. Developed at regional level.	Automatic for most regions	Central and Regional authorities	Depends on Regions
Cyprus	National	N/A	Central authority	Public access (after request)
Latvia	N/A	N/A	N/A	N/A
Lithuania	National	Automatic	Central authority	Public access
Luxembourg	National	Manual	Central authority	No public Access
Hungary	National	N/A	Central authority	Public access
Malta	N/A	N/A	N/A	N/A
Netherlands	National	Automatic	Central authority	Public access to limited data
Austria	Implemented at national level. Developed at regional level.	Automatic	Central and Regional authorities	Depends on Regions
Poland	National	Automatic & Manual	Central authority	Public access to limited data
Portugal	National	Automatic	Central and Regional authorities	No public Access
Romania	National	Manual	Central authority	No public access
Slovenia	National	Automatic	Central authority	Public access
Slovakia	National	Automatic	Central authority	Public access to limited data
Finland	National	Automatic	Central authority	Public access to limited data
Sweden	N/A	N/A	N/A	N/A

Source: JRC elaboration, 2023

Table 10. EPC register websites.

	Link
Austria	N.A.
Belgium - Brussels	https://www.peb-epb.brussels/certificats-certificaten/
Belgium - Flanders	https://www.vlaanderen.be/energieprestatiecertificaten-epcs https://www.vlaanderen.be/epb-pedia/werken-als-verslaggever/energieprestatiedatabank
Belgium - Wallonia	N.A.
Bulgaria	https://portal.seea.government.bg/bg/IndustrialSystemsReport
Croatia	https://eenergetskicertifikat.mgipu.hr/login.html
Cyprus	https://epc.meci.gov.cy/
Czechia	https://www.mpo.cz/cz/energetika/energeticka-ucinnost/strategicke-dokumenty/informace-o-prubezne-evidenci-prukazu-energeticke-narocnosti-budov-v-cr--249720/
Denmark	https://emoweb.dk/emodata/test/
Estonia	http://www.ehr.ee/
Finland	http://www.energiatodistusrekisteri.fi/
France	https://observatoire-dpe-audit.ademe.fr/accueil
Germany	N.A.
Greece	http://bpes.ypeka.gr/?page_id=21
Hungary	https://www.e-epites.hu/e-tanusitas/
Ireland	http://ber.seai.ie/ (residential) http://ndber.seai.ie/ (non-residential)
Italy	https://siape.enea.it/ 20 regions can send digital EPCs since 2020
Latvia	https://bis.gov.lv/bisp/lv/epc_documents
Lithuania	N.A.
Luxembourg	N.A.
Malta	https://epc.gov.mt/information-assessors?l=1
Netherlands	http://www.ep-online.nl/ https://www.energielabel.nl/woningen/zoek-je-energielabel/

Poland	https://rejestrcheb.mrit.gov.pl/
Portugal	https://www.sce.pt/estatisticas/ (Mainland, Madeira) https://portaldaenergia.azores.gov.pt/portal/Servicos/SCE-Acores/Indicadores (Azores)
Romania	https://cauta.mdlpa.ro/upload_form
Slovakia	https://www.inforeg.sk/ec/
Slovenia	N.A.
Spain	https://energia.gob.es/desarrollo/EficienciaEnergetica/CertificacionEnergetica/Paginas/certificacion.aspx
Sweden	https://www.boverket.se/sv/energideklaration/sok-energideklaration/

Source: JRC elaboration, 2023

Table 11. EPC register: Type of data collected; Type of building categories.

	Type of data collected	Type of building categories
Belgium - Brussels	Absolute	New/existing, Residential, Single flat, Private/public buildings
Belgium - Flanders	N/A	N/A
Belgium - Wallonia	All data that is included in the EPC is collected in the database	New/existing, Residential/Single flat/total building, Private/public buildings
Bulgaria	N/A	New/existing, Residential/non-residential - per categories, Total building, Private/public buildings
Czechia	Absolute	Administrative; Family house; Apartment; Building for accommodation and eating; Health care building; Educational; Sport; Commercial; Cultural; Others
Denmark	Relative per class	New/existing, Residential/non-residential, Private/public buildings
Germany	N/A	N/A
Estonia	Relative per EPC type (based on measured or calculated energy consumption)	New and existing, residential and non-residential, total building, private and public buildings
Ireland	All data entered by experts	Dwellings – House or apartment. Buildings other than dwellings - all buildings that are not a house or apartment Display Energy Certificates for public buildings

	Type of data collected	Type of building categories
Greece	Calculated energy demands for heating, cooling, hot water	N/A
Spain	More than 180 data are collected for each EPC. (XML file)	New/existing, Residential/non-residential, Single flat/total building/single family home.
France	All data that is included in the EPC is collected in the database	Existing residential building: (1) flat; (2) whole multi-dwelling building; (3) single family building New residential building: (1) flat; (2) whole multi-dwelling building; (3) single family building Existing non-residential building: (1) offices, administration or education; (2) buildings with continuous occupancy (e.g. hospitals, hotels, etc.); (3) other non-residential
Croatia	N-A	New/existing, Residential/non-residential
Italy	Description of the building/dwelling (including data from dwelling cadastre), description of technical building systems, energy carriers. Absolute or relative per class	New/existing, Residential/non-residential, independent house/single dwelling in a multifamily house, Private/public buildings
Cyprus	N-A	N-A
Latvia	N/A	N/A
Lithuania	Absolute	N/A
Luxembourg	All results of the calculation of the EPC (absolute and relative values) are collected.	New/existing, Residential, Total building, Private/public buildings
Hungary	N/A	N/A
Malta	N/A	N/A
Netherlands	Absolute	New/existing, Residential/non-residential, Single flat
Austria	Absolute	New/existing, Residential/non-residential - per categories
Poland	All data that is included in the EPC is collected in the database	New/existing, Residential/non-residential, Single flat/total building, Private/public buildings every kind of buildings
Portugal	N/A	N/A
Romania	All data included in the EPC	New/existing, Residential/non-residential, all buildings categories,
Slovenia	N/A	N/A

	Type of data collected	Type of building categories
Slovakia	Absolute	New/existing, Residential/non-residential, Single flat/total building, Private/public buildings
Finland	All data that is included in the EPC is collected in the database	New/existing, Residential/non-residential - per categories
Sweden	N/A	N/A

Source: JRC elaboration, 2023

4.2 Number of EPCs collected and average energy demand

In the following tables the number of EPCs issued in 2011, 2018 and 2021 are shown where available for residential (Table 12), non-residential (Table 13) and public buildings (Table 14).

Table 12. Number of EPCs issued for residential buildings in 2011, 2018, 2021.

Residential buildings	2011	2018	2021	%var 2011-2018	%var 2018-2021
Belgium - Brussels	21854	234899	N-A	975%	-
Belgium - Flanders	555961	1509921	1632375	172%	8%
Belgium - Wallonia	65410	538278	726640	723%	35%
Bulgaria	13	2670	3088	20438%	16%
Czechia	N-A	74.545	156606 (2020)	-	-
Denmark	256750	653118	858576	154%	31%
Germany	N/A	1231384	2599562	-	111%
Estonia	6381	22887	29867	259%	30%
Ireland	271360	897797	1149460	231%	28%
Greece	50958	1237100	N-A	2328%	-
Spain	N-A	3332316	4694536	-	41%
France	N-A	N-A	2807594	-	-
Croatia	N-A	0	64527	-	-
Italy	N-A	N-A	1571574	-	-
Cyprus	N-A	N-A	25162	-	-
Lithuania	4091	206747	N-A	4954%	-
Hungary	N-A	N-A	449625	-	-

Netherlands	N-A	N-A	4630000	-	-
Poland	N-A	205436	444294	-	116%
Portugal	431551	1401901	1951645	225%	39%
Slovenia	N-A	47016	N-A	-	-
Slovakia	18229	111662	N-A	513%	-
Finland	N-A	94366	188961	-	100%

Source: JRC elaboration, 2023

Table 13. Number of EPCs issued for non-residential buildings in 2011, 2018, 2021.

Non-res. buildings	2011	2018	2021	%var 2011-2021	%var 2018-2021
Belgium - Flanders	5408	20671	27452	282%	33%
Bulgaria	553	4997	5835	804%	17%
Czechia	N-A	12.896	23915 (2020)	-	-
Denmark	22383	49094	60548	119%	23%
Germany	N/A	44398	121458	-	174%
Estonia	654	4009	6559	513%	64%
Ireland	8023	54884	66392	584%	21%
Greece	2691	262523	N-A	9656%	-
Spain	N-A	305372	406506	-	33%
France	N-A	N-A	1947659	-	-
Croatia	N-A	0	8301	-	-
Italy	N-A	N-A	228723	-	-
Cyprus	N-A	N-A	1957	-	-
Lithuania	406 (indust.)	2836 (indust.)	N-A	599%	-
Hungary	N-A	N-A	29257	-	-
Netherlands	N-A	N-A	170000	-	-

Poland	N-A	4255	12067	-	184%
Portugal	21474	157299	216919	633%	38%
Slovenia	N-A	2412	N-A	-	-
Slovakia	224	1237	N-A	452%	-
Finland	N-A	11484	22286	-	94%

Source: JRC elaboration, 2023

Table 14. Number of EPCs issued for public buildings in 2011, 2018, 2021.

Public buildings	2011	2018	2021	%var 2011-2021	%var 2018-2021
Belgium - Brussels	N-A	307	N-A	-	-
Belgium - Flanders	7095	11359	13620	60%	20%
Belgium - Wallonia	N-A	0	1593	-	-
Estonia	41	438	1761	968%	302%
Greece	394	4770	N-A	1111%	-
France	N-A	N-A	202706	-	-
Italy	N-A	N-A	14951	-	-
Cyprus	N-A	N-A	126	-	-
Lithuania	2010	13198	N-A	557%	-
Poland	N-A	10061	16160	-	61%
Portugal	913	4376	6018	379%	38%
Slovenia	N-A	2662	N-A	-	-
Slovakia	1443	6686	N-A	363%	-
Finland	N-A	3693	5687	-	54%

Source: JRC elaboration, 2023

It is possible to compare the number of EPCs issued in the different MSs with the stock of buildings considering residential and non-residential units.

Table 15. Number of EPCs issued for residential buildings and building stock (data for 2021 except where otherwise stated; data on number of residential units come from ODYSSEE[2] and refer to permanently occupied dwellings).

	Number of residential units	Number of certificates	Number of certificates per 1000 units
Belgium*	5008551	2603615	519,8
Bulgaria*	2958077	3088	1,0
Czechia**	4442588	156606	35,3
Denmark	2895049	858576	296,6
Germany	39637392	2599562	65,6
Estonia	688009	29867	43,4
Ireland	1841802	1149460	624,1
Greece***	4173816	1237100	296,4
Spain*	18754800	4694536	250,3
France	29726000	2807594	94,4
Croatia	1522500	64527	42,4
Italy	25439066	1571574	61,8
Cyprus	373813	25162	67,3
Lithuania***	1472623	206747	140,4
Hungary	3903000	449625	115,2
Netherlands	7615576	4630000	608,0
Poland*	13897902	444294	32,0
Portugal	4112466	1951645	474,6
Slovenia***	776674	47016	60,5
Slovakia***	1760000	111662	63,4
Finland	2986089	188961	63,3

Note: (*) for Belgium, Bulgaria, Spain and Poland data for units are from 2020; (**) for Czechia all data are from 2020; (***) for Greece, Lithuania, Slovenia and Slovakia all data are from 2018.

Source: JRC elaboration, 2023

[2] https://www.indicators.odyssee-mure.eu/energy-efficiency-database.html

Table 16. Number of EPCs issued for non-residential buildings and building stock (building stock data for 2016, EPC data for 2021 except where otherwise stated; data on number of non-residential units come from the HOTMAPS project[3]).

	Number of non-residential units	Number of certificates	Number of certificates per 1000 units
Bulgaria	587374	5835	9,9
Czechia*	701350	23915	34,1
Denmark	758122	60548	79,9
Germany	11886974	121458	10,2
Estonia	770034	6559	8,5
Ireland	426482	66392	155,7
Greece**	1192522	262523	220,1
Spain	2975436	406506	136,6
France	6130317	1947659	317,7
Croatia	505143	8301	16,4
Italy	2990054	228723	76,5
Cyprus	309336	1957	6,3
Hungary	407305	29257	71,8
Netherlands	1299698	170000	130,8
Poland	2646159	12067	4,6
Portugal	935704	216919	231,8
Slovenia**	232499	2412	10,4
Slovakia**	94983	1237	13,0
Finland	761705	22286	29,3

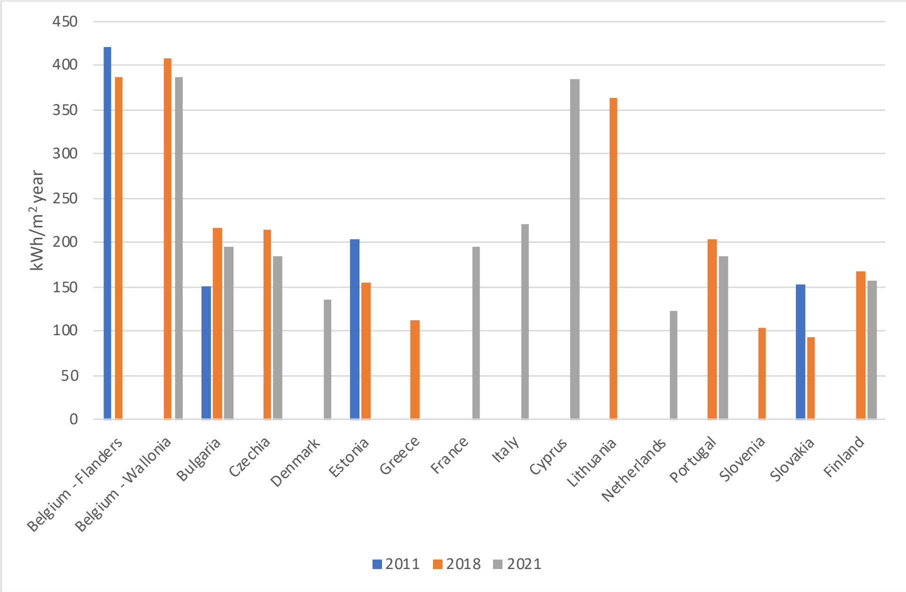
Note: (*) for Czechia data for EPC are from 2020; (**) for Greece, Slovenia and Slovakia data for EPC are from 2018.

Source: JRC elaboration, 2023

The average Energy demand in kWh/(m^2 year) is shown for residential buildings (Figure 1) for non-residential buildings (Figure 2) and for public buildings (Figure 3). Bulgaria shows an increase in the average demand between 2011 and 2021, that may be linked to the relative small amount of EPC realised (1 every 1000 residential units). Also Portugal shows an increase in the average demand between 2018 and 2021 for non-residential buildings, in this case it may be linked to the increase in the number of EPCs issued (+38%).

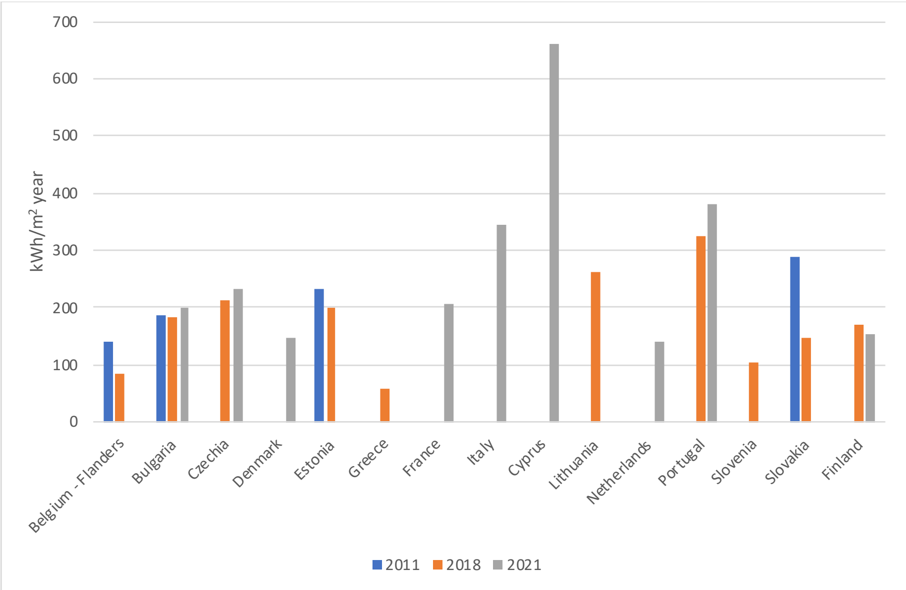
[3] https://gitlab.com/hotmaps/building-stock/-/blob/master/data/building_stock.xlsx

Figure 1. Energy demand per building type in kWh/(m^2 year) – Residential buildings



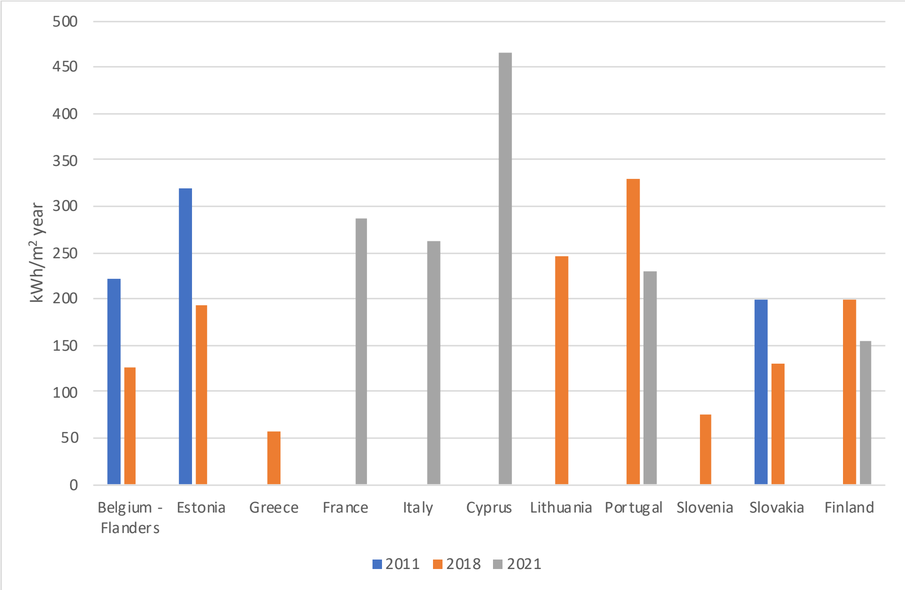
Source: JRC elaboration, 2023

Figure 2. Energy demand per building type in kWh/(m^2 year) – Non-residential buildings



Source: JRC elaboration, 2023

Figure 3. Energy demand per building type in kWh/(m^2 year) – Public buildings



Source: JRC elaboration, 2023

4.3 Expert accreditation and quality control schemes

It is very difficult to assess the actual quality of the EPC system adopted in each Member State. We have collected information concerning the expert accreditation and the quality control system that may suggest whether one Member State has designed a system with checks and balances or not. In order to better understand the actual quality of the system adopted in each MS, it is necessary to increase the number and quality of public information available.

The bodies in charge of experts' accreditation, the number of experts and any obligation to carry out on-site audit are listed in Table 17.

Table 17. Quality of EPC: bodies in charge of experts' accreditation; number of experts; on-site audit requirement

EU MSs	Bodies in charge of qualified **experts' accreditation**	Number of experts	On-site audit requirement
Belgium - Brussels	Regional Environment and energy agency	202 experts for residential units (existing buildings - 2022)	Mandatory
Belgium - Flanders	Regional Energy Agency	2839 (2022)	Mandatory
Belgium - Wallonia	Regional Energy department	New residential buildings experts : > 1393 Existing residential buildings experts : > 1906 Public buildings experts : > 380 (2022)	Mandatory
Bulgaria	National Energy Agency and technical university	Public register of companies for building energy audits 260; Public register of consultants for (small) building's energy audits 26 consultants Public register for industry & street lighting systems energy auditing companies 52 companies. (2022)	Mandatory
Czechia	Ministry of Industry and Trade	1368 (2022)	Not mandatory (common practice)
Denmark	National Energy Agency	198 Companies (2022)	Mandatory. Some exception .
Germany	Public technical authority for buildings	32146 (2022)	N/A
Estonia	Ministry of Education and Research	91, however for detached house architects and HVAC engineers can also issue EPC on building permit stage - increasing the experts up to ~800. (2022)	Not mandatory (common practice)
Ireland	National Energy Agency	Dwellings 508 Non-residential (buildings other than dwellings) 142 (2020)	Mandatory. Some exception .
Greece	Ministry of Environment, Energy and Climate Change	19217 (2020)	Mandatory
Spain	17 Autonomous Communities	N/A	Mandatory
France	Accredited certification bodies	>8000 (2022)	Mandatory
Croatia	Ministry of Physical Planning, Construction and State Assets	>700 (2020)	Mandatory

EU MSs	Bodies in charge of qualified **experts' accreditation**	Number of experts	On-site audit requirement
Italy	Professional associations (orders)	N/A	Mandatory
Cyprus	Ministry of Energy, Commerce, Industry and Tourism (MECIT)	202 (2022)	N/A
Latvia	National accreditation body	93 (2020)	N/A
Lithuania	Ministry of Environment	668 (2020)	Mandatory
Luxembourg	Professional association (order) and the Ministry of Energy and Spatial Planning	Approx. 2000 (2022)	Not mandatory (common practice)
Hungary	Professional associations (orders)	N/A	Not mandatory
Malta	Building and Construction Authority	Approx 400 for dwellings and 180 for non-dwellings (2020)	N/A
Netherlands	Independent foundation	2020 experts (2022)	Mandatory. Some exception .
Austria	Austrian provinces	N/A	N/A
Poland	Ministry of Development	15546 (2020)	N/A
Portugal	National Energy Agency	2171 (2022)	Mandatory
Romania	Ministry of Development, Public Works, and Administration	1729 (2023)*	Mandatory
Slovenia	Building Institute and Professional association (order)	397 (2020)	N/A
Slovakia	Professional association (order)	approx 400 (2022)	N/A
Finland	Housing Finance and Development Center (Ministry of the Environment)	>1000 (2022)	Mandatory
Sweden	National accreditation body	830 (2020)	N/A

*Ministry of Development, Public Works, and Administration, Energy Auditors, available at: https://www.mdlpa.ro/pages/registrepublice
Source: JRC elaboration, 2023

Concerning the professionals' qualification, in most MSs a national authority is in charge of experts' qualification. It may be one ministry, the energy agency, a national accreditation body or the professional orders. Each MSs has provided a licence to hundreds or thousands of experts. All MSs have implemented some quality control schemes: the most common approach implies an automatic checks for all EPCs plus additional manual check to a statistically representative number of EPC, as shown in Table 18.

Table 18. Quality of control schemes of EPC

EU MSs	Quality control schemes
Belgium - Brussels	Inspections, investigations and audits
Belgium - Flanders	Quality check: desk or onsite
Belgium - Wallonia	Automatic checks for all EPCs plus additional random manual check
Bulgaria	Systematic or random sampling of the audited buildings
Czechia	Annually one in twenty EPCs issued in the previous calendar year, plus checks on request
Denmark	Automatic checks for all EPCs plus additional random manual check
Germany	National first level checks. Regional second and third level check.
Estonia	Random checks
Ireland	Manual check to a statistically representative number of EPC
Greece	Random checks
Spain	Different approaches in the 17 Autonomous communities
France	New experts are checked 4 times during the first year, and 4 more times in the following 4 years. Following this first cycle of certification, experts are checked 4 times every 5 years.
Croatia	Automatic checks for all EPCs plus additional random manual check
Italy	Regional quality control checks of at least 2% of EPCs registered
Cyprus	Random checks
Latvia	Random checks
Lithuania	National quality assessment system
Luxembourg	Automatic checks for all EPCs plus additional manual check when critical issue emerge
Hungary	Automatic checks for all EPCs plus additional random manual check
Malta	Random checks (at least one certificate from each active registered assessor is verified)
Netherlands	Checks on a certain percentage of the EPCs each expert has registered annually
Austria	Random checks (regional system)
Poland	Automatic checks for all EPCs
Portugal	Automatic checks for all EPCs plus additional random manual check

EU MSs	Quality control schemes
Romania	Annual random check of at least 10%* of issued EPCs and the supporting energy audits
Slovenia	Automatic checks for all EPCs plus additional random manual check
Slovakia	Random checks
Finland	Automatic checks for all EPCs plus additional manual check when critical issue emerge
Sweden	Automatic checks for all EPCs

*Romanian Government, Law no. 372 of December 13, 2005 (republished in 2022) on the energy performance of buildings, chapter XVI, Control system, art 34.

Source: JRC elaboration, 2023

5 Survey of EPC general rules, class boundaries and specimen

The previous sections of this report summarize and compare the main features of the different approaches used by the EU MSs in implementing the EPBD classification and the EPC systems. The research work that has led to this synthesis has also clearly shown that, besides the main features that can be easily highlighted and used for the comparison, a lot of details can also be different in the different approaches. Also, showing the look and feel of the different certificate templates can also be helpful and can indirectly provide practical tips and imaginative suggestions. For these reasons, in this chapter we present a survey of Energy Performance Certificate general rules, class boundaries and specimen in the different Member States presenting details that cannot be synthesized.

5.1 Belgium

In Belgium the energy classification takes into account the consumption of the heating, the hot water, the auxiliaries (CMV, ventilation, etc.) and, eventually, the cooling. It does not take into account the electricity consumption for electrical equipment or lighting. The classification scheme may vary in the three Brussels, Flanders and Wallonia.

5.1.1 Belgium – Brussels

The classes are identical for residential and non-residential buildings and are shown in Table 19.

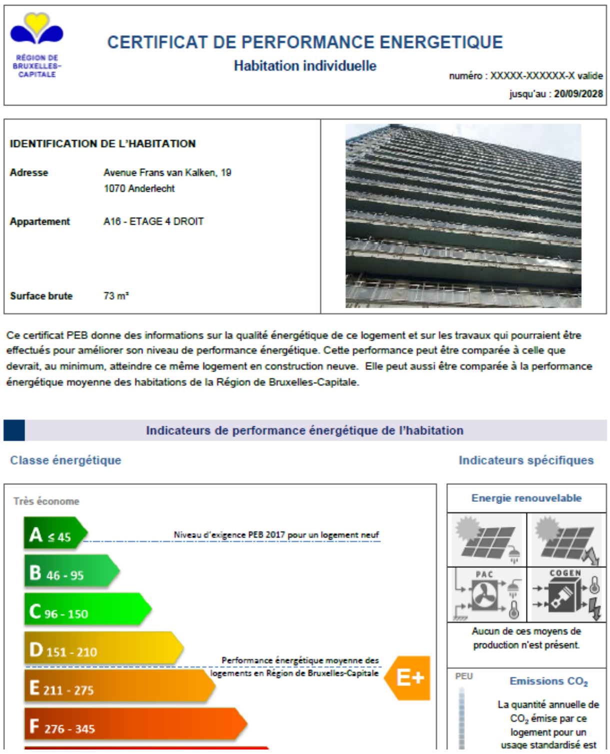
Table 19. Limits for Energy classes in Brussels

Class	Limit kWh/(m^2 year)
A	< 45
B	< 95
C	< 150
D	< 210
E	< 275
F	< 345
G	> 345

Source: https://www.pebbruxelles.com/

Figure 4 includes an excerpt from the Energy performance certificate in Brussels.

Figure 4. Excerpt from the Energy performance certificate in Brussels



Source: https://www.pebbruxelles.com/

5.1.2 Belgium – Flanders

Small non-residential buildings (where the usable floor space of the unit does not exceed 500 m²) and residential buildings are classified trough an "energiescore". Class limits are different as shown in Table 20.

Table 20. Limits for Energy classes in the Flanders for residential and small (<500 m^2) non-residential buildings.

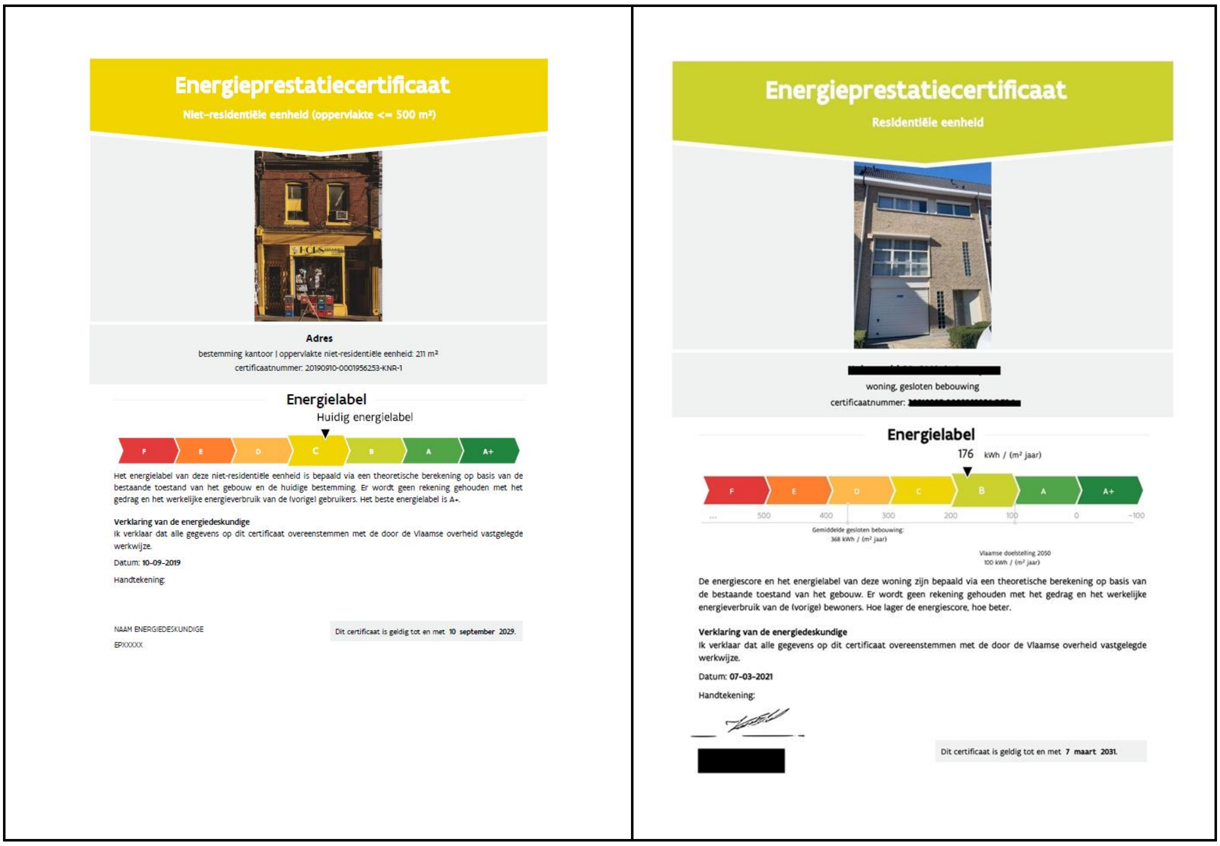
Energy rating (Energielabel)	Small non-residential kWh/(m^2 year)	Residential kWh/(m^2 year)
A+	<= 0	<= 0
A	<= 160	<= 100
B	<= 265	<= 200
C	<= 365	<= 300
D	<= 470	<= 400
E	<= 575	<= 500

F	> 575	> 500

Source: https://www.vlaanderen.be/epc-voor-kleine-niet-residentiele-eenheid-epc-knr
https://www.vlaanderen.be/epc-voor-een-residentiele-eenheid

Figure 5 includes the first pages of the Energy performance certificate for residential buildings in the Flanders, which depends on the floor area (different for area under 500 m^2).

Figure 5. (Left) First page of the Energy performance certificate for small non-residential buildings (<500 m^2) and (Right) First page of the Energy performance certificate for residential buildings in the Flanders.



Source: https://www.vlaanderen.be/epc-voor-kleine-niet-residentiele-eenheid-epc-knr
https://www.vlaanderen.be/epc-voor-een-residentiele-eenheid

Bigger than 500 m^2 non-residential buildings have a different classification system based on the renewable share as shown in Table 21.

Table 21. Limits for Energy classes in the Flanders for non-residential buildings bigger than 500 m^2

Energy rating (Energielabel)	Share of renewables
A	100%
B	> 50%

C	> 25%
D	> 10%
E	> 5%
F	> 0%
G	no renewable energy that can count
X	Undetermined*

* The mandatory measurements are not or not all available, or there is no renewable energy use as stated in the table above. The latter case only applies in the start-up phase. In a later phase of the EPC trajectory, the latter case will be assigned a label G

Source: https://www.vlaanderen.be/energieprestatiecertificaat-voor-een-niet-residentiele-eenheid-epc-nr

5.1.3 Belgium – Wallonia

In October 2018 it was introduced a Ministerial decree relating to the content and methods of updating the public building EPC: the deadline to prepare EPCs is January 1st 2021 or January 1st 2022, depending on the category of public authorities (article 50 of the Decree of the Walloon Government of 15 May 2014). The first page of the public building EPC is displayed in a visible and legible place in the public building (public access).

Class limits for residential buildings are shown in the Table 22, while Figure 6 shows the first page of the Energy performance certificate for existing residential buildings in Wallonia. The EPB certificate for non-residential building is not yet implemented.

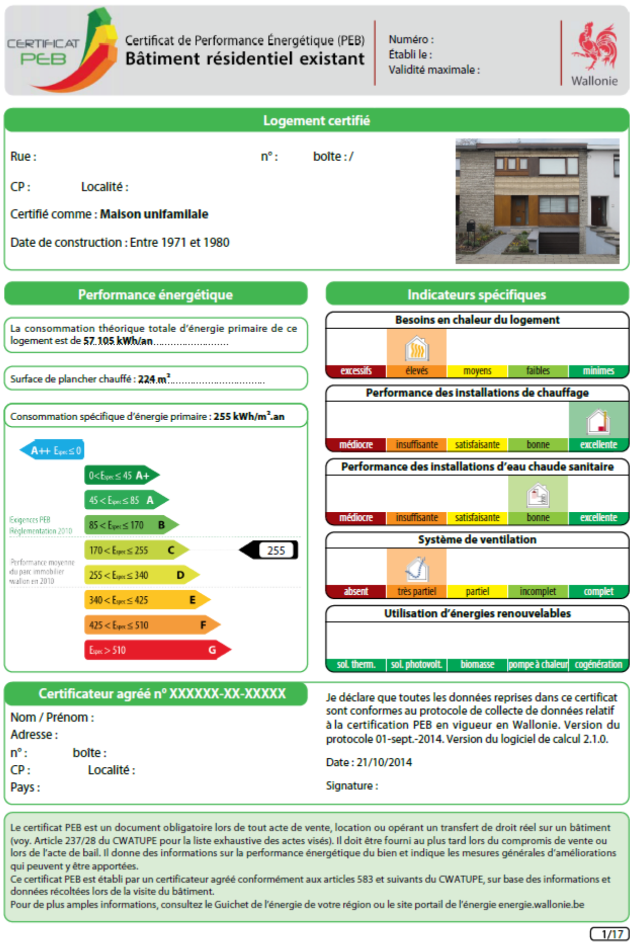
Table 22. Limits for Energy classes in Wallonia for residential buildings.

Energy class	Residential kWh/(m^2 year)
A++	<= 0
A+	<= 45
A	<= 85
B	<= 170
C	<= 255
D	<= 340
E	<= 425

F	<= 510
G	> 510

Source: https://energie.wallonie.be/fr/quelles-informations-dans-le-certificat-peb.html?IDC=8787&IDD=50688

Figure 6. First page of the Energy performance certificate for existing residential buildings in Wallonia.


CERTIFICAT PEB

Certificat de Performance Énergétique (PEB)

Bâtiment résidentiel existant

Numéro :
Établi le :
Validité maximale :

Wallonie

Logement certifié

Rue : n° : boîte : /

CP : Localité :

Certifié comme : **Maison unifamilale**

Date de construction : Entre 1971 et 1980

Performance énergétique

La consommation théorique totale d'énergie primaire de ce logement est de **57 105 kWh/an**

Surface de plancher chauffé : **224 m²**

Consommation spécifique d'énergie primaire : **255 kWh/m².an**

A++ $E_{spec} \leq 0$
$0 < E_{spec} \leq 45$ A+
$45 < E_{spec} \leq 85$ A
$85 < E_{spec} \leq 170$ B
$170 < E_{spec} \leq 255$ C
$255 < E_{spec} \leq 340$ D
$340 < E_{spec} \leq 425$ E
$425 < E_{spec} \leq 510$ F
$E_{spec} > 510$ G

255

Exigences PEB Réglementation 2010

Performance moyenne du parc immobilier wallon en 2010

Indicateurs spécifiques

Besoins en chaleur du logement
excessifs | élevés | moyens | faibles | minimes

Performance des installations de chauffage
médiocre | insuffisante | satisfaisante | bonne | excellente

Performance des installations d'eau chaude sanitaire
médiocre | insuffisante | satisfaisante | bonne | excellente

Système de ventilation
absent | très partiel | partiel | incomplet | complet

Utilisation d'énergies renouvelables
sol. therm. | sol. photovolt. | biomasse | pompe à chaleur | cogénération

Certificateur agréé n° XXXXXX-XX-XXXXX

Nom / Prénom :
Adresse :
n° : boîte :
CP : Localité :
Pays :

Je déclare que toutes les données reprises dans ce certificat sont conformes au protocole de collecte de données relatif à la certification PEB en vigueur en Wallonie. Version du protocole 01-sept.-2014. Version du logiciel de calcul 2.1.0.

Date : 21/10/2014

Signature :

Le certificat PEB est un document obligatoire lors de tout acte de vente, location ou opérant un transfert de droit réel sur un bâtiment (voy. Article 237/28 du CWATUPE pour la liste exhaustive des actes visés). Il doit être fourni au plus tard lors du compromis de vente ou lors de l'acte de bail. Il donne des informations sur la performance énergétique du bien et indique les mesures générales d'améliorations qui peuvent y être apportées.
Ce certificat PEB est établi par un certificateur agréé conformément aux articles 583 et suivants du CWATUPE, sur base des informations et données récoltées lors de la visite du bâtiment.
Pour de plus amples informations, consultez le Guichet de l'énergie de votre région ou le site portail de l'énergie energie.wallonie.be

1/17

Source: https://energie.wallonie.be/fr/quelles-informations-dans-le-certificat-peb.html?IDC=8787&IDD=50688

5.2 Bulgaria

Calculation of the energy consumption for the classification of buildings in Bulgaria includes all the consumed final energy: needed for the space heating, domestic hot water, the ventilation, air conditioning, lighting and all the other electricity consumption. For building classification purposes, this final energy is turned into primary energy, with specific coefficient depending on each energy source.

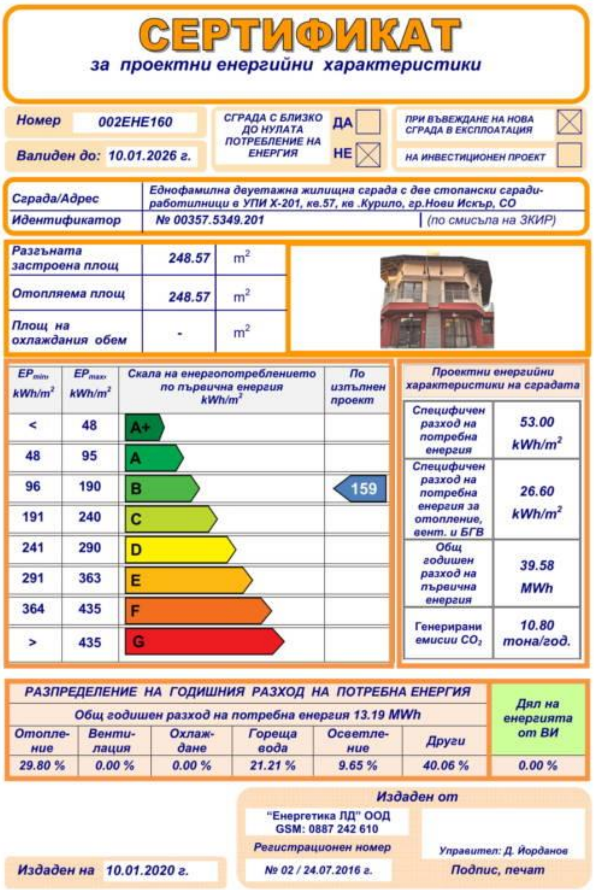
Buildings are classified in 12 different categories (Residential; Libraries & community centers; Kindergartens; Health care; Trade; Education; Administrative; Sport; Theatres, cinemas, operas; Transport; Hotels; Others). Each category has its class limits. Class limits for residential buildings are shown in Table 23. Figure 7 shows an Energy performance certificate for residential buildings in Bulgaria

Table 23. Limits for Energy classes in Bulgaria for residential buildings.

Energy class	Residential kWh/(m^2 year)
A+	< 48
A	< 96
B	< 191
C	< 241
D	< 291
E	< 364
F	< 436
G	> 436

Source: https://energetika-ld.com/wp-content/uploads/2020/03/Pic-1-1-3.jpg

Figure 7. Energy performance certificate for residential buildings in Bulgaria.



Source: https://energetika-ld.com/wp-content/uploads/2020/03/Pic-1-1-3.jpg

Definition of Nearly zero energy building is given in acting Energy Efficiency Act: "A building that simultaneously meets the following conditions:

1. the energy consumption of the building, designated as primary energy, corresponds to Class A of the scale of energy classes for the type of buildings concerned;
2. not less than 55 percent of the (supplied) energy used for heating, cooling, ventilation, domestic hot water and lighting is energy from renewable sources, located on site at or near the building level."

5.3 Czechia

According to Decree No. 264/2020 Coll. Decree on the energy performance of buildings the main classification class shows the value based on Primary energy from non-renewable energy sources comparing the results of the calculation for the analysed building to a reference building (E_R):

> "The parameters and values of the reference building E_R are determined in such a way as to ensure the cost-optimal level of energy efficiency of buildings and building elements, calculated for their expected economic life cycle in accordance with the comparative methodological framework 1) , with regard to achieving the optimal level of a healthy indoor environment, indoor air quality and thermal comfort."

The actual definition of reference building is quite complex. The Energy Certificate (see Figure 8) also includes a table on the right part of the first page with reference to different classes for other indicators as explained in the following and in Table 24:

> "For comparison, the determined indicators of the building's energy efficiency according to § 10, paragraph 1 of this decree are classified into classification classes determined by their upper limit

according to the table in this appendix and are compared in the certificate with a graphically expressed scale of classification classes."

There is no difference in the system between residential and non-residential buildings.

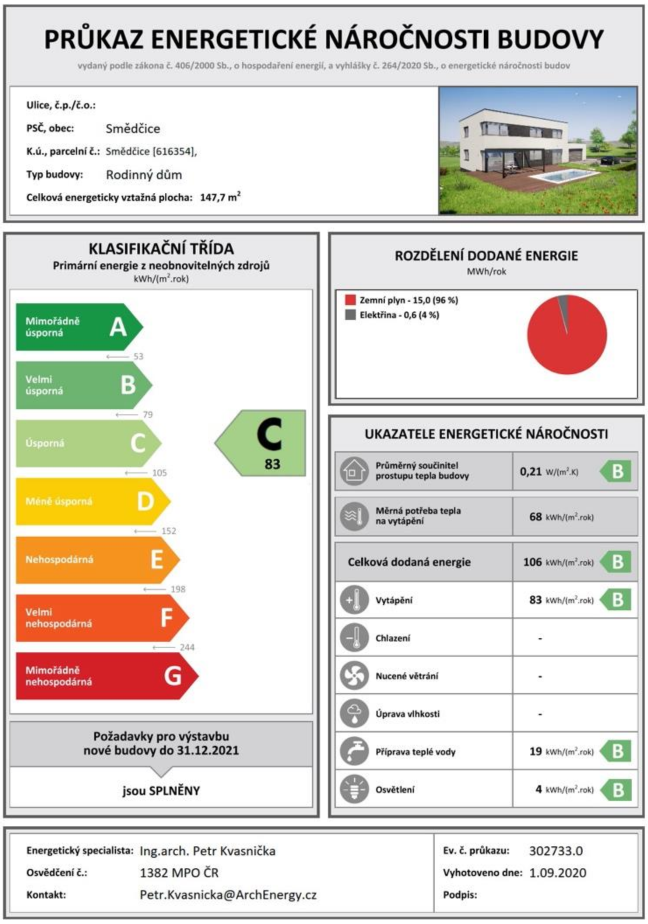
Table 24. Limits for Energy classes in Czechia.

Classification class	The value for the upper limit of the classification class						Verbal representation of the classification class
	Primary energy from non-renewable energy sources*	total energy supplied	Partial delivered energy			At em	
			Hot water and humidity control	Heating and cooling	Lighting of the interior of the building and forced ventilation		
A	0.8 x E R	0.7 x E R	0.7 x E R	0.6 x E R	0.5 x E R	0.7 x E R	Extremely economical
B	1.2 x E R	0.9 x E R	0.8 x E R	0.8 x E R	0.7 x E R	0.9x E R	Very economical
C	1.6 x E R	1.2 x E R	1 x ER	U x E R	0.9 x E R	1.2 x E R	Economical
D	2.3 x E R	1.5 x E R	1.2 x E R	1.5 x E R	1.2 x E R	1.7x E R	Less economical
E	3 x E R	2 x ER	1.4 x ER	2 x ER	1.5 x E R	2.3 x E R	Inefficient
F	3.7 x E R	2.5 x E R	1.6 x E R	2.5 x E R	2 x E R	2.9x E R	Very wasteful
G							Extremely wasteful

* Main indicator in the certificate ("primární energie z neobnovitelných zdrojů")

Source: https://www.zakonyprolidi.cz/cs/2020-264

Figure 8. Energy performance certificate in Czechia.



Source: https://budovyprukaz.cz/energeticky-stitek/jak-cist-prukaz/

According to our survey the average yearly primary energy from non-renewable energy sources for EPC included in the different classes in 2019 and 2020 are as shown in Table 25.

Table 25. Average yearly primary energy from non-renewable energy sources in 2019 and 2020 in Czechia.

Energy class	2019	2020
	kWh/(m²·year)	kWh/(m²·year)
NZEB	144	102
A	85	72
B	115	104
C	233	129
D	192	174

E	273	258
F	367	333
G	605	583

Source: Energy Efficiency and Savings Department – Ministry of Industry and Trade – private communication

5.4 Denmark

Since 2021, EPC containing multiple households no longer shows the status for the total building. Now it only shows status for the individual household.

In 2021, a new EPC layout was introduced (Figure 9 shows the first page), which promotes recommendations with a profitability greater than 1, on the front page. This is done by supplying the recommendations with additional information, on how long it will take to complete (in defined intervals) and informing about which group of professionals can do the work.

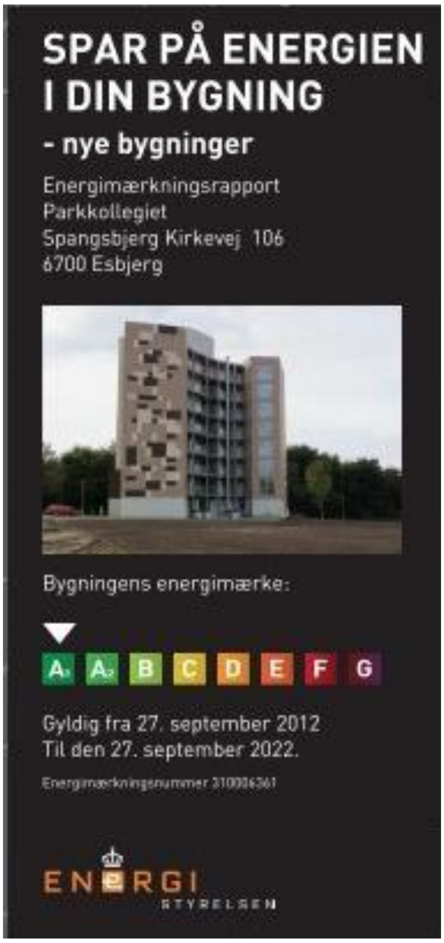
Energy performance of the building is calculated under standard weather conditions. Energy labelling according to actual (measured) consumption can be made when you rent out all or part of a single-family dwelling, institution or commercial and service building. Limits for Energy classes in Denmark are shown in Table 26, while Table 27 includes average yearly primary energy from non-renewable energy sources in 2019, 2020 and 2021 for different energy classes

Table 26. Limits for Energy classes in Denmark. Area is the heated area in m²

Energy class	Residential kWh/(m²·year)	Non-residential kWh/(m²·year)
A2020	27	33
A2015	30.0 + 1000 / Area	41.0 + 1000 / Area
A2010	52.5 + 1650 / Area	71.3 + 1650 / Area
B	70.0 + 2200 / Area	95.0 + 2200 / Area
C	110 + 3200 / Area	135 + 3200 / Area
D	150 + 4200 / Area	175 + 4200 / Area
E	190 + 5200 / Area	215 + 5200 / Area
F	240 + 6500 / Area	265 + 6500 / Area
G	240 + 6500 / Area	265 + 6500 / Area

Source: Danish Energy Agency – private communication

Figure 9. First page of the Energy performance certificate in Denmark.



Source: https://ens.dk/sites/ens.dk/files/OmOs/energimaerke_311383519_carsten_niebuhrs_gade_43_1577_koebenhavn_v.pdf

Table 27. Average yearly primary energy from non-renewable energy sources in 2019, 2020 and 2021 in Denmark.

Energy class	2019	2020	2021
	kWh/(m²·year)		
A2020	13,8	17,5	21,4
A2015	33,2	33,1	33,1
A2010	57,3	57,3	57,8
B	80,6	80,5	80,6

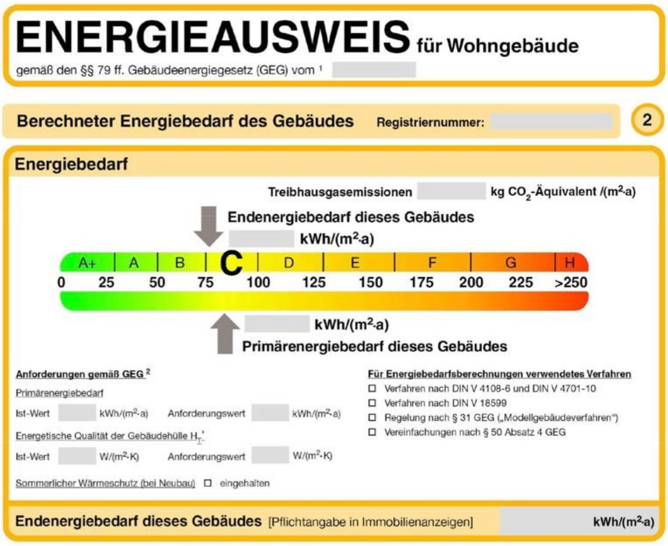
C	112,9	111,3	110,8
D	154,9	154,3	153,8
E	202,5	202,0	201,8
F	258,4	257,7	256,3
G	378,2	375,0	372,7

Source: Danish Energy Agency – private communication

5.5 Germany

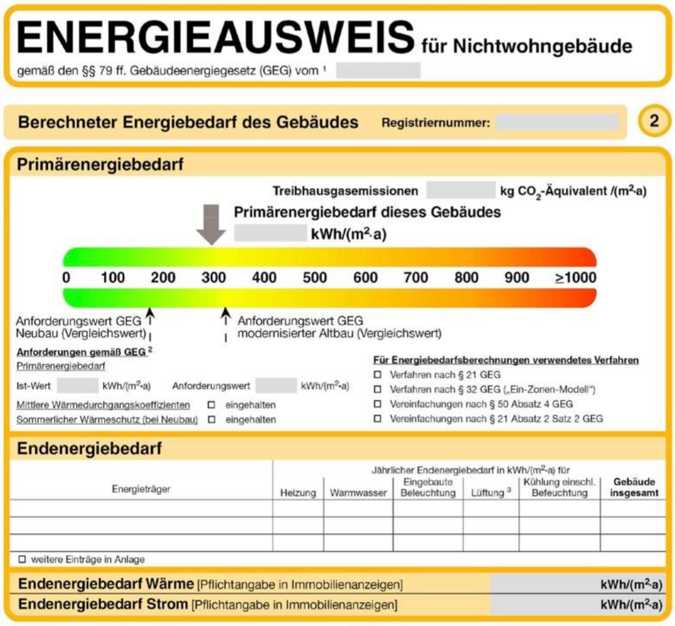
A new Buildings Energy Act has been approved in 2021 but the EPC scheme has not changed (see Figure 10 and Figure 11). Energy performance certificates for non-residential buildings do not include energy classes. No classes are shown (see Figure 11), only a coloured band from green to red (0 to 1000 kWh/(m^2 year)).

Figure 10. Excerpt from the Energy performance certificate for residential buildings in Germany



Source: https://www.bundesanzeiger.de/pub/publication/2SIU5op5G3yYlYriRYt?0

Figure 11. Excerpt from the Energy performance certificate for non-residential buildings in Germany



Source: https://www.bundesanzeiger.de/pub/publication/2SIU5op5G3yYlYriRYt?0

5.6 Estonia

The energy performance certificate of a building shall be based on either:

1. energy calculation (for dwelling a simplified method of verification of the minimum energy performance requirements set out in the Regulation on minimum energy performance requirements can be used). Building energy performance is calculated in standard weather conditions, standard indoor climate conditions and with standard occupation time;
2. measured energy consumption (in case there is no measured energy consumption data available based on energy calculation or the lowest energy performance class (H) is given). Measured energy consumption is standardised based on energy days.

According to Regulation No. 36 "Requirements for issuing energy labels and energy labels" Appendix 3 (in the wording of Regulation No. 50 of the Minister of Economy and Infrastructure of 12.08.2019) energy classes scales are different for 16 different building types: Single-family houses (under 120 m^2; between 120 m^2 and 220 m^2; above 220 m^2); Apartment building; Military Barracks; Office building, library and research building; Hotels; Restaurant and service building; Public building; Commercial building; Educational building; Kindergarten; Healthcare; Warehouse; Light industry building; High energy-demand building. Class A buildings are NZEB. All new buildings must be class A (NZEB), except a) Detached house with heated floor area < 120 m2; b) Detached house with heated floor area 120 – 220 m2 and row houses, which can be class B. Major renovation - class C.

In Table 28 the class limits for some categories are shown.

Table 28. Class limits for some building categories in Estonia

Class		Single-family houses (under 120 m^2)	Apartment building	Offices	Public Building	Business building	Educational building	Health care building
		kWh/(m^2 year)	kWh/(m^2 year)	kWh/(m^2 year)	kWh/(m^2 year)	kWh/(m^2 year)	kWh/(m^2 year)	kWh/(m^2 year)

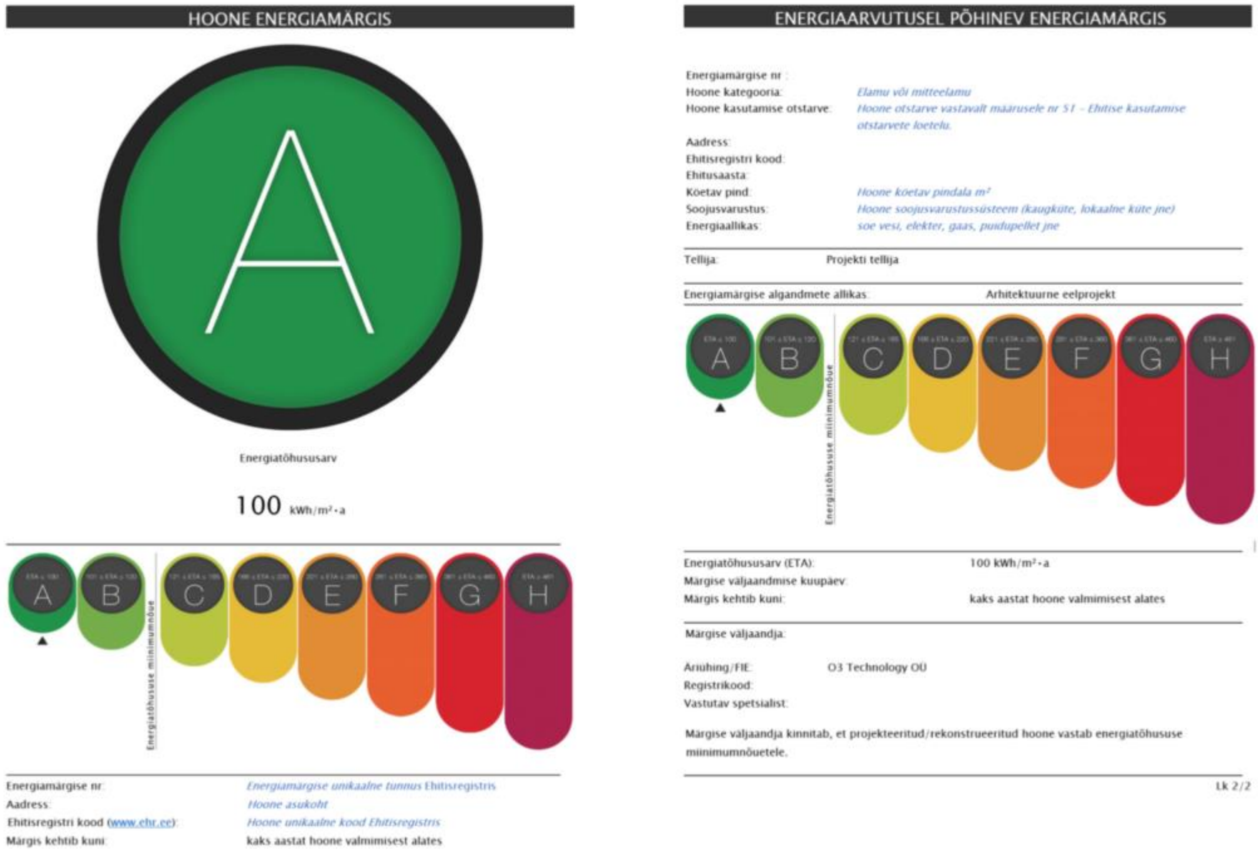
A	≤	145	105	100	120	160	90	130
B	≤	165	125	130	150	190	120	160
C	≤	185	150	160	200	230	160	210
D	≤	235	180	210	250	280	200	270
E	≤	285	220	260	310	330	250	340
F	≤	350	280	320	390	390	310	420
G	≤	420	340	400	490	460	390	510
H	≥	421	341	401	491	461	391	511

Source: https://www.riigiteataja.ee/aktilisa/1060/5201/5002/MKM_m36_lisa3.pdf#

The energy performance of a building is the calculated or measured amount of energy required to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, water heating and lighting. Heated area is calculated excluding rooms where the temperature is usually lower than the rest of the building (cellars, garages, other specific rooms).

Figure 12 shows the first and second page of the Energy performance certificate in Estonia.

Figure 12. First and second page of the Energy performance certificate in Estonia.



Source: https://o3.ee/energiamargis/

5.7 Ireland

Ireland has adopted two different approaches for residential and non-residential buildings. For residential buildings the approach is described in the "Introduction to DEAP for Professionals"[4] guide. The Dwelling Energy Assessment Procedure (DEAP) is the official Irish methodology for calculating the energy performance and associated carbon dioxide emissions for the provision of space heating, ventilation, water heating and lighting in dwellings. Classes are defined on fixed boundaries.

Table 29. Class limits in Ireland for residential buildings

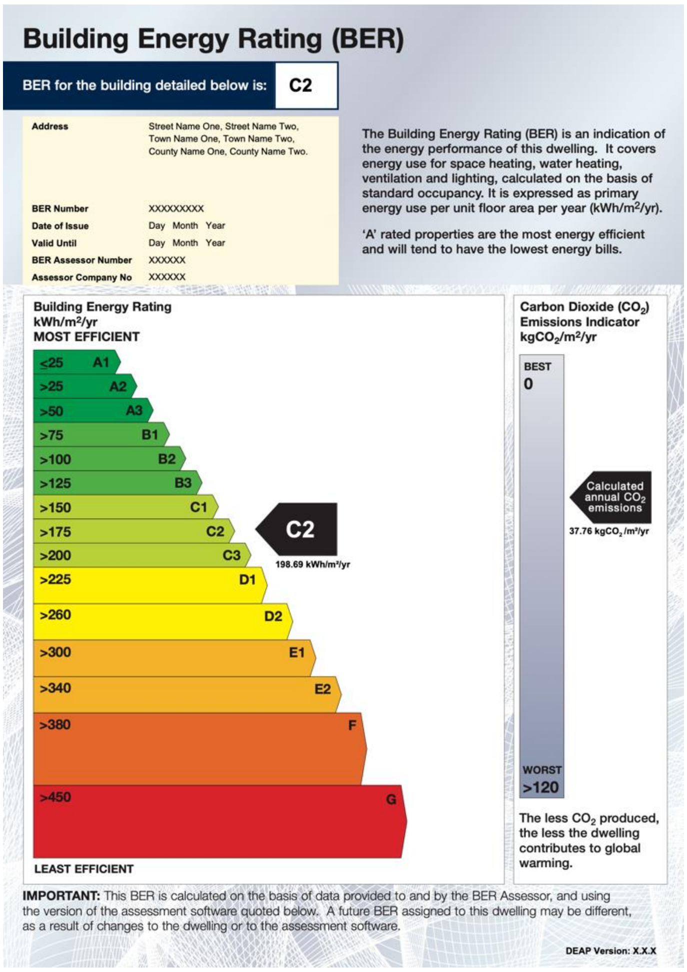
Energy class		kWh/(m² year)
A1	<	25
A2	<	50
A3	<	75
B1	<	100

[4] https://www.seai.ie/publications/Introduction_to_DEAP_for_Professionals.pdf

B2	<	125
B3	<	150
C1	<	175
C2	<	200
C3	<	225
D1	<	260
D2	<	300
E1	<	340
E2	<	380
F	<	450
G	>	450

Source: https://www.seai.ie/home-energy/building-energy-rating-ber/understand-a-ber-rating/Sample-BER-Cert.pdf

Figure 13. Sample of a Building Energy Rating Certificate for residential buildings in Ireland



Source: https://www.seai.ie/home-energy/building-energy-rating-ber/understand-a-ber-rating/Sample-BER-Cert.pdf

While in the residential sector a fixed boundaries approach was adopted, for non-residential buildings the classes are based on a reference building: the notional building. The Notional building, is the basis for setting the energy rating scale for the Building Energy Ratings and is defined in the Non-Domestic Energy Assessment Procedure – Modelling Guide[5]. Classes are defined by the Building Energy Rating (BER) that is the calculated primary energy consumption rate of the building divided by that of the Notional building. Class boundaries are shown in Table 30. Figure 14 shows a Sample of a Building Energy Rating Certificate in Ireland.

Table 30. Class limits in Ireland for non-residential buildings based on the Building Energy Rating.

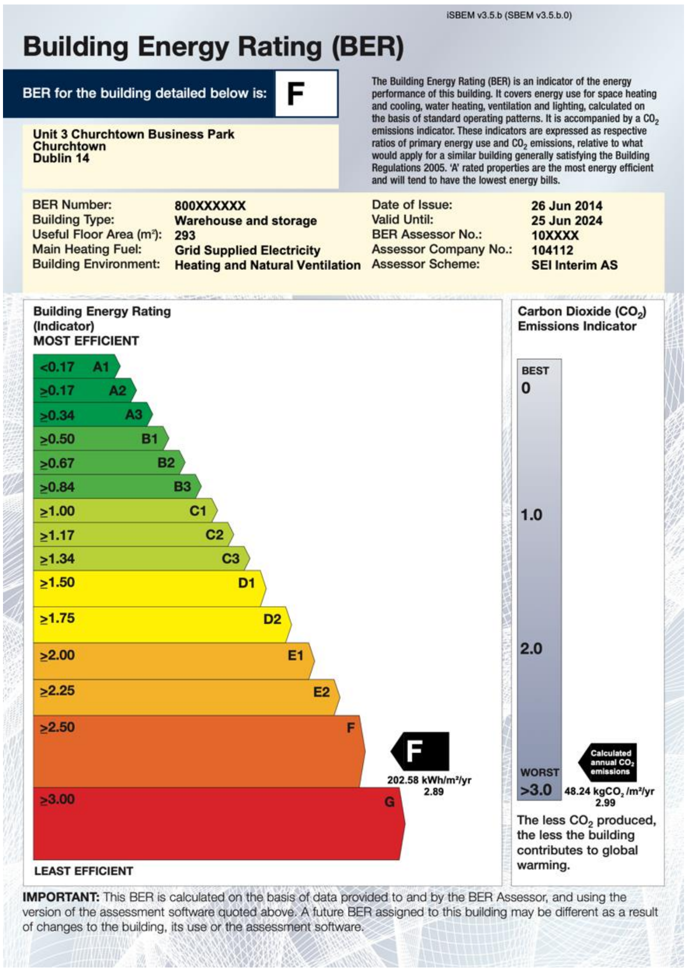
Energy class	Building Energy Rating (BER)	
A1	<	0.17
A2	<	0.34
A3	<	0.50

[5] https://www.seai.ie/publications/NEAP_Modelling_Guide.pdf

B1	< 0.67
B2	< 0.84
B3	< 1
C1	< 1.17
C2	< 1.34
C3	< 1.50
D1	< 1.75
D2	< 2
E1	< 2.25
E2	< 2.50
F	< 3
G	> 3

Source: https://www.cso.ie/en/media/csoie/methods/non-domesticbuildingenergyratings/PR_600214_Quality_Report_for_Non-Domestic_Building_Energy_Ratings_Release_2020.pdf

Figure 14. Sample of a Building Energy Rating Certificate for non-residential buildings in Ireland



Source: http://www.commercialenergyratings.ie/ber-cert-commercial-unit.pdf

The regulation concerning non-residential buildings are included in the Part L (Conservation of Fuel and Energy) of the Building Regulations. Part L was amended in 2019 concerning NZEB regulation. For all new builds, NZEB is equivalent to a 25% improvement in energy performance on the 2011 Building Regulations. Key changes to Part L for NZEB compliance include a Maximum Energy Performance Coefficient of 0.3, a Maximum Carbon Performance of 0.35 and a renewable Energy Ratio of 20%. This typically corresponds to an A3 Building Energy Rating.

5.8 Greece

In Greece there is no difference between residential and non-residential buildings. The class system is developed with the reference building method, following the scheme detailed in Table 31. Figure 15 shows an excerpt from the Energy performance certificate in Greece.

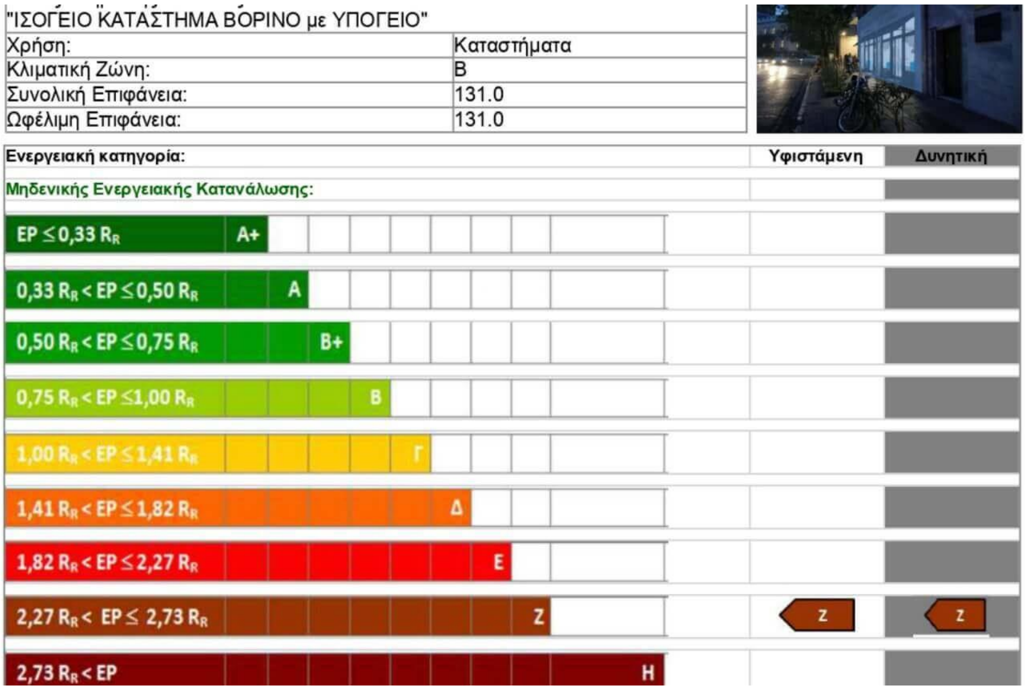
Table 31. Class limits in Greece (defined comparing the actual consumption to the reference building consumption)

Energy class	Ratio between the calculated consumption for the actual building ant the consumption of the reference building	
A+	<	0.33
A	<	0.50

B+	<	0.75
B	<	1.00
C	<	1,41
D	<	1.82
E	<	2.27
G	<	2.73
H	>	2.73

Source: https://ypen.gov.gr/energeia/energeiaki-exoikonomisi/ktiria/kenak/

Figure 15. Excerpt from the Energy performance certificate in Greece



Source: *https://greenbuilding.gr/energeiako-pistopoihtiko/*

According to our survey the average yearly consumption for EPC included in the different classes in 2017 and 2018 are shown in Table 32.

Table 32. Average yearly primary energy from non-renewable energy sources in 2017 and 2018 in Greece

	2017			2018		
	kWh/(m²·year)			kWh/(m²·year)		
	heating	cooling	Hot water	heating	cooling	Hot water
NZEB	33,56	45,72	20,37	34,57	44,55	20,67
A+	41,66	61,58	25,94	60,68	38,29	21,11
A	37,33	30,43	11,30	37,51	41,16	18,35
B+	47,61	37,65	20,20	47,97	40,68	21,25
B	49,70	42,51	19,15	49,76	39,72	30,94
C	62,56	43,94	19,19	54,72	41,50	19,83
D	65,50	48,00	18,65	66,17	44,17	19,95
E	80,32	53,19	19,01	80,94	48,05	19,65
G	97,73	51,04	20,25	97,44	50,65	20,32
H	157,88	66,25	20,66	155,18	63,84	21,14

Source: Directorate of Hellenic Southern Inspectorate – private communications

5.9 Spain

There are two different system for the definition of classes, one for residential and one for non-residential buildings. Both are based on a reference building using different indices (C1 and C2 for residential and C for non-residential). C1 and C2 are defined as follows:

$$C_1 = \frac{(R \cdot I_o/\bar{I}_r) - 1}{2(R - 1)} + 0{,}6$$

$$C_2 = \frac{(R^0 \cdot I_o/\bar{I}_s) - 1}{2(R^0 - 1)} + 0{,}5$$

Where:

I_0: It is the value of the indicator analyzed (annual CO_2eq emissions, annual consumption of non-renewable primary energy, heating demand, etc.) of the object building.

I_r: It is the average value of the indicator of the reference stock of new buildings for private residential use (housing).

R: It is the ratio between the value of Ir and the value of the indicator corresponding to the 10% percentile of the reference stock of new buildings for private residential use (housing).

I_S: It is the average value of the indicator of the reference stock of existing buildings for private residential use (housing).

R′: It is the ratio between the value of I_s and the value of the indicator corresponding to the 10% percentile of the reference stock of existing buildings for private residential use (housing).

I_r R I_S and R′ vary depending on the climatic zone.

Rating scale for buildings for private residential use (housing)

Calificación	Índice				
A			$C1$	<	0,15
B	0,15	≤	$C1$	<	0,50
C	0,50	≤	$C1$	<	1,00
D	1,00	≤	$C1$	<	1,75
E	1,75	≤	$C1$		
			$C2$	<	1,00
F	1,75	≤	$C1$		
	1,00	≤	$C2$	<	1,50
G	1,75	≤	$C1$		
	1,50	≤	$C2$		

Rating scale for buildings for other uses

Calificación	Índice				
A			C	<	0,40
B	0,40	≤	C	<	0,65
C	0,65	≤	C	<	1,00
D	1,00	≤	C	<	1,30
E	1,30	≤	C	<	1,60
F	1,60	≤	C	<	2,00
G	2,00	≤	C		

The two main indicators shown in the EPC (consumption and emissions, see Figure 16) include the impact of heating, cooling, domestic hot water production and, in uses other than private residential (housing), lighting, as well as the reduction of emissions or consumption of non-renewable primary energy derived from use from renewable energy sources.

Figure 16. Specimen of a Energy Performance Certificate in Spain

Source: https://oceanrealestate.es/que-es-la-etiqueta-de-eficiencia-energetica/

The Spanish Technical Building Code minimum requirements are set according to cost optimal calculations. NZEB is defined in the Spanish Technical Building Code as one that meets its minimum requirements. For residential buildings there is not link with the EPC. For non-residential building NZEB are B or A classes (EPC).

According to our survey the Primary Energy consumption of each building in that class are shown in Table 33.

Table 33. Average yearly primary energy from non-renewable energy sources in Spain

Energy class	Class limits kWh/(m²·year)
A	26,61
B	44,09
C	69,46
D	107,28

E	227,24
F	256,94

Source: Institute for the Diversification and Saving of Energy, IDAE-Ministry for the Ecological Transition and the Demographic Challenge – private communications

5.10 France

New regulations have been adopted:

- Decree no. 2020-1610 of December 17, 2020 on the validity period of energy performance diagnosis
- Decree no. 2020-1609 of December 17, 2020 relating to the energy performance diagnosis and the display of information relating to the energy consumption of dwellings in real estate advertisements and leases
- Order of March 31, 2021 amending various provisions relating to energy performance diagnosis
- Order of March 31, 2021 on procedures applicable to energy performance diagnosis and software establishing it
- Order of March 31, 2021 relating to the energy performance diagnosis for buildings or parts of buildings for residential use in metropolitan France

The reform of the DPE (*diagnostic de performance énergétique*) housing has made it possible, among other things, to modify the labels by integrating greenhouse gas emissions, to modify the calculation method so that all the DPE housing are carried out on the basis of a conventional calculation (some were based on real consumption in the past), or to add the consumption of auxiliaries and lighting. For residential buildings in France class limits are calculated depending on energy consumption and greenhouse gas emissions (see Table 34 and Figure 17). For other categories only energy consumption is taken into account (see Table 35). Average yearly primary energy consumption in France per building type and per energy class are shown in Table 36.

Table 34. Class limits for residential buildings in France depending on energy consumption in kWh/(m².y) and greenhouse gas emissions in $kgCO_2$ /(m².y)

Class	Limits PEC in kWh/(m².y) and GHGE in $kgCO_2$ /(m².y)		
A	PEC < 70 kWh/(m².y) and GHGE < 6 $kgCO_2$ /(m².y)		
B	70 ≤ PEC < 110 and GHGE < 11	or	6 ≤ GHGE < 11 and PEC < 110
C	110 ≤ PEC < 180 and GHGE < 30	or	11 ≤ GHGE < 30 and PEC < 180
D	180 ≤ PEC < 250 and GHGE < 50	or	30 ≤ GHGE < 50 and PEC < 250
E	250 ≤ PEC < 330 and GHGE < 70	or	50 ≤ GHGE < 70 and PEC < 330
F	330 ≤ PEC < 420 and GHGE < 100	or	70 ≤ GHGE < 100 and PEC < 420
G	PEC ≥ 420	or	GHGE ≥ 100
For residential properties located in climatic zones H1b, H1c and H2d and at an altitude of over 800 m, classes E, F and G are modulated differently:			
E	250 ≤ PEC < 390 and GHGE < 80	or	50 ≤ GHGE < 80 and PEC < 390

F	390 ≤ PEC < 500 and GHGE < 110	or	80 ≤ GHGE < 110 and PEC < 500
G	PEC ≥ 500	or	GHGE ≥ 110

* PEC = primary energy consumption / UNIT : kWh/(m².y) GHGE = greenhouse gas emissions / UNIT : $kgCO_2$/(m².y)

Source: Directorate General for Planning, Housing and Nature - Ministry of Ecological Transition and Territorial Cohesion – private communication

Table 35. Class limits for non-residential buildings in France depending on energy consumption

Class		Offices, administration or education	Buildings with continuous occupancy (e.g. hospitals, hotels, etc.)	Other non-residential
		kWh/(m².y)	kWh/(m².y)	kWh/(m².y)
A	≤	50	100	30
B	≤	110	210	90
C	≤	210	370	170
D	≤	350	580	270
E	≤	540	830	380
F	≤	750	1130	510
G	>	750	1130	510

Source: Directorate General for Planning, Housing and Nature - Ministry of Ecological Transition and Territorial Cohesion – private communication

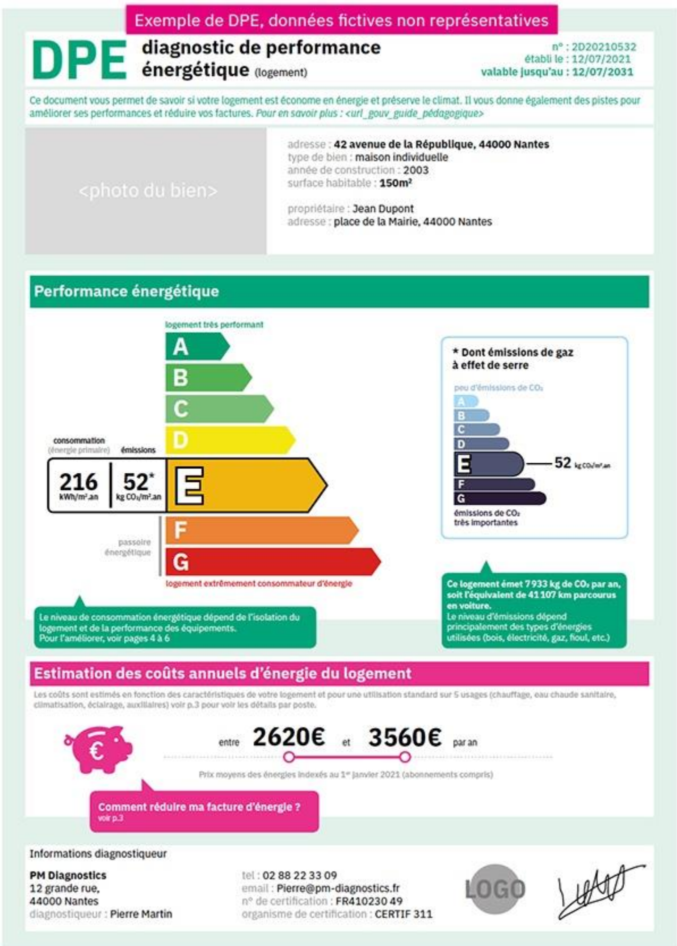
Table 36. Average yearly primary energy consumption in France per building type and per energy class 2019-2021

	2019	2020	2021 until June 31st	2021 after July 1st
per building type	kWh/(m².y)	kWh/(m².y)	kWh/(m².y)	kWh/(m².y)
Multi-dwelling building	174	207	149	254
Single-family home	182	182	177	247
Non-residential	304	250	227	378
per energy classes	kWh/(m².y)	kWh/(m².y)	kWh/(m².y)	kWh/(m².y)
A	23	31	32	28
B	68	69	69	79
C	125	125	124	132

D	193	193	194	203
E	279	280	280	277
F	387	387	387	354
G	1.705	2.900	1.139	681

Source: Directorate General for Planning, Housing and Nature - Ministry of Ecological Transition and Territorial Cohesion – private communication

Figure 17. Specimen of the new Energy Performance Certificate in France (after 2021).



Source: https://www.ecologie.gouv.fr/sites/default/files/2021.02.16_dp_dpe.pdf

5.11 Croatia

Two different classes are shown in the EPC. In the first one ($Q''_{H,nd,ref}$ see Table 37 an absolute scale is taken into account (specific annual heat demand for heating for reference climate data). In the second (E_{prim} see Table 38) the specific annual primary energy is considered. Class limits are different per climate (coastal/continental) and for building category (9 different categories). From 2014 to 2017, the certificate has a class only according to $Q''_{H,nd,ref}$, and from 2017 according to $Q''_{H,nd,ref}$ and E_{prim} (see Figure 18). E_{prim} for residential buildings includes energy for heating, domestic hot water and ventilation / air conditioning, and for non-residential buildings includes energy for lighting and those of thermotechnical systems. The floor area considered is the useful floor area of the heated part of the building.

Table 37. Absolute scale for heat demand in Croatia ($Q''_{H,nd,ref}$)

Energy class	Class limits kWh/(m² year)	
A+	<	15
A	<	25
B	<	50
C	<	100
D	<	150
E	<	200
F	<	250
G	>	250

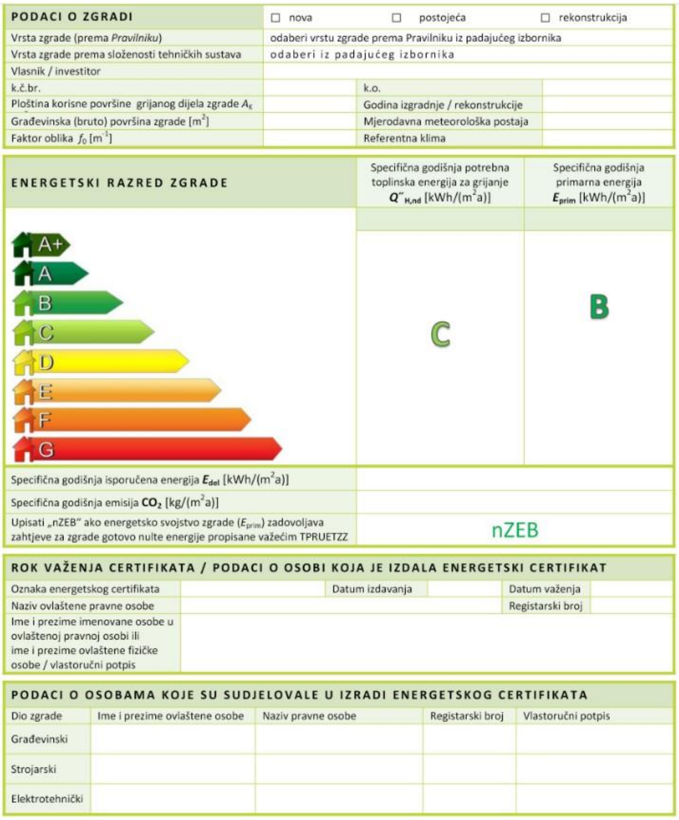
Source: Ministry of Physical Planning, Construction and State Assets – private communication

Table 38. Class limits for specific annual primary energy (E_{prim}) for some building categories in Croatia (all data in kWh/(m² year))

Energy class		Residential		Single family house		Offices	
		Continental	Coastal	Continental	Coastal	Continental	Coastal
		kWh/(m² year)					
A+	<	80	50	45	35	35	25
A	<	100	75	80	55	55	50
B	<	120	90	115	70	70	70
C	<	265	220	280	230	100	90
D	<	410	350	445	385	125	110
E	<	515	435	560	485	155	140
F	<	615	520	670	580	190	165
G	>	615	520	670	580	190	165

Source: Ministry of Physical Planning, Construction and State Assets – private communication

Figure 18. First page of the new Energy Performance Certificate in Croatia (after 2017).


PODACI O ZGRADI
☐ nova ☐ postojeća ☐ rekonstrukcija
Vrsta zgrade (prema *Pravilniku*) odaberi vrstu zgrade prema Pravilniku iz padajućeg izbornika
Vrsta zgrade prema složenosti tehničkih sustava odaberi iz padajućeg izbornika
Vlasnik / investitor
k.č.br.
k.o.
Ploština korisne površine grijanog dijela zgrade A_K
Godina izgradnje / rekonstrukcije
Građevinska (bruto) površina zgrade [m^2]
Mjerodavna meteorološka postaja
Faktor oblika f_0 [m^{-1}]
Referentna klima
ENERGETSKI RAZRED ZGRADE
Specifična godišnja potrebna toplinska energija za grijanje $Q''_{H,nd}$ [kWh/(m^{2}a)]
Specifična godišnja primarna energija E_{prim} [kWh/(m^{2}a)]
A+
A
B
C
D
E
F
G
C
B
Specifična godišnja isporučena energija E_{del} [kWh/(m^{2}a)]
Specifična godišnja emisija CO_2 [kg/(m^{2}a)]
Upisati „nZEB“ ako energetsko svojstvo zgrade (E_{prim}) zadovoljava zahtjeve za zgrade gotovo nulte energije propisane važećim TPRUETZZ
nZEB
ROK VAŽENJA CERTIFIKATA / PODACI O OSOBI KOJA JE IZDALA ENERGETSKI CERTIFIKAT
Oznaka energetskog certifikata
Datum izdavanja
Datum važenja
Naziv ovlaštene pravne osobe
Registarski broj
Ime i prezime imenovane osobe u ovlaštenoj pravnoj osobi ili ime i prezime ovlaštene fizičke osobe / vlastoručni potpis
PODACI O OSOBAMA KOJE SU SUDJELOVALE U IZRADI ENERGETSKOG CERTIFIKATA
Dio zgrade
Ime i prezime ovlaštene osobe
Naziv pravne osobe
Registarski broj
Vlastoručni potpis
Građevinski
Strojarski
Elektrotehnički

Source: http://www.m-investa.hr/energetskicertifikati.aspx

5.12 Italy

In Italy since 2015 class limits are defined according to the Reference building in the same climate (see Table 39). The index includes heating, cooling, ventilation, DHW. Non-residential buildings will include also lighting, elevators and escalators. Figure 19 shows the first page of the new Energy Performance Certificate in Italy (after 2015).

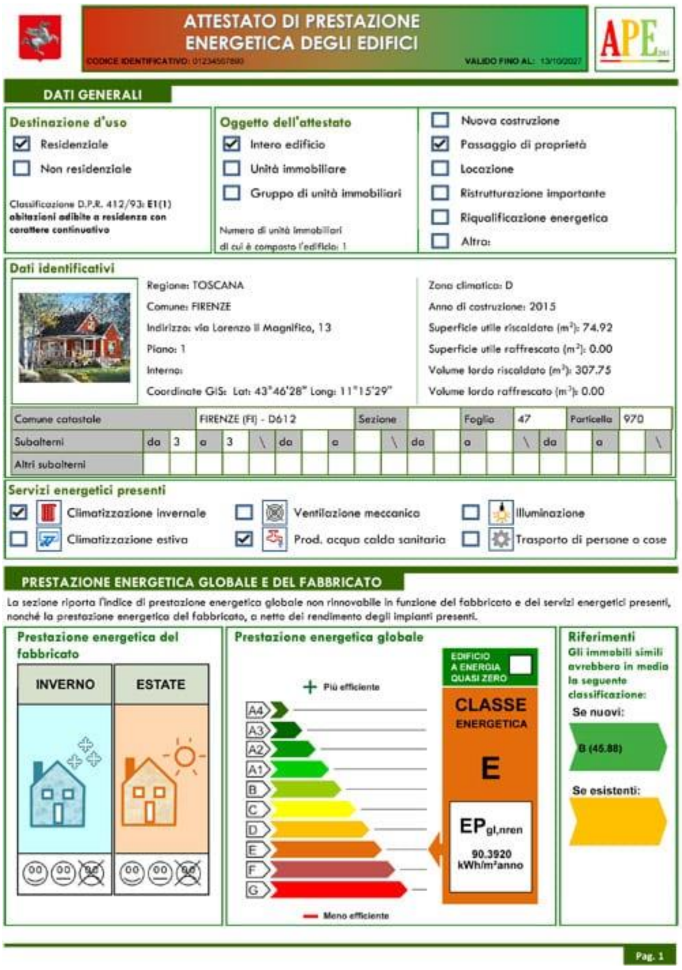
Table 39. Class limits in Italy, in comparison to the reference building (residential and non-residential)

Class	Limit	
A4	<	0,4
A3	<	0,6
A2	<	0,8
A1	<	1
B	<	1,2
C	<	1,5
D	<	2

E	<	2,6
F	<	3,5
G	>	3,5

Source: https://www.mimit.gov.it/images/stories/normativa/DM_Linee_guida_APE_allegato1.pdf

Figure 19. First page of the new Energy Performance Certificate in Italy (after 2015).



ATTESTATO DI PRESTAZIONE ENERGETICA DEGLI EDIFICI

CODICE IDENTIFICATIVO: 01234567890

VALIDO FINO AL: 13/10/2027

APE

DATI GENERALI

Destinazione d'uso
- [x] Residenziale
- [ ] Non residenziale

Classificazione D.P.R. 412/93: **E1(1) abitazioni adibite a residenza con carattere continuativo**

Oggetto dell'attestato
- [x] Intero edificio
- [ ] Unità immobiliare
- [ ] Gruppo di unità immobiliari

Numero di unità immobiliari di cui è composto l'edificio: 1

- [ ] Nuova costruzione
- [x] Passaggio di proprietà
- [ ] Locazione
- [ ] Ristrutturazione importante
- [ ] Riqualificazione energetica
- [ ] Altro:

Dati identificativi

Regione: TOSCANA
Comune: FIRENZE
Indirizzo: via Lorenzo Il Magnifico, 13
Piano: 1
Interno:
Coordinate GIS: Lat: 43°46'28" Long: 11°15'29"

Zona climatica: D
Anno di costruzione: 2015
Superficie utile riscaldata (m^2): 74.92
Superficie utile raffrescata (m^2): 0.00
Volume lordo riscaldato (m^3): 307.75
Volume lordo raffrescato (m^3): 0.00

Comune catastale	FIRENZE (FI) - D612	Sezione		Foglio	47	Particella	970
Subalterni	da 3 a 3	da	a	da	a	da	a
Altri subalterni							

Servizi energetici presenti
- [x] Climatizzazione invernale
- [ ] Climatizzazione estiva
- [ ] Ventilazione meccanica
- [x] Prod. acqua calda sanitaria
- [ ] Illuminazione
- [ ] Trasporto di persone o cose

PRESTAZIONE ENERGETICA GLOBALE E DEL FABBRICATO

La sezione riporta l'indice di prestazione energetica globale non rinnovabile in funzione del fabbricato e dei servizi energetici presenti, nonché la prestazione energetica del fabbricato, a netto del rendimento degli impianti presenti.

Prestazione energetica del fabbricato

INVERNO | ESTATE

Prestazione energetica globale

Più efficiente

A4 A3 A2 A1 B C D E F G

Meno efficiente

EDIFICIO A ENERGIA QUASI ZERO

CLASSE ENERGETICA

E

$EP_{gl,nren}$

90.3920 kWh/m^2anno

Riferimenti

Gli immobili simili avrebbero in media la seguente classificazione:

Se nuovi: B (45.88)

Se esistenti:

Pag. 1

Source: https://biblus.acca.it/ape-obbligatorio/

5.13 Cyprus

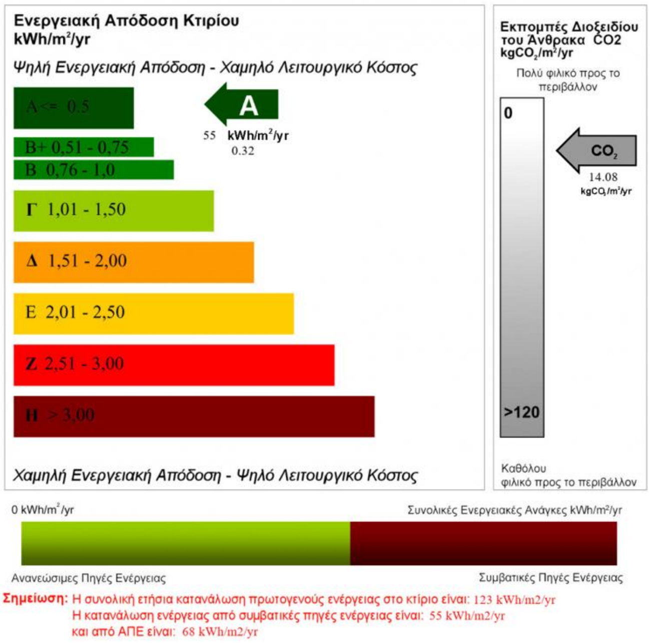
In Cyprus the class system is developed with the reference building method, following the scheme shown in Table 40. Figure 20 and Figure 21 show an excerpt from the Energy performance certificate in Cyprus (versions in Greek and in English).

Table 40. Class limits in Cyprus, in comparison to the reference building (residential and non-residential)

Class	Limit
A	< 0,5
B+	< 0,75
B	< 1
C	< 1,5
D	< 2
E	< 2,5
F	< 3
G	> 3

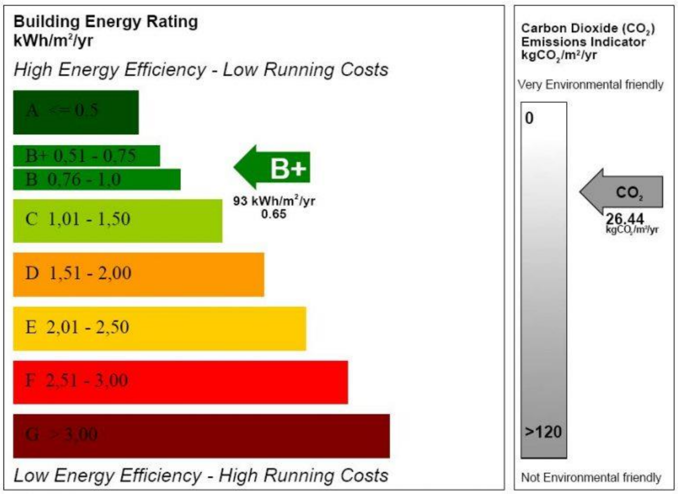
Source: https://www.cea.org.cy/wp-content/uploads/2016/08/pistopoiitiko-energeiakis-apodosis-ktirioy_3p_final_low-res.pdf

Figure 20. Excerpt from the Energy performance certificate in Cyprus (version in Greek).



Source: https://ecosmart.com.cy/wp-content/uploads/2014/09/1-%CE%A0%CE%95%CE%91-square-1024x993.png

Figure 21. Excerpt from the Energy performance certificate in Cyprus (version in English).



Source: https://www.epc.cy/

5.14 Latvia

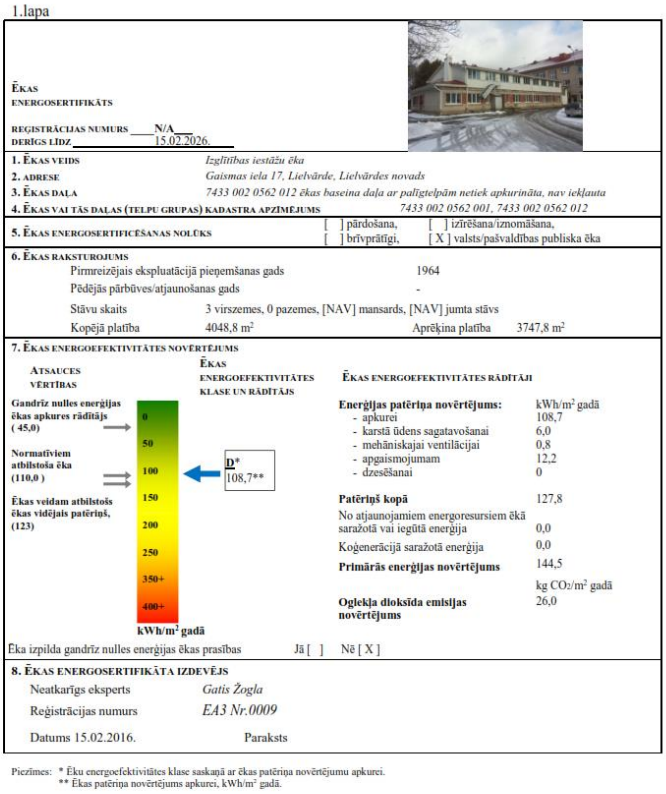
Class limits in Latvia are defined as shown in Table 41. Energy consumption calculation include heating, cooling, ventilation, hot water preparation and lighting of a building. The Energy Performance Certificate in Latvia is shown in Figure 22.

Table 41. Class limits in Latvia for residential and non-residential buildings.

Class	Class limits (in kWh/(m^2 year))		
		Residential	Non-residential
A	<	40	45
B	<	60	65
C	<	80	90
D	<	100	110
E	<	150	150
F	>	150	150

Source: https://www.vvc.gov.lv/en/laws-and-regulations-republic-latvia-english/cab-reg-no-383-regulations-regarding-energy-certification-buildings-amendments-10112015

Figure 22. The Energy Performance Certificate in Latvia.



1.lapa

ĒKAS ENERGOSERTIFIKĀTS

REĢISTRĀCIJAS NUMURS ____N/A___
DERĪGS LĪDZ 15.02.2026.

1. ĒKAS VEIDS *Izglītības iestāžu ēka*
2. ADRESE *Gaismas iela 17, Lielvārde, Lielvārdes novads*
3. ĒKAS DAĻA *7433 002 0562 012 ēkas baseina daļa ar palīgtelpām netiek apkurināta, nav iekļauta*
4. ĒKAS VAI TĀS DAĻAS (TELPU GRUPAS) KADASTRA APZĪMĒJUMS *7433 002 0562 001, 7433 002 0562 012*

5. ĒKAS ENERGOSERTIFICĒŠANAS NOLŪKS [ ] pārdošana, [ ] izīrēšana/iznomāšana, [ ] brīvprātīgi, [X] valsts/pašvaldības publiska ēka

6. ĒKAS RAKSTUROJUMS
Pirmreizējais ekspluatācijā pieņemšanas gads 1964
Pēdējās pārbūves/atjaunošanas gads -
Stāvu skaits 3 virszemes, 0 pazemes, [NAV] mansards, [NAV] jumta stāvs
Kopējā platība 4048,8 m² Aprēķina platība 3747,8 m²

7. ĒKAS ENERGOEFEKTIVITĀTES NOVĒRTĒJUMS

ATSAUCES VĒRTĪBAS
Gandrīz nulles enerģijas ēkas apkures rādītājs (45,0)
Normatīviem atbilstoša ēka (110,0)
Ēkas veidam atbilstošs ēkas vidējais patēriņš, (123)

ĒKAS ENERGOEFEKTIVITĀTES KLASE UN RĀDĪTĀJS
0, 50, 100, 150, 200, 250, 350+, 400+
kWh/m² gadā
D*
108,7**

ĒKAS ENERGOEFEKTIVITĀTES RĀDĪTĀJI

Enerģijas patēriņa novērtējums:	kWh/m² gadā
- apkurei	108,7
- karstā ūdens sagatavošanai	6,0
- mehāniskajai ventilācijai	0,8
- apgaismojumam	12,2
- dzesēšanai	0
Patēriņš kopā	127,8
No atjaunojamiem energoresursiem ēkā saražotā vai iegūtā enerģija	0,0
Koģenerācijā saražotā enerģija	0,0
Primārās enerģijas novērtējums	144,5
	kg CO_2/m² gadā
Oglekļa dioksīda emisijas novērtējums	26,0

Ēka izpilda gandrīz nulles enerģijas ēkas prasības Jā [ ] Nē [X]

8. ĒKAS ENERGOSERTIFIKĀTA IZDEVĒJS
Neatkarīgs eksperts *Gatis Žogla*
Reģistrācijas numurs *EA3 Nr.0009*
Datums 15.02.2016. Paraksts

Piezīmes: * Ēku energoefektivitātes klase saskaņā ar ēkas patēriņa novērtējumu apkurei.
** Ēkas patēriņa novērtējums apkurei, kWh/m² gadā.

Source: https://www.ekodoma.lv/en/services/energy-performance-certificate

5.15 Lithuania

As shown in Table 42, classes are based on energy performance indexes C1 (which describes the efficiency of primary non-renewable energy for heating, ventilation, cooling and lighting) and C2 of the building, (which describes the efficiency of primary non-renewable energy for the production of domestic hot water).

> "The energy performance class of a building is determined by the values of the following building indicators:
>
> - the calculated specific heat loss of the building envelope;
> - tightness of the building; the technical characteristics of the mechanical ventilation system with recuperation; energy consumption for heating the building;
> - thermal properties of building bulkheads and intercommunication floors;
> - the value of the building's energy performance index C 1, which describes the efficiency of primary non-renewable energy for heating, ventilation, cooling and lighting;
> - the value of the energy efficiency index C 2 of the building, which describes the efficiency of primary non-renewable energy for the production of domestic hot water;
> - the share of energy from renewable sources in the building."

Table 42. Class boundaries in Lithuania depending on indexes C1 and C2

Class	Class boundaries
A++	$C1 < 0.3$ and $C2 \leq 0.70$

A+	C 1 < 0.5 and C 2 ≤ 0.80
A	C 1 < 0.7 and C 2 ≤ 0.85
B	C 1 < 1 and C 2 ≤ 0.99
C	C 1 < 1.5
D	C 1 < 2
E	C 1 < 2.5
F	C 1 < 3
G	C 1 ≥ 3

Source: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/15767120a80711e68987e8320e9a5185/asr

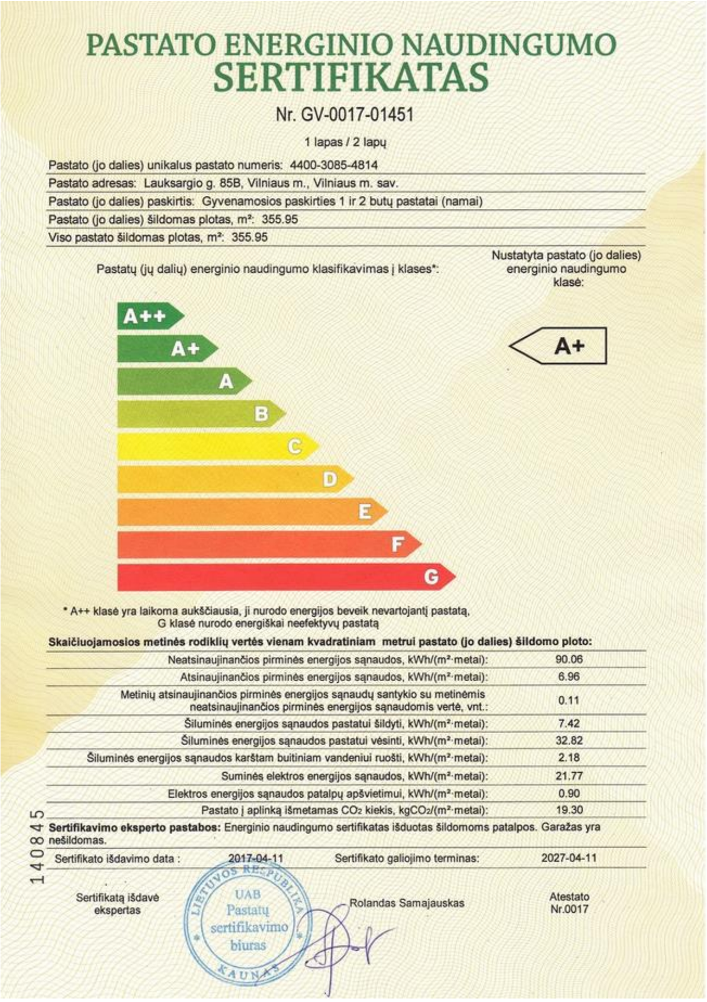
Average energy consumption for different categories in 2018 were 363.2 kWh/(m²·year) for residential buildings, 262.6 kWh/(m²·year) for non-residential (industrial) buildings and 245.7 kWh/(m²·year) for public buildings. According to our survey the average yearly consumption for all EPC included in the different classes in 2017 and 2018 are shown in Table 43. Figure 23 shows the Energy Performance Certificate in Lithuania.

Table 43. Average yearly consumption in Lithuania in 2018 depending on the energy classes (kWh/(m²·year))

Class	Average yearly consumption 2018
	kWh/(m²·year)
A++	4.6
A+	13.9
A	32.0
B	75.7
C	131.4
D	191.5
E	660.9
F	632.8
G	633.4

Source: Ministry of Environment of the Republic of Lithuania – private communications

Figure 23. The Energy Performance Certificate in Lithuania.



PASTATO ENERGINIO NAUDINGUMO
SERTIFIKATAS

Nr. GV-0017-01451

1 lapas / 2 lapų

Pastato (jo dalies) unikalus pastato numeris: 4400-3085-4814

Pastato adresas: Lauksargio g. 85B, Vilniaus m., Vilniaus m. sav.

Pastato (jo dalies) paskirtis: Gyvenamosios paskirties 1 ir 2 butų pastatai (namai)

Pastato (jo dalies) šildomas plotas, m²: 355.95

Viso pastato šildomas plotas, m²: 355.95

Pastatų (jų dalių) energinio naudingumo klasifikavimas į klases*:

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

Nustatyta pastato (jo dalies) energinio naudingumo klasė:

A+

* A++ klasė yra laikoma aukščiausia, ji nurodo energijos beveik nevartojantį pastatą, G klasė nurodo energiškai neefektyvų pastatą

Skaičiuojamosios metinės rodiklių vertės vienam kvadratiniam metrui pastato (jo dalies) šildomo ploto:

Neatsinaujinančios pirminės energijos sąnaudos, kWh/(m²·metai):	90.06
Atsinaujinančios pirminės energijos sąnaudos, kWh/(m²·metai):	6.96
Metinių atsinaujinančios pirminės energijos sąnaudų santykio su metinėmis neatsinaujinančios pirminės energijos sąnaudomis vertė, vnt.:	0.11
Šiluminės energijos sąnaudos pastatui šildyti, kWh/(m²·metai):	7.42
Šiluminės energijos sąnaudos pastatui vėsinti, kWh/(m²·metai):	32.82
Šiluminės energijos sąnaudos karštam buitiniam vandeniui ruošti, kWh/(m²·metai):	2.18
Suminės elektros energijos sąnaudos, kWh/(m²·metai):	21.77
Elektros energijos sąnaudos patalpų apšvietimui, kWh/(m²·metai):	0.90
Pastato į aplinką išmetamas CO_2 kiekis, $kgCO_2$/(m²·metai):	19.30

Sertifikavimo eksperto pastabos: Energinio naudingumo sertifikatas išduotas šildomoms patalpos. Garažas yra nešildomas.

Sertifikato išdavimo data : 2017-04-11 Sertifikato galiojimo terminas: 2027-04-11

Sertifikatą išdavė ekspertas Rolandas Samajauskas Atestato Nr.0017

LIETUVOS RESPUBLIKA UAB Pastatų sertifikavimo biuras KAUNAS

140845

Source: https://epbd-ca.eu/outcomes/2015-2018/book2018/countries/lithuania/img_2.jpg

5.16 Luxembourg

A new Buildings Energy Act has been approved in 2021 (*Règlement grand-ducal modifié du 9 juin 2021 (RGD 2021) concernant la performance énergétique des bâtiments*). For residential and non-residential buildings the EPC is based on a calculated energy demand of the building. Class limits have been updated for class A to E (see Table 44). The EPC is completed with consumption data of the building. All calculations are done with standardized usage and climate conditions. The results are therefore independent of the occupants' individual behaviours.

— EPC includes different end uses:

— For residential buildings: heating and production of hot water.

— For non-residential buildings: heating, production of hot water, lighting, ventilation, cooling, and humidification.

Table 44. Class limits in Luxembourg for residential buildings (in kWh/(m² year)).

Class	Residential single family house	Residential multi-family house

	kWh/(m² year)	kWh/(m² year)
A+	< 22	< 16
A	< 41	< 41
B	< 90	< 71
C	< 123	<84
D	< 142	< 98
E	< 208	< 154
F	< 295	< 225
G	< 395	< 280
H	< 530	< 355
I	> 530	> 355

Source: Department of Energy - Ministry of Energy and Spatial Planning – private communications

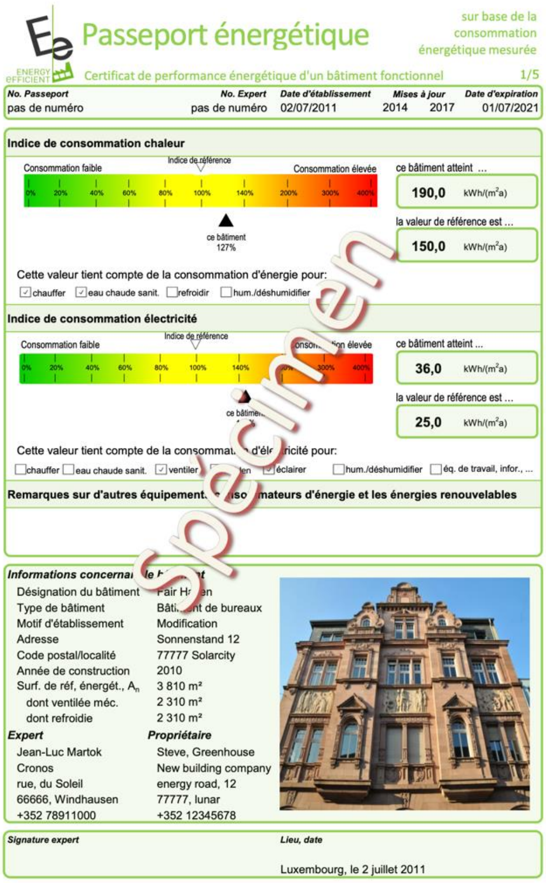
EPC include also information on emissions, recommendations and consideration on auto-consumption of on-site RES-electricity by the building and of heat produced by solar thermal installations. In particular, they also include:

— For residential buildings: thermal insulation class and environmental performance class (CO_2 emissions).

— For non-residential buildings: thermal insulation class, environmental performance class (CO_2 emissions), primary energy class for heating, primary energy class for cooling, primary energy class for ventilation, primary energy class for lighting, economic efficiency class.

Depending on the date of the building permit, a distinction will be made between energy passport based on "measured energy consumption" (based on electricity and heating energy bills, see Figure 24) and energy passport based on the “calculated energy requirement” (see Figure 25). During a sale, rental, extension, modifications subject to prior authorization or a substantial modification, the electricity and heating consumption is compared with the consumption of a reference building for assessing the energy quality of the existing functional building.

Figure 24. Energy passport based on "measured energy consumption" in Luxembourg


Passeport énergétique
sur base de la consommation énergétique mesurée
Certificat de performance énergétique d'un bâtiment fonctionnel 1/5

No. Passeport	No. Expert	Date d'établissement	Mises à jour	Date d'expiration
pas de numéro	pas de numéro	02/07/2011	2014 2017	01/07/2021

Indice de consommation chaleur

Consommation faible · Indice de référence · Consommation élevée

0% 20% 40% 60% 80% 100% 140% 200% 300% 400%

ce bâtiment 127%

ce bâtiment atteint ... 190,0 kWh/(m²a)

la valeur de référence est ... 150,0 kWh/(m²a)

Cette valeur tient compte de la consommation d'énergie pour:

☑ chauffer ☑ eau chaude sanit. ☐ refroidir ☐ hum./déshumidifier

Indice de consommation électricité

Consommation faible · Indice de référence · Consommation élevée

0% 20% 40% 60% 80% 100% 140% 200% 300% 400%

ce bâtiment atteint ... 36,0 kWh/(m²a)

la valeur de référence est ... 25,0 kWh/(m²a)

Cette valeur tient compte de la consommation d'électricité pour:

☐ chauffer ☐ eau chaude sanit. ☑ ventiler ☑ éclairer ☐ hum./déshumidifier ☐ éq. de travail, infor., ...

Remarques sur d'autres équipements consommateurs d'énergie et les énergies renouvelables

Informations concernant le bâtiment

Désignation du bâtiment	Fair H...
Type de bâtiment	Bâtiment de bureaux
Motif d'établissement	Modification
Adresse	Sonnenstand 12
Code postal/localité	77777 Solarcity
Année de construction	2010
Surf. de réf. énergét., A_n	3 810 m²
dont ventilée méc.	2 310 m²
dont refroidie	2 310 m²
Expert	**Propriétaire**
Jean-Luc Martok	Steve, Greenhouse
Cronos	New building company
rue, du Soleil	energy road, 12
66666, Windhausen	77777, lunar
+352 78911000	+352 12345678

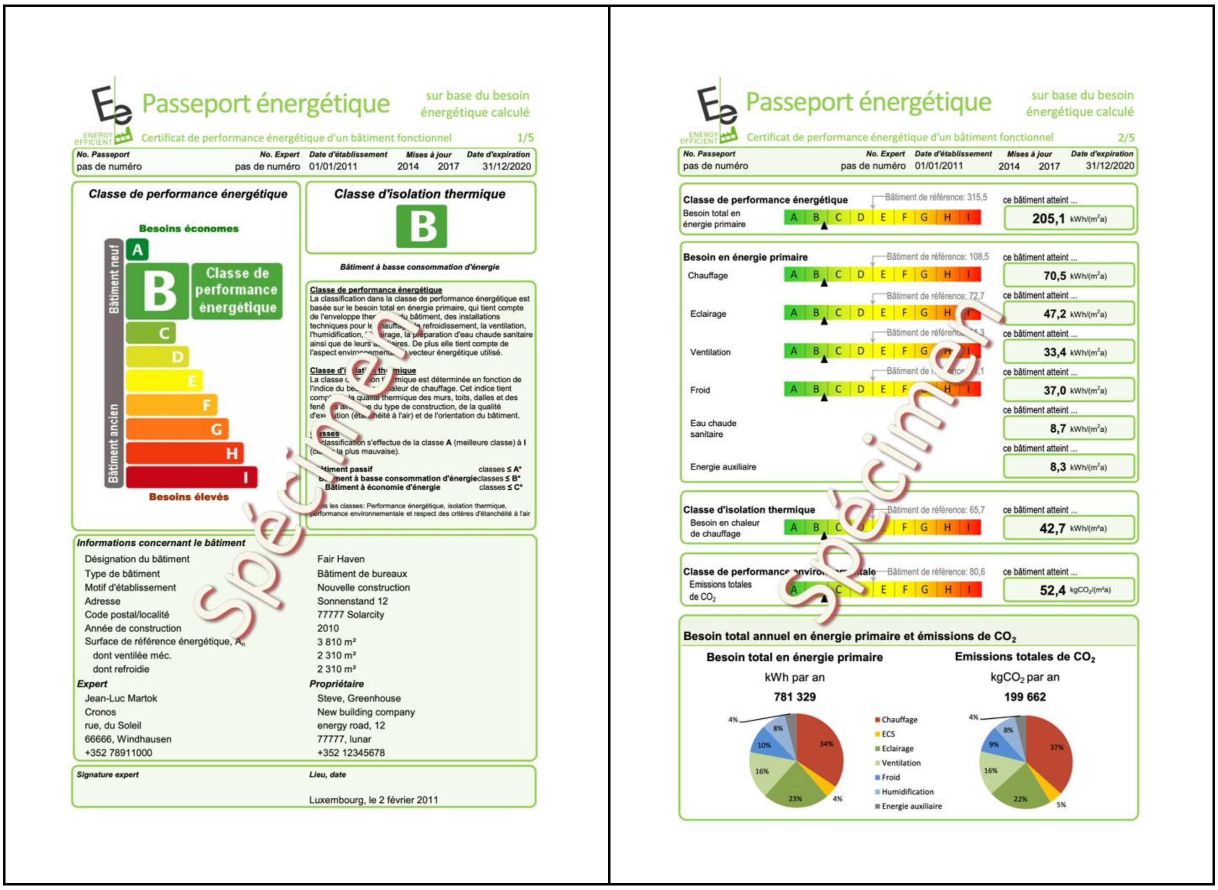
Signature expert · **Lieu, date**

Luxembourg, le 2 juillet 2011

Source: https://guichet.public.lu/dam-assets/citoyens/en/logement/construction/performances-energie/demande-passeport-energetique/specimen-certificat-batiments-fonctionnels-existants-FR.pdf

In the case of a new construction and during an extension of the volume of the building greater than 25% (in the 2 cases of figure authorization to build after the 01.01.2011), the evaluation of the energy quality is carried out according to the needs in electric current and in heat which are compared with reference values of a characteristic functional building.

Figure 25. Energy passport based on the “calculated energy requirement” in Luxembourg



Source: https://guichet.public.lu/dam-assets/citoyens/fr/logement/construction/performances-energie/demande-passeport-energetique/specimen-certificat-batiments-fonctionnels-neufs-FR.pdf

5.17 Hungary

The general approach in Hungary is based on asset method and class limits are in comparison to the NZEB requirements building (see Table 45). Different NZEB requirements are foreseen for residential, educational and office buildings. End-uses include: heating, cooling, ventilation, hot water (and lighting for non-residential). NZEB are in BB class. Renewable primary energy use must be higher than 25% of the non-renewable primary energy use. The Energy Performance Certificate in Hungary is shown in Figure 26.

Table 45. Class limits in Hungary, in comparison to the NZEB requirements building (residential and non-residential)

Class	Limit (compared to NZEB requirements)	
AA++	<	40%
AA+	<	60%
AA	<	80%
BB	<	100%
CC	<	130%

DD	<	160%
EE	<	200%
FF	<	250%
GG	<	310%
HH	<	400%
II	<	500%
JJ	>	500%

Source: Department of Building Services and Process Engineering - Budapest University of Technology and Economics – private communications

Figure 26. The Energy Performance Certificate in Hungary.

HITELES ENERGETIKAI TANÚSÍTVÁNY

ÖSSZESÍTŐ LAP HET-

Épület (önálló rendeltetési egység)

Rendeltetés: Lakó- és szállásjellegű
Cím: 1010 Város
Utca, házszám, emelet, ajtó
HRSZ: 1234/A/12
Az épület védettsége: Nem védett

Megrendelő

Név: Megrendelő neve
Cím: Megrendelő lakcíme

Energetikai minőség szerinti besorolás: CC

Korszerű

Energetikai adatok

Fűtött alapterület: 69 m²
Összesített energetikai jellemző:
-méretezett érték: 125,05 kWh/m²a
-követelményérték: 100 kWh/m²a
-a követelményérték százalékában: 125%

Korszerűsítési javaslat

Korszerűsítési javaslat leírása...

A javaslattal elérhető besorolás: -

Megjegyzés

A tanúsítvány tíz évig hatályos. Ha a tanúsítvány hatálya alatt az épületre irányadó jogszabályban meghatározott követelményérték megváltozik, az épület energetikai minőségi osztályba sorolását ismételten el kell végezni, ha a tanúsítvány hatálya alatt eladás, vagy bérbeadás történik. Új tanúsítvány készítésével az előző hatályát veszti.

Tanúsító szakember adatai

Név:
Cím:

Telefon:
Email:

Tanúsítás módszere: Épületrész, számítással

A tanúsítvány kiállításának oka:
ingatlan adásvétel

Jogosultsági szám:
Alátámasztó munkarész:
-kelte:
-készítő szoftver megnevezése:

Hiteles kiállítás dátuma: **Aláírás** *(Pecsét helye)*

ORSZÁGOS ÉPÍTÉSÜGYI NYILVÁNTARTÁS, E-TANÚSÍTÁS - ET adatlap verzió 2.1.0 https://entan.e-epites.hu

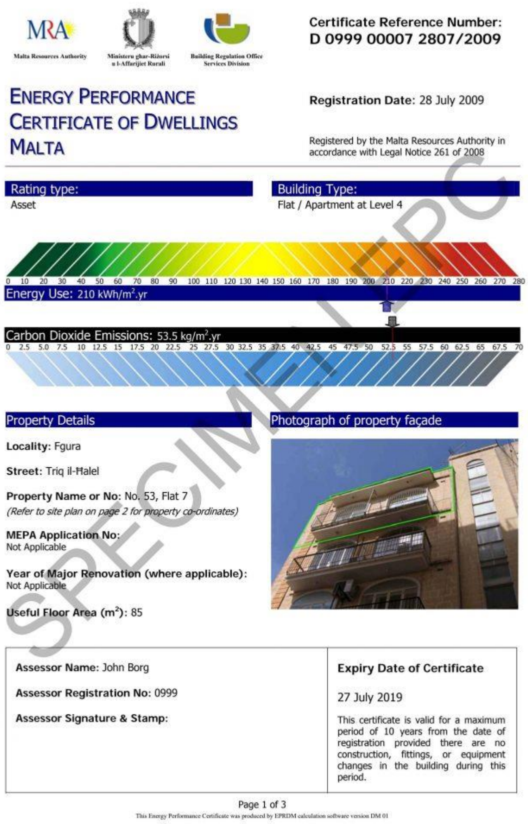
Source: https://etanus.hu/energetikai-tanusitvany/

5.18 Malta

Energy performance of a building (EPB) means the calculated or measured amount of energy, needed to meet the energy demand associated with a typical use of the building (heating, cooling, ventilation, hot water and lighting). Certification for building units shall be based on the assessment of an individual building unit when it deals with residential buildings. For all other non-residential uses, delineation shall be based on use factor or ownership.

No classes are shown in the EPC, only a coloured band from green to red. For Dwellings, the coloured band ranges from 0 to 280 kWh/(m^2 year), as shown in Figure 27.

Figure 27. Malta EPC for dwellings - Specimen



Source: https://ssemalta.com/epc/sampleepc/

It was not possible to collect any data on EPC average consumption.

5.19 Netherlands

In 2015 a Simplified EPC (VEL = Vereenvoudigd EnergieLabel) was introduced for residential buildings. Since 2021 the simplified EPC is no longer valid. EPC are based on energy performance calculation on a monthly basis (NTA8800) for all buildings both residential and non-residential and both new and existing. The energy performance is expressed as the primary fossil energy consumption in kWh/(m^2 year). In the Netherlands there is only one climate zone. New class limits are shown in Table 46. There are 10 non-residential building functions and each has separate class boundaries, the one for the office buildings is shown as an example.

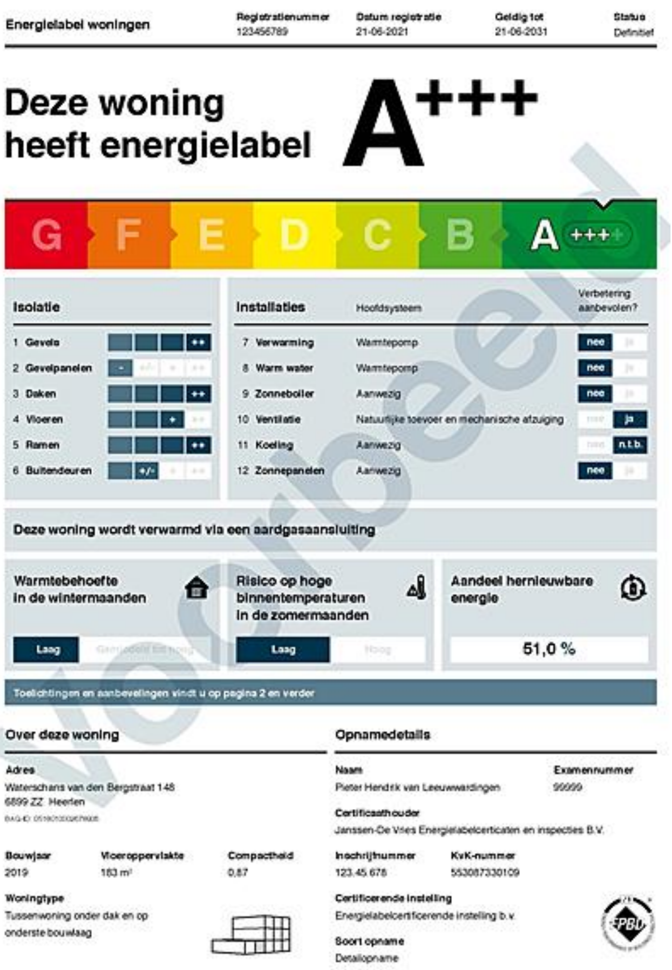
Table 46. Class limits in the Netherlands for residential and office buildings (in kWh/(m^2 year)).

		Residential	Office buildings
		kWh/(m^2 year)	kWh/(m^2 year)
A+++++	≤		0
A++++	≤	0	40
A+++	≤	50	80
A++	≤	75	120
A+	≤	105	160
A	≤	160	180
B	≤	190	200
C	≤	250	225
D	≤	290	250
E	≤	335	275
F	≤	380	300
G	>	380	300

Source: Netherlands Enterprise Agency – private communications

Beyond RES production, emission of CO_2eq and recommendations, EPCs (see Figure 28) include information such as heat demand in winter season, risk of overheating in summer period, indication of energy bill (euro/month) and detailed descriptions of building envelope and installations. It also indicates if the building meets the 'Standard for thermal insulation' and if it is heated with natural gas.

Figure 28. Specimen of the Energy Performance Certificate in the Netherlands for residential buildings



Source: *https://www.amstelveenweb.com/nieuws-Nieuw-energielabel-voor-gebouwen-komt-per-1-janu&newsid=363734985*

5.20 Austria

The building energy performance is calculated for the site climate and an Austrian reference climate. The reference climate is used for the main display of the indicators. The primary energy demand includes: Heating, DHW, Electricity plus the necessary auxiliary energy demand and all the upstream losses, less any final energy yields. Class limits are the same for residential and non-residential buildings. The certificates include four indicators (see Table 47 and Figure 29): heat energy demand (HWB), primary energy demand (PEB), CO_2 emissions and overall energy efficiency factor (f_{GEE}).

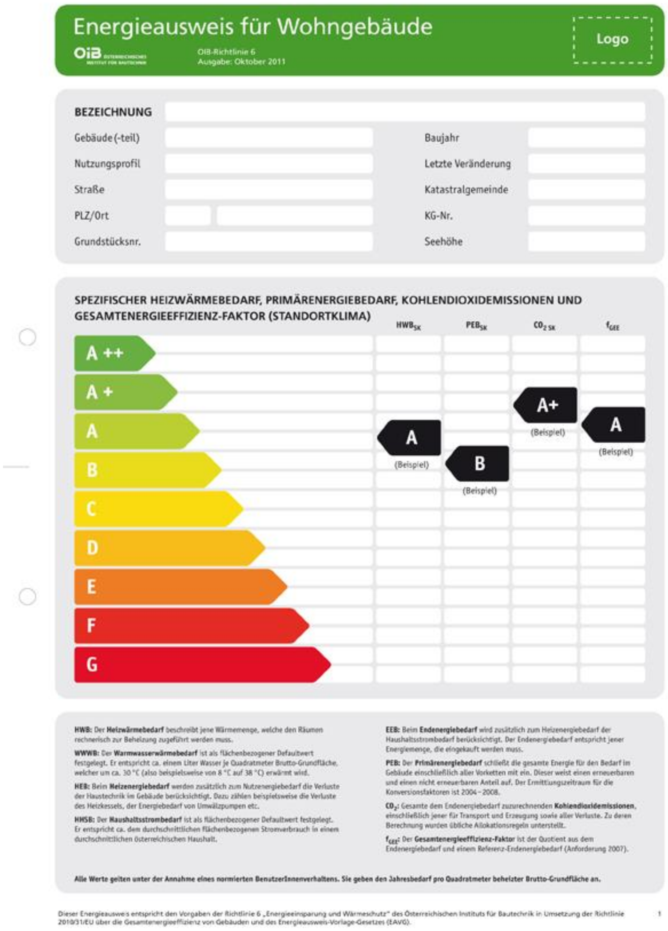
Table 47. Class limits in the Austria for the four indicators included in the EPC.

		Heating energy demand	Primary energy demand	CO_2 emissions	Overall energy efficiency index
		kWh/(m² year)	kWh/(m² year)	kg/(m² year)	-
A++	<	10	60	8	0,55
A+	<	15	70	10	0,7

A	<	25	80	15	0,85
B	<	50	160	30	1,00
C	<	100	220	40	1,75
D	<	150	280	50	2,50
E	<	200	340	60	3,25
F	<	250	400	70	4,00
G	>	250	400	70	4,00

Source: https://www.oib.or.at/sites/default/files/richtlinie_6_12.04.19_1.pdf

Figure 29. Specimen of the Energy Performance Certificate in Austria

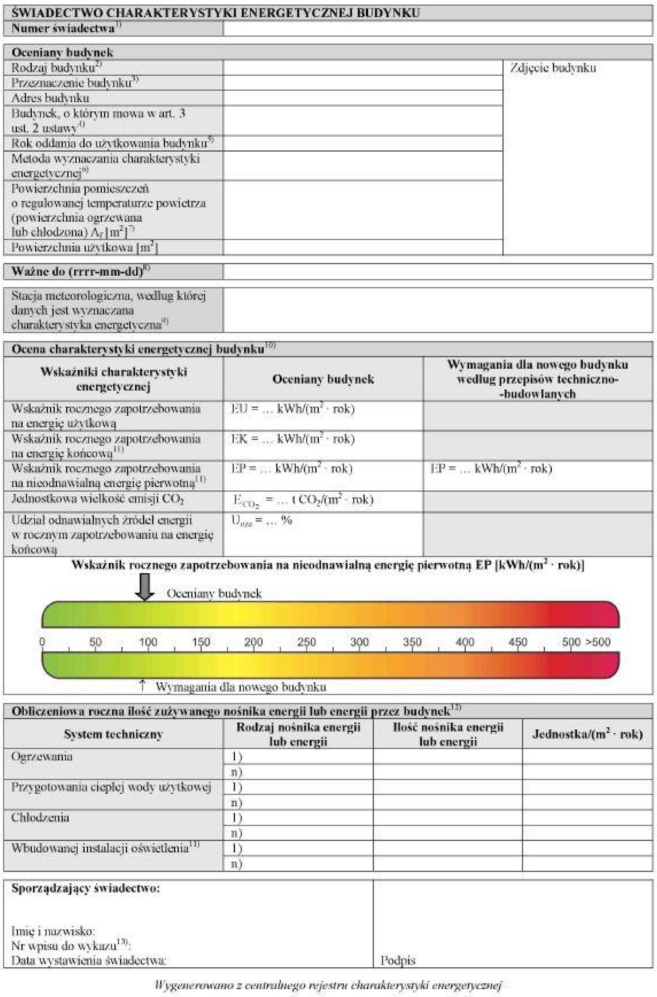


Source: https://www.oib.or.at/sites/default/files/rl6_061011_2.pdf

5.21 Poland

There are two types of EPCs in Poland for both residential and not residential buildings: if the sale/rental concerns a building, an energy performance certificate for the building should be drawn up, and if the sale/rental concerns a part of the building (premises), an energy performance certificate for a part of the building should be drawn up. The energy performance of the building (or part of the building) is determined on the basis of a comparison of the indicator of the annual demand for non-renewable primary energy EP necessary to meet the energy needs of the building (or part of the building). No classes are shown, only a coloured band from green to red (0 to 500 kWh/(m^2 year), see Figure 30). A system based on classes is expected to be implemented during 2023.

Figure 30. Specimen of the Energy Performance Certificate in Poland



ŚWIADECTWO CHARAKTERYSTYKI ENERGETYCZNEJ BUDYNKU	
Numer świadectwa[1)]	

Oceniany budynek		
Rodzaj budynku[2)]		Zdjęcie budynku
Przeznaczenie budynku[3)]		
Adres budynku		
Budynek, o którym mowa w art. 3 ust. 2 ustawy[4)]		
Rok oddania do użytkowania budynku[5)]		
Metoda wyznaczania charakterystyki energetycznej[6)]		
Powierzchnia pomieszczeń o regulowanej temperaturze powietrza (powierzchnia ogrzewana lub chłodzona) A_f [m^2][7)]		
Powierzchnia użytkowa [m^2]		

Ważne do (rrrr-mm-dd)[8)]	
Stacja meteorologiczna, według której danych jest wyznaczana charakterystyka energetyczna[9)]	

Ocena charakterystyki energetycznej budynku[10)]		
Wskaźniki charakterystyki energetycznej	**Oceniany budynek**	**Wymagania dla nowego budynku według przepisów techniczno-budowlanych**
Wskaźnik rocznego zapotrzebowania na energię użytkową	EU = … kWh/(m^2 · rok)	
Wskaźnik rocznego zapotrzebowania na energię końcową[11)]	EK = … kWh/(m^2 · rok)	
Wskaźnik rocznego zapotrzebowania na nieodnawialną energię pierwotną[11)]	EP = … kWh/(m^2 · rok)	EP = … kWh/(m^2 · rok)
Jednostkowa wielkość emisji CO_2	E_{CO_2} = … t CO_2/(m^2 · rok)	
Udział odnawialnych źródeł energii w rocznym zapotrzebowaniu na energię końcową	U_{oze} = … %	

Wskaźnik rocznego zapotrzebowania na nieodnawialną energię pierwotną EP [kWh/(m^2 · rok)]

Obliczeniowa roczna ilość zużywanego nośnika energii lub energii przez budynek[12)]			
System techniczny	**Rodzaj nośnika energii lub energii**	**Ilość nośnika energii lub energii**	**Jednostka/(m^2 · rok)**
Ogrzewania	1)		
	n)		
Przygotowania ciepłej wody użytkowej	1)		
	n)		
Chłodzenia	1)		
	n)		
Wbudowanej instalacji oświetlenia[11)]	1)		
	n)		

Sporządzający świadectwo:	
Imię i nazwisko: Nr wpisu do wykazu[13)]: Data wystawienia świadectwa:	Podpis

Wygenerowano z centralnego rejestru charakterystyki energetycznej

Source: https://www.infor.pl/akt-prawny/DZU.2023.103.0000697,rozporzadzenie-ministra-rozwoju-i-technologii-zmieniajace-rozporzadzenie-w-sprawie-metodologii-wyznaczania-charakterystyki-energetycznej-budynku-lub-czesci-budynku-oraz-swiadectw-charakterystyki-energ.html

The “Long-term building renovation strategy - Supporting the renovation of the national building stock” (*Długoterminowa strategia renowacji budynków - Wspieranie renowacji krajowego zasobu budowlanego*) introduces Energy efficiency ranges of buildings according to the EP index [kWh/(m^2 year)] adopted for the scenario analysis, with limits as shown in Figure 31.

Figure 31. Energy efficiency ranges of buildings according to the EP index in the Long-term building renovation strategy

do 50	50 - 90	90 - 150	150 - 230	230 - 330	330 - 450	ponad 450

Source: https://www.gov.pl/web/rozwoj-technologia/Dlugoterminowa-strategia-renowacji-budynkow

This ranges have been introduced based on KAPE assumptions (*Krajowa Agencja Poszanowania Energii* - National Energy Conservation Agency). They should not be intended as energy classes.

It was not possible to collect any data on EPC average consumption.

5.22 Portugal

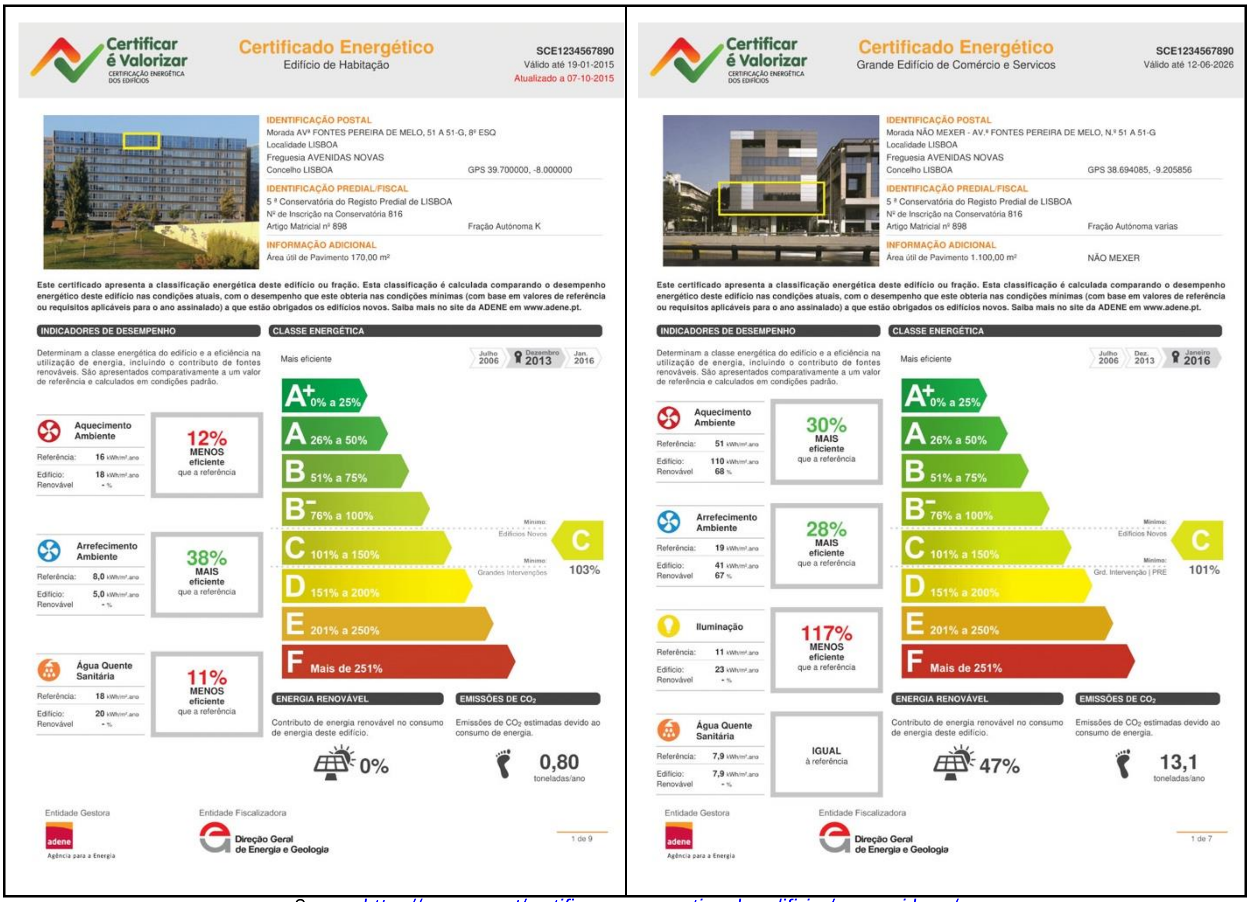
In Portugal class limits are defined according to the Reference building as shown in Table 48. The index includes heating, ventilation, cooling, DHW and lighting (only in non-residential). NZEB Residential Buildings are defined as buildings with a label A+ or A and additional energy requirements (% RES and thermal comfort), while Non-Residential NZEB include also class B buildings. Figure 42 shows the first page of the Energy Performance Certificate for residential and commercial/services buildings.

Table 48. Class limits in Portugal, in comparison to the reference building (residential and non-residential)

Class	Limit	
A+	<	25%
A	<	50%
B	<	75%
B-	<	100%
C	<	150%
D	<	200%
E	<	250%
F	>	251%

Source: Portuguese Energy Agency – private communications

Figure 32. First page of the Energy Performance Certificate in Portugal residential (left) and commercial/services (right)



Source: https://www.sce.pt/certificacao-energetica-de-edificios/consumidores/

5.23 Romania

Romania adopted changes in its EPC scheme in February 2023 (Romanian Ministry of Development, 2023). The new energy classes differ depending on the building type (Table 49). There are three EPC templates for residential buildings (single-family houses, multi-family houses, and apartments) and six EPC templates for non-residential buildings (offices, healthcare, educational, commercial, tourism, and sport facilities).The energy classes are based on the primary energy demand for heating, DHW, cooling (not mandatory), ventilation (not mandatory for residential buildings) and built-in lighting and it is expressed in kWh/(m^{2}year)[6]. Moreover, the EPC includes distinct energy classes for each end-use. To note that collective buildings and apartments share the same energy classes' boundaries. In addition, the new EPC provides GHG emissions classes for all these building categories, expressed in kg CO_2eq/(m^{2}year) as shown in Table 50.

The new specimen of the Energy Performance Certificate for building in Romania is shown in Figure 33 (the specimen for apartments is slightly different).

Table 49. Energy classes boundaries in Romania in kWh/(m^2 year).

	SFH	MHF and Apartments	Administration	Education	Healthcare	Tourism	Commerce	Sport
Primary energy demand for heating, cooling, ventilation, DHW, built-in lighting in kWh/(m^2 year)								

[6] If cooling or ventilation are not included, the classes' boundaries must be recalculated.

A+	<91	<73	<91	<48	<117	<67	<88	<75
A	<129	<101	<129	<68	<165	<93	<124	<104
B	<257	<198	<257	<135	<331	<188	<248	<206
C	<390	<297	<390	<246	<501	<321	<320	<350
D	<522	<396	<522	<358	<671	<452	<393	<494
E	<652	<495	<652	<447	<838	<565	<492	<617
F	<783	<595	<783	<536	<1005	<678	<591	<741
G	>783	>595	>783	>536	>1005	>678	>591	>741

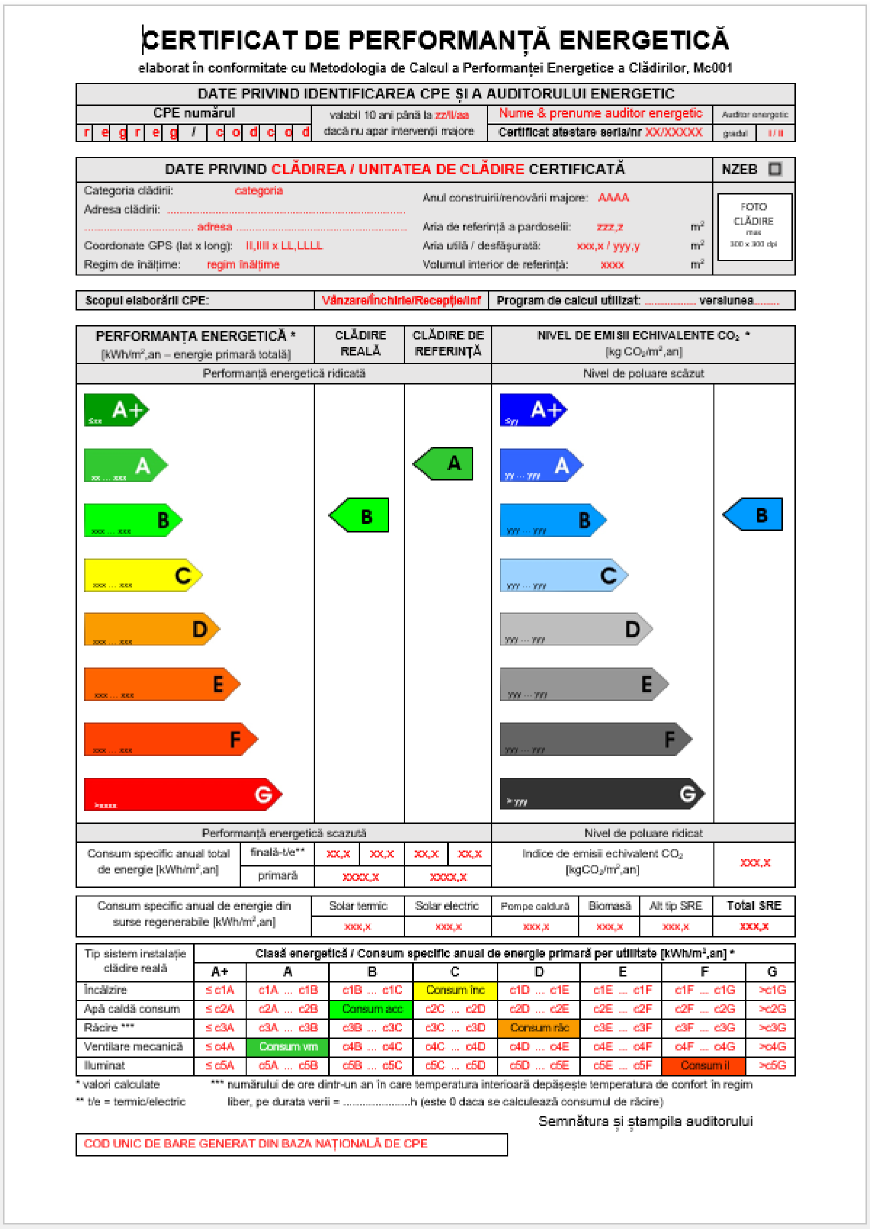
Source: Romanian Ministry of Development, Public Works, and Administration: Methodology for the Calculation of the Energy Performance of Buildings, Mc 001-2022, 2023

Table 50. Emission classes boundaries in Romania in kg CO_2eq/(m^2year)

	SFH	MHF and Apartments	Administration	Education	Healthcare	Tourism	Commerce	Sport
Primary energy demand for heating, cooling, ventilation, DHW, built-in lighting in kWh/(m^2year)								
A+	<16.1	<12.7	<10.4	<8.3	<19.7	<11.8	<15.4	<12.3
A	<22.8	<17.6	<14.8	<11.6	<27.8	<16.4	<21.6	<17.0
B	<45.5	<34.6	<29.7	<23.0	<55.8	<33.1	<43.4	<33.7
C	<70.1	<52.2	<46.1	<42.5	<84.0	<57.0	<54.5	<57.4
D	<94.8	<69.9	<62.4	<62.2	<112.3	<80.6	<65.7	<81.2
E	<118.4	<87.4	<77.8	<77.6	<140.2	<100.7	<82.3	<101.4
F	<142.1	<104.9	<93.4	<93.1	<168.1	<120.8	<98.9	<121.7
G	>142.1	>104.9	>93.4	>93.1	>168.1	>120.8	>98.9	>121.7

Source: Romanian Ministry of Development, Public Works, and Administration: Methodology for the Calculation of the Energy Performance of Buildings, Mc 001-2022, 2023

Figure 33. EPC template in Romania



Source: Romanian Ministry of Development, Public Works, and Administration, 2023 (https://www.mdlpa.ro/subarticles/7/anunt03032023)

5.24 Slovenia

In Slovenia two types of energy certificates are possible:

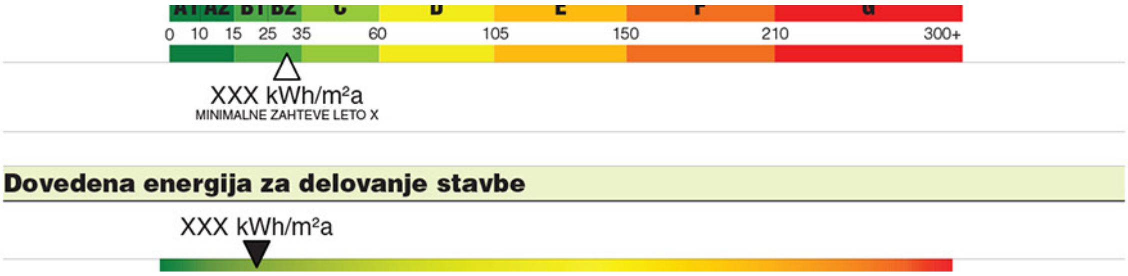
1. calculated energy certificate, which is issued for newly constructed buildings and newly constructed parts of buildings, existing residential buildings and apartments (see Table 51 and Figure 34);

Table 51. Class limits in Slovenia for calculated energy certificate (in kWh/(m^2 year)).

Class	Limit	
A1	<	10
A2	<	15
B1	<	25
B2	<	35
C	<	60
D	<	105
E	<	150
F	<	210
G	>	210

Source: https://www.uradni-list.si/_pdf/2023/Ur/u2023004.pdf

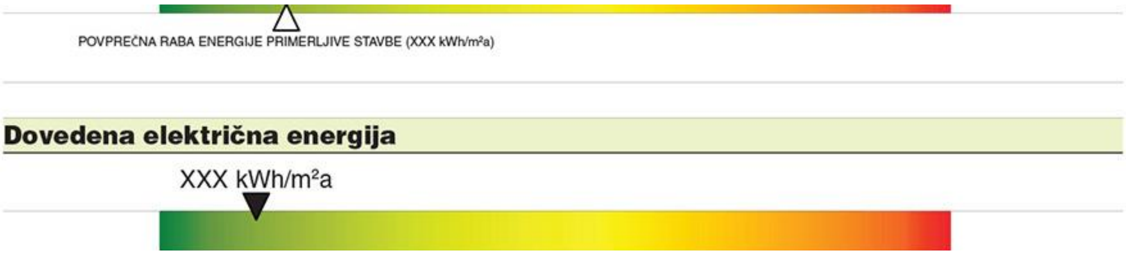
Figure 34. Excerpt from the calculated energy certificate in Slovenia



Source: https://www.uradni-list.si/_pdf/2023/Ur/u2023004.pdf

2. measured energy certificate, which is issued for existing non-residential buildings or non-residential parts of buildings, where no classes are shown, only a coloured band from green to red, as shown in Figure 35.

Figure 35. Excerpt from the measured energy certificate in Slovenia



Source: https://www.uradni-list.si/_pdf/2023/Ur/u2023004.pdf

The average yearly consumption for EPC included in the different classes in 2018 and 2019 are included in Table 52.

Table 52. Average yearly primary energy from non-renewable energy sources in 2018 and 2019 in Slovenia

	2018	2019
	kWh/(m²·year)	kWh/(m²·year)
A1	4,2	7,1
A2	13,2	13,2
B1	20,3	-
B2	28,7	27,8
C	48,1	48,0
D	82,2	82,7
E	128,2	128,5
F	181,3	180,9
G	316,3	316,8

Source: Institut Jožef Stefan – private communications

5.25 Slovakia

For the purposes of the calculation (and the definition of the class boundaries), buildings in the Slovak Republic are divided into 9 categories: family house; apartment building; offices; school building or school facility; hospital building; hotel or restaurant building; sports hall or other building intended for sports; commercial (a building for wholesale or retail trade); other buildings, including mixed-use buildings. According to energy performance, the different categories of buildings are classified in energy classes from A to G. Each energy class is expressed by a numerical range and is the sum of numerical indicators from each location and energy consumption in the building sub energy classes. In particular, the impact of climatic conditions and the availability of energy infrastructure shall be taken into account. The total floor area of a dwelling shall be determined from the external dimensions of the part of the building bounded by the vertical external structure, the internal partitioning between the apartments considered by their half thickness and the internal partitioning between the dwelling and the common space.

In the following Table 53 the class limits for some categories are shown.

Table 53. Class limits for primary energy for some building categories in Slovakia - All data in kWh/(m² year)

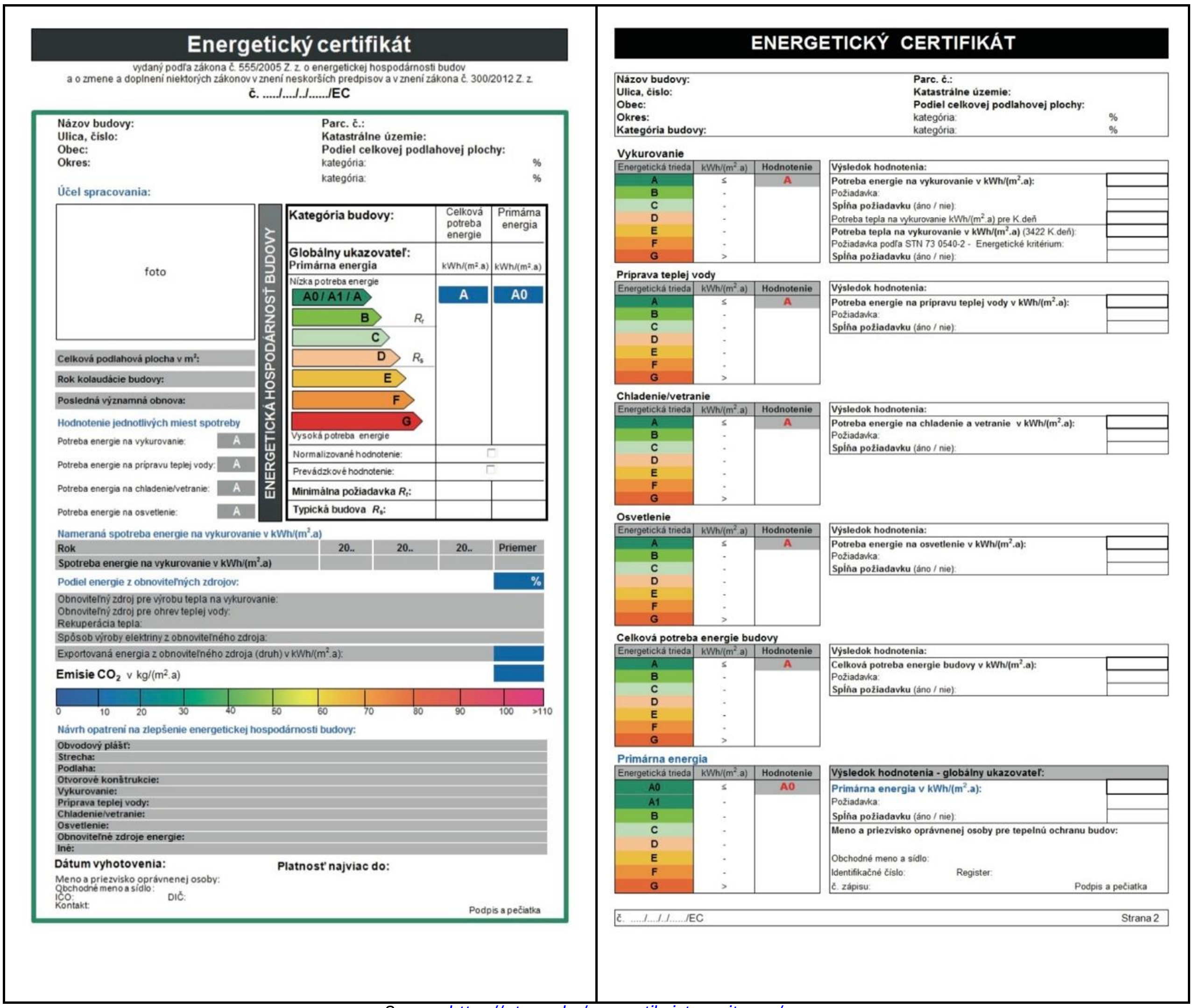
	Family houses	Apartment building	Offices	Commercial

A0 - NZEB	<	54	32	61	107
A1	<	108	63	122	213
B	<	216	126	255	425
C	<	324	189	383	638
D	<	432	252	511	850
E	<	540	315	639	1062
F	<	648	378	766	1275
G	>	648	378	766	1275

Source: https://www.slov-lex.sk/static/pdf/2012/364/ZZ_2012_364_20200310.pdf

A global indicator (primary energy) is used for the calculation of the main energy class and includes heating, hot water preparation, mechanical ventilation and cooling, lighting. EPCs (see Figure 36) include also other five additional classes for different indicators: heating; hot water preparation; mechanical ventilation and cooling; lighting; total energy demand in the building.

Figure 36. First and second page of the Energy performance certificate in the Slovak Republic.



Source: *https://etanus.hu/energetikai-tanusitvany/*

5.26 Finland

The energy rating of a building is based on a calculated energy efficiency, so-called E-value. The E-value of a building ($kWh_E/(m^2year)$) is calculated by dividing the building's calculated consumption of delivered energy based on the standardised use of the building (including heating, hot water, ventilation, air conditioning, system auxiliary units, electricity of consumer equipment and lighting), weighted by energy carrier factors, by the net heated surface area of the building (A_{net}) in a year. Energy classes limits are different for 9 building categories: Small residential buildings (in 4 different sub categories); Apartment buildings; Office; Commercial; Hotels; Educational and Nursery; Sports; Hospitals; other. Class limits for E-value for some sample building categories in Finland are shown in Table 54. New buildings, which fulfil NZEB regulations, are in principle in class A or B. The specimen of a Energy Performance Certificate in Finland after 2018 is shown in Figure 37.

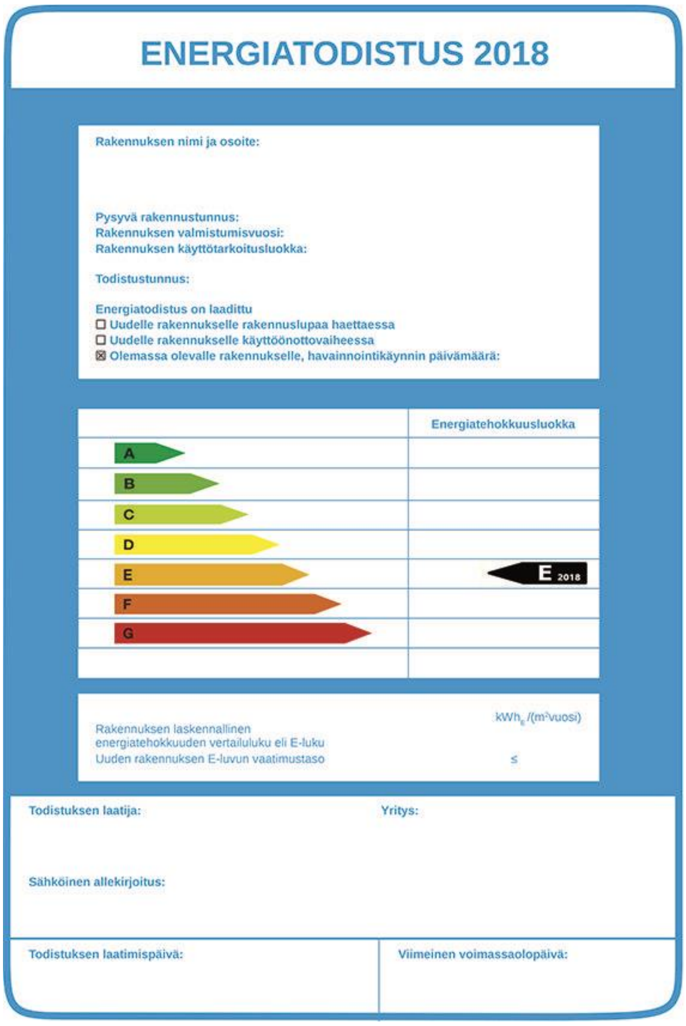
Table 54. Class limits for E-value for some building categories in Finland - All data in kWh/(m² year)

		Single house (50-150 m²)	Apartment blocks	Office	Commercial
A	<	110 – 0,2 x A_{netto}	75	80	90
B	<	215 – 0,6 x A_{netto}	100	120	170

C	<	252 – 0,6 x A_{netto}	130	170	240
D	<	332 – 0,6 x A_{netto}	160	200	280
E	<	462 – 0,6 x A_{netto}	190	240	340
F	<	532 – 0,6 x A_{netto}	240	300	390
G	>	532 – 0,6 x A_{netto}	241	301	391

Source: Ministry of the Environment/Department of the Built Environment – private communications

Figure 37. Specimen of an Energy Performance Certificate in Finland after 2018.



Source: https://www.theseus.fi/bitstream/handle/10024/703833/Hakanen_Mikko.pdf?sequence=2&isAllowed=y

5.27 Sweden

The energy classes are based on the ratio between the energy performance of the building in question (EP) and the requirement for energy use that is placed on new buildings being constructed today, as shown in Table 55. Energy class C corresponds to the requirements that apply to the building if it were to be built today. The requirements for new buildings are found in the Swedish Housing Authority's building regulations (BFS 2011:6) and depend on

— the type of building (single house <50 m2; single house 50-90 m2; single house 90-130 m2; single house >130 m2; apartment building; other);

— whether it is electrically heated or not;

— and where in Sweden it is located (51 different climatic factors).

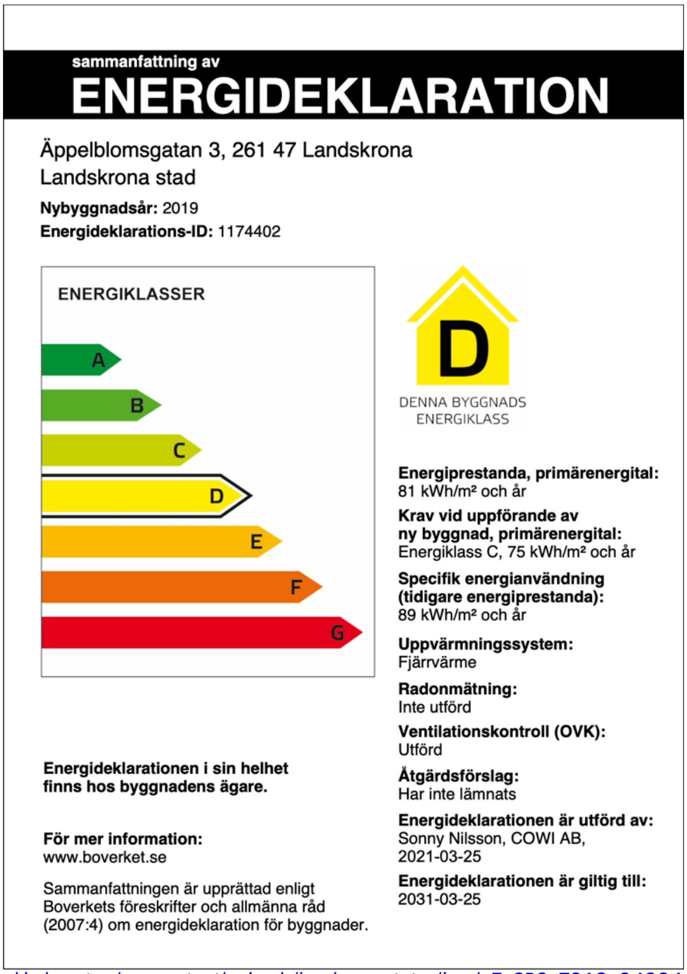
As of January 1, 2019, energy performance is expressed in primary energy instead of specific energy use and include heating, air-conditioning, hot tap water and the building's property electricity. Sample of the Energy Performance Certificate in Sweden is shown in Figure 38.

Table 55. Class limits in Sweden, in comparison to the requirements for new buildings (residential and non-residential)

Class	Limit	
A	<	50%
B	<	75%
C	<	100%
D	<	135%
E	<	180%
F	<	235%
G	>	235%

Source: https://www.boverket.se/sv/energideklaration/energideklaration/energideklarationens-innehall/

Figure 38. Sample of the Energy Performance Certificate in Sweden



sammanfattning av

ENERGIDEKLARATION

Äppelblomsgatan 3, 261 47 Landskrona
Landskrona stad

Nybyggnadsår: 2019
Energideklarations-ID: 1174402

ENERGIKLASSER

A
B
C
D
E
F
G

D
DENNA BYGGNADS ENERGIKLASS

Energiprestanda, primärenergital:
81 kWh/m² och år

Krav vid uppförande av ny byggnad, primärenergital:
Energiklass C, 75 kWh/m² och år

Specifik energianvändning (tidigare energiprestanda):
89 kWh/m² och år

Uppvärmningssystem:
Fjärrvärme

Radonmätning:
Inte utförd

Ventilationskontroll (OVK):
Utförd

Åtgärdsförslag:
Har inte lämnats

Energideklarationen är utförd av:
Sonny Nilsson, COWI AB,
2021-03-25

Energideklarationen är giltig till:
2031-03-25

Energideklarationen i sin helhet finns hos byggnadens ägare.

För mer information:
www.boverket.se

Sammanfattningen är upprättad enligt Boverkets föreskrifter och allmänna råd (2007:4) om energideklaration för byggnader.

Source: https://svenskamaklarhuset.se/wp-content/uploads/kowboy-estates/img/_F_ORG_T218_24334_20220331154908.pdf

6 Conclusions

Between July 2022 and February 2023 a survey was conducted concerning the status of implementation of Energy Performance Certificates of building in the 27 EU Member States. The survey built on the experience of a previous work carried out in early 2020. The survey was carried out contacting national experts (including those suggested by Concerted Action EPBD coordinator and CINEA - European Climate, Infrastructure and Environment Executive Agency) that in most cases provided updated data. In parallel, a search of public data and documents was developed in order to complete the database and clarify some specific aspects of the schemes as much as possible.

The national experts were asked to fulfil a questionnaire organised in three parts: the first one concerning all major evolution occurred in the legislation or in the organisation of EPC system since 2020; the second one concerning an update of the database; the third one including possible synergies between EPC schemes and other instruments (namely Smart Readiness Indicator, LEVEL(s), Building renovation passports and Digital logbooks).

At the end of the survey, that in some cases required several attempts with several different experts, data or information were collected for most MSs. It was not possible to collect any data or information from Greece, Latvia, Lithuania, Slovenia and Sweden. Although the data are not complete, it is possible to present the main conclusion of the analysis and highlight the main challenges to be faced in the hoped-for progressive harmonization of national EPC schemes.

The research was firstly aimed at understanding the general approach adopted in the EPC certification schemes, such as:

- which indicators are chosen to identify performance classes (primary energy, final energy, emissions, ...);
- how class limits are defined: trough fixed benchmark (e.g. in kWh/(m^2 year)) or using a reference building;
- whether the class limits are equal or different for specific building categories;
- if and how the climate zones are taken into account;
- which end-uses are included in the calculations;
- how the floor area is defined;
- how NZEB is defined and its relationship with the energy classes.

Regarding end-uses, as expected, all MSs include space heating. Just Slovenia and Denmark only consider space heating without including auxiliaries and domestic hot water. Luxembourg (for residential buildings), Germany and Austria (for all buildings) do not include ventilation and air conditioning, while Ireland does not include air conditioning for residential buildings. Only eighteen countries include lighting, five of which only for non-residential buildings. Most MSs consider the net heated floor area.

As to the definition of energy classes, only Poland and Malta did not define energy classes, however Poland plans to introduce class boundaries in 2023. Most MSs have introduced between 7 and 9 different classes, normally indicated with a letter, in some cases with one or more "+". The only exceptions are Latvia with 6 classes, Italy 10, Hungary 12, Netherland 12 (11 for residential buildings), Ireland 15. In all MSs except Netherlands, the number of classes is the same for different building categories.

Fourteen MSs have adopted fixed class boundaries (i.e. normally limits defined in kWh/(m^2 year) as shown in Table 5). Additionally, in Denmark and Finland the boundaries may vary depending on the building floor area. The fixed class limits in some cases are the same for all categories (Slovenia, Austria), in other cases vary between residential and non-residential buildings (Brussels, Denmark, Latvia). In other cases the number of categories with different limits can increase from 2 up to 12.

Ten MSs (one of which, Ireland, only for non-residential buildings) have adopted the reference building method: normally class boundaries in this case are defined calculating the ratio between the actual building energy consumption and the reference building calculated consumption. MSs that have adopted the reference building approach in most cases define classes using the same boundaries for all categories. By defining different reference buildings, it is possible to take account of different building categories, of the building size and of the climate.

In most cases, EPCs show many different indicators, although only the primary energy consumption is shown under a class system. Some MSs have adopted a class system also for some other indicators that are shown in the EPC.

A second important aspect analysed is the status of implementation of the EPC national register. This includes information on the way data are uploaded, the organisation in charge of the management of the system, whether data are collected at a regional or a national level, whether data are publicly accessible.

Most MSs have a national system, managed by a central authority that automatically collects data from the professionals that are developing them. Normally data are collected classifying buildings in different categories. In 9 MSs data are publicly accessible (in some cases upon request). In 5 MSs only limited data are accessible. In 6 MSs data are not accessible and in 3 it depends on the regional authority. For 4 MSs it was not possible to collect the information.

Where possible, the number of EPCs issued in 2011, 2018 and 2021 were included, divided by residential, non-residential and public buildings. Specifically it was calculated the number of EPCs issued every 1000 residential buildings. In most MSs they are less than 40, while for six they are more than 100 every 1000 buildings (Ireland, Greece, Spain, France, Netherland and Portugal).

It is very difficult to assess the actual quality of the EPC system adopted in each member states. We have collected information concerning the expert accreditation and the quality control system that may suggest whether one Member State has designed a system with checks and balances or not. In order to better understand the actual quality of the system adopted in each MS, it is necessary to increase the number and quality of public information available.

Concerning the professionals' qualification, in most MSs a national authority is in charge of experts' qualification. It may be one ministry, the energy agency, a national accreditation body or the professional orders. Each MS has provided a licence to hundreds or thousands of experts. Most MSs secure the quality of EPCs by requiring an on-site audit and organising automatic check followed by random in-depth checks. The EPBDs up until now have left to MSs freedom to choose the EPC schemes characteristics, and therefore schemes may widely vary. By reviewing all the different systems adopted, most minor differences appear to be easily overcome, since most MSs have chosen similar approaches. Based on our analysis of the different schemes we may suggest that:

- the energy consumption calculation must include Heating, Hot Water, Auxiliaries, Ventilation and Air conditioning (built-in lighting could be included for non-residential buildings, since they depend on the building design);
- in order to calculate the specific consumption per unit area, net heated area should be taken into account;
- the number of classes may be limited to 7-8 classes, leaving the possibility to MSs to add subclasses introducing one or more "+".

With this approach the EPC national systems can have a far better harmonisation compared to today. But there are at least two major challenges that remain to be addressed:

- although several different indicators may be shown on the EPC, there is one main indicator that is generally highlighted as the one that defines which class is assigned to the building: which should be the main indicator?
- class boundaries should be defined with absolute figures (that may be different for different building categories) or with the reference building method?
- normally EPCs are valid for 10 years, therefore when a new approach is adopted there will be buildings with the old EPC that are on the market with the old class value at the same time with building that have their classes calculates with the new approach: that may be confusing.

Concerning the main indicator, if the main aim is the reduction of energy consumption, than it should be based on the primary energy consumption calculated. While if the main aim is the reduction of emissions, it should be based on the CO_2eq emissions in standard conditions or on non-renewable primary energy consumption. A third possible approach is to adopt two different indicators, one for energy consumption and the other one for emissions.

Concerning the fixed values or reference building approach, as already underlined in paragraph 3.4, when fixed class boundaries are decided it is easier to compare the actual energy consumption (or emissions) of different buildings in the same category. Two different buildings with the same energy consumption or emissions are in the same class, and this is easy to understand.

On the contrary, the reference building approach leaves room to complexity and flexibility. The reference building may have different characteristics depending on the building category. Furthermore, the building size and the climate influence the consumption or the emissions of the building considered, therefore this approach does not need to define different boundaries for different categories/climate. General rules concerning the complexity and flexibility may be introduced at EU level in order to reduce the risk of confusion.

Main counterarguments against the Reference building approach are the fact that only 10 MSs have adopted it until now and the fact that this approach could result in buildings with identical energy consumption levels (or equivalent CO_2 emissions) being labelled with distinct energy classes. This discrepancy may arise due to variations in size (or surface-area-to-volume ratio) or geographical location, specifically in different climates. The latter may create some confusion in the final customer without any technical expertise that may wrongly expect that the same energy consumption should lead to the same energy class.

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List of abbreviations and definitions

BER	Building energy rating
CINEA	European Climate, Infrastructure and Environment Executive Agency
CMV	Controlled mechanical ventilation
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
DEAP	Dwelling energy assessment procedure
DG ENER	Directorate-General for Energy
DHW	Domestic hot water
EPBD	Energy Performance of Buildings Directive
EPC	Energy performance certificates
EU	European Union
GHGE	Greenhouse gas emissions
HVAC	Heating, ventilation and air conditioning
JRC	Joint Research Centre
MS	Member State
NZEB	Nearly zero-energy building
PEC	Primary energy consumption
RES	Renewable energy source
ZEB	Zero emission building

List of boxes

List of figures

List of tables

Annexes

Annex 1. Specimen of the questionnaire used for the EPC system survey

Between July 2022 and February 2023 a survey was conducted concerning the status of implementation of Energy Performance Certificates of building in the 27 Member States. The survey was carried out contacting national that were asked to fulfil a questionnaire organised in three parts: the first one concerning all major evolution occurred in the legislation or in the organisation of EPC system since 2020; the second one concerning an update of the database; the third one including possible synergies between EPC schemes and other instruments (namely Smart Readiness Indicator, LEVEL(s), Building renovation passports and Digital logbooks).

In the following a specimen of the questionnaire is shown.

Figure 39. First part of the questionnaire: general information on the features of the EPC system adopted in the relevant MS

Member State:	

Certification scheme

National (or regional) Regulations

Year	Level	Reference

Implementation timeline

Date	Type of building	Notes
Links with public incentives:		

Total Energy classes

General approach (e.g. climate/category dependency):	
About NZEB:	
Cost-optimal minimum energy performance requirement	
End-uses included:	
Floor area considered:	

Residential				Non-residential			
Class	Limit		Unit	Class	Limit		Unit
	<				<		
	<				<		
	<				<		
	<				<		
	<				<		
	<				<		
	<				<		
	>				>		

Additional information displayed

Other energy classes (heating/DHW/cooling)	Y/N	
RES	Y/N	
Emission of CO2eq	Y/N	
Recommendations	Y/N	
...	Y/N	

Other

Bodies in charge of qualified experts' accreditation:	
Registers of experts:	
Number of experts	
Type of calculation tool:	
On-site audit requirement:	
Quality control schemes:	

Source: JRC elaboration, 2023

Figure 40. First part of the questionnaire: general information on the features of the EC register adopted in the relevant MS

EPC register	
General	
Implementation status:	Implemented at national level/Implemented at regional level/Planned
Upload of EPC data:	Automatic/Manual/Central transferring data
Management of the EPC registers:	Central authority/Regional authorities/Research institute/Private company
Access to EPC data:	Public access/Access for some organisations/Depends on Region/No public access
Type of data collected:	Absolute or relative per class
Type of building categories:	New/existing, Residential/non residential, Single flat/total building, Private/public buildings

Source: JRC elaboration, 2023

Figure 41. Second part of the questionnaire: number of EPC (total, per building type, per market category, per class)

Member State:	

Data access

Date	Language	Notes

Number of EPC (cumulative)

per building type	2019	2020	2021
Residential			
Non-residential			
Public			
...			
per market categories			
New building			
Sales			
Rents			
Renovated			
...			
per energy classes			
NZEB			
A			
B			
C			
D			
E			
F			
G			
...			
per climatic zone			
Zone 1 (...)			
Zone 2 (...)			
Zone 3 (...)			
...			

Source: JRC elaboration, 2023

Figure 42. Second part of the questionnaire: average energy demand (per building type, per market category, per class, per climatic zone)

Average energy demand				
per building type				Unit
Residential				
Non-residential				
Public				
...				
per market categories				Unit
New building				
Sales				
Rents				
Renovated				
...				
per energy classes				Unit
NZEB				
A				
B				
C				
D				
E				
F				
G				
...				
per climatic zone				Unit
Zone 1 (...)				
Zone 2 (...)				
Zone 3 (...)				
...				

Source: JRC elaboration, 2023

Figure 43. Third part of the questionnaire: possible synergies between EPC schemes and other instruments

Member State:	
General	
Smart Readiness Indicator (SRI)	(if present)
LEVEL(s)	(if present)
Building renovation passports	(if present)
Digital logbooks	(if present)

Source: JRC elaboration, 2023

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