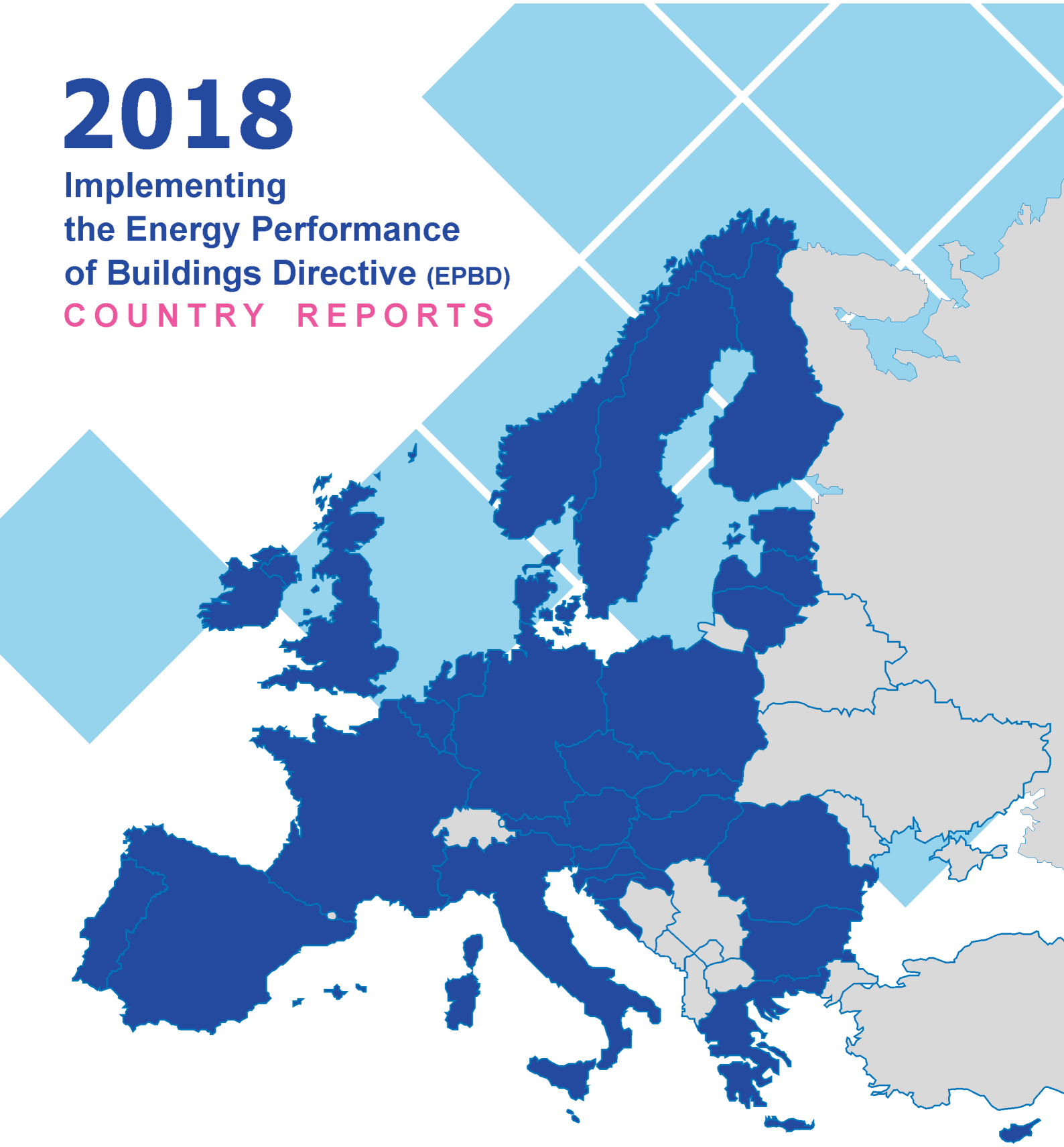
CONCERTED ACTION
ENERGY PERFORMANCE
OF BUILDINGS

Co-funded by the Horizon 2020 programme
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2018

Implementing the Energy Performance of Buildings Directive (EPBD)

COUNTRY REPORTS



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Editor's message

The Concerted Action EPBD (CA EPBD) is a unique forum that brings together national experts involved in the transposition and implementation of the Energy Performance of Buildings Directive (EPBD) as well as in the practical day-to-day management of initiatives related to the energy performance of buildings in general. A central focus is on sharing good and bad experiences, best practices, common challenges and efficient implementation mechanisms.

A key element in the CA EPBD is the plenary meetings, which take place approximately every 8-9 months, bringing together 150 experts from all 28 EU Member States plus Norway for discussion in sessions organised around the topics considered most relevant at the time. In the latest phase of the CA EPBD, the CA EPBD 2015-2018, the main focus was on topics related to the construction of new Nearly Zero-Energy Buildings (NZEB), on policies to improve the Existing Building Stock, on the Certification of Buildings (EPCs), and on Inspections of Building Supply Systems. Many discussions also concerned cross-cutting topics, such as Technical Elements, Complementary Policies for finance and information, as well as Compliance and Enforcement Issues.

Although the main objective of the CA EPBD is to connect national policy experts of all EU Member States and Norway, and to foster the exchange of knowledge and solutions among them, it has also collected a wealth of information which could be useful to a wider audience. In order to ensure broader and easier access to this information, also for experts outside the CA EPBD community, two major collections of the public material derived from the work performed in the context of the CA EPBD in 2015-2018 have been developed, one for Country Reports and one for Thematic Reports, as a way of further harvesting knowledge and information.

The present publication is the compilation of 34 Country (or region) Reports on the status of implementation of the EPBD in 2016/2017, authored under the responsibility of the individual country teams who were given the freedom to emphasise more on topics which were considered more advanced, of highest national priority, or a success story of implementation in the country. The Country Reports have undergone a systematic review process in the Concerted Action. As Coordinator of the action, I had the pleasure to read each report multiple times, and to comment and discuss on various topics; but, in the end, the main content of the reports is the responsibility of the individual authors / countries, as is also indicated on the front page of each individual report. The European Commission, DG ENER and EASME have supported the work and provided their feedback but hold no responsibility for the content.

The Thematic Reports (compiled into a similar separate publication) are organised around the topics selected for discussion and exchange among CA EPBD experts during the plenary sessions, where discussions were often supported by additional research and material collected through national experts in the form of questionnaires or posters. The Thematic Reports, therefore, give an EU-wide overview and allow for the comparison of regulations and supportive schemes on the implementation at EU level, giving the opportunity for the systematic collection of lessons learned and recommendations for future processes or new implementation.

The Country Reports have been created as snapshots at a certain point in time until 2017, while the Thematic Reports have been developed in two steps, starting in 2016/17 and updated in 2018 in order to include the last part of the CA EPBD 2015-2018 work.

The developed material is envisioned to provide both an insight on the developments at the individual country/region level, as well as an EU overview, lessons learned and analytics on the development of policies related to the energy performance of buildings across Europe.

In the past, this type of information has been presented in the form of a printed book which was published every 2-3 years, containing the developments since the previous version. In CA EPBD 2015-2018, there was an intentional and gradual shift towards a more interactive and modern way of presenting this information, which is based on a database. The aim is that, on the longer term, this database will allow for a more systematic selection and combination of material from these reports. The online database will also allow for a simpler and more frequent update of material.

The Country Reports and the Thematic Reports are available in the online database, in the mentioned electronic compilations and individually on the website. Please note that further updates might become available online as further developments are being realised, so that, hopefully, the database will keep growing to become more interactive in the coming years.

The Country Reports and the Thematic Reports are further complemented by other publications. These include the Key Implementation Decision (KIDs) Reports, which present relevant performance indicators or implementation decisions for certain regions or countries, as well as the factsheets, which highlight one particular topic in a short and concise way. Both the KIDs and the factsheets are only available as individual reports directly on the CA EPBD website.

Finally, the website has also been used to directly share other information, including news and presentations from open events organised by the CA EPBD. Material has also been shared through collaboration with the other two Concerted Actions, on the Renewable Energy Sources Directive (DIRECTIVE 2009/28/EC), and on the Energy Efficiency Directive (DIRECTIVE 2012/27/EU).

In the period 2015-2018, key issues have been linked to the Directive 2010/31/EU such as NZEB public buildings, building codes and the implementation of new rules for certificates. Towards the end of the action, however, and in particular during the in-depth workshop in Frankfurt in May 2018, discussions and actions started to focus on the changes expected to derive from the upcoming amendment of the EPBD, now Directive (EU) 2018/844.

In the field of NZEB policies for new buildings, great progress has taken place during 2015-2018, but it is clear that there is still a very large potential in the existing building stock and that there is an increasing importance for collaboration in the field. These two issues will therefore be of increasing focus for the CA EPBD in the coming years.

Additionally, with the amendment of the EPBD in 2018, new challenges come into focus for the Concerted Action communities, and new elements are being integrated in the next phase of the CA EPBD; hopefully, the new structure will facilitate the development of fresh material on these interesting new topics while keeping the existing material relevant and up to date. The Concerted Action EPBD will continue to support countries and regions in the development of policies for the energy performance of buildings.

I hope that you will find the CA EPBD work and publications interesting, informative and inspiring, and that the collected material will contribute towards achieving buildings energy efficiency as well as the EU climate targets.

Jens Laustsen
Coordinator of the CA EPBD
20 August 2019

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Austria

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.oib.or.at

1. Introduction

The implementation of the EPBD (Directive 2010/31/EU) in Austria has been completed by the nine (9) provinces (Länder). It formed an opportunity for the development and harmonisation of a common calculation methodology, as well as for the application of new regulations for technical building systems. The issuance of EPCs was already a fact in several provinces even before implementing the EPBD. The EPBD implementation has resulted in further developed building regulations.

Following the implementation of the EPBD as well as signing into law the mandatory provision of the EPC (the Energy Performance Certificate Providence Act) in April 2012, which applies to apartment or building purchases and rentals, and its tightening through the imposition of penalties for non-compliance later that same year, the EPC has become an important tool.

The Austrian national plan for increasing the number of residential and non-residential NZEB by 2020 was finalised and published in 2014. The national building regulation directive (OIB-Directive 6) as regards energy efficiency is being tightened in two-year steps to achieve the requirements by 2020. The recast of OIB-Directive 6 was published in spring 2015. Furthermore, defining national goals for 2030 and beyond – based on the Paris climate conference agreement which entered into force in 2016 – has already started in Austria.

2. Current Status of Implementation of the EPBD

In Austria, the implementation of building regulations is under the jurisdiction of the provinces. The Austrian Institute of Construction Engineering (OIB) was assigned to manage the harmonising process of

the implementation of the EPBD in the provinces in 2006. The outcome is the OIB Directive, whose contents are implemented in each respective province's building regulations. The recent OIB Directive 6[1] was published in March 2015. This directive defines the format of the EPCs and the requirements for the thermal performance of the building envelope, domestic hot water and parts of the technical heating and cooling systems.

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

Requirements in the OIB Directive 6 for residential buildings differ to those for non-residential (public or commercial) buildings only in including requirements for the maximum energy demand for cooling. The remaining parameters regarding U-values, space-heating demand, the energy efficiency factor, heating and final energy demand are the same for residential and non-residential buildings.

U-values requirements of the different building elements in the new OIB Directive (2015) are the same as in the former version (2011). The maximum space heating demand requirement is tightened and requirements for heating energy demand and final energy demand, as well as a total energy efficiency factor are now included. The implementation date of the OIB Directive 6 2015 in the building regulations differs in the nine Austrian provinces. Therefore, there are two different effective dates mentioned according to minimum requirements: one valid from entry into force in the Austrian Province until the end of 2016 and one valid starting from 2017 (which is more tightened).

Residential buildings

The minimum requirements for residential buildings are now either:

- a combination of space heating demand, heating energy demand and final energy demand;

New buildings		[kWh/m².year)]
Space Heating Demand $_{Ref,RC}$	from entry into force until 31.12.2016	16 x (1+3.0/l_c)
	from 01.01.2017	14 x (1+3.0/l_c)
Space Heating Demand $_{max,Ref,RC}$	from entry into force until 31.12.2016	54.4
	from 01.01.2017	47.6
Heating Energy Demand $_{RC}$	from entry into force until 31.12.2016	Heating Energy Demand $_{max,RB,RC}$
	from 01.01.2017	
Final Energy Demand $_{RC}$	from entry into force until 31.12.2016	Final Energy Demand $_{max,RB,RC}$
	from 01.01.2017	

Ref: Reference space heating demand for reference climate

RB: Residential building

RC: Reference climate

f_{GEE}: Total energy efficiency factor

l_C: Building shape factor

Table 1. Maximum requirements for the energy performance of new residential buildings by heating energy demand.

or, alternatively,

- a combination of space heating demand and final energy efficiency factor.

New buildings		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	16 x (1+3.0/l_c)
	from 01.01.2017	
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	54.4
	from 01.01.2017	
f_{GEE}	from entry into force until 31.12.2016	0.90
	from 01.01.2017	0.85

Ref: Reference space heating demand for reference climate

RC: Reference climate

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 2. Maximum requirements for the energy performance of new residential buildings by total energy efficiency factor.

Non-residential buildings

The minimum requirements for non-residential buildings are either:

- a combination of space heating demand, heating and cooling energy demand, lighting, humidification and dehumidification and final energy demand;

New buildings		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	16 x (1+3.0/l_c)
	from 01.01.2017	14 x (1+3.0/l_c)
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	54.4
	from 01.01.2017	47.6
Space Cooling Demand$_{max,RC}$	from entry into force until 31.12.2016	1.0
	from 01.01.2017	
Heating Energy Demand$_{RC}$	from entry into force until 31.12.2016	Heating Energy Demand$_{max,NRB,RC}$
	from 01.01.2017	
Final Energy Demand$_{RC}$	from entry into force until 31.12.2016	Final Energy Demand$_{max,NRB,RC}$
	from 01.01.2017	

Ref: Reference space heating demand for reference climate

RC: Reference climate

NRB: Non-residential building

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 3. Maximum requirements for the energy performance of new non-residential buildings by heating energy demand.

or, alternatively,

- a combination of space heating and cooling demand and final energy efficiency factor.

New buildings		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	16 x (1+3.0/l_c)
	from 01.01.2017	
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	54.4
	from 01.01.2017	
Space Cooling Demand$_{max,RC}$	from entry into force until 31.12.2016	1.0
	from 01.01.2017	
f_{GEE}	from entry into force until 31.12.2016	0.90
	from 01.01.2017	0.85

Ref: Reference space heating demand for reference climate

RC: Reference climate

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 4. Maximum requirements for the energy performance of new non-residential buildings by total energy efficiency factor

Furthermore, the OIB Directive 6 (2015) sets additional requirements concerning the use of RES in buildings and includes measures for the protection of the internal building elements (e.g., walls) against harmful condensation resulting from thermal bridges as well as improved protection against summer overheating for both residential and non-residential buildings.

2.I.ii. Format of national transposition and implementation of existing regulations

The revised OIB Directive 6 was published in March 2015.

Following the requirements of this directive, the calculation method is based on Austrian Standards (ÖNORMs), created by the Austrian Standard institute which is represented in CEN; therefore, the standards used in the OIB Directive 6 are in accordance with the European Committee for Standardisation.

The main indicators for the energy performance calculation of buildings (space heating demand, useful energy demand, final energy demand, primary energy demand and CO_2 emissions), maximum U-value of the building elements, geometry of the building, energy carriers, heating/cooling systems and domestic hot water systems as well as household appliances are defined in the OIB Directive 6 or respectively in Austrian Standards (the OIB Directive 6 refers according to user profiles for lighting, ventilation, humidification to valid Austrian Standards).

The determination of the required maximum space heating demand is based on the cost-optimal verification report[2].

The conversion factors for the energy carriers in the calculation of the primary energy demand have slightly changed to match the electricity mix of the Austrian market.

	Energy carrier	f_{PE}	$f_{PE,n.renew.}$	$f_{PE,ren.}$	f_{CO2}
		[-]	[-]	[-]	[g/kWh]
1	Coal	1.46	1.46	0.00	337
2	Oil	1.23	1.23	0.00	311
3	Gas	1.17	1.17	0.00	236
4	Biomass	1.08	0.06	1.02	4
5	Electricity mix in Austria	1.91	1.32	0.59	276
6	District heating by renewables	1.60	0.28	1.32	51
7	District heating by fossil fuel	1.52	1.38	0.14	291
8	District heating by high-efficient CHP (default value)	0.94	0.19	0.75	28
9	District heating by high-efficient CHP (best value)	≥0.30	ind. evidence		≥20
10	Waste heat (default value)	1.00	1.00	0.00	20
11	Waste heat (best value)	≥0.30	ind. evidence		≥20

Table 5. The conversion factor of energy carriers in the OIB Directive 6, 2015.

2.I.iii. Action plan for progression to NZEB for new buildings

The first draft of the Austrian national plan on increasing the number of NZEB by 2020 was published in 2012 for residential buildings and 2014 for non-residential buildings, according to OIB[3]. This document was agreed by all nine (9) federal provinces and their requirements were implemented in the regional building regulations successively until January 2017.

The NZEB is defined as an energy-efficient building with a thermally well-insulated envelope and an efficient heating system.

The minimum requirements for the energy performance of NZEB are shown in Tables 6-9.

Compliance with the requirements of the OIB Directive 6 can be achieved by two methods:

- Through the provision of the maximum permissible final energy demand of the building. In this case the focus relies on the insurance of a tight building envelope in order to reduce the space heating demand (HWB) (not considering the f_{GEE} factor).
- Through the installation of a very efficient or renewable heating system. In this case the total energy efficiency factor (f_{GEE}) has to be taken into account, which reflects the type of energy use and production. In this method, a slightly higher space heating demand of the building is acceptable.

In both cases, the maximum values for primary energy demand and CO_2 emissions are defined.

	HWB_{max}	EEB_{max}	$f_{GEE,max}$	PEB_{max}	CO_{2max}
	[kWh/m².year]	[kWh/m².year]	[-]	[kWh/m².year]	[kg/m².year]
2020	10 × (1 + 3.0 / ℓ_c)	using $HTEB_{Ref}$		160	24
	Or				
	16 × (1 + 3.0 / ℓ_c)		0.75		

Table 6. Minimum energy performance requirements for new residential NZEB, 2020.

	HWB_{max} [kWh/m³.year]	EEB_{max} [kWh/m².year]	$f_{GEE,max}$ [-]	PEB_{max} [kWh/m².year]	$CO2_{max}$ [kg/m².year]
2020	**3.33** × (1 + 3.0 / ℓ_c)	using $HTEB_{Ref}$		170	27
	Or				
	5.50 × (1 + 3.0 / ℓ_c)		$f_{GEE,DLGneu,max}$		
	$f_{GEE,DLGneu,max}$ These values are the result of a stricter space heating demand and the use of reference technical equipment for energy supply.				

Table 7. Minimum energy performance requirements for new non-residential NZEB, 2020.

	HWB_{max} [kWh/m².year]	EEB_{max} [kWh/m².year]	$f_{GEE,max}$ [-]	PEB_{max} [kWh/m².year]	$CO2_{max}$ [kg/m².year]
2020	17 × (1 + 2.5 / ℓ_c)	using $HTEB_{Ref}$		200	32
	Or				
	25 × (1 + 2.5 / ℓ_c)		0.95		

Table 8. Minimum energy performance requirements for existing residential buildings in the case of major renovation to NZEB, 2020.

	HWB_{max} [kWh/m³.year]	EEB_{max} [kWh/m².year]	$f_{GEE,max}$ [-]	PEB_{max} [kWh/m².year]	$CO2_{max}$ [kg/m².year]
2020	5.67 × (1 + 2.5 / ℓ_c)	using $HTEB_{Ref}$		250	39
	Or				
	8.50 × (1 + 2.5 / ℓ_c)		$f_{GEE,DLGsan,max}$		
	$f_{GEE,DLGsan,max}$ These values are the result of a stricter space heating demand and the use of reference technical equipment for energy supply.				

Table 9. Minimum energy performance requirements for existing non-residential buildings in the case of major renovation to NZEB, 2020.

HWB: Space (useful) heating demand	EEB: Final energy demand	f_{GEE}: Total energy efficiency factor	PEB: Primary energy demand	CO_2: CO_2 emission
HTEB: Heating system - Auxiliary energy demand for the heating system		l_c: characteristic length of the building or building shape factor (V/A) [m]		

Figures and statistics on existing NZEB

In the past 15 years, considerable efforts have been made to reduce energy consumption in the building sector. Implementing new building regulations for the energy demand of buildings and providing subsidies for energy efficiency measures in new buildings and renovations are considered the engine for implementing energy efficiency. This has contributed to the increase in the number of buildings with low energy consumption. There are, however, no statistics on the number of buildings meeting the NZEB 2020 requirements yet. The following are two best-practice examples of built NZEB in Austria.



Type of building: primary school Mariagrün in Graz, Styria

Space Heating Demand: 11 kWh/m².year

Primary Energy Demand: 86 kWh/m².year

2,500 m² gross floor area

Year of construction: 2014

Figure 1. Best-practice examples of built NZEB in Austria, Picture: Kurt Hoerbst, Source: BMLFUW.



Type of building: residential building in the 11. district of Vienna

Space Heating Demand: 14 kWh/m².year

Primary Energy Demand: 55 kWh/m².year

11,645 m² gross floor area

Year of construction: 2013

Figure 2. Best-practice examples of built NZEB in Austria, Picture: Kurt Hoerbst, Source: BMLFUW.

2.I.iv. Requirements for systems and/or building components for new buildings

The maximum U-values for building components are set by the OIB Directive 6. They apply for new residential and non-residential buildings (see Figure 3).

Building elements	U-value [W/m²K]
Exterior wall / wall adjoining unheated attic	0.35
Wall adjoining frost free rooms like garage	0.6
External doors	1.7
Ceiling / roof	0.2
Ceiling between building units (apartments)	0.9
Floor on the ground or over basement	0.4
Floor over garage	0.3

Figure 3. A selection of U-values of the OIB Directive 6.

Furthermore, the OIB 6 Directive requires that energy systems of buildings must consider and demonstrate the technological, ecological and economic feasibility of high-efficient systems. In this context, new apartment buildings with more than three (3) building units must have central heating systems (specific exceptions are allowed) and ventilation systems must be equipped with a heat recovery system.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The OIB Directive 6 includes requirements for heating, cooling and final energy demand for existing buildings undergoing major renovations.

Residential buildings

Tables 10 and 11 show the minimum requirements for the energy efficiency of residential buildings, either as a combination of the requirements of space heating demand, heating energy demand and final energy demand (Table 10), or, alternatively, as a combination of space heating demand and final energy efficiency factor (Table 11).

Major renovation		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	23 x (1+2.5/l_c)
	from 01.01.2017	21 x (1+2.5/l_c)
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	-
	from 01.01.2017	-
Heating Energy Demand$_{RC}$	from entry into force until 31.12.2016	Heating Energy Demand$_{max,RB,RC}$
	from 01.01.2017	
Final Energy Demand$_{RC}$	from entry into force until 31.12.2016	Final Energy Demand$_{max,RB,RC}$
	from 01.01.2017	

Ref: Reference space heating demand for reference climate

RC: Reference climate

RB: Residential building

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 10. Maximum value requirements for the energy performance of major renovations of existing residential buildings by heating energy demand.

Major renovation		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	25 × (1+2,5/lc)
	from 01.01.2017	
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	-
	from 01.01.2017	
f_{GEE}	from entry into force until 31.12.2016	1.10
	from 01.01.2017	1.05

Ref: Reference space heating demand for reference climate

RC: Reference climate

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 11. Maximum value requirements for the energy performance of major renovations of existing residential buildings by total energy efficiency factor.

Non-residential buildings

Respectively, Tables 12 and 13 show the minimum requirements for the energy efficiency of non-residential buildings in the case of major renovations, either as the combination of space heating demand, heating and cooling energy demand and final energy demand (Table 12), or, as the combination of space heating and cooling demand and final energy efficiency factor (Table 13):

Major renovation		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	23 x (1+2.5/l_c)
	from 01.01.2017	21 x (1+2.5/l_c)
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	-
	from 01.01.2017	-
Space Cooling Demand$_{max,RC}$	from entry into force until 31.12.2016	2.0
	from 01.01.2017	
Heating Energy Demand$_{RC}$	from entry into force until 31.12.2016	Heating Energy Demand$_{max,NRB,RC}$
	from 01.01.2017	
Final Energy Demand$_{RC}$	from entry into force until 31.12.2016	Final Energy Demand$_{max,NRB,RC}$
	from 01.01.2017	

Ref: Reference space heating demand for reference climate

RC: Reference climate

NRB: Non-residential building

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 12. Maximum value requirements for the energy performance of major renovations of existing non-residential buildings by heating energy demand.

Major renovation		[kWh/m².year)]
Space Heating Demand$_{Ref,RC}$	from entry into force until 31.12.2016	25 x (1+2.5/l_c)
	from 01.01.2017	
Space Heating Demand$_{max,Ref,RC}$	from entry into force until 31.12.2016	-
	from 01.01.2017	
Space Cooling Demand$_{max,RC}$	from entry into force until 31.12.2016	2.0
	from 01.01.2017	
f_{GEE}	from entry into force until 31.12.2016	1.10
	from 01.01.2017	1.05

Ref: Reference space heating demand for reference climate

RC: Reference climate

f_{GEE}: Total energy efficiency factor

l_c: Building shape factor

Table 13. Maximum value requirements for the energy performance of major renovations of existing non-residential buildings by total energy efficiency factor.

The national plan (March 2014) also defines minimum requirements for residential and non-residential buildings undergoing major renovations valid from 1 January 2021. Deviations to these requirements may be undertaken if necessary measures are not feasible[4].

2.II.ii. Plans to improve the existing building stock

The requirements for turning existing buildings into NZEB by 2020 were published in 2014[5].

The first Austrian National Energy Efficiency Action Plan (NEEAP), developed by the Federal Ministry of Science, Research and Economy together with the Austrian provinces, was published in April 2014 according to Article 4 of Directive 2012/27/EU (Energy Efficiency Directive - EED). This plan describes the way towards increasing energy efficiency and standardising the energy efficiency regulations in Austria until 2020, and envisages the increase in demand for energy-efficient services, reduction of energy consumption and simultaneously fighting energy poverty while avoiding nuclear energy. Additionally, the government shall set a good example by speeding up the implementation of energy efficiency in public buildings. Through these measures, the government aims to reduce energy consumption by 20% compared to 2007 (equivalent to 1,100 Peta J; the present target based on the Energy Efficiency Act is 1,050 Peta J).

The measures for the building sector focus on the following categories:

- subsidies for residential buildings (e.g., a renovation subsidy like the "*Sanierungscheck*");
- subsidies for district heating (e.g., for the installation of a heat transfer station);
- operational and environmental subsidy schemes for companies in Austria (e.g., subsidies for PV installations);
- energy efficiency measures in building regulations (e.g., further development of the OIB Directive 6).

2.II.iii. Regulation of system performance, distinct from whole building performance

In addition to the aforementioned requirements, the OIB Directive 6 also includes specific mandatory requirements for individual elements used in connection with the renovation of existing buildings, such as minimum requirements for the insulation of the heat distribution system.

Furthermore, Directive 2009/125/EG (the Eco design Directive) includes specific requirements for HVAC systems to guarantee the implementation of energy-efficient technologies. This directive enables the European Commission to set mandatory minimum requirements for individual product groups. In Austria, the implementation of Directive 2009/125/EG was provided by the update of the national Eco design decree ("*Ökodesign-Verordnung*" 2007). The following relevant mandatory requirements for HVAC systems came into force by decree between 2015 and 2016:

- The decree for space heaters and combination heaters came into force on 26 September 2015, including specific requirements for seasonal space heating energy efficiency, sound power level, emissions of nitrogen oxides and product information (Regulation 107/2009).
- The decree for water heaters and hot water storage tanks came into force on 26 September 2015, including specific requirements for water heating energy efficiency, sound power level, emissions of nitrogen oxides and product information. Furthermore, the decree includes requirements for standing losses and product information for hot water storage tanks (Regulation 814/2013).
- The decree for ventilation units came into force on 1 January 2016, including specific requirements for energy efficiency, sound power level and product information (Regulation 1253/2014).

2.II.iv. Encouragement of intelligent metering

In Austria, metering is one of the regulated activities (§ 45 Z 10 ElWOG "*Elektrizitätswirtschafts- und –organisationsgesetz*: *Electricity Industry and Organisation Act*" 2010) of the electricity distribution system operators (DSOs). There is a similar decree regulating gas distribution system operators (§ 60 GWG 2011) and a law concerning the metering of heat and hot water consumption (§6 HeizKG "*Heizkostenabrechnungsgesetz*").

The majority of the 6.1 million electrical metering points are still equipped with conventional electromechanical meters. Since the full liberalisation of the electricity market in 2001, about 30,000 customers with an annual consumption of more than 100,000 kWh and a power rating of more than 50 kW have been equipped with intelligent meters. In an amendment to the Austrian Electricity Act (ElWOG) in 2011, the Minister for Economy was authorised to determine a mandatory rollout plan for intelligent electricity meters. In 2012, the Minister of Economy enacted a decree which obliges the DSOs to install intelligent meters. This decree was amended in 2014 and determines the following programme for the rollout:

- By the end of 2015 all network operators had to submit a rollout plan.
- Seventy per cent (70%) of all customers have to be equipped with intelligent meters by the end of 2017.
- Ninety per cent (90%) of all customers have to be equipped by the end of 2019.

There are additional decrees of the Energy Regulatory Authority (E-Control Austria), which specify, for example, the technical requirements of intelligent meters.

By the end of 2015, the majority of the Austrian DSOs were in an early rollout stage. About 456,000 customers (7.4% of all customers) were already equipped with intelligent meters. The network operators had another 285,000 intelligent meters already in stock to be installed in 2016[6].

Due to delays in the rollout, it is expected that the intended implementation rates for 2017 and 2019 will not be achieved. Estimations of the Energy Regulatory Authority assume that by the end of 2017 about 25%, and by the end of 2019 about 70% of customers will have intelligent meters.

This means that the national targets will likely be missed, but the expected developments indicate that the EU target of 80% by 2020 according to Directive 2009/72/EG, Annex I, can be reached.

There are no comparable obligations for installing intelligent meters for gas in Austria for the time being.

2.II.v. Financial instruments and incentives for existing buildings

In Austria, a large number of renovations, especially in the residential sector, are financially supported by subsidy programmes[7] provided by the Austrian provinces. The conditions under which these subsidies are granted focus on the improvement of building quality in terms of higher comfort and better energy performance (i.e., buildings with lower space heating demand and lower greenhouse gas emissions). Most subsidies are distributed in the form of non-refundable payments (one-time non-repayable investment expense).

Federal subsidies[8] (national schemes) on building renovations have been provided since 2009 for privately owned single-family households. The renovation campaign of 2016 *("Sanierungscheck"* 2016) grants financial support for the thermal insulation of roofs, external walls, floors, replacement of windows and exterior doors and for changing the heating system into a renewable heating system. The available grant of federal subsidies lies between 3,000 and 5,000 € depending on the level of renovation (either according to OIB Directive 6 or with higher quality according to *klima**aktiv***[9] criteria). For the first time in 2016 it was possible to obtain increased funding within the scope of a "*best-practice renovation*"[10], particularly for sustainable thermal renovation measures. In this case, the space heating demand had to be very low[11] and 80% of the energy demand had to be provided by renewable energy carriers. For this kind of renovation, up to 8,000 € of funding could be granted per building. In apartment buildings the grant amounts to a maximum of 30% of investments for thermal renovation[12].

There is also a list of on-going individual initiatives in the Austrian provinces. Salzburg, for example, provides a cost-free online energy accounting system for building owners and managers. This programme encourages the stakeholders to enter the real energy consumption of their building into the database and to obtain an annual or monthly overview of their energy consumption. By this initative, the energy consumption of buildings can be monitored both by the owner and by the province[13]. The aim of this initiative is to raise the awareness of the consumers and thus to increase renovation activities.

2.II.vi. Information campaigns / complementary policies

Since the introduction of the EPBD, comprehensive efforts (annual energy and building exhibitions[14], congresses[15] and international conferences and competitions[16]) have been undertaken in Austria to provide information to the public and to professionals. The Austrian regions and their regional energy agencies develop and implement training programmes for different target groups in the building sector and offer comprehensive information campaigns, competitions and energy advice services for building owners and users. For example, the "*Energy Academy*" in Upper Austria offers more than 30 courses every year on building-related technologies and services. In the context of the "*Arge Eba*", the nine (9) Austrian regions offer standardised training for energy advisers[17].

The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management's "*klima**aktiv***" initiative and especially its "*Building and renovation*" programme (launched in 2008) is a main promoter of energy efficiency in buildings in Austria. Since 2012, the yearly granted state prize for architecture and sustainability[18] is awarded to outstanding achievements in energy-efficient buildings.

The ministry also organises a climate protection prize in cooperation with the Austrian television every year where projects or companies are awarded regarding their contribution to environmental issues and relating to the energy efficiency of buildings. An expert jury nominates four (4) projects from four (4) categories: daily life, agriculture, community and regions, and businesses. The Austrian national television (ORF) presents the nominees and the chosen winners in a big event. The ninth climate protection prize took place in November 2016.



Figure 4. The Austrian climate protection prize.

2.III. Energy performance certificate requirements

The format and content of an EPC is defined by the OIB Directive 6. This directive recommends the use of four (4) indicators (space heating demand, primary energy demand, CO_2 emissions and a final energy efficiency factor) on the cover page of the EPC.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

In some Austrian provinces, EPCs have been issued for buildings (as a basis for granting subsidies) for many years. In Austria, issuing an EPC became mandatory in 2012 through the federal law "*Energieausweis-Vorlage-Gesetz*"[19] at the point of sale or rent of a building or building unit following the implementation of the EPBD (Directive 2010/31/EU). An EPC has to be provided for both residential and non-residential buildings (commercial and public) and is valid for ten (10) years. An EPC also has to be issued when applying for a building permit for a new construction and for major renovations, as well as for requesting subsidies.

In December 2012, the Federal Law Gazette I No. 137/2006 and its recast No. 27/2012 (EAVG) was tightened by implementing a penalty (up to 1,450 €) if an EPC is not provided by the owner in the case of selling or renting a property.

2.III.ii. Quality Assurance of EPCs

The Austrian provinces regularly conduct random automated EPC controls. EPCs issued for receiving subsidies or for building permits are checked by the authorities in detail as part of the subsidy approval process. If major errors are identified, the EPC is sent back for corrections.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Displaying the front page (including the labelling) of EPCs in buildings frequently visited by the public is mandatory in all federal provinces. EPCs are displayed in all public buildings owned by public authorities and visited by the public (including the buildings managed by the Federal Real Estate Company (BIG).

The format and content of the EPC for public buildings is also defined in the OIB Directive 6 and follows the same methodology as the EPC for non-residential buildings.

2.III.iv. Implementation of mandatory advertising requirement – status

Since 2012, if a building or building unit is advertised (either in print or online) for sale or rent, the space heating demand and the total energy efficiency factor (fGEE) must be provided.

2.IV. Inspection requirements – heating systems, air conditioning

Articles 14 and 15 of the EPBD (Directive 2010/31/EU) have been implemented according to an agreement[20] between Austrian provinces regarding regular on-site inspections and monitoring of the emissions of HVAC systems.

2.IV.i. Report on equivalence of model A and B for Heating Systems

Corresponding inspection reports or protocols are collected by the provinces and are made available for inspectors of the provinces (e.g., chimney sweeps which are traditionally responsible for the inspection of boilers).

2.IV.ii. Progress and current status on heating systems

The Austrian provinces have a long tradition of inspections of heating systems regarding emissions and the performance of boilers. The periods of inspections vary based on the kind of energy used, from one (1) inspection per year (e.g., for biomass boilers) up to four (4) inspections per year (e.g., for gas-fired boilers). Regular inspections fulfilling the specifications of the EPBD were introduced after 2012 by different regulations in the Austrian provinces (the legislative regulations are continually being adapted).

The qualification of inspectors is set in the Austrian trade regulation act ("*Gewerbeordnung*") on a national level.

2.IV.iii. Progress and current status on AC systems

Up until the late 1990s, AC systems were rarely used in Austria except in new non-residential buildings. As a result of the EPBD, performance-related requirements were implemented for new and existing systems.

Vienna started implementing some articles on AC systems in a law concerning the performance and inspection of heating systems (> 20 kW), including dimensioning of boilers and cooling systems (> 12 kW). The other Austrian provinces followed by implementing inspections through different regulations, either by modifying existing clean air acts or laws for heating systems (Burgenland, Tyrol, Vienna) or building codes (Carinthia, Lower Austria, Salzburg, Styria, Vorarlberg), or by ratifying a new act (Upper Austria).

Inspection intervals range from one (1) to three (3) years for a simplified procedure (visual inspection) and from five (5) to 12 years for an additional comprehensive inspection (including a complex performance check: Upper Austria, Styria, and Vienna). Lower Austria, Salzburg and Tyrol provide one (1) inspection every five (5) years.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

For the enforcement of inspection laws, penalties are imposed under the relevant laws of some of the Austrian provinces[21], but there are no statistical data indicating frequency and level of penalties, which have yet to be imposed.

Quality control of inspection reports

The Austrian provinces conduct quality controls of inspections reports regularly. Some of the Austrian provinces had combined the first full inspections of heating systems with an information and formation action for inspectors[22], thus controlling the quality of inspections (mentioned above) and of the inspectors as well. These actions had been supervised by the administrations of the provinces. Results show that many installations had hydraulic problems or had inefficient pumps and/or oversized boilers.

Further information campaigns are based on the results of these actions. The process of quality control is still under development in Austria.

Impact assessment

There are no statistical data about the impact of the regular inspections of heating systems corresponding to the requirements of Article 14, but it can be asserted that the effect of the additional requirements is overestimated and not as important as the savings potential, which could already be earned by the emission limits and minimum performance requirements. Furthermore, Directive 2009/125/EG includes specific requirements for heating systems to guarantee the implementation of energy-efficient technologies.

3. A success story in EPBD implementation

The EPBD (Directive 2010/31/EU) stipulates that buildings have to be built and used more energy efficiently. The national implementation of the EPBD is mainly realised by the OIB Directive 6. The OIB Directive 6 is successively applied through the regional building regulations and directives. It sets the framework for the buildings' energy performance and defines NZEB 2020. The NZEB standard sets requirements for the efficiency of both new buildings and major renovations as regards the building envelope, heating and cooling systems and energy supply.

The OIB Directive 6 was revised in 2015 and the requirements for the energy efficiency of buildings were tightened. The current directive defines not only the lowered maximum space heating demand for new buildings but also the minimum share of the renewable energy carriers in new buildings (starting 1 January 2017).

Furthermore, the EPC calculation tools are being optimised by more precise methods in order to meet the new requirements for energy efficiency.

The implementation of Article 12 of Directive 2010/31/EU regarding the provision of EPCs is set by the federal law ("*Energieausweis-Vorlage-Gesetz*"). The energy performance of the buildings through their EPCs contributes to raising awareness in the real estate market and makes the expected energy costs more transparent. Therefore, energy efficiency and building quality become more relevant for consumers.

Raising awareness is also achieved through promotion activities, information campaigns and awarding best-practice examples. Thanks to these activities, the heating demand of buildings, especially residential buildings, has decreased continuously (Figure 5).

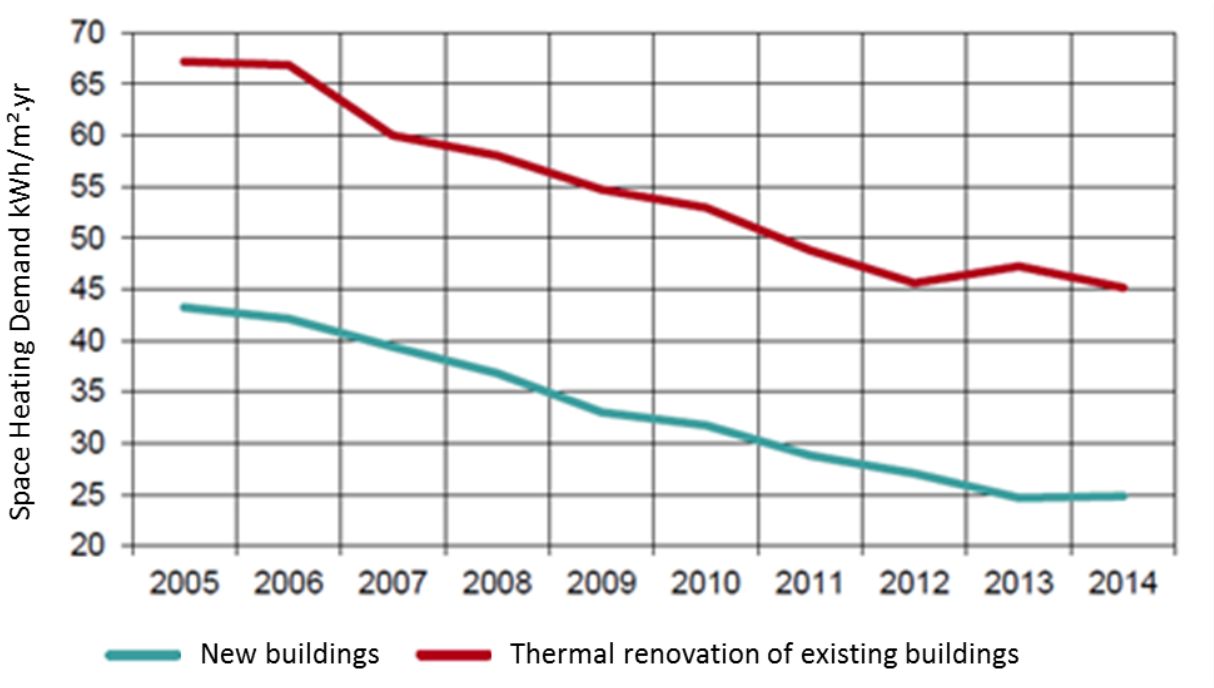


Figure 5. Development of space heating demand of new buildings and major renovations for subsidy schemes in the Austrian provinces. Source: Federal Ministry of Agriculture, Forestry, Environment and Water Management 2016, UBA.

The stronger energy efficiency requirements for buildings according to the EPBD (targets for 2020) have driven the building sector towards decarbonisation. In this context, the implementation of complementary tools and control systems (such as the EPC, its implementation, and the carrying out of inspections) are the foundation for harmonising building regulations across federal provinces.

4. Conclusions, future plans

Austria has taken many steps to fulfil the requirements set out by the EPBD. The national implementation of the EPBD and attaining the Austrian energy efficiency and climate protection goals determine important efficiency criteria for buildings, either newly built or renovated.

All articles of Directive 2010/31/EU have been implemented in the building regulations in all Austrian provinces. The definition of NZEB for 2020 for residential and non-residential buildings has been defined in a national plan[23] which contains the minimum requirements for new buildings and major renovations. A further recast of the OIB Directive 6 (2015) is presently under preparation.

The Austrian regions and their regional energy agencies offer comprehensive information campaigns, competitions and energy advice services for building owners and users as well as international conferences. They develop and implement training programmes for different target groups in the building sector.

Also, the Austrian klima**aktiv**[24] initiative, which is the Austrian climate protection programme, promotes voluntary quality standards for buildings (for new constructions and renovations as well as infrastructure, ecological building construction materials and indoor air quality). Furthermore, the Austrian klima**aktiv** initiative provides training for professionals and disseminates information to home owners and companies. Since 2004 the initiative is one of the most influential systems for implementing energy efficiency. Every year projects are awarded equally for their architectural value as well as their quality with respect to ecology, energy use, and social and economic sustainability in this programme. The klima**aktiv** platform will continue setting best practice examples for the promotion of sustainability in buildings.

At present, the Austrian government is working on the goals for 2030 and beyond (2050). Different scenarios for this time period show a high range of potentials for the reduction of GHG emissions in the building sector. These potentials focus mainly on energy-efficient renovations and energy-efficient household appliances. The reduction of energy (mainly space heating demand) for the residential and non-residential sector is still the main factor for reaching the goals of 2030 and beyond.

In order to achieve the ambitious climate goals, increasing the rate of renovations as well as achieving a high energy performance in the construction and renovations of buildings is necessary. The renovation necessity increases due to building age and constant associated repair and maintenance measures. Therefore, it is necessary to implement ambitious renovation standards at the earliest possible stage. In addition to the reduction of space heating demand, increasing the use of energy-efficient heating systems and RES are very important measures to reduce GHG emissions in the building sector. By all accounts, the increased launching of subsidies for environmentally friendly buildings supports the achievement of these goals.

Implementing the ambitious goals of the Paris Agreement (COP21) is being achieved in many ways in Austria. Currently, Austria is transforming the recently developed "*green paper for an integrated energy and climate strategy*"[25], into a more concrete strategy (white paper)[26]. This strategy will consider key issues for energy systems as regards scenarios for future developments for both 2030 and the long-term perspective (2050).

Endnotes

1. *OIB Directive 6: Energy saving and heat retention of both residential and non-residential buildings*, March 2015.
2. "*OIB-Dokument zum Nachweis der Kostenoptimalität der Anforderungen der OIB-RL6 bzw. des Nationalen Plans gemäß Artikel 4 (2) zu 2010/31/EU)*", which was published in 2013.
3. https://www.oib.or.at/sites/default/files/nationaler_plan.pdf, published in March 2014, last access 4 January 2017.
4. Because of construction reasons or building law.
5. OIB national plan, March 2014.
6. E-Control Austria, 2016.
7. '*Wohnbauförderung*': residential building subsidy.
8. National *Sanierungscheck* 2016: renovation cheque.
9. *klima**aktiv*** is the Austrian climate protection initiative and part of the Austrian climate strategy and is on voluntary basis.
10. "*Mustersanierungen*".
11. Reduced to 40 kWh/m².year or lower.
12. This amount is a maximum of 3,000 € per building unit: https://www.umweltfoerderung.at/fileadmin/user_upload/media/umweltfoerderung/Dokumente_Private/TGS_Priv_2017/infoblatt_mgw_sanierungsscheck2017.pdf
13. Right now over 1,500 buildings are participating in this programme.
14. E.g., *Bauen & Energie Messe*, http://www.bauen-energie.at/, last access 4 January 2017; www.energiesparmesse.at
15. E.g., BauZ!, http://www.bauz.at/, last access 4 January 2017, www.wsed.at
16. E.g., Climate Protection Prize, http://www.klimaschutzpreis.at, last access 4 January 2017; www.energiestar.at
17. E.g., www.energyacademy.at
18. http://www.klimaaktiv.at/bauen-sanieren/staatspreis.html, last access 4 January 2017.
19. EAVG: Federal Law Gazette I No. 137/2006 and its recast No. 27/2012.
20. Agreement Art. 15a B, -VG for small combustion plants, combustion plants and CHP plant.
21. E.g., in Carinthia, up to 4,000 € or Styria, up to 20,000 €.
22. Like Carinthia: 2,500 inspections; Styria: 1,000 inspections.
23. https://www.oib.or.at/de/guidelines/oib-richtlinie-6-nationaler-plan, last access 4 January 2017.

24. http://www.klimaaktiv.at, last access 4 January 2017.

25. C. Maurer et. al: green book for an integrated energy and climate strategy, Hrsg: Vienna, May 2016 http://www.bmwfw.gv.at/EnergieUndBergbau/EnergiestrategieUndEnergiepolitik/Documents/Gr%c3%bcnbuch%20integrierte%20Energiestrategie.pdf, last access 4 January 2017.

26. https://konsultation-energie-klima.at, last access 4 January 2017.

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Belgium - Brussels Capital Region

Status in December 2016

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1. Introduction

In Belgium, the implementation of the EPBD is a regional responsibility. In the Brussels-Capital Region, the EPBD is under the responsibility of the Minister of the Government of the Brussels-Capital Region, responsible for housing, quality of life, environment and energy.

The first relevant ordinance (EPB ordinance) dates from June 2007, and in May 2013, the Brussels-Capital Region Government adopted a new ordinance for the Brussels Air, Climate and Energy Code (COBRACE), which entered into force on 1 January 2015. This ordinance transposes Directive 2010/31/EU[1].

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The energy performance requirements have been mandatory since July 2008 for new buildings and for renovations in which a building permit is requested. The applicable energy performance requirements are set for primary energy consumption, insulation level, ventilation rate, overheating, technical installation, etc. These requirements are different for new or renovated buildings and units depending on the function (residential, office, educational, other non-residential). These requirements have been strengthened over the years, and in 2011, the energy performance requirement (E-level[2]) was tightened and became E70 (for

housing) and E75 (for offices and schools). Moreover, a requirement regarding thermal bridges was introduced. The reduction in energy consumption linked to this reinforcement of requirements has been evaluated at 25% by simulation.

In 2014, the global insulation requirement for the envelope (K-level[3]) K40 (for housing) and K45 (for offices and schools) did not change, but some maximum U-values were tightened for all new or retrofitted elements of the building envelope.

In 2015, the E-level and K-level requirements for housing, offices and schools were replaced by two new requirements, referred to as 'very high performance' requirements, one concerning the total primary energy consumption (PEC), and the other concerning the net heating requirement (NHR). The requirements by type of units are presented in Table 1.

Building/Unit	Net Heating Requirement (NHR)	Primary Energy Consumption (PEC)
Residential	15 kWh/m².year or X kWh/m².year	45 + max(0 ; 30-7.5*C) + 15 * max(0 ; 192/V_{EPR}-1) kWh/m².year
Offices and Schools	15 kWh/m².year or X kWh/m².year	95-(2.5*C) kWh/m².year or (95-(2.5*C)) + (1,2*(X-15)) kWh/m².year
Other	-	-

⋆ The 'X' is an alternative requirement that has been designed for EPB-units whose poor orientation or compactness makes it unfeasible to enforce compliance with a net heating energy requirement of 15 kWh/m².year.

EPB units are defined in the COBRACE as a set of rooms in the same protected volume, which is designed or altered to be used separately.

Table 1. Since 2015 requirements for new units by unit type.*

Units considered as new (over 75% change in the envelope and replacement of all the technical installations) are subjected to the same requirements as new units, aside from a 20% loss in the net energy use for heating requirement as of the total primary energy consumption.

As of 1 July 2017, the requirement for the total energy consumption (PEC) is extended to all non-residential buildings and units (offices, schools, shops, healthcare facilities, courts, laboratories) (Table 2).

Building/Unit	Net Heating Requirement (NHR)	Primary Energy Consumption (PEC)
Residential	15 kWh/m².year or X kWh/m².year	45 + max(0 ; 30-7.5 * C)+15*max(0 ; 192/V_{EPR}-1) kWh/m².year
Non-Residential	-	$\frac{\sum_f A_{gross\ fct\ f} \cdot PEC_{max\ fct\ f,Uref}}{A_{gross}}$ kWh/m².year With: $PEC_{max\ fct\ f,Uref} = Y \cdot E_{spec\ ann\ prim\ en\ cons,ref}$ With: $E_{spec\ ann\ prim\ en\ cons,ref}$: the primary energy consumption of the reference building/unit Y**: For functions 'offices', 'teaching' and 'technical spaces': Y = 0.6 For all the other non-residential functions: Y = 0.9
Industrial	-	-

* The 'X' is an alternative requirement that has been designed for EPB-units whose poor orientation or compactness makes it unfeasible to enforce compliance with a net heating energy requirement of 15 kWh/m².year.

EPB units are defined in the COBRACE as a set of rooms in the same protected volume, which is designed or altered to be used separately.

** The 'Y' value will decrease gradually by 2021.

Table 2. As of 1 July 2017, requirements for new units by unit type.*

2.I.ii. Format of national transposition and implementation of existing regulations

In 2013, COBRACE[4] replaced the 2007 EPB ordinance and transposed Directive 2010/31/EU. Several decrees (available on the Brussels Environment website[5]) describe the procedures to be followed and the calculation method and requirements to be met. A set of resources are available for construction sector professionals, e.g., a handbook, info-sheets, and FAQ, available on the Brussels Environment website[6]. In 2015, an evaluation of the EPB-legislation in the Brussels-Capital Region was realised. In November 2015, the government approved the recommendations made by the real estate and construction sectors.

The calculation procedure is defined in an executive order adopted on 21 February 2013. The method is similar to those established in the Flemish and Walloon Regions. This method has been modified by a new

executive order coming into force on 1 July 2017. The calculation method for primary energy already included the input of RES, e.g., solar energy (thermal and photovoltaic), biomass heating, geothermal heating and heat pump systems, as well as passive cooling techniques. Changes implemented in July 2017 integrate, among others, the prescriptions of the "Ecodesign" Directive 2009/125/EC in the calculation.

All new (or considered as new[7]) residential building-units must respect the same primary energy requirement (PEC) expressed in kWh/m². For all new (or considered as new) non-residential buildings and units, the primary requirements are specified by means of a virtual reference building or unit, which coincides with the actual unit in geometry, floor area, orientation and functionality. Due to this reference building approach, each new building or unit has an individual energy performance requirement that takes its specific details into account. This requirement is also expressed in kWh/m² (Table 2).

The compliance of the procedure and energy performance requirements are checked by the Brussels Environment Office. The percentage of buildings not meeting one or more of the requirements is less than 6%. The fines are established in the Cobrace Art. 2.6.1. Most of the fines are imposed for not meeting ventilation requirements, whereas non-compliance with the primary energy requirement (E-level before 2015, PEC after 2015) is extremely rare.

Professionals responsible for monitoring projects (called EPB advisors) for new buildings and major renovations must be accredited. To become accredited, they must have an architecture or engineering degree and have followed 5-day training sessions and retraining sessions when requested by Brussels Environment Office.

Since 2017, an independent organisation performs an inspection of the quality of the work on a randomly selected amount of EPB-advisors. The EPB-advisor can be suspended if the requirements are not met.

2.I.iii. Action plan for progression to NZEB for new buildings

In the Brussels-Capital Region, the NZEB obligation implemented to comply with Article 9 of Directive 2010/31/EU has been integrated into COBRACE and will make NZEB obligatory by 2021 (2019 for public buildings).

The Brussels-Capital Region has set up ambitious energy standards for new constructions, which was applied starting in 2015. These standards target "nearly zero or very low energy consumption" and are inspired by the "passive standard", where high-energy performance is first achieved similarly to the NZEB requirements. These standards are presented in Table 1.

The 2015 EPBD requirements are very ambitious for an urban context and comply with the nearly zero-emission objective. The energy losses are in fact reduced to their minimum (from a cost-optimal perspective) and the need for compensation by renewable energy is implied by the requirement to fulfil the maximum primary energy consumption requirement (45 kWh/m^2.year); however, the specific RES share is not quantified.

2.I.iv. Requirements for systems and / or building components for new buildings

A study on the revision of the requirements for heating systems was carried out in 2015 and 2016. The results will be incorporated into a revision of the regulations in 2018.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

All types of building units (residential, commercial and public buildings) undergoing renovations are required to obtain a building permit and have to comply with the same U-value requirement level as a new building unit. They also need to comply with a minimum requirement of ventilation rate. In addition, a building undergoing renovations of more than 75% of its surface is subject to the requirements of primary energy consumption (PEC) (like new units).

2.II.ii. Plans to improve the existing building stock

The first step made was to raise awareness of the energy issue and to technically prepare the construction sector. Therefore, advanced training internships are given by the Brussels Environment Office to architects, design and technical consultants, engineers, professional project owners, developers, building managers and contractors; free specialist services are offered to help inhabitants reduce their consumption (www.maisonenergiehuis.be) and high performance exemplary projects are subsidised by the Region.

Based on the return of all these actions, the Brussels Environment Office is currently establishing a renovation strategy and is defining the NZEB levels for all types of building.

To promote renewable energy in existing public buildings, a subsidy of 5 million €/year over the course of four years until 2020 is planned for installing PV panels on the roofs of these buildings.

Another subsidy of 10 million € is foreseen to installing RES in multi-family houses owned by public authorities.

2.II.iii. Regulation of system performance, distinct from whole building performance

A study on the revision of the requirements for heating systems was carried out in 2015 and 2016. The results will be incorporated into a revision of the regulations during 2018.

2.II.iv. Encouragement of intelligent metering

Since 2012, an annual subsidy of 368,188 € is provided for the development and availability of the tool NRClick[8] for the Brussels Region's communes. NRClick's goal is to assist public authorities in their energy management (purchase, distribution, use, monitoring). NRClick helps public authorities to achieve their goals – mandatory or not – regarding energy efficiency. This programme is divided in three complementary sections:

- an energy accounting tool, NRClick Scan;
- a service that allows public authorities to access interesting contracts regarding energy purchase and works of energy efficiency improvement;
- support in the organisation and monitoring of works of energy efficiency improvement.

2.II.v. Financial instruments and incentives for existing buildings

A Green Loan, with a 0-2% rate, can be obtained for renovation works in residential buildings for insulation, ventilation or for a performant heating system. More information is available at www.maisonenergiehuis.be.

Since 2004, energy premiums are given for renovation works on insulation, mechanical ventilation, performant heating systems and thermal regulation. The premium level is defined based on the income of the applicant and the type of building (single-family house, multi-family house, non-residential/industrial).

Financial year energy premiums	Number of premiums granted	Amounts granted
2004	1,840	€ 160,200
2005	15,419	€ 1,767,486
2006	18,381	€ 3,797,638
2007	15,126	€ 10,399,637
2008	16,489	€ 15,658,545
2009	25,951	€ 34,267,573
2010	16,652	€ 11,441,477
2011	19,526	€ 14,862,834
2012	13,787	€ 12,354,840
2013	15,169	€ 22,370,360
2014	15,528	€ 23,588,272
2015	**17,345**	**€ 20,022,273**
TOTAL	191,213	€ 170,691,135

Table 3: Subsidy for energy efficiency improvements in buildings.

Since 2007, the Brussels-Capital Region calls for exemplary projects in order to enhance and support renovations and new constructions. The purpose is to demonstrate that it is possible to achieve high performing and environmentally friendly buildings within a reasonable budget. Overall, the calls for projects launched between 2007 and 2013 have seen 243 projects being selected (for a total of 621,000 m²). These projects will all be completed by 2017 at the latest, with a financial support of 33 million € from the Region.

2.II.vi. Information campaigns / complementary policies

Multiple campaigns were run during the first half of 2016. A first campaign regarding inspection of heating systems was launched to promote the advantages of complying with the mandatory inspection. The chosen angle of this campaign was to show the impact heating systems have on the environment. This campaign was broadcasted on the radio and through colourful posters displayed in public places (subways, bus stops, bars) (Figure 1).



Figure 1. Information campaign for citizens about the mandatory control of boilers.

A second campaign regarding certification was launched shortly after. The aim of this next campaign was to convince the public that the EPB certificate is not just an administrative burden but that it contains very useful information for whoever intends to buy or rent a building unit. The message was “before buying or renting a good you should check what it has under the hood”. As for the first campaign posters were displayed in public places (Figure 2).



Figure 2. Information campaign for citizens on the need for the Energy Performance Certificate prior to sale or renting.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

A complete update of the various systems in place for some years has been carried out:

- An updated calculation method has been published in October 2016 for houses and apartments, together with the development of an improved methodology and new software incorporating cost-effective recommendations.
- A new EPC template, more attractive and clearer, was created for houses and apartments, and this layout has also been applied in 2017 for EPC templates to be used for offices.
- New software and an enhanced methodology for public buildings has been developed in early 2017.

2.III.ii. Quality Assurance of EPCs

Controls on the quality of EPCs continue. Despite communication around frequently made mistakes and modifications carried out on the software, there was no dramatic enhancement to EPC quality.

A mandatory training for updating the knowledge has therefore been planned for already approved experts. They must have attended this training and passed the subsequent exam before mid-2018 in order to keep their accreditation.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

In mid-2015, the area threshold for which buildings occupied by public authorities must display an EPC was decreased to 250 m².

2.III.iv. Implementation of mandatory advertising requirement – status

The information required in mandatory advertisements is energy consumption in kWh/(m².year), CO_2 emissions and energy class.

The mean compliance rate of announcements with the required information increases from year to year; however, by the end of 2016, it was limited to about 60%. By the end of 2016, a large control campaign with zero tolerance began in order to quickly reach a rate of 100% compliant ads.

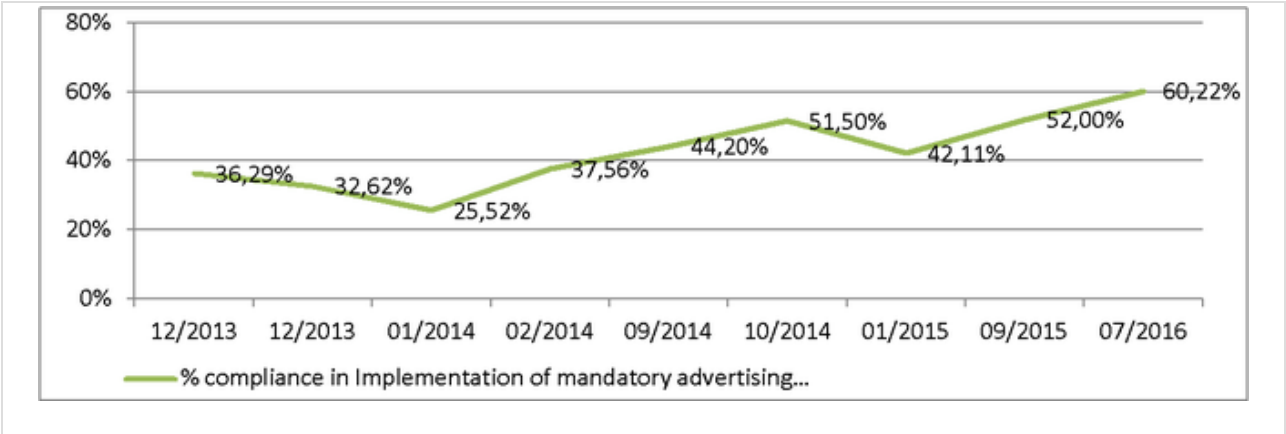


Figure 3. Percentage of real estate advertising with the required information about EPC.

2.IV. Inspection requirements - heating systems, air conditioning

The Brussels Capital Region has adopted the inspection option for heating and AC systems.

2.IV.i. Progress and current status on heating systems

A regulatory review is underway to integrate technological and regulatory developments, improve harmonisation with regulations in the other two Regions and take account of experience in this area; this work should be finalised in 2017. Moreover, since January 2015, the administration has a new database to follow up the inspection reports.

2.IV.ii. Progress and current status on AC systems

In 2016, training courses have been organised for professionals wishing to have the approval necessary to carry out the inspection of AC systems.

2.IV.iii. Enforcement and impact assessment of inspections

Quality control of inspection reports

One hundred and forty-seven (147) inspection reports (heating systems) were controlled by a licensed inspection body in 2016. It appears from this check that some of the certified technicians do not complete the inspection reports correctly. In 2017, the development of a computer application has been planned to help technicians in conducting inspections and report writing.

3. A success story in EPBD implementation

In Brussels, the Passive House standard was adopted as the building code in 2015, making it the first region in the world to require such a stringent standard. Recognised then as a leader regarding high-performance building standards, Brussels representatives were invited to New York to show the world what Brussels has to offer in that area during the Brussels Days 2018[9]. Ten years after this Brussels dedicated event, a new Ice Box Challenge will be organised in the New York City. This new challenge is intended to demonstrate the performance (with no energy added) of a highly efficient envelope.

New York City and Brussels, while on different continents and of different sizes, share a common vision. They want to advance their community towards a sustainable and renewable future through ambitious energy saving goals and programmes. Recognising the two cities' expertise, New York City and Brussels aim to further enhance their exchange of knowledge and provide support to each other. Together, these two cities, as well as with cities from around the world, will continue to be leaders in taking climate action and paving the way for a more sustainable future for our children and environment.

4. Conclusions, future plans

With the experience gained every day through the operational implementation of the different parts of the EPBD legislation, the stakeholders acknowledge more and more the importance of fixing ambitious requirements and of laying bridges between the different acts provided by the EPBD legislation, the methods of calculation included in the legislation and the data that is generated.

Endnotes

1. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0031&from=EN
2. E-level is the annual primary energy consumption divided by a reference consumption.
3. K-Level is a function of the average U-value of the building envelope weighted by areas and correlated with compacity.
4. www.ejustice.just.fgov.be/doc/rech_f.htm
5. www.environnement.brussels/thematiques/batiment/la-peb/construction-et-renovation/legislation
6. www.environnement.brussels/thematiques/batiment/la-peb/construction-et-renovation/documents-utiles
7. A unit is considered as new when construction and/or demolition-reconstruction works exceed 75% of the area of loss including the placement and/or replacement of all technical installations
8. https://nrclick.be/nrclick
9. http://brusselsdays.brussels



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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Belgium - Flemish Region

Status in December 2016

AUTHORS

Marijke De Meulenaer, Kristien Triest, *Flemish Energy Agency Organisation*

NATIONAL WEBSITES

www.energiesparen.be

1. Introduction

In Belgium, the implementation of the EPBD is the responsibility of the regional governments. The Flemish Energy Agency (VEA) and the Ministry of Environment, Nature and Energy are the responsible public bodies in the Flemish Region. They are also in charge of managing the certification scheme, the accreditation of experts and compliance checking. A central register is used to collect data from all certificates as well as the calculations of new building requirements.

In 2014, an evaluation process of the Flemish legislation concerning the certification of existing buildings was finalised, and in 2015, an evaluation process of the legislation concerning the requirements for new and renovated buildings was also finalised. A new calculation method for new and renovated non-residential buildings was implemented in 2016. The NZEB requirements for these buildings are currently being implemented.

This report presents an overview of the current status of implementation of the EPBD and future developments in the Flemish region. It addresses, among other issues, requirements, certification and inspection systems, including quality control mechanisms, training of qualified experts and information campaigns.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

In Belgium, regulations on building energy performance are set at the regional level. However, the three regions cooperate to establish a common methodology for new and refurbished buildings, leaving each region free to define its own requirements. Also, the three regions use a jointly developed single software tool (Figure 1). The Flemish Energy Agency is the public organisation responsible for the energy performance requirements in the Flemish Region.

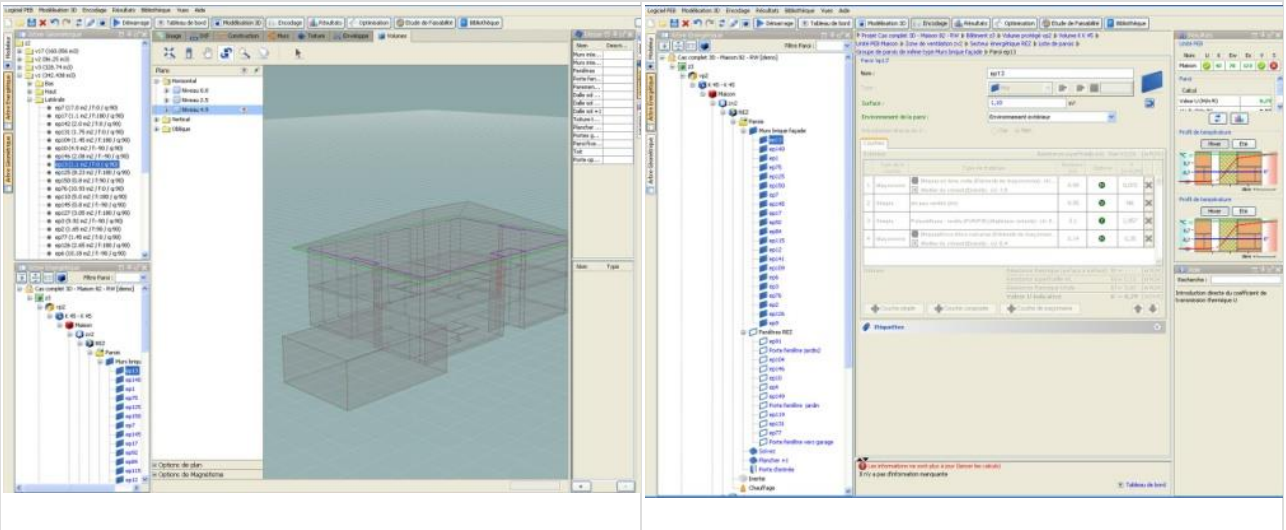


Figure 1. Software tool for the calculation of the building energy performance of new and refurbished buildings.

2.I.i. Progress and current status of new buildings

The most important requirement concerns the dimensionless E-level[1]. The E100-level was introduced in 2006 for new houses, offices and schools. Up to 2016, it was subsequently reduced by 50% to E50, based on cost-optimal studies. The introduction of the E-level for all non-residential buildings (hotels, hospitals, retail, etc.) has started in 2017.

Since 2006, existing requirements have been strengthened for all new buildings. A number of new requirements were introduced in the following years (in 2012 for net energy demand, in 2014 for the minimal share of RES). This set of requirements and its cost-optimal levels were thoroughly evaluated in 2015, with three large studies having been conducted (cost-optimal level for residential[2], cost-optimal level for non-residential[3], energy performance requirements[4]).

Until 2016, more than 280,000 final declarations (calculations of the energy performance requirements in as-built situations) were collected in the central register (Figure 2).

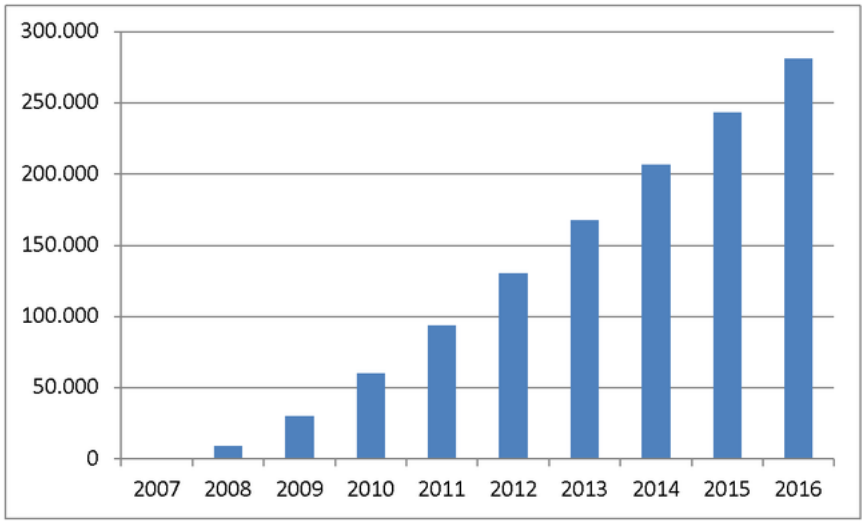


Figure 2. Total number of final energy performance declarations (cumulative).

The analysis by the Flemish Energy Agency (the most recent report is found at www2.vlaanderen.be/economie/energiesparen/epb/doc/cijferrapport_2017.pdf) indicates that the average E-level decreases every year (Figure 3). This evolution is most evident for new single-family houses. The number of single-family houses with an E-level higher than E50 drops from nearly 98% for building permits in 2006 and 85% for building permits in 2010 to 34% for building permits in 2014 (Figure 4).

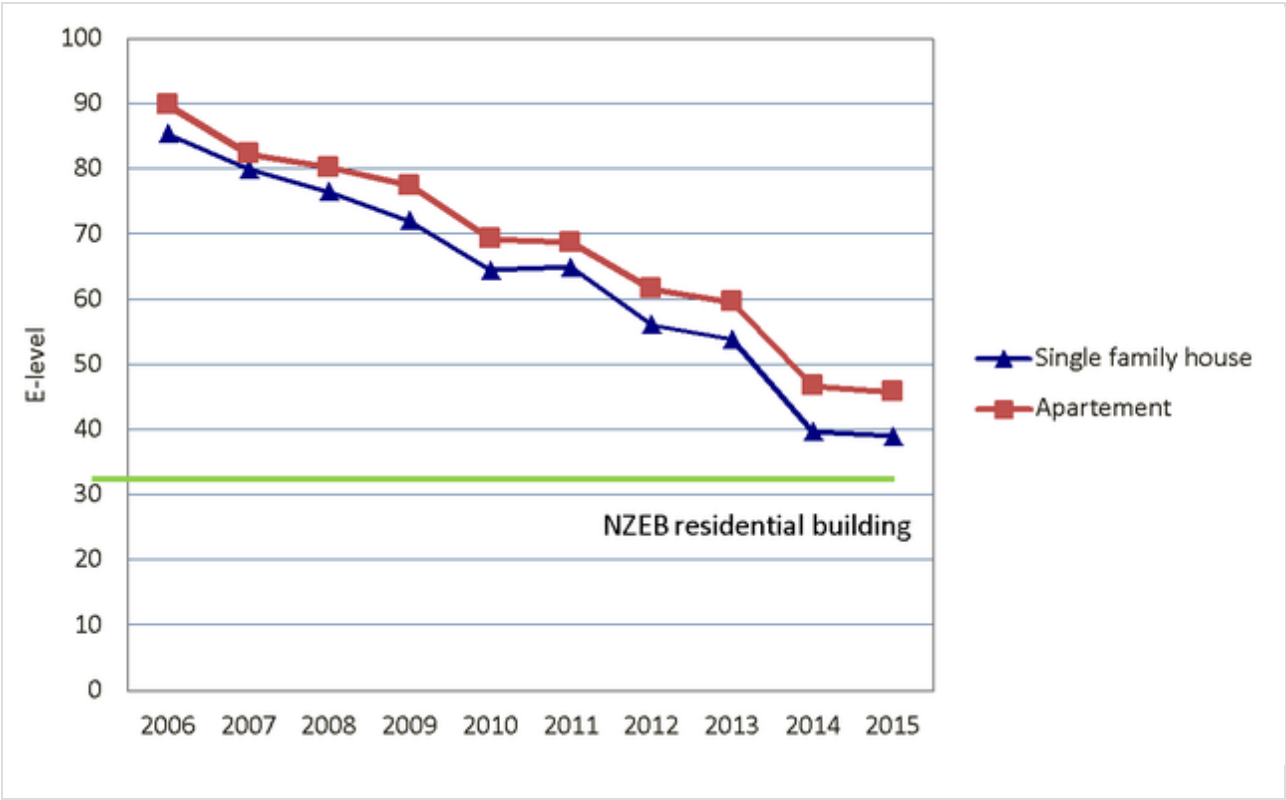


Figure 3. Evolution of the average energy performance level of new residential buildings, per year of the building permit application.

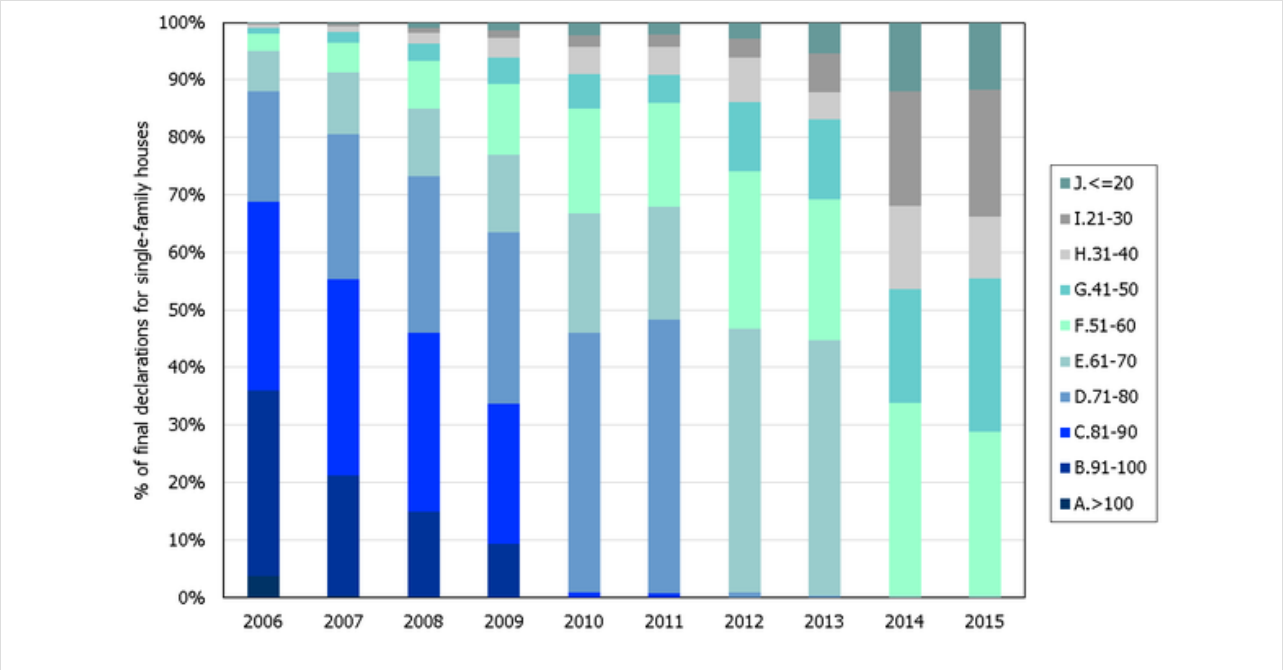


Figure 4. Distribution of E-levels per year (application of building permit).

2.I.ii. Format of national transposition and implementation of existing regulations

Energy performance requirements for new and renovated buildings in the Flemish Region first started in January 2006. The legislation was consolidated in the energy decree of 2009 (*het Energiedecreet van 8 mei 2009*[5]) and the energy law of 2010 (*het Energiebesluit van 19 november 2010*[6]). Each new building must fulfil requirements on energy performance (E-level) and insulation (U-values and global insulation 'K-level'[7]) as well as on the indoor air quality and thermal comfort (risk of overheating and ventilation).

The energy performance level or E-level sets the maximum allowed primary energy use for a building. The calculation includes, e.g., thermal bridges, shading devices and the infiltration rate. The airtightness measurement has to comply with the requirements of a quality-assurance scheme as part of technical specifications STSP71-3 (annex 6). Two energy performance methodologies are described in the energy law: one for residential buildings, and the other for non-residential buildings (with a new method substituting for the former method for offices and schools and based on CEN methods). The primary energy factor for electricity is 2.5, and for other sources 1.

Every two years, all levels of requirements are evaluated by carrying out cost-optimal studies, and the levels are adjusted when needed.

The Flemish Energy Agency checks the compliance with the procedures (submitting, to a central database, a calculation at the start and again at the as-built situation) and with the requirements. In case of non-compliance with the procedures, the builder receives a warning to submit the calculation to the central database. The central database automatically checks that each individual building meets all the requirements. The compliance rate of new buildings with the E-level is very high (> 99% for E-level), as it is for most other requirements as well (Figure 5). For the ventilation requirements, however, the compliance rate is lower, but shows improvement, whereas the systematic tightening of the requirements on E-level has not influenced the high compliance rate. Those responsible for buildings that, after being warned, do not comply with the procedures, or that do not meet the requirements, receive an administrative fine (Table 1).

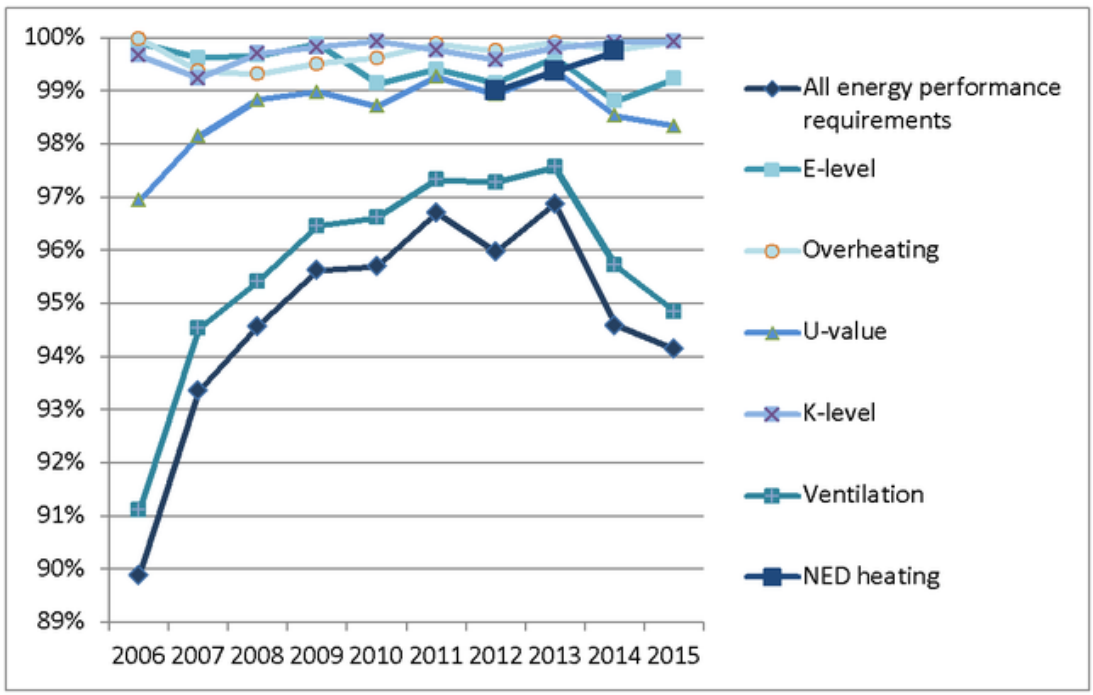


Figure 5. Compliance rate with the energy performance requirements (new buildings).

		2015	2016
Procedures	at start	83	27
	as-built	192	153
requirements		1.226	1.371
experts		19	37

Table 1. Administrative sanctions for infringements of procedures regarding energy performance requirements.

The Flemish Energy Agency also checks a building sample on the quality of the as-built calculations. In 2015, 182 calculations were checked, and in 2016, 45 calculations were checked. In order to further improve the quality of the reports, experts must attend continuing education since 2015. In 2016, 3,453 experts were suspended, most of them non-active experts who did not attend any education courses.

2.I.iii. Action plan for progression to NZEB for new buildings

Since 2012, the Flemish NZEB action plan focuses on informing, educating, facilitating and financially aiding governments and the public, as well as public, professional, financial and commercial organisations with the introduction of NZEB in the different domains of society by involving them in over 30 actions and projects[8] [9].

An important action consists of clearly defining and communicating NZEB regulations, and supporting them by financial subsidy systems that are in place for the frontrunners. The NZEB-levels are defined by the cost-optimal studies that take into account the methodology framework provided by the European Commission. The cost-optimal studies of 2015 on residential and non-residential buildings resulted in a revision of the energy performance indicator (E-level) for non-residential buildings and buildings of public administrations, defining the following requirements[10]:

1. for residential buildings: E50 in 2017, E40 in 2018, E35 in 2020, E30 (= NZEB level) in 2021;
2. for non-residential buildings: see Table 2 (NZEB levels are mentioned in the last column);
3. for buildings of public administrations: see Table 3 (NZEB levels are mentioned in the last column).

E-level, function	2017	2018	2021
Lodging functions	80	70	70
Offices	55	55	50
Education	55	55	55
Health care with lodging	80	70	70
Health care without lodging	80	65	65
Health care operating rooms	60	50	50
Meeting areas high occupancy	80	65	65
Meeting areas low occupancy	80	65	65
Meeting areas cafetaria/refectory	70	60	60
Kitchens	70	55	55
Commerces	70	60	60
Sports: sports hall	65	50	50
Sports: fitness, dance	65	40	40
Sports: sauna, swimming pool	65	50	50
Technical plants/control rooms	55	45	45
Common areas	55	55	50
Other	85	80	80
Unknown	85	80	80

Table 2. E-level tightening scheme for non-residential buildings.

E-level, function	2017	2018	2019
Offices	50	50	50
Meeting areas high occupancy	80	65	65
Meeting areas cafetaria/refectory	70	60	60
Kitchens	70	55	55
Technical plants/control rooms	50	45	45
Common areas	50	50	50

Table 3. E-level tightening scheme for public administration buildings.

Apart from the E-level, the NZEB definition for new buildings includes additional requirements such as a minimal share of RES.

Recent NZEB actions, targeted at local governments, aim to enhance their NZEB knowledge and motivation by a regionwide road show of good examples, well documented by the mayors, members of the city council and the building team (Figures 6 to 9). Furthermore, the local governments can apply for free NZEB assistance and advice for their building projects during a period of 18 months[11].


BEN PRESTATIEFICHE

Buitenschoolse kinderopvang

met polyvalente kantoorruimtes

BEKKEVOORT

Functie gebouw: buitenschoolse kinderopvang met polyvalente kantoorruimtes
Bouwjaar: 2014 - 2015
Opvallende kenmerken: passiefbouw, kader in een masterplan, inbreiding, dubbel gebruik van parking, flexibel inzetbaar, uitbreidbaar

Het project

Bekkevoort is een kleine landelijke gemeente. Midden in de dorpskern, rond een parkeer- en voetgangerszone zijn een aantal publieke gebouwen gegroepeerd: het gemeentehuis, een politiecommissariaat en een openbare bibliotheek. Achteraan op de site staan sociale appartementen. In het verleden werd in de bibliotheek een tijdelijke kinderopvang georganiseerd en het braakliggend terrein tussen de bibliotheek en het voorste appartementsgebouw werd deels benut als buitenspeelruimte. Het is op dit perceel dat de gemeente de nieuwbouw inplande, centraal tussen bibliotheek, appartementen en gemeentehuis. De bestaande buitenspeelruimte bleef behouden.

Het nieuwe gebouw is een aanbouw aan de appartementen en geen vrijstaand gebouw. De al ingerichte buitenspeelruimte is toegankelijk vanuit het nieuwe gebouw en de parking wordt gedeeld met de bestaande publieke gebouwen. Het gemeentehuis is te klein geworden voor alle gemeentediensten. Door een nieuwbouw te realiseren naast het bestaande gemeentehuis blijven alle diensten toch samen op één locatie.
Het hellende dak boven de kinderopvang beperkt het uitzicht naar de omliggende woningen en beschermt zo de privacy van de bewoners. Het groendak op het hellende dak zorgt toch voor een aangenaam uitzicht vanuit de kantoren.
De ingang van het gebouw werd zo ingepland dat het in de toekomst mogelijk is om het gebouw nog verder uit te breiden wanneer zou blijken dat er nood is aan bijkomende kantoorruimte. De gemeente koos voor een lage-energie gebouw, gerisoleerd volgens de passiefbouwstandaard. Dit werd geïmplementeerd in zowel de bouwkundige constructie als de technische installaties. Het gebouw bestaat uit een stockagekelder voor de uitleendienst van de Dienst Vrije Tijd, archiefruimte voor de gemeente, een buitenschoolse kinderopvang en een aantal polyvalente en flexibel inzetbare kantoorruimtes.

DUBO VLAAMS-BRABANT.BE

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Figure 6. Good example for local governments: a NZEB after school day care center: (source: BEN-guide for local governments).



BUITENSCHOOLSE KINDEROPVANG BEKKEVOORT

Technische fiche

Gebouwgegevens

Bruikbare vloeroppervlakte kantoor	890 m²
K-peil	24
E-peil	het gebouw is niet E-peil plichtig
Luchtdichtheid (n50)	geen meting uitgevoerd
Compactheid	1.71
Energievraag verwarming (kWh/m²/j)	-
Energievraag koeling (kWh/m²/j)	-

Isolatie

Schildeel	U-waarde	Dikte	Materiaal
Platte daken	0.08 W/m²K	30 cm	PUR
Hellende daken	0.18 W/m²K	28.5 cm	cellulose
Buitenmuren	0.08 W/m²K	30 cm	PUR
Schrijnwerk	0.99 W/m²K	-	aluminium
Beglazing	0.60 W/m²K	-	-
Deuren	1.59 W/m²K	-	-
Keldermuren	6.28 W/m²K		
Keldervloeren	6.06 W/m²K	20 cm	XPS

Technieken

Verwarming
Warmteafgifte: vloerverwarming en naverwarming op ventilatielucht
Warmteopwekking: lucht-water warmtepomp en condenserende gasketel
Regeling: kamerthermostaten per deel gebouw sturen de verwarming van de ventilatielucht en de vloerverwarming aan. De vloerverwarming zorgt voor de basisverwarming, de verwarming op de ventilatielucht kan inspelen op de wisselende bezetting van het gebouw.

Sanitair warm water
Decentrale elektrische opwarming omwille van beperkte vraag en legionellaregelgeving

Ventilatie
Systeem D met warmte-terugwinning en naverwarming op ventilatielucht

Regenwater
Hergebruik voor toiletspoeling

Hernieuwbare energie
Lucht-water warmtepomp

Materialen

Gevel
Van binnen naar buiten: binnenbepleistering / metselwerk in kalkzandsteen (140 mm) / PUR-isolatie (3 x 100 mm) / gevelbekleding op houten regelwerk: houten blokregels in thermisch behandeld hout of kleipannen

Platte daken
Van binnen naar buiten: binnenbepleistering / betonnen predalen / dampscherm / PUR-isolatie (3 x 100 mm) / dakdichting

Hellende daken
Van binnen naar buiten: gipskartonbeplating / vochtregulerend dampscherm / cellulose-isolatie tussen houten balken (225 + 60 mm) / OSB-beplating / dakdichting

Draagconstructie
Massiefbouw: betonnen kelder, welfsels, predalen, kolommen, balken + dragend metselwerk in kalkzandsteen

Budget
Totale bouwkost
€ 1 355 000

Kostprijs technieken
€ 325 000

Bruto vloeroppervlakte
1064 m²

Bouwkost/m² excl. BTW
1273.50 €/m²

Bouwpartners

Bouwheer
Gemeente Bekkevoort

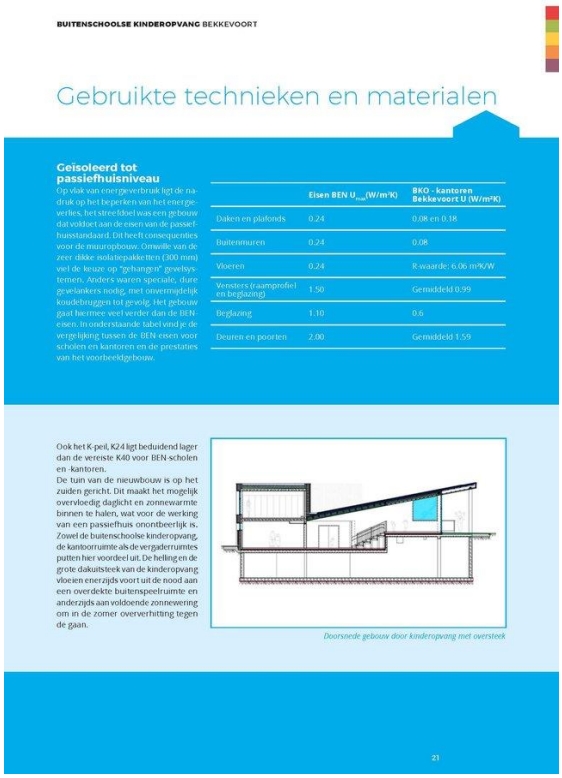
Architect
Eiland 7 architecten bv-bvba

Studiebureaus
Enerdo bvba (technieken) / B.TA Ingenieurs bvba (stabiliteit)

Uitvoerders
Bouwwerken Postelmans – Frederix nv (algemene bouwwerken) / Camps bvba (HVAC & Sanitair) / Electro Corbeels nv (elektrische installaties)

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Figure 7. Good example for local governments: a NZEB after school day care center: energy performance (source: BEN-guide for local governments).



BUITENSCHOOLSE KINDEROPVANG BEKKEVOORT

Gebruikte technieken en materialen

Geïsoleerd tot passiefhuisniveau

Op vlak van energieverbruik ligt de nadruk op het beperken van het energieverlies, het streefdoel was een gebouw dat voldoet aan de eisen van de passiefhuisstandaard. Dit heeft consequenties voor de muuropbouw. Omwille van de zeer dikke isolatiepakketten (300 mm) viel de keuze op "gehangen" gevelsystemen. Anders waren speciale, dure gevelankers nodig, met onvermijdelijk koudebruggen tot gevolg. Het gebouw gaat hiermee veel verder dan de BEN-eisen. In onderstaande tabel vind je de vergelijking tussen de BEN-eisen voor scholen en kantoren en de prestaties van het voorbeeldgebouw.

	Eisen BEN U_{max} (W/m²K)	BKO - kantoren Bekkevoort U (W/m²K)
Daken en plafonds	0.24	0.08 en 0.18
Buitenmuren	0.24	0.08
Vloeren	0.24	R-waarde: 6.06 m²K/W
Vensters (raamprofiel en beglazing)	1.50	Gemiddeld 0.99
Beglazing	1.10	0.6
Deuren en poorten	2.00	Gemiddeld 1.59

Ook het K-peil, K24 ligt beduidend lager dan de vereiste K40 voor BEN-scholen en -kantoren.
De tuin van de nieuwbouw is op het zuiden gericht. Dit maakt het mogelijk overvloedig daglicht en zonnewarmte binnen te halen, wat voor de werking van een passiefhuis onontbeerlijk is. Zowel de buitenschoolse kinderopvang, de kantoorruimte als de vergaderruimtes putten hier voordeel uit. De helling en de grote dakuitsteek van de kinderopvang vloeien enerzijds voort uit de nood aan een overdekte buitenspeelruimte en anderzijds aan voldoende zonnewering om in de zomer oververhitting tegen de gaan.

Doorsnede gebouw door kinderopvang met overstek

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Figure 8. Good example for local governments: a NZEB after school day care center: materials and installations (source: BEN-guide for local governments).



Figure 9. Good example for local governments: a NZEB after school day care center: materials and installations (source: BEN-guide for local governments).

Continuous NZEB actions that aim to educate and motivate local governments, architects and the public consist of introducing the NZEB-label (Figure 10), a NZEB-handbook (Figures 11 to 13), and the website www.BEN-architect.be where one can search for existing NZEB projects and training. A catalogue of 141 residential, public, office and commercial buildings provides details on the designer, the energy performance, the applied techniques and insulations (Figures 14 to 16).

Finally, other continuous NZEB actions cover quality control, including education (competences and knowledge), execution (study as well as execution on the building site), and defining regulations for good practice (ventilation, airtightness and RES installations). These projects are executed in close collaboration with the Department of Education, educational institutions and the professional federations of architects, contractors and energy experts.



Figure 10. Branding the NZEB-label, available for NZEB frontrunners.



Figure 11. NZEB-handbook: cover.

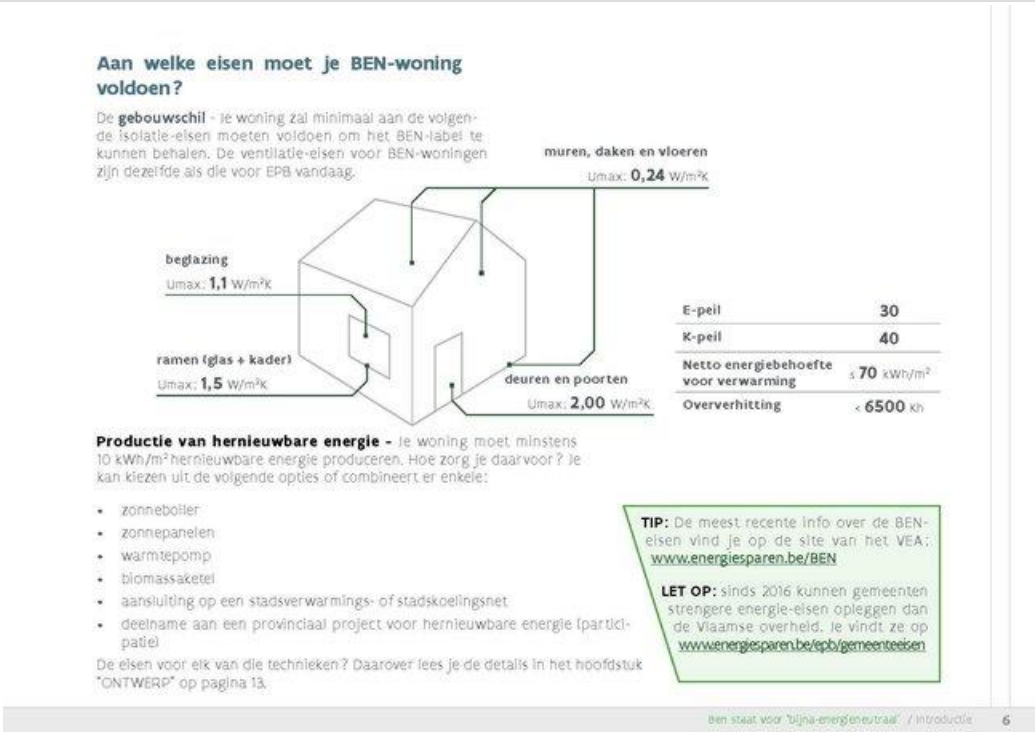
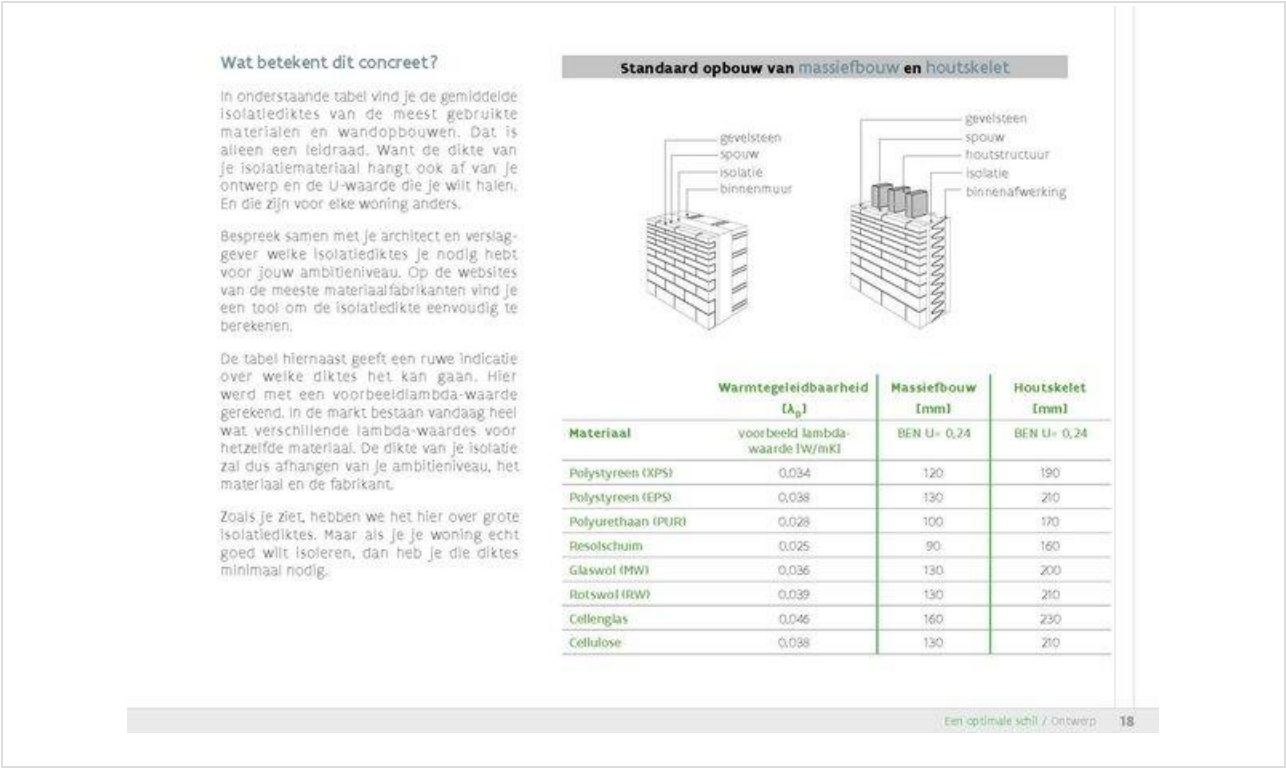


Figure 12. NZEB-handbook: NZEB requirements.



Wat betekent dit concreet?

In onderstaande tabel vind je de gemiddelde isolatiediktes van de meest gebruikte materialen en wandopbouwen. Dat is alleen een leidraad. Want de dikte van je isolatiemateriaal hangt ook af van je ontwerp en de U-waarde die je wilt halen. En die zijn voor elke woning anders.

Bespreek samen met je architect en verslaggever welke isolatiediktes je nodig hebt voor jouw ambitieniveau. Op de websites van de meeste materiaalfabrikanten vind je een tool om de isolatiedikte eenvoudig te berekenen.

De tabel hiernaast geeft een ruwe indicatie over welke diktes het kan gaan. Hier werd met een voorbeeldlambda-waarde gerekend. In de markt bestaan vandaag heel wat verschillende lambda-waardes voor hetzelfde materiaal. De dikte van je isolatie zal dus afhangen van je ambitieniveau, het materiaal en de fabrikant.

Zoals je ziet, hebben we het hier over grote isolatiediktes. Maar als je je woning echt goed wilt isoleren, dan heb je die diktes minimaal nodig.

Standaard opbouw van massiefbouw en houtskelet

Materiaal	Warmtegeleidbaarheid [λ_D] voorbeeld lambda-waarde [W/mK]	Massiefbouw [mm] BEN U= 0,24	Houtskelet [mm] BEN U= 0,24
Polystyreen (XPS)	0,034	120	190
Polystyreen (EPS)	0,038	130	210
Polyurethaan (PUR)	0,028	100	170
Resolschuim	0,025	90	160
Glaswol (MW)	0,036	130	200
Rotswol (RW)	0,039	130	210
Cellenglas	0,046	160	230
Cellulose	0,038	130	210

Figure 13. NZEB-handbook: guidelines for design and execution.

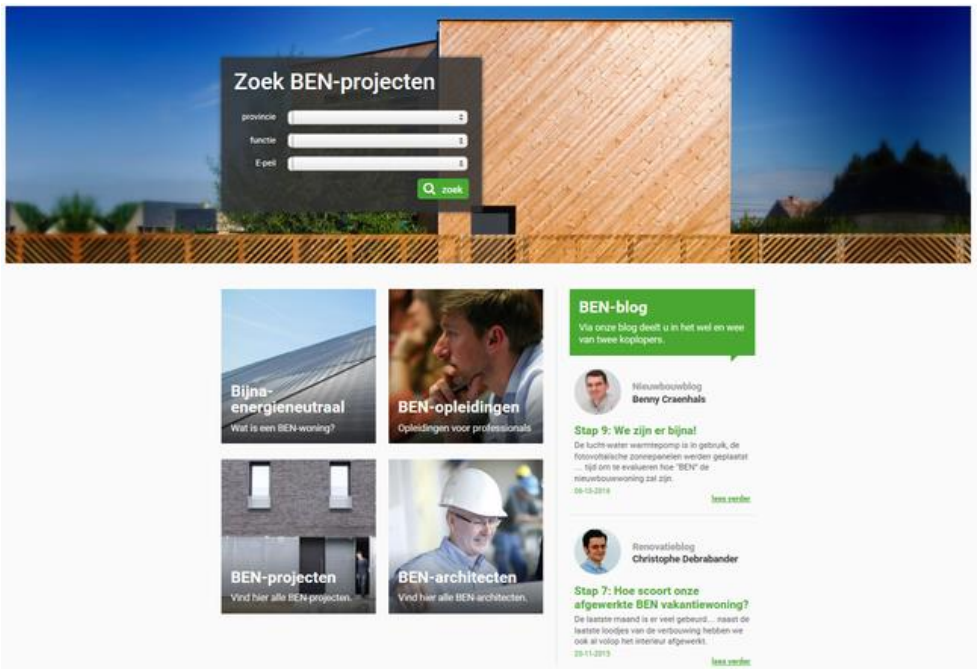


Figure 14. NZEB website with 141 NZEB residential, office, commercial and public buildings, providing energy performance details, information on material, installations, NZEB architects and NZEB training.



Figure 15. Zero-energy office, bank office in Gooik. E-level 1, K-level 25.

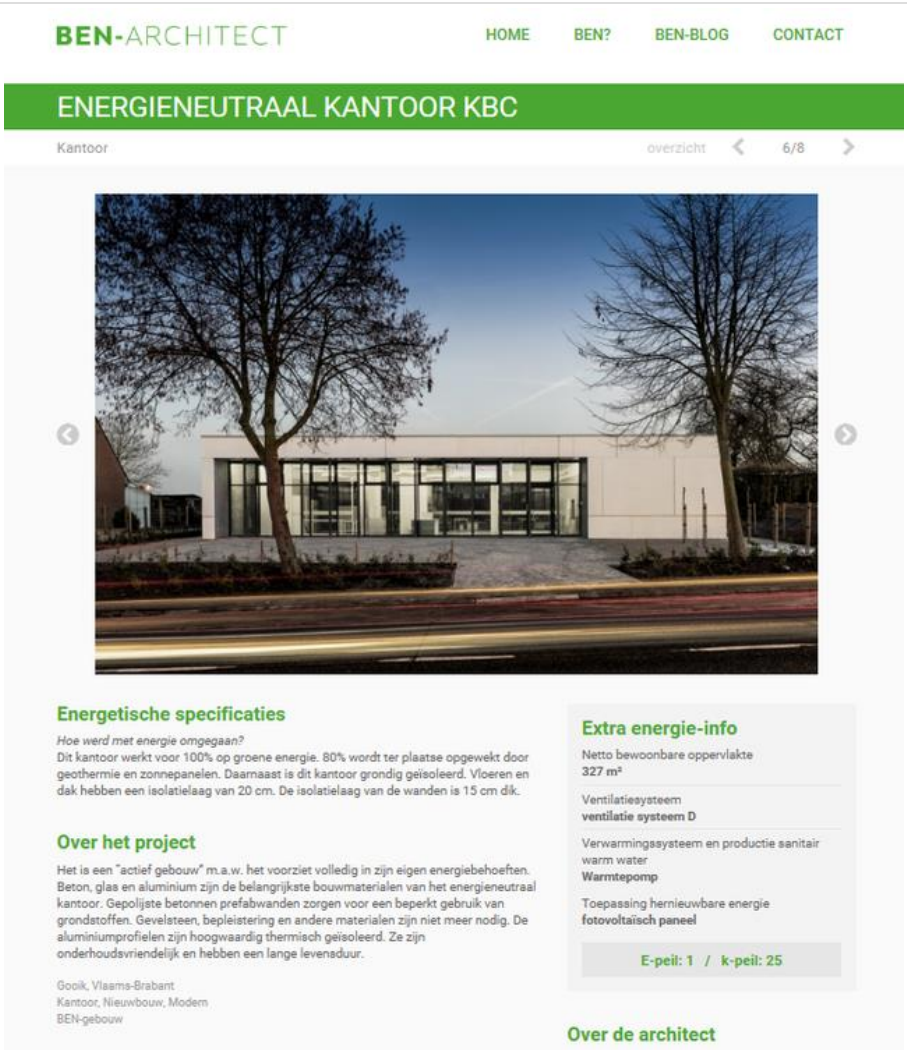


Figure 16. Energy performance details on www.BEN-architect.be of the office building in image 15: E-level 1, K-level 25.

2.I.iv. Requirements for systems and / or building components for new buildings

There are no specific requirements for technical building systems for new residential and non-residential buildings. The performance of systems is integrated in the calculation methods of the energy performance (E-level). Since the performance of the installations is taken into account in the E-level, there is no need for individual requirements. Individual requirements for new buildings are therefore considered an extra administrative burden that in addition reduces freedom in design without a proportionate benefit.

In 2017, the same requirements on technical building systems that have existed since 2015 for renovations will apply to new industrial buildings, since this type of buildings does not have an E-level.

Since 2006, maximal U-values are in place for new building components. These levels were systematically strengthened during the years and are meeting current cost-optimal levels (Table 4).

	Maximum U-value (in W/m².K)					
	from 2006 to 31/12/2009	**from 2010 to 31/12/2011**	**from 2012 to 31/12/2013**	**from 2014 to 31/12/2014**	**from 2015 to 31/12/2015**	**from 2016**
Roofs, ceilings to attics	0.40	0.30	0.27	0.24	0.24	0.24
Outer walls	0.60	0.40	0.32	0.24	0.24	0.24
Floors on the ground, or above cellars	0.40	0.40	0.35	0.30	0.30	0.24
Windows (profile + glazing)	2.50	2.50	2.20	1.80	1.80	1.50
Glazing	1.60	1.60	1.30	1.10	1.10	1.10
Insulated existing walls (outside)	-	-	-	-	0.24	0.24
Insulated existing walls (cavity)	-	-	-	-	0.55	0.55
Insulated existing roofs	-	-	-	-	0.24	0.24
Insulated existing floors in contact with outdoor environment	-	-	-	-	0.30	0.24

Table 4. Overview of maximum U-values since 2006.

2.II. Energy performance requirements: EXISTING BUILDINGS

Energy performance requirements for renovated buildings in the Flemish Region (as for new buildings) first started in January 2006. Each building that undergoes a renovation with a permit[12] must fulfil requirements on insulation levels (U-values) and on the indoor air quality (ventilation).

2.II.i. Progress and current status of existing buildings

Since 2006, the U-value requirements have been strengthened systematically. A number of new requirements were introduced in 2015: minimal requirements for technical building systems, maximal U-values for existing, insulated structures and a maximal E-level for deep renovations. A “deep renovation” is defined as a renovation where more than 75% of the surfaces in contact with the outdoor environment are insulated and all technical building systems are replaced. The calculation method of the E-level is the same as for new buildings, but values to calculate the transmission of existing building components are added also. The set of requirements and its cost-optimal levels were thoroughly evaluated in 2015.

2.II.ii. Plans to improve the existing building stock

The Flemish strategy for renovating buildings (EED Article 4) consists of two parts. The basic part of the strategy is the Energy Renovation Programme 2020. The ambition of this programme is that by 2020, every citizen of the Flemish Region lives in an energy-efficient house with roof insulation, no single glazing and an efficient heating installation. If, in an existing house, the roof insulation is missing, single glazing is still present or the heating installation is older than 25 years, then the priorities for the EPC are the insulation of the roof and the replacement of the single glazing and boiler. The Energy Renovation Programme is completed with the strategy “*On the road to NZEB*”, supporting early adopters.

The Energy Renovation Programme 2020 aimed to set energy upgrades and energy efficient renovations into motion. However, in order to increase the level of ambition from fragmented improvements towards deep renovations of all existing houses, the government decided to establish a multi-stakeholder partnership. Starting in December 2014, working groups of stakeholders together with public authorities prepared recommendations for a “*Renovation Pact*”, a long-term strategy for residential buildings, to be applied until 2050. The definition of a long-term 2050 target for energy performance of Flemish houses is one of the many subjects of this pact (Figure 17).

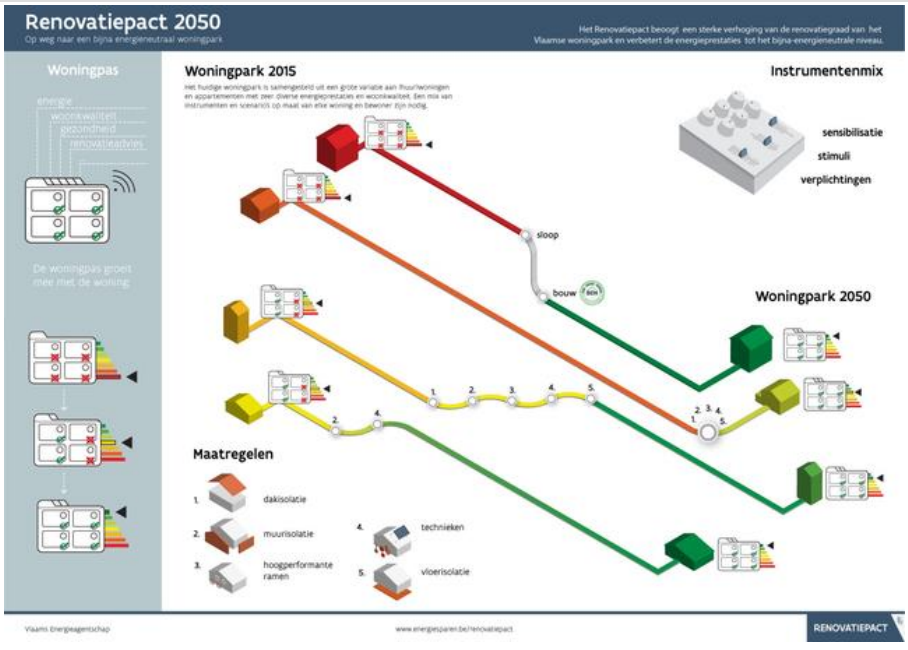


Figure 17. Visualisation of the ‘Renovation Pact’ with long term goals towards 2050.

To implement EED Article 5, the Flemish government has chosen the alternative approach. This requires a series of measures to be taken in public buildings with a total of energy savings equivalent to a deep renovation of the central government's building stock. A first calculation based on available data in 2013 has shown that 150 buildings with an estimated total usable floor area of 900,000 m^2 fall under this obligation. These 150 buildings represent only those that fall under the implementation of Article 5. As a result, the Flemish government has to realise 2.4 GWh of savings under the default approach. The first calculations with the alternative approach estimate that it is possible to save 28 GWh during the 2014-2020 period. In view of the 4th Flemish Energy Efficiency Action Plan, new calculations will be undertaken, taking into account new data on buildings owned and occupied by the central Flemish government. The goal is that the public buildings that fall under Article 5 in the EED will, after renovation, improve their energy performance to at least the yellow zone of the EPC. Overall, this means an estimated energy saving of 10%.

2.II.iii. Regulation of system performance, distinct from whole building performance

Requirements for technical building systems can be found in the environmental regulation for heating and cooling systems as well as in the energy performance requirements for buildings (Table 5).

Type of installation	Requirement on
Heating systems with space heaters (gaseous and liquid fuels)	Minimum efficiency
Heating systems with electrical heat pumps	Minimum seasonal performance factor (SPF)
Electrical resistance heating	Maximal power
Electrical boilers and water heater for domestic hot water (DHW)	Maximal power
Pipework insulation for heating/cooling systems and DHW	Mandatory for forced circulation, stimulated for other systems
Cooling system with ice-water distribution systems	Minimum efficiency
Ventilation systems with mechanical supply and extraction	Minimum efficiency of heat recovery
Non-residential lighting systems	Maximal equivalent specific installed power Use of modulating systems is stimulated

Table 5. Overview of requirements for technical building systems.

The energy performance requirements for technical building systems are created with the purpose of applying them to new, replaced or upgraded systems in existing buildings. The requirements apply to new installations or installations which are altered or expanded in existing buildings with a building permit. The

requirements apply from 1 January 2015. Existing technical building systems which remain unchanged during a refurbishment or works that do not require a building permit do not need to comply with these requirements. However, it is expected that the HVAC contractors will adopt the requirements as benchmarks for these works. Requirements for renovations carried out without a building permit are difficult to enforce. The Flemish government chose not to lay down requirements in cases where enforcement is not possible in practice, or where the extra administrative burden to prove compliance would be too high.

The requirements apply to both large and small modifications to installations in residential as well as non-residential buildings. If the impact of the modification is so small that it is not technically feasible to meet the requirements, there is a procedure for requesting an exception.

2.II.iv. Encouragement of intelligent metering

The energy performance regulations for technical building systems contain requirements for energy metering of large installations. Table 6 gives an overview of the requirements. The presence of such metering systems is obligatory, but it has no impact on the energy performance of the building. The meters need to comply with standards and they can transmit data by using a form of electronic communication. Intelligent metering of the whole building is not yet mandatory. The Flemish government decided to introduce digital meters for electricity and gas in households starting from 2019. The introduction will be gradual, starting with the replacement of limited meters and outdated meters.

Type of installation	Power	Type of meter
Heat-production	> 70 kW	Fuel + meter
Heat-production	> 400 kW	Calorimeter
Electrical heat pump	> 10 kW	Meter for electrical consumption
Electrical heat pump	> 100 kW	Meter for the amount of useful energy
Cooling (ice-water)	> 10 kW	Meter for electrical consumption
Cooling (ice-water)	> 100 kW	Meter for the amount of useful energy

Table 6. Overview of legally-required meters.

2.II.v. Financial instruments and incentives for existing buildings

In order to stimulate energetic renovation, a package of financial incentives and subsidies for individual measures is available (Figure 18). Some measures fit within the EPBD. The main focus for individual insulation measures are roof insulation, wall (outside, cavity, inside) insulation, floor insulation and high efficiency glazing. Main individual RES measures are subsidies for thermal boilers and heat pumps. In 2015, nearly 100 million € of subsidies were distributed for these measures (EPBD and non-EPBD). The most popular measure is roof insulation, with 54,000 roofs insulated.



Figure 18. Brochure regarding subsidies and fiscal advantages (regarding energy-saving investments in residential buildings).

Since 2017, individual measures are extended with global measures, called the "total renovation bonus" in order to promote deep renovations, mainly EPBD related. As soon as 3 (up to 7) measures are combined, additional incentives are foreseen. Investments can be spread over a period of 5 years.

Since October 2016, a new financial incentive for a period of 5 years has been introduced for "IER-EPBD-renovations", or deep energetic renovations, achieving an E-level of max. E90. A reduction of 50% (E90 or below) or 100% (E60 or below) is granted on property tax for a period of 5 years.

The total amount of combined subsidies for deep renovations ranges between 10,000 and 20,000 € per house.

2.II.vi. Information campaigns / complementary policies

The communication about EPBD mainly focusses on the E-level to be achieved by law and the lower level for financial incentives and the path to NZEB (E30) by 2021. In recent years, for new buildings, the communication focused on *BEN-bouwen* (BEN = *Bijna EnergieNeutraal* = NZEB) and the levels to be achieved. The Flemish region focuses on the forerunners (companies, administrations, architects, material producers). By the end of 2016, some 854 forerunners were registrered on www.energiesparen.be/BEN. The slogan is "*ik BEN mee*" (I get it). By the end of 2015, houses were built on average E43 and 20% of them already achieve the NZEB or BEN-level (E30).

For deep renovations, by the end of 2016 a new campaign started called "*BENOveren*" (Figure 19). This means "to renovate better" and focuses on the long-term goals towards 2050.



Figure 19. Branding deep renovations with long term goals towards 2050.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The Flemish Energy Agency is the responsible organisation for implementing EPCs. In January 2006, the certification of new buildings started with the implementation of the energy performance requirements.

More than 200,000 EPCs for new buildings have been issued in the Flemish Region since 2006.

For existing residential buildings (for sale), certification started on 1 November 2008. In case of the rental of existing houses, certification is compulsory as of January 2009. More than 1.2 million EPCs for existing residential buildings have been issued since then. Non-residential buildings, in case of sale or rental, do not yet require an EPC. The implementation of the energy certification scheme for the sale and rental of non-residential existing buildings is still under development and it is expected to start in the course of 2019.

Only a qualified expert can issue an EPC, and the qualified expert has to use a specific certification software, provided by the Flemish government. All EPCs must be reported to a (non-public) database[13], which is property of the Flemish Energy Agency. Qualified experts can only view their own files/EPCs.

The energy score on the EPC is based on a calculation (asset rating). The EPC includes standardised recommendations (depending on the qualified expert's input).

An EPC has to be available from the moment a building is put up for sale or rent. The buyer receives the EPC, and in case of rental, the tenant receives a copy of the EPC. In case of sale, the notary has to report the absence of the EPC to the Flemish Energy Agency. Since December 2015, the notary might have to pay a fine when he does not report the absence to the Flemish Energy Agency. When an EPC is not available by the time of advertising, the seller might have to pay a fine.

The EPC is valid for a period of 10 years. Currently, there is no obligation that a new EPC should be issued in case of renovation.

2.III.ii. Quality Assessment of EPCs

In addition to the checks on new buildings (45 in 2016), the Flemish Energy Agency executes a quality check on the work of a number of qualified experts, based on possible illogical inputs of data as well as at random. Each month, a sample of EPCs made in the previous month is taken. A part of those EPCs is checked by desk controls, another by site visits. Since 2016, the Flemish Energy Agency has increased the number of site visits (10 in 2015 and 38 in 2016) in order to improve the quality of the EPCs. In addition, the Flemish Energy Agency also handles complaints regarding the quality. In case of a complaint, the quality is investigated on the spot (site visit).

In 2016, 202 EPCs were checked using the random sampling method and 108 EPCs by targeted control. After checking the evidence, 286 qualified experts were evaluated as complying or received a warning, 23 experts had to pay a fine, and 1 was suspended.

In addition, there were 9 complaints (14 in 2015) and 8 of the qualified experts had to pay a fine. These high figures are based on a targeted control. Conclusions on the overall quality of all EPCs cannot be derived from this.

Since December 2015, the minimum fine for the incorrect issuing of an EPC is reduced. Experts now risk a fine which ranges between 250 € and 5,000 € if the control shows that the certificates were not correctly issued.

In order to further improve the quality of the EPCs, experts must attend continuing education from January 2017.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

In the Flemish region, the certification of public buildings has been gradually introduced. Initially (since January 2009), only large (> 1,000 m²) public buildings needed to have an EPC on display. Since January 2013, all public buildings larger than 500 m² need to display an EPC. As of January 2015, small public buildings (> 250 m²) are also included.

Since September 2016, it is possible to use the EPC for new buildings, or in the future, the EPC can be used for non-residential buildings, in order to meet the above requirement.

In case of rental or sale, an EPC for non-residential buildings will be necessary. The EPC for existing non-residential buildings is still under development.

From 2009 until the end of December 2016, almost 10,000 certificates for public buildings were issued. These certificates are issued on the basis of an operational rating (measured energy consumption).

Public buildings are defined as buildings of the federal, regional and local governments, schools and health and welfare institutions. Private buildings visited by the public are not yet included.

2.III.iv. Implementation of mandatory advertising requirement – status

Since January 2012, it is mandatory to publish the energy score and the address or the unique certificate reference number in all commercial advertisements. In 2016, 3,085 controls were executed regarding the advertising requirements. Ninety-one percent (91%) of the controlled advertisements had the correct advertisement requirements (89% in 2015).

Since December 2015, the minimum fine for not publishing the required data was reduced to 250 €. Both private individuals and broker agencies can receive a fine which ranges between 250 € and 5,000 € for not publishing the required data regarding the EPCs.

In the period between the start of 2012 until the end of December 2016, 454 fines were imposed (139 of these in 2016).

2.IV. Inspection requirements – heating systems, air conditioning

Flanders has adopted inspections for both heating and AC systems.

2.IV.i. Progress and current status on heating systems

Boilers must be inspected for safety aspects as well as energy efficiency by a recognised technician before first use. Boilers with a nominal output of 20 kW and above must be maintained and inspected frequently by a recognised technician, who checks the safety and energy efficiency. If not compliant, the boiler must be adjusted or replaced. Finally, the recognised technician periodically checks the energy efficiency of the entire central heating system and suggests possible energy-saving methods (Table 7).

All results of inspections are documented in reports. In 2017, a new web application will be launched allowing digital documentation of inspection results and storage of data in a central database as well as the generation of statistics on heating systems.

As of 1 January 2018, energy efficiency requirements of older boilers using gaseous fuels and premix-technology boilers using liquid fuels will be increased. A communication campaign was launched in 2015[14] (Figure 20).

Type of inspection	Fuel	Nominal power	When?	What?	By whom?*
Inspection before first utilisation	Gaseous	All	Before using a new or modifier boiler (e.g. replaced burner, modified chimney)	Thorough inspection of several safety aspects and proper functioning of the boiler as defined by law, including adjustment of the boiler when deemed necessary.	RTG
	Liquid				RTL
	Solid				SC
Maintenance	Gaseous	≥ 20 kW	At least every two years		RTG
	Liquid		At least each year		RTL
	Solid	All			SC
Heating audit	Gaseous	≥ 20 kW and ≤ 100 kW	At least every five years	Inspection of the entire heating system by means of specialised software, provided by the government, in order to determine energy-saving methods. By using this software, the energy efficiency of the entire heating installation is estimated.	RTG
		>100 kW	At least every four years		RTH
	Liquid	≥ 20 kW and ≤ 100 kW	At least every five years		RTL
		>100 kW	At least every five years		RTH
	Solid	All	At least every five years		RTH

* Abbreviations: RTG (recognised technician gaseous fuel), RTL (recognised technician liquid fuel), RTH (recognised technician heating audit), SC (skilled craftsman).

Table 7: Summary of inspection types on central heating systems powered by a boiler on gaseous, liquid or solid fuel.

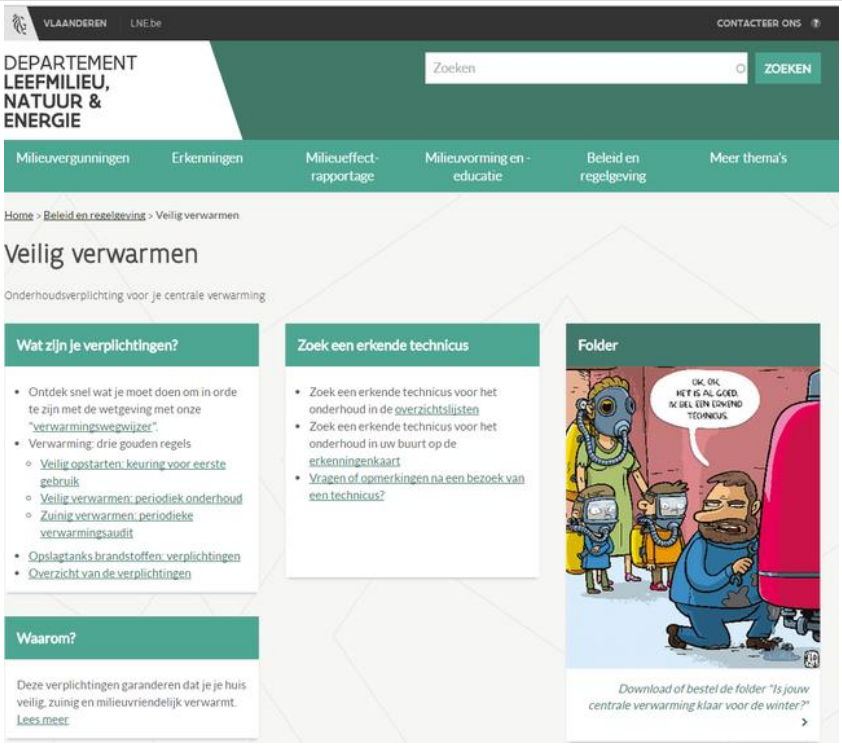


Figure 20: Communication campaign website www.veiligverwarmen.be

2.IV.ii. Progress and current status on AC systems

AC systems with a cooling capacity above 12 kW require inspection within 12 months of commissioning and regular inspection by a recognised expert. The frequency of inspections is dependent on the nominal cooling capacity (Table 8). Since September 2016, the nominal cooling capacity is determined at the building level (previously at system level). A web application was developed in 2015 and supplied freely by the Flemish government to evaluate energy efficiency and the dimensioning of AC systems. This system generates a report including recommendations for cost-effective energy performance improvements.

Nominal cooling capacity	**Frequency of inspection**
> 12 and < 50 kW	every 5 years
≥ 50 kW and <250 kW	every 3 years
≥ 250 kW	every 2 years

Table 8: Frequency of inspection of air-conditioning systems.

Since January 2015, only recognised experts that meet certain requirements, attend a specific training course and pass a specific exam are allowed to perform the inspections. Additional training every five years is required as well.

A communication campaign was launched in 2016[15] (Figure 21).

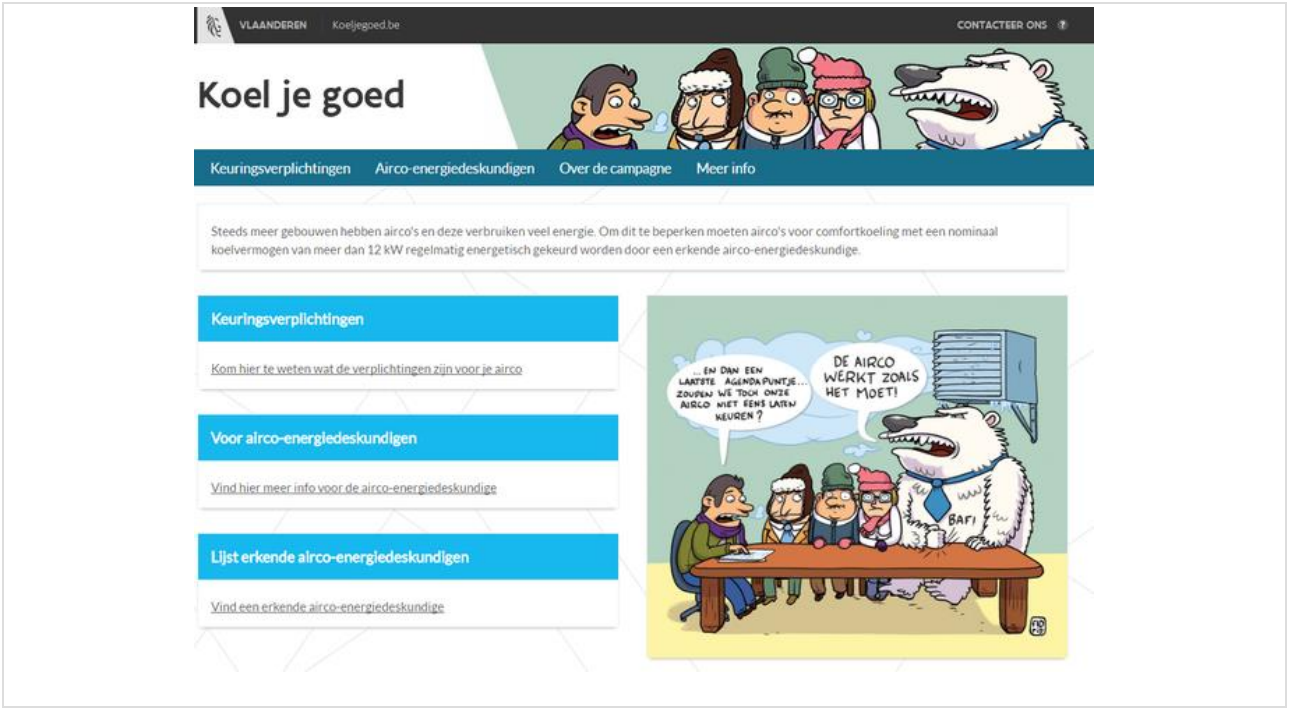


Figure 21: Communication campaign website www.koeljegoed.be

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Municipal supervisors and supervisors of the police zones may sanction the owner or user of a heating or AC system when a mandatory inspection has not been carried out. A list of possible sanctions is included in the decree of 5 April 1995 concerning general provisions relating to environmental policy (e.g., a fine that depends on the kind of infraction). There are no statistics available on the use of these sanctions.

Quality control of inspection reports

As of 2017, the number of technicians recognised to inspect liquid or gaseous fuels exceeds 4,000 and 7,000, respectively. Since 2014, annually approximately 600 randomly selected recognised technicians as well as technicians against whom complaints have been made are subjected to quality control by an accredited inspection body, which is appointed by the government. If quality requirements are not met, the technician will be warned, fined or prosecuted and/or the recognition can be suspended or withdrawn (sanctions have been issued to 64 technicians since 2013). Non-recognised technicians performing any of the aforementioned mandatory inspections that are reported to the government are prosecuted (15 non-recognised persons have been prosecuted since 2013).

As of 2017, almost 120 AC-energy experts have been accredited**.** Recognised AC-energy experts must provide information on all inspections conducted in the last three years to the supervising government upon request. The government can suspend or withdraw the recognition in specific cases. At the beginning of 2017, a statistically significant number of issued reports are subjected to quality control by (an independent accredited inspection body appointed by) the government. No penalties have been levied yet.

Impact assessment

No impact assessment has been performed.

3. A success story in EPBD implementation

The housing stock of nearly 3 million houses is old, with poor average energy performance and a renovation rate of under 1% per year. Thirty-seven per cent (37%), or over 1 million, of the houses are below standard for comfort, health and safety as stated in current housing legislation (Vlaamse Wooncode van 15 juli 1997[16]). On a total of more than 800,000 EPCs for existing residential buildings, 57% of houses built before 1970 show a dramatically low energy performance. The greenhouse gas emissions of residential buildings in the Flemish Region represent 13% of the total GHG emissions for the Flemish Region in 2014. The potential for energy savings and greenhouse gas reduction is enormous. The sector of building, energy and environmental services (25% of the GNP and 13% of employment), is a crucial partner for exploiting this potential and for raising the level of renovation from the actual 1% per year to 2.5 – 3% from 2020 onward.

The Energy Renovation Programme 2020, which since 2009 has been stimulating renovations in roof insulation, double glazing and efficient heating for all houses by 2020, is a leading force in energy efficiency and has a vital effect on society. In order to increase the level of ambition from fragmented towards deep renovation of all existing houses, the government decided to set up a multi-stakeholder partnership. Starting in December 2014, working groups of over 30 stakeholders, together with public authorities, prepared recommendations for a Renovation Pact, a long-term renovation strategy for the residential sector in Flanders. The Flemish government adopted this Renovation Pact in July 2015 and commissioned the Ministers of Energy, Environment and Housing to co-create a long-term coherent action plan. The overall strategy of the Renovation Pact is to put forward and implement a feasible, acceptable and ambitious long-term energy performance level that all residential buildings have to meet by 2050 at the latest, and to provide adequate supportive and normative instruments as well as marketing and action plans. Reaching this energy performance requirement would mean an average decrease of the energy performance indicator of between 65 and 85%.

This broad and continuous multi-stakeholder approach shaped the operational plan and roadmap for the Renovation Pact. This resulted in, amongst other things:

- the definition of a long-term 2050 target for energy performance of Flemish houses;
- the development of a concept of a Housing Passport that will serve from 2018 onward to monitor and register the evolution of every single home towards the long-term objective. As a unique electronic record, it will contain information about the energy performance (evolution), a renovation advice (also available in 2018) and data on housing quality and energy-saving investments, at the very least;
- the start of a service design trajectory covering 2016-2017 for full availability in 2019 offering an EPC+ with a renovation advice.
- the implementation of a Energy Poverty Programme on 4 March 2016 by the Flemish government, which approved a comprehensive action programme fighting energy poverty based on an inclusive approach of vulnerable families in the renovation strategies;
- the approval by the Flemish government of a revised grant scheme which, since January 2017, focuses more on deep energetic retrofits, neighbourhood renovations and specific measures for vulnerable groups;

- the development of a scientifically validated follow-up indicator for measuring the evolution towards the long-term goals for the Flemish housing market;
- the setup of a communication campaign for the broad public.

In the next phase the focus will be on further developing and implementating products and tools, capacity building, demonstration projects and integration of policies (energy, housing, environmental planning and taxation).

4. Conclusions, future plans

Directive 2010/31/EU was a strong driver in getting the EPBD implementation to a higher level and increased ambition has been a driver for the Flanders region progress.

Requirements for new buildings were strengthened multiple times and the path to 2021 was laid out; the average energy performance of new buildings now improves every year. A good functioning enforcement strategy is one of the keys to this success. A close follow-up based on cost-optimality of this path to 2021 is foreseen with bi-annual cost-optimal studies. The roll-out of the NZEB action plan delivered a successful introduction of the NZEB level. Many frontrunner companies support the NZEB message.

At the end of 2016, almost 30% of the existing residential buildings had an EPC. Ninety-seven per cent (97%) of existing buildings have an EPC when rented or sold. Eighty-six per cent (86%) of a sample of controlled advertisements in 2016 complied with the requirements on the EPC. The Flemish Energy Agency puts a continuous effort to ameliorate the quality of the EPCs.

In order to increase the level of ambition from fragmented towards deep renovation of all existing houses, the government decided to set up a multi-stakeholder partnership: the Renovation Pact and new subsidy schemes incentivising multiple improvements and deep renovation.

Tools and accreditation schemes on inspections were improved over the past years to achieve a larger impact.

Endnotes

1. The E-level is the level of global energy performance. It is the annual primary energy consumption divided by a reference consumption. The reference consumption for residential buildings is a regression formula based on the consumption of a set of buildings with reference measures in 2006.This level was set at E100. For non-residential buildings, the reference consumption is calculated on the same building geometry with a set of reference measures.
2. www.energiesparen.be/sites/default/files/atoms/files/verslag_NB_20150703.pdf
3. www.energiesparen.be/sites/default/files/atoms/files/VEAStudiekostenoptimaleniveaus20151207.pdf
4. www.energiesparen.be/sites/default/files/atoms/files/studieEPBeisenpakket_eindrapport.pdf

5. https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1018092&param=inhoud&ref=search&AVIDS
6. https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1019755&param=inhoud
7. The K-level is the level of global insulation of the building (as a whole). It includes thermal transmission through the building shell and through thermal bridges. It is also influenced by the compactness (ratio surface-volume) of the building.
8. www2.vlaanderen.be/economie/energiesparen/epb/BEN/Vlaams_actieplan/Monitoringrapport-BEN-actieplan_20150924.pdf
9. www2.vlaanderen.be/economie/energiesparen/epb/BEN/Actieplan_BEN_versie_juni2012.pdf
10. www.energiesparen.be/BEN
11. Full report on www.energiesparen.be
12. A building permit is needed for most new constructions, renovations and demolitions. Some works are exonerated, like the replacement of windows, the replacement of finishing materials with the same materials or the installation of solar panels. In some cases, a simple building permit is enough, and no energy performance requirements apply, e.g., adding a small window in the back façade. In most cases, an extensive permit is needed, with cooperation of an architect, e.g., when volumes change or when a construction problem needs to be fixed. In that case, the energy performance requirements are applied. However, there is no link with the building value or the ratio of the surface as defined in the EPBD.
13. www.energieprestatiedatabank.be
14. www.veiligverwarmen.be
15. www.koeljegoed.be
16. https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1005498&param=inhoud

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Belgium - Walloon Region

Status in January 2017

AUTHORS

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NATIONAL WEBSITES
http://energie.wallonie.be

1. Introduction

In Belgium, the implementation of the EPBD is the responsibility of the regional governments. This report focuses on the implementation of the EPBD in the Walloon region; the Flemish and Brussels regions are responsible for implementing the EPBD within their respective material and territorial jurisdictions.

With the overall revision of the regulations (Decree of 28 November 2013[1] and its execution order of 15 May 2014[2]) carried out as part of transposing the Directive, the Walloon Region has promoted several developments, such as the display of energy performance indicators within sale and rental advertisements (January 2015), the addition of technical building system requirements (May 2016), and the development of the levels of NZEB requirements (with an intermediate stage in January 2017).

Along with this amendment, the calculation method has evolved to be extended to all non-residential buildings. This progress makes it possible to set overall energy performance requirements for this building type (January 2017). It also sets the basis for the certification of non-residential buildings.

Further achievements in the W*alloon Region include systematised compliance checks with Energy Performance of Buildings (EPB*) procedures and requirements, as well as certification and advertising requirements, including the quality of the services provided by accredited experts.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The administrative procedure foresees that an initial *EPB* statement ("*déclaration PEB initiale*") is submitted along with the planning permission request. This initial *EPB* statement requires a complete energy performance calculation. The administrative procedure for new buildings, subject to an overall energy performance level requirement, is as follows:

At the time of the planning permission request:
• Initial *EPB* statement. This is a document in which the applicant details the measures taken to meet the requirements. Compliance with the requirements is mandatory to obtain a building permit. This document is submitted to the administration and uploaded to a central *EPB* database.
At the end of works:
• Final *EPB* statement. In this document the applicant demonstrates compliance with the energy performance requirements. This document is also submitted to the administration and uploaded to the same *EPB* database.
• The EPC is then issued by the expert, based on the information provided in the final *EPB* statement.

The amendments to the regulation also set requirements for accrediting qualified experts, which include the requirement to undergo training and pass an examination. To ensure a smooth transition, all previous accredited experts[3] could directly attempt the exam without going through training up until the end of 2016.

Meanwhile, the administration put the necessary elements in place to prepare the sector for the arrival of the 2021 building regulation, which includes the NZEB requirements. Continuous training for qualified experts has been taking place since April 2017.

2.I.ii. Format of national transposition and implementation of existing regulations

Since January 2017, the level of regulatory requirements has been tightened. The previous reinforcement dates back to January 2014. A new reinforcement corresponding to NZEB is planned on 1 January 2019 for public buildings and on 1 January 2021 for all other buildings. An overview of the requirements is presented in Table 1.

Requirements		Before EPBD		EPBD				
		Old requirements (2)	Requirements sept '08 - apr '10	Requirements may '10 - aug '11	Requirements sept '11 - dec '13	Requirements jan '14 - dec '16	Requirements jan '17 - dec '20 (dec '18)	Requirements jan '21 (jan '19) - ...
A - U_{max} values ($W/m^2.K$) - New and existing (1) houses, collective housing, hospitals, offices and schools - New and existing shops, catering buildings, sports facilities, business and industry								
1.	Walls defining the protected volume, excluding dividing walls with an adjacent protected volume							
1.1.	Windows and other translucent walls, excluding doors, garage doors, curtain walls and glass brick walls	$U_{w,max}$ = 3.5	$U_{w,max}$ = 2.5 and $U_{g,max}$ = 1.6	$U_{w,max}$ = 2.5 and $U_{g,max}$ = 1.6	$U_{w,max}$ = 2.2 and $U_{g,max}$ = 1.3	$U_{w,max}$ = 1.8 and $U_{g,max}$ = 1.1	$U_{w,max}$ = 1.5 and $U_{g,max}$ = 1.1	$U_{w,max}$ = 1.5 and $U_{g,max}$ = 1.1
1.2.	Opaque walls							
1.2.1.	Ceilings and roofs	0.4	0.3	0.3	0.27	0.24	0.24	0.24
1.2.2.	Walls without any contact with the ground, with the exception of walls covered in 1.2.4	0.6	0.5	0.4	0.32	0.24	0.24	0.24
1.2.3.	Walls in contact with the ground	0.9	0.9	R_{min} = 1.0	R_{min} = 1.3	R_{min} = 1.5	0.24	0.24
1.2.4.	Vertical walls and sloping walls in contact: - with underfloor spaces	0.6	0.6	R_{min} = 1.0	R_{min} = 1.2	R_{min} = 1.4	0.24	0.24
	- with cellars outside the protected volume	0.9	0.9					
1.2.5.	Floor in contact with the outside environment or above an underfloor space	0.6	0.6	0.6	0.35	0.3	0.24	0.24
1.2.6.	Others floors: - above a crawl space - above a cellar outside the protected volume - basement floors underground	0.9	0.9	U_{max} = 0.4 or R_{min} = 1.0	U_{max} = 0.35 or R_{min} = 1.3	U_{max} = 0.3 or R_{min} = 1.75	0.24	0.24
	- above the ground	1.2						
1.3.	Doors and garage doors	$U_{D,max}$ = 3.5	$U_{D,max}$ = 2.9	$U_{D,max}$ = 2.9	$U_{D,max}$ = 2.2	$U_{D,max}$ = 2.0	$U_{D,max}$ = 2.0	$U_{D,max}$ = 2.0
1.4.	Curtain walls	3.5	$U_{CW,max}$ = 2.9 and $U_{g,max}$ = 1.6	$U_{CW,max}$ = 2.9 and $U_{g,max}$ = 1.6	$U_{CW,max}$ = 2.2 and $U_{g,max}$ = 1.3	$U_{CW,max}$ = 2.0 and $U_{g,max}$ = 1.1	$U_{CW,max}$ = 2.0 and $U_{g,max}$ = 1.1	$U_{CW,max}$ = 2.0 and $U_{g,max}$ = 1.1
1.5.	Glass brick walls	3.5	3.5	3.5	2.2	2.0	2.0	2.0
2.	Walls between 2 protected volumes located on adjacent properties	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3.	Opaque walls inside a same protected volume or adjacent to another protected volume on the same property, except for doors and garage doors:							
3.1.	between distinct residential units	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3.2.	between residential units and common spaces (staircase, entrance hall, passage)	-						
3.3.	between residential units and non-residential occupancy spaces	1.0						
3.4.	between industrial occupancy spaces and non-industrial occupancy spaces	1.0						

(1) Renovated buildings where a building permit is mandatory, and unheated buildings changing their occupancy
(2) These U-value requirements do not apply to shops, catering buildings, sports facilities, business and industry

Requirements		Before EPBD		EPBD				
		Old requirements (2)	Requirements sept '08 - apr '10	Requirements may '10 - aug '11	Requirements sept '11 - dec '13	Requirements jan '14 - dec '16	Requirements jan '17 - jan '21 (jan '19)	Requirements jan '21 (jan '19) - ...
B - K values (-) – Global insulation level (function of average U-value and compactness)								
New buildings:								
	Houses	K55	K45	K45	K45	K35	K35	K35
	Offices and schools	K65						
	Collective housing, hospitals, shops, catering buildings, sports facilities and business	-						
	Industry	-	K55	K55	K55	K55	K55	K55
Existing unheated buildings changing their occupancy to:								
	Houses	K65	K65	K65	K65	K65	K65	K65
	Offices and schools	K70						
	Other uses (heated)	-						
Existing heated buildings (except industry) changing their occupancy to:								
	Houses	K65	-	-	-	-	-	-
	Offices and schools	K70						
	Other uses (heated)	-						
Existing industry (heated or unheated) changing their occupancy to:								
	Houses	K65	K65	K65	K65	K65	K65	K65
	Offices and schools	K70						
	Other uses (heated)	-						
Others		-	-	-	-	-	-	-

Requirements		Before EPBD		EPBD				
		Old requirements (2)	Requirements sept '08 - apr '10	Requirements may '10 - aug '11	Requirements sept '11 - dec '13	Requirements jan '14 - dec '16	Requirements jan '17 - jan '21 (jan '19)	Requirements jan '21 (jan '19) - ...
C - E_w (-) – Global energy performance level (calculated primary energy consumption divided by calculated primary energy consumption of a reference building) **D - E_{spec} (kWh/m².year) – Specific energy consumption** (calculated primary energy consumption per m² of heating floor area) **E - Overheating rating (K.h)**								
New buildings:								
	Houses	-	-	Ew ≤ 100 Espec ≤ 170 loverh ≤ 17.500	Ew ≤ 80 Espec ≤ 130 loverh ≤ 17.500	Ew ≤ 80 Espec ≤ 130 loverh ≤ 17.500	Ew ≤ 65 Espec ≤ 115 loverh ≤ 6.500	Ew ≤ 45 Espec ≤ 85 loverh ≤ 6.500
	Offices and schools	-	-	E_w ≤ 100	E_w ≤ 80	E_w ≤ 80	Ew ≤ [65-90] cf. formula	Ew ≤ [45-90] cf. formula
	Other destinations	-	-	-	-	-		
Existing buildings:		-	-	-	-	-	-	-

Requirements	Before EPBD		EPBD				
	Old requirements (2)	Requirements sept '08 - apr '10	Requirements may '10 - aug '11	Requirements sept '11 - dec '13	Requirements jan '14 - dec '16	Requirements jan '17 - jan '21 (jan '19)	Requirements jan '21 (jan '19) - ...
F - Ventilation							
New houses and buildings changing their occupancy to houses	Requirements are set in the annex C2 (based on NBN D50-001)						
New offices, schools and buildings changing their occupancy to offices or schools	Requirements on air outputs are function of premises use	Requirements are set in the annex C3 (based on NBN EN 13779)					
New collective housing, hospitals, shops, catering buildings, sports facilities, businesses and buildings changing their occupancy to these uses	-						
Renovated houses with a mandatory building permit	Partial system (only for supply air if windows are replaced in dry space)					Partial system (only for supply air if windows are placed/replaced in dry space + exhaust air in new wet space)	Partial system (only for supply air if windows are placed/replaced in dry space + exhaust air in new wet space)
Renovated offices and schools with a mandatory building permit	Partial system (only for supply air if windows are replaced in dry space)					Partial system (only for supply air if windows are placed/replaced in dry space + exhaust air in new wet space)	Partial system (only for supply air if windows are placed/replaced in dry space + exhaust air in new wet space)
Renovated collective housing, hospitals, shops, catering buildings, sports facilities and businesses with a mandatory building permit	-	Partial system (only for supply air if windows are replaced in dry space)				Partial system (only for supply air if windows are placed/replaced in dry space + exhaust air in new wet space)	Partial system (only for supply air if windows are placed/replaced in dry space + exhaust air in new wet space)
New and existing industry	-	-	-	-	-	-	-

Table 1. Overview of regulatory requirements (click for larger size online)

Up until now, only residential buildings, schools, office buildings and services buildings were calculated in terms of overall energy performance. From 1 January 2017, this calculation is extended to all other non-residential types of building units (called *PEN units*). The threshold of the requirement for *PEN units* is variable (Table 2) and depends on the functional parts present in the unit and their respective sizes, according to the following formula:

$$E_{W,PEN,max} = \frac{\sum_f A_{ch,fct\ f} \cdot E_{W,max,fct\ f}}{A_{ch}}$$

with:

$E_{W,PEN,max}$ the threshold for the EW level of the studied *PEN unit* (dimensionless);

$A_{ch,\ fct\ f}$ the total heated floor area of each function f of the *PEN unit*, in m²;

$E_{W,\ fcf\ f}$ the assumed requirement level per function, for each function f of the *PEN unit* (dimensionless);

A_{ch} the total heated floor area of the studied *PEN unit*, in m².

Non-residential units			2017	2021 (2019)
			$E_{W,\ fcf\ f}$	$E_{W,\ fcf\ f}$
FUNCTIONS	Accomodation		90	90
	Offices		65	45
	Schools		65	45
	Health care	With nocturnal occupation	90	90
		Without nocturnal occupation	90	90
		Operating room	90	90
	Group	High occupancy		
		Low occupancy		
		Cafeterias / large dining rooms		
	Kitchen		90	90
	Commerce		90	90
	Sports facilities	Sports hall / gymnasium	90	90
		Fitness Dance	90	90

Non-residential units			2017	2021 (2019)
		Sauna Pool	90	90
	Technical local		65/90	45/90
	Common		65/90	45/90
	Other		90	90
	Unknown		90	90

Table 2. The values of the requirement levels per function $E_{W,fcff}$

2.I.iii. Action plan for progression to NZEB for new buildings

NZEB requirements are based on the results of calculations on model geometry, statistical data and subsidy databases[4]. These new requirements were approved by the regional stakeholders of the building sector and adopted by the government on 28 January 2016[5]. They are presented in Table 2.

If Wallonia does not set intermediate targets in terms of the share of new NZEB buildings before 2021, it has nevertheless:

- set up two calls for projects for *Wallonian exemplary buildings* addressed respectively to residential and non-residential buildings, in order to prepare the building sector and citizens for future NZEB requirements. This action covers new buildings as well as the renovation of residential and non-residential buildings. Actual achievements are highlighted on the energy portal site but also in the print and audio-visual media (partnerships with the broadcast "*Une brique dans le ventre"* and "*Clé sur porte*" on the two main French-speaking television channels in Belgium);

- organised seminars with the Union of Towns and Municipalities of Wallonia (*Union des Villes et Communes de Wallonie*) to inform the municipalities of changes to the regulations (NZEB requirements, certification of public buildings, control of regulations related to planning permission, etc.).

Based on requirements for NZEB (see requirements in Tables 1 & 2), 137 non-residential buildings and 6,542 residential buildings included in the *EPB* database meet the definition of NZEB, representing 4.6% and 6.8% respectively of total *EPB* statements.

For residential buildings, the renewable solutions most commonly proposed by the designers to meet the NZEB requirements include the use of PV (24.2%), a heat pump (7.4%), a combination of a heat pump and PV (7.4%), solar thermal panel (3.7%), a combination of PV and biomass heating system (2.4%), a biomass heating system (1.9%), or a combination of PV and solar thermal panel (1.8%). It is interesting to observe that, in 49.7% of cases, the net energy needs for heating and overheating set out in the NZEB requirements for primary energy consumption are met without the use of RES (Figure 1).

For non-residential buildings, the renewable solutions most commonly proposed by the designers to meet the NZEB requirements include the use of PV (33.6%), while 63.5% meet the requirements without the use of RES (Figure 2).

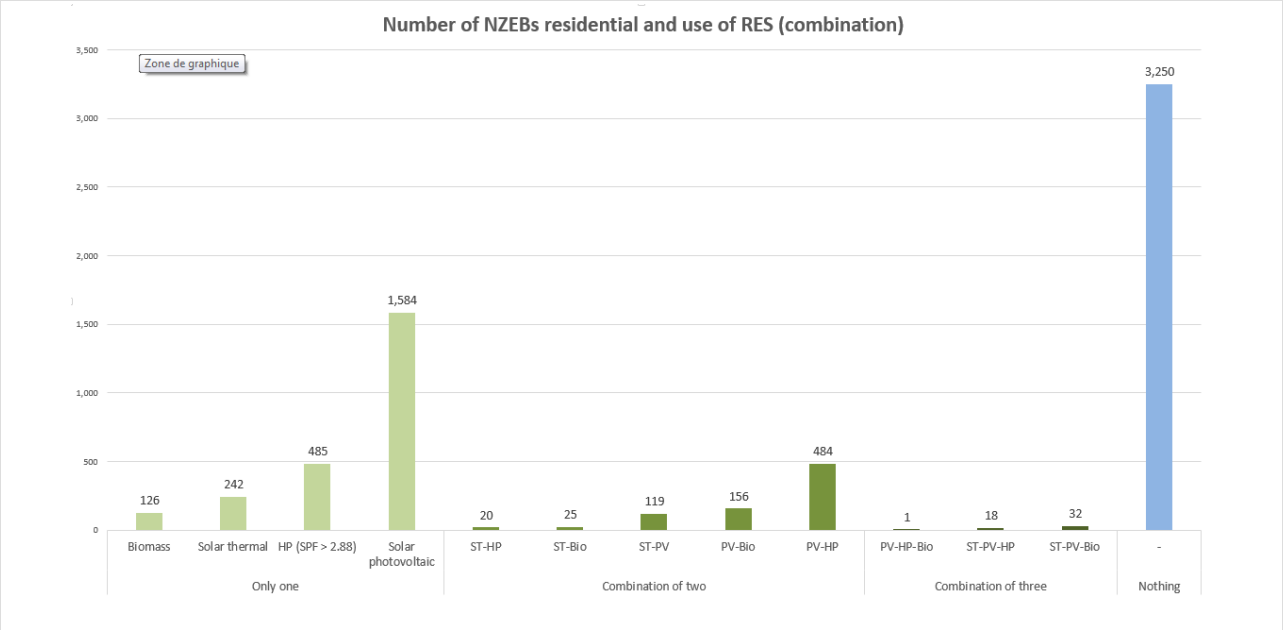


Figure 1. The number of residential NZEB and use of RES (combination).

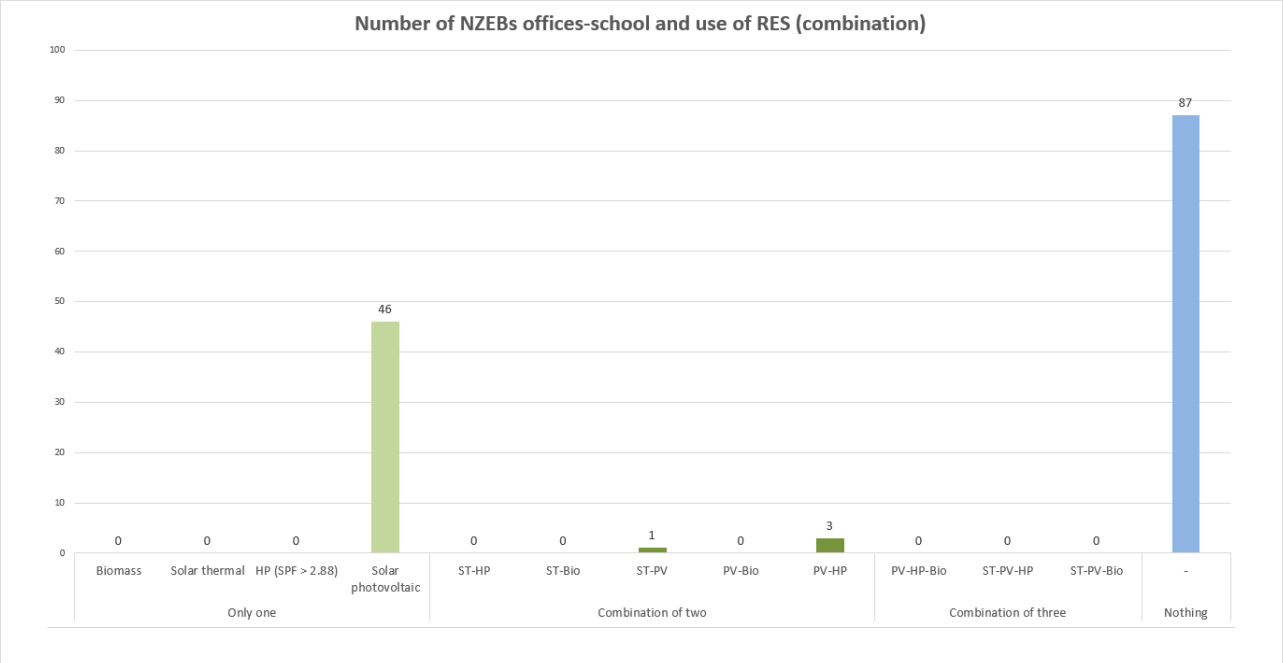


Figure 2. The number of non-residential NZEB and use of RES (combination).

2.I.iv. Requirements for systems and / or building components for new buildings

As mentioned in Table 1, there are requirements relating to each element of the building envelope, defining the protected building volume (U_{max}). In addition, requirements are also prescribed for the hygienic ventilation rates of the building. Finally, the transposition of Article 9.3 of the EED requires that meters be placed in case of centralised distribution of heat and/or cold between several buildings and between several building units within a building. For new buildings, the other systems are accounted for in the overall energy performance assessment. Wallonia intends to extend the scope of some technical building system requirements for new buildings.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.I.i. Progress and current status of existing buildings

The performance of existing residential buildings is assessed by the building certification process. According to the database gathering all the certificates (approximately 400,000 to date), the average energy performance of the Walloon housing in 2016 corresponds to the EPC energy class F, i.e., a theoretical consumption of 434 kWh/m².year (Figure 3).

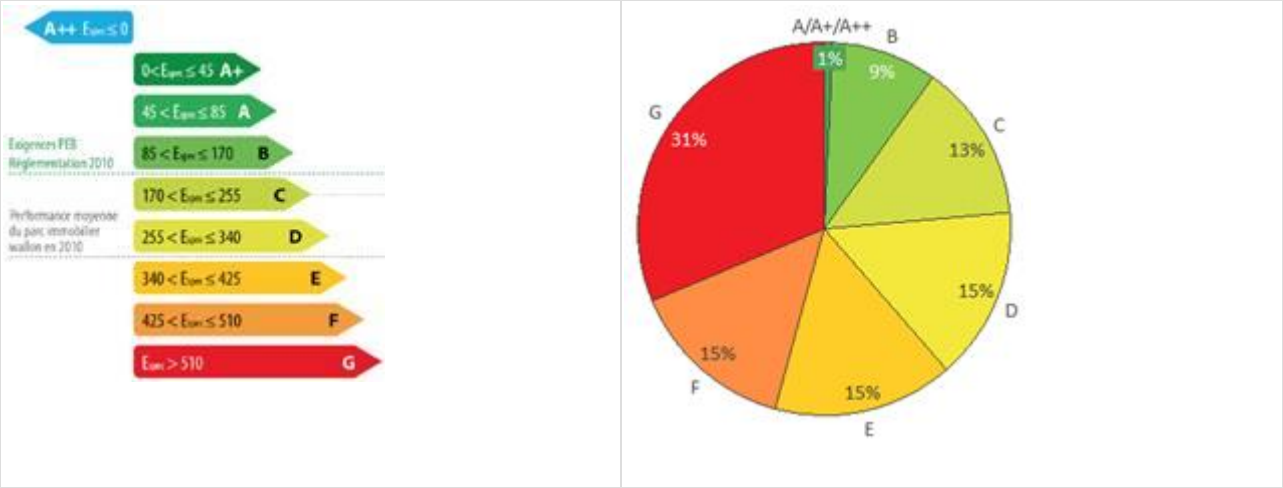


Figure 3. The distribution of Walloon residential buildings by energy performance (EPC database).

The Walloon housing stock is old; almost 25% of the houses were built before 1921 and about 80% date from before 1991. These old buildings consume the most energy (Figure 2). The majority of houses show a poor energy performance: > 30% at level G, 15% at level F and 15% at level E (Figure 4).

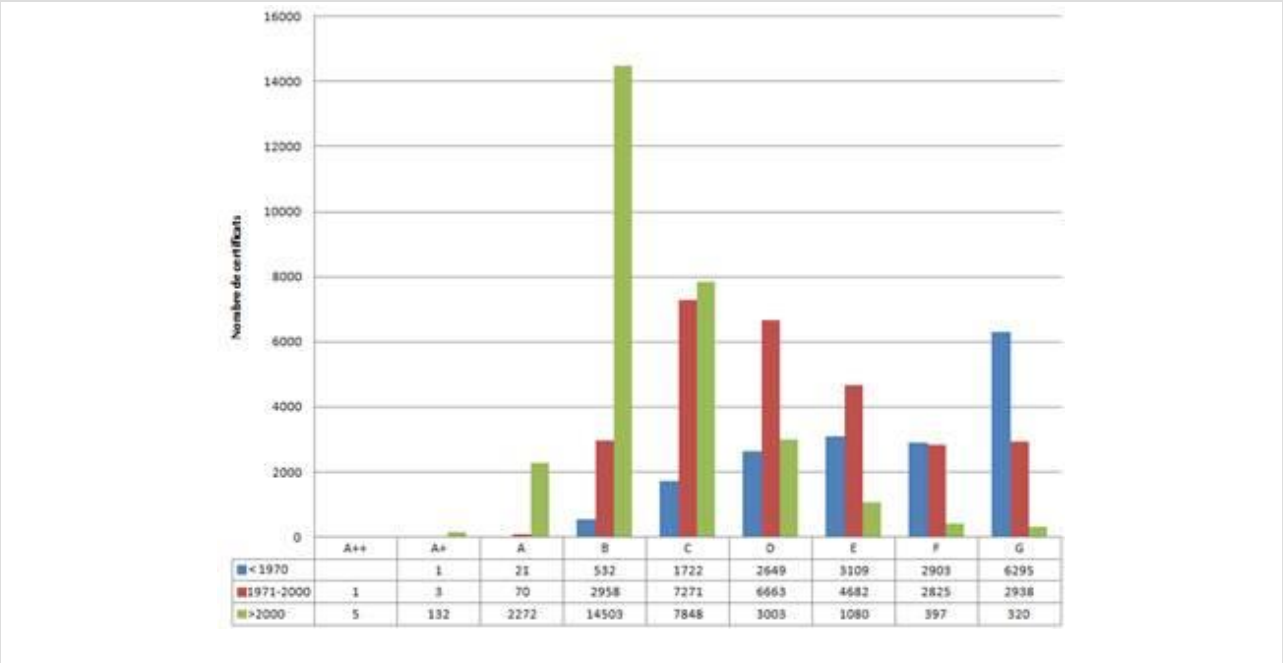


Figure 4. Repartitioning of EPC energy classes by age of building.

In addition, the existing housing stock has a low rate of renovation; every year, applications for planning permission refurbishments are submitted for just 1% of the houses.

The total residential energy consumption in 2013 is only 5% higher than its 1990 level, although the housing stock has grown by 16%, and the annual degree-days have increased by 24% during that period. Figure 5 shows the evolution of this consumption.

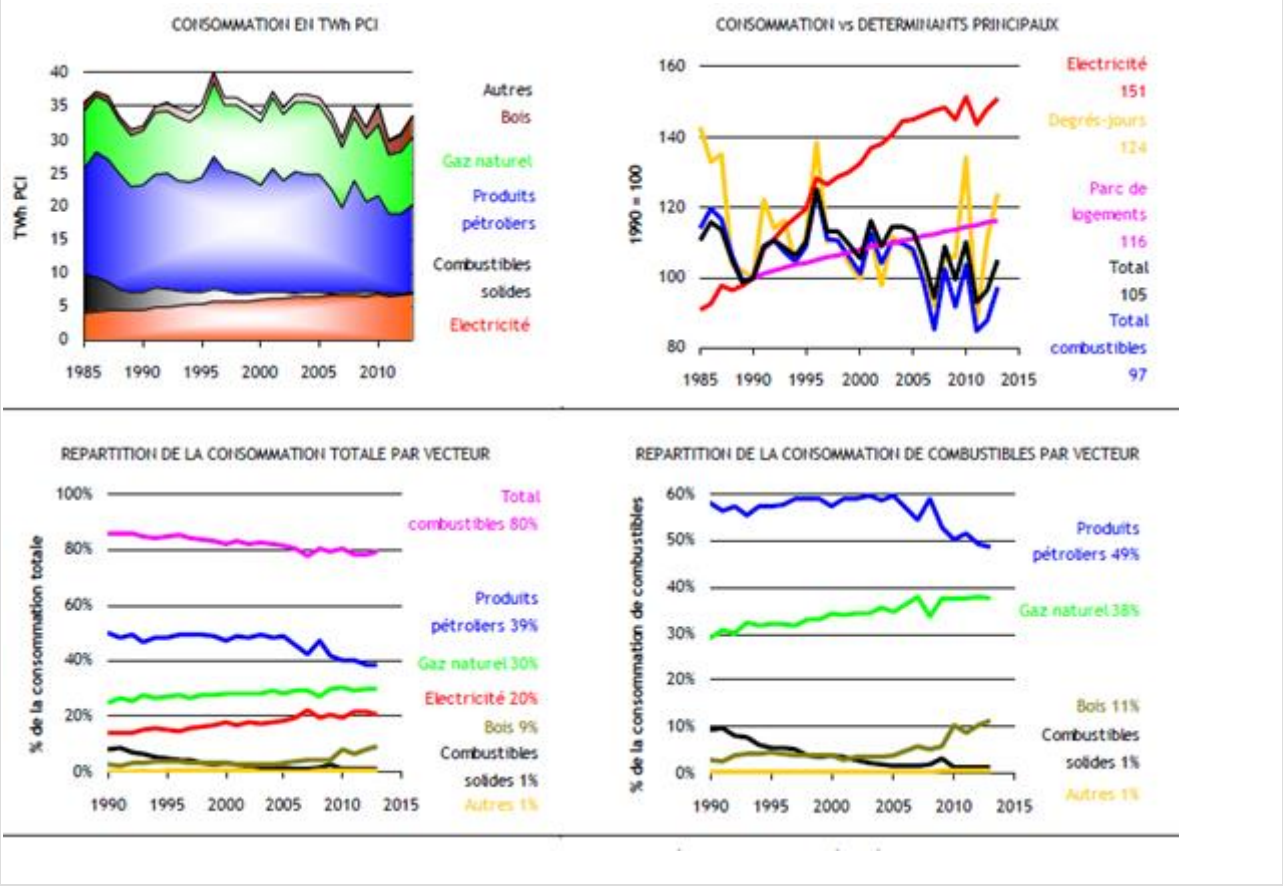


Figure 5. Evolution of the residential sector consumption by energy vector ("Bilans wallons" 2013).

2.II.ii. Plans to improve the existing building stock

The NZEB targets in the Walloon Region are closely linked to the planned objectives of the Walloon renovation strategy.

Although the NZEB definition of an existing building has not yet been fixed, the long-term objectives for renovating buildings implicitly include the NZEB targets. The building renovation strategy indeed sets the 2050 target of significantly improving the performance of housing so that, on average, they will reach the EPC energy class A, whose threshold is set at 85 kWh/m².year, the level defined for new NZEB. The intention is to target an identical NZEB level for new and existing buildings.

Intermediate steps in 2020 and 2030 will verify progress and identify the necessary corrective actions for reaching these targets.

For non-residential buildings, the goal is to reach an energy-neutral building stock in 2050 for heating, cooling and lighting, which means that these buildings will produce as much energy as they consume.

To achieve its objectives, Wallonia plans to focus on deep renovations and develop tools such as a building passport and a renovation roadmap, enabling all renovation projects to be registered and guided to achieve the global energy refurbishment either in one step or in phases, with the NZEB level as the ultimate goal.

Primarily, it will be a matter of encouraging each opportunity for improvement (envelope or system) to place the building on a path towards the long-term NZEB objective while at the same time give priority to renovating the least efficient housing (levels G and F).

Concerning EED Article 4, a long-term renovation strategy[6] for Wallonia is finalised and integrated into the 4th National Energy Efficiency Action Plan (NEEAP) as of 30 April 2017. This plan, drawn up in consultation with stakeholders, presents a range of provisions identified as priorities to stimulate deep renovations of residential and non-residential buildings with a long-term goal as outlined in point a.

These provisions are staggered for short-term (2020), medium-term (2030) and long-term (2050) implementation. Some have already been validated by the government within other plans (*Alliance-Emploi Environnement*, *Plan Marshall*, *Décret Climat*, *Plan Air-Climat-Energie*, etc.) and can therefore be activated in the near future.

Concerning Article 5 of the EED, Wallonia has chosen to adopt an alternative approach to the required annual renovation of 3% of existing public buildings.

Wallonia decided to determine its target based on the pre-existing register of buildings' energy performance, with data collected by different institutions in the central government, which can then be compared to the cost-optimal energy performance. This sets the goal of primary energy savings, corresponding to the required 3% of annual savings that must be achieved by each official institution that must comply with this EED requirement (for 2015 results, cf. Table 3).

Obliged area 2013	258,426	m²	
Non-compliant area 2013	36,562	m²	14% of obliged building stock
Non-compliant area 2015	25,155	m²	10% of obliged building stock
Surface made conform in 2015 compared to 2013	11,407	m²	31% of 2013 non-compliant building stock
Primary EE 2015 vs 2013	1,701,315	kWh	Decrease of 2.3% vs 2013
Final EE 2015 vs 2013	512,827	kWh	Decrease of 1.0% vs 2013

Table 3. 2015 results for Walloon government buildings.

The measures that Wallonia plans to take in order to achieve its energy savings objectives are those recommended by the existing Walloon energy audits[7].

2.II.iii. Regulation of system performance, distinct from whole building performance

The Walloon Region sets a number of requirements concerning the individual elements of the buildings.

The walls, window frames, glazing and roofs must have a minimal thermal performance expressed with a U-value [W/m².K]. Since 1 January 2017, the U_{max} value for walls and roofs are harmonised and strengthened to 0.24 as is also the case for the $U_{w,max}$ and $U_{g,max}$ of windows, which are set to 1.5 and 1.1. From then on, the U-values are the same in the three regions of Belgium.

Every time a window sash or glazing is installed or replaced, the ventilation of the room has to be provided with a minimum fresh-air-flow rate.

Every time a heating, AC or ventilation system is installed, replaced or upgraded in existing residential and non-residential buildings, it must fulfil some minimum requirements related to energy, which entered into force on 1 May 2016 (Table 4).

Works submitted or not as part of a building permit	Performance	Insulation	Energy metering
Existing buildings	• Gas boiler • Oil boiler • Electrical heat pumps • Direct electric heating • Ice-water cooling machines • Ventilation heat recovery unit	• Hot water pipes • Ice-water pipes • Air ducts	• Large installations • Central source servicing multiple buildings • Central source servicing multiple units within a building
New buildings and assimilated	Accounted for in global performance calculation	Accounted for in global performance calculation	• Central source servicing multiple buildings • Central source servicing multiple units within a building

Table 4. Energy-related requirements for installed, replaced or upgraded heating, AC or ventilation systems.

Requirements concerning the consumption metering between buildings or in multi-purpose buildings (Article 9.3 of the EED) are included; these requirements also affect new buildings.

2.II.iv. Encouragement of intelligent metering

It is mandatory through the technical building system requirements to ensure that energy metering is undertaken for large installations. An overview is given in Table 5. The meters need to comply with harmonised standards and are readable either on-site or remotely. Smart metering is not yet mandatory.

Type of installation	Condition	Type of meter
Gas and liquid fuel boiler	> 100 kW thermal output	Fuel meter
Gas and liquid fuel boiler	> 400 kW thermal output	Calorimeter
Solid fuel boilers	> 100 kW thermal output	Calorimeter
Electrical heat pumps	> 12 kW thermal output	Electricity meter
Electrical heat pumps	> 100 kW thermal output	Calorimeter
Solar thermal panel	> 10 m²	Calorimeter
Cooling (ice-water)	> 12 kW thermal output	Electricity meter
Cooling (ice-water)	> 100 kW thermal output	Calorimeter
Cooling tower / External dry cooler		Electricity meter
Ventilation	> 10,000 m³/h	Electricity meter
Central heating or cooling source servicing multiple buildings		Calorimeter at each building*
Central heating or cooling source servicing multiple units within a building		Calorimeter at each unit or heat cost allocator on each radiator*

* If technically and economically feasible.

Table 5. Energy metering requirements for large installations.

2.II.v. Financial instruments and incentives for existing buildings

Concerning residential buildings, there are mainly two forms of incentives aimed at improving energy performance:

- Allowances covering part of the amount of renovation work (Table 6). These basic allowances may be increased according to household income (Table 7);
- Short-term credit (*Ecopacks / Renopack*[8]*s*) or mortgage loans (*Accesspack*[9]) at preferential rates. The amount of allowances for the proposed works shall be deducted from the loan amount.

Actual achievements:

- In 2015, 27,101 energy allowances were accepted for a total of 32 million €, and 2,900 *Ecopacks* have been signed for a total of 27.4 million €. These loans covered about 5,800 works to improve energy performance for a premium amount of 3.2 million €.
- In 2016, 11,870 energy allowances were accepted for a total of 10 million €, and *Ecopack* loans were signed for a total of 18.4 million €. These loans covered approximately 2,900 energy performance improvements for a premium amount of approximately 2 million €. During the same period, *Renopack* loans were signed for a total of 30 million €, corresponding to approximately 5,300 works with energy performance requirements for an allowance amount of approximately 3.6 million €.

Thermal insulation of roofs	by requester	R ≥ 4.5 m² K/W	6 €/m² (max. 100 m²)
	by contractor		15 €/m² (max. 100 m²)
Thermal insulation of walls (by contractor)	by inside	R ≥ 2 m² K/W	12 €/m² (max. 100 m²)
	by cavity	R ≥ 1.5 m² K/W	6 €/m² (max. 100 m²)
	by outside	R ≥ 3.5 m² K/W	25 €/m² (max. 100 m²)
Thermal insulation of floor (by contractor)	by cellar	R ≥ 3.5 m² K/W	10 €/m² (max. 100 m²)
	by slab	R ≥ 2 m² K/W	
Installation of heating system and/or sanitary hot water system (by contractor)	Condensing gas boiler		200 €
	SHW heat pump		750 €
	Heat pump for heating and combination heat pump		1,500 €
	Biomass boiler		1,750 €
	Solar water heater		1,500 €
Performing of energy audit	by an assessor		220 €

Table 6. Types of eligible work for an energy allowance and amount of basic allowances (as of 1 March 2018).

Income category	Household reference income	Increase of basic premium
C1	Less than or equal to 21,900 €	Base allowance multiplied by **3**
C2	Higher than 21,900.01 and less than or equal to 31,100 €	Base allowance multiplied by **2**
C3	Higher than 31,100.01 and less than or equal to 41,100 €	Base allowance multiplied by **1.5**
C4	Higher than 41,100.01 and less than or equal to 93,000 €	Base allowance multiplied by **1**

Table 7. Increase in basic allowances by household income categories.

2.II.vi. Information campaigns / complementary policies

The Walloon Region provides continuous information on EPCs, energy performance in buildings requirements, energy efficiency, etc. to the general public as well as to professionals through different communication tools:

The various publications available are:

- in the 16 energy information centres of the Department of Energy and Sustainable Buildings (*DESB*);
- in the 10 general information centres of the Walloon Region;
- in 10 annual fairs and exhibitions related to building and energy;
- on the website http://energie.wallonie.be (817,000 users from 1 January 2015 to 31 December 2016).

The two quarterly magazines published by the *DESB* are (Figure 6):

- "*Energie4*" (general public – 13,500 subscribers)[10];
- "*REactif*" (7,500 professional subscribers)[11].

A banner campaign to promote the EPC on the most relevant property sales & rentals website (*immoweb.be*)

Press articles in:

- "*Architrave*" (quarterly magazine for architects);
- "*SudPresse*" (daily press).

Video sequences are broadcast on public and private Belgian television channels as well as YouTube®.

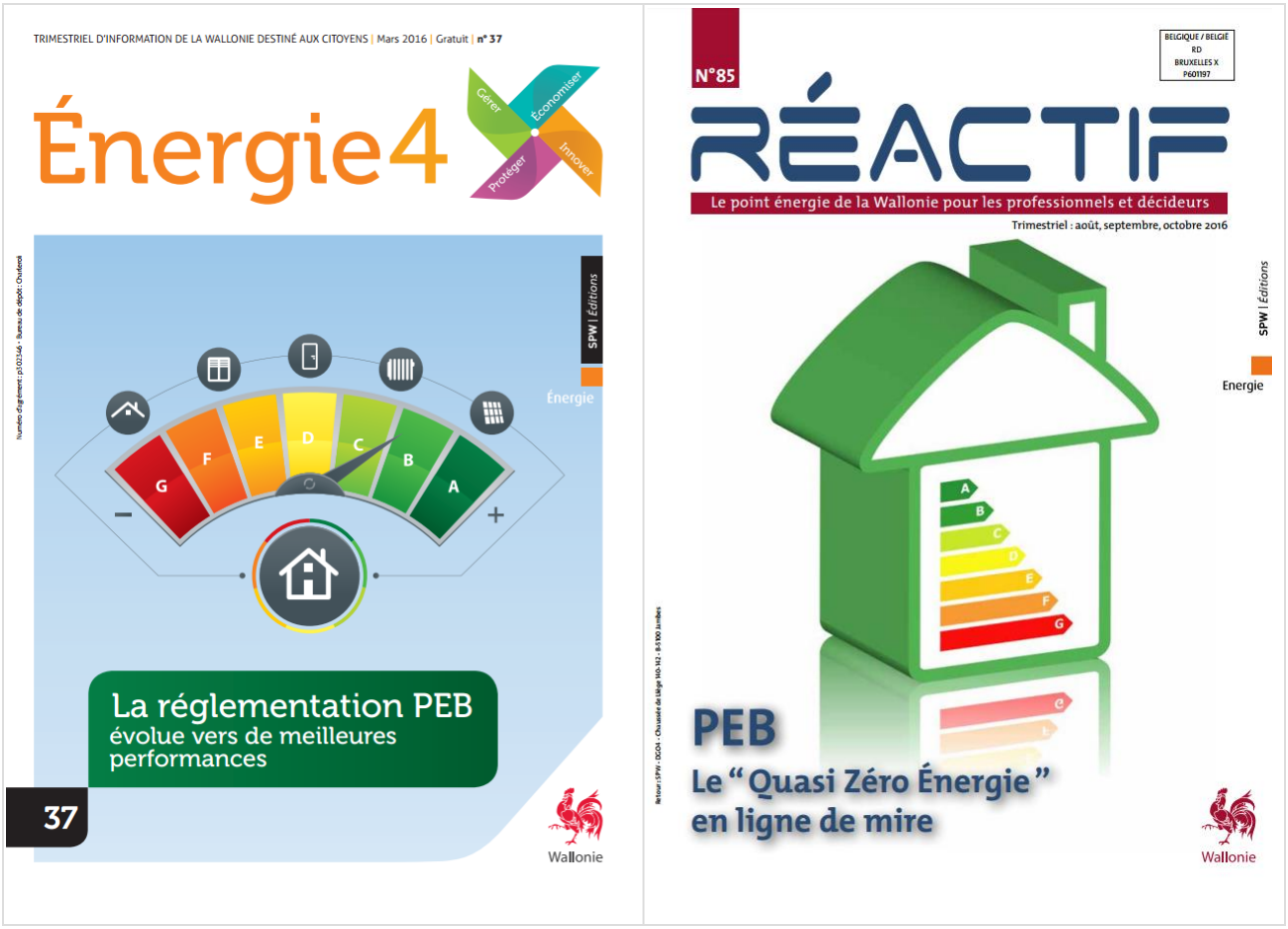


Figure 6. Information campaigns – Magazines "Energie4" and "REactif".

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

a. Oversight and administration system

For existing residential buildings, a dedicated, stand-alone software called *PACE* is used by assessors to input the building data collected, after which the server generates the EPC. The *PACE* software includes built-in validation rules which prevent incomplete EPCs to be sent to the database (which also includes new buildings). It also contains validation rules for input data to prevent mistakes (with rules prohibiting or flagging certain values). The files with the building data and the EPC are recorded in a database before the certificate is sent to the assessors by e-mail in a PDF format.

b. How apartments are certified in apartment buildings

Certification is performed individually for each apartment. In case systems are collective (e.g., heating or cooling system, centralised ventilation, and/or RES), an assessor performs an initial report regarding the systems, and data are collected and inputted into a database in order for certificates for each connected apartment to be issued.

c. Format and content of the EPC

For residential buildings, the EPC contains graphics regarding the global evaluation of energy performance, information on input data, and recommendations. It also includes illustrations and comments as well as explanations of the importance and type of documentation that can be considered as acceptable evidence (Figure 7).

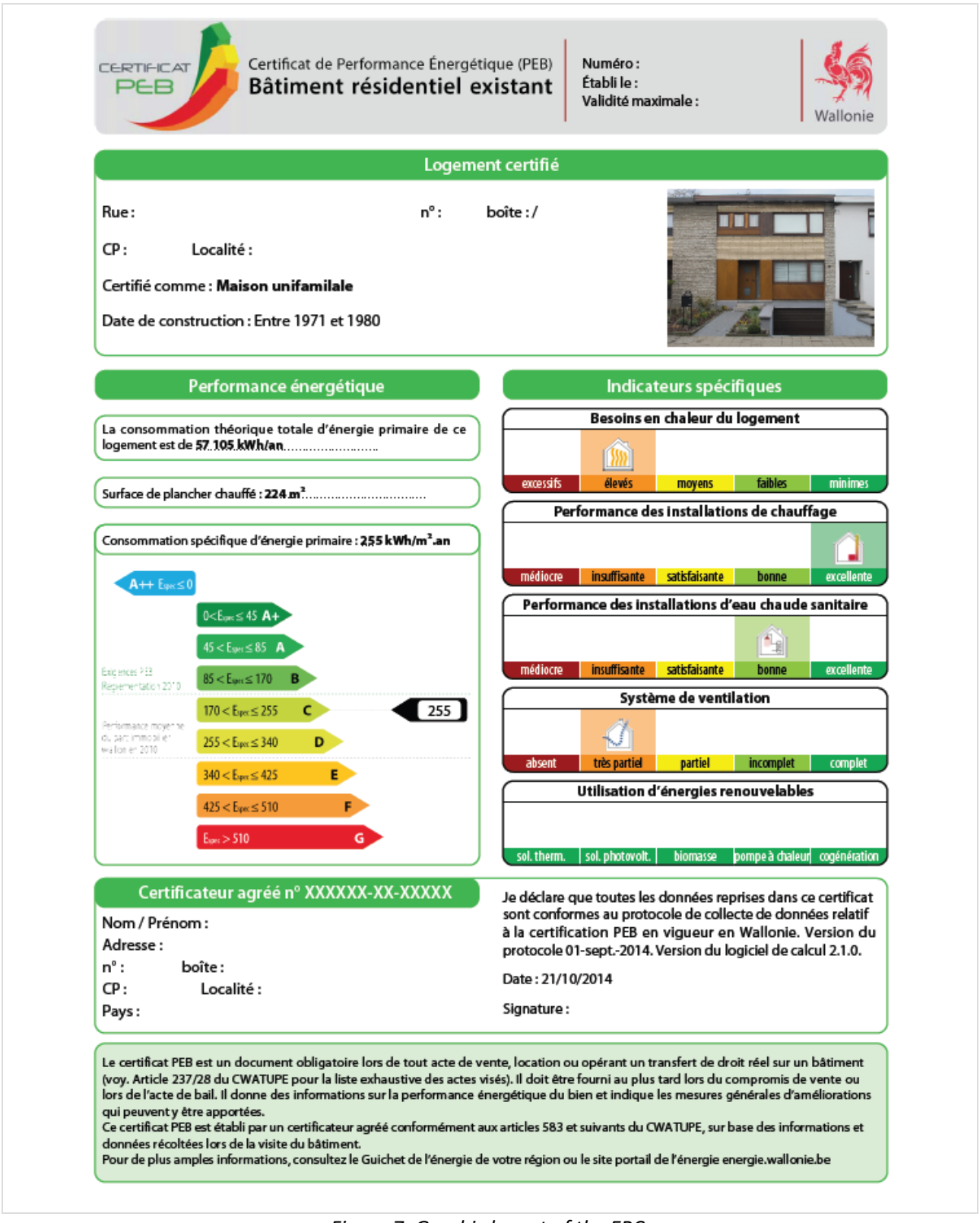


Figure 7. Graphic layout of the EPC.

d. EPC activity levels

Between June 2010 and late 2016, more than 395,000 certificates for existing residential buildings were registered in the database. This represents about 26% of the building stock. It is not possible to know how many EPCs have been issued for renovated buildings, since it is not an input data necessary for completing an EPC.

For new residential buildings, 12,996 certificates were issued by the administration and registered in the database between May 2010 and May 2015. Since May 2015, 6,473 certificates have already been issued by qualified experts and registered in the database.

e. Typical EPC costs

For existing residential buildings, the certification process is quick (about four hours), in order to keep the price – which is displayed on the certificate – low. In the early stages of certification, the average price for single-family houses was 480 € (VAT included). Currently, it is about 250 € (VAT included). The average price for an apartment was initially 250-350 € and is currently about 150 €. The total turnover generated since the beginning of the certification of existing residential buildings in June 2010 is about 102 million € (VAT included).

f. Assessor corps

At the end of 2016, more than 2,150 assessors were accredited.

In order for a firm to be accredited, there must be at least one accredited expert working for the company.

g. Compliance levels by sector

From May 2015, an administrative fine of 1,000 € is due in the absence of an EPC at the time of transaction. The fine will be doubled in the case of recidivism within three (3) years. By late 2016, this fine has been applied six (6) times. Other fines are also incurred for failing to communicate EPC results to the buyer or tenant, for example.

2.III.ii. Quality Assessment of EPCs

A Control web application is used to automatically screen all the EPCs submitted to the database by flagging inconsistant data or values and selecting a statiscally representative number of EPCs to be humanly controlled.

Its main functionalities are:

- screening of suspicious EPC data (based on improved data analysis feedback) and identifying the certificates concerned;
- randomly selecting EPCs so that each qualified expert gets regularly controlled;
- providing an interface for exchange between qualified experts and controllers;
- archiving control documents related to assessors.

The controller has access to a summary panel where he finds information on each qualified expert, e.g., the total number of EPCs submitted, the EPCs with inconsistencies and the EPCs selected for random control. The controller also has access to the EPC details and the list of inconsistencies.

If the investigation concludes that a control procedure should be launched, for example due to frequently occurring errors, the controller notifies the qualified expert of his errors and requests that supporting documentary evidence are provided. If necessary, wrong EPCs are corrected.

Whether the qualified expert receives a sanction or not depends on the frequency, quantity and type of errors, as well as on their impact on the EPC outcome, particularly on the label of the building.

Table 8 shows the number of EPCs selected by the Control web application and the total EPCs available in the database, per year whereas Table 9 presents the number of EPCs checked by the administration.

		certificates with SI status			certificates with AI status		
Year	Number of certificates	SI	SI*	% (SI+SI*)	AI	AI*	% (AI+AI*)
2011	65,011	34,089	1,766	55%	27,722	1,434	45%
2012	74,991	45,454	2,355	64%	25,813	1,369	36%
2013	65,037	46,640	2,483	76%	15,114	800	24%
2014	67,157	32,000	2,095	51%	30,897	2,165	49%
2015	71,547	49,569	2,608	73%	18,357	1,013	27%
2016	68,574	48,235	2,586	74%	16,889	864	26%

AI means certificates with inconsistent data or values

AI* means randomly selected certificates with inconsistent data or values

SI means without inconsistent data or values

SI* means randomly selected without inconsistent data or values

Table 8. Number of EPCs selected by the Control web application and the total EPCs available in the database, per year.

Year	Control Folder	Certificates checked	Certificates with error	Certificates without error or with an insignificant error	Certificates with suspicion of error (under checking)
2013	6	71	70	1	0
2014	73	1,075	874	201	0
2015	39	180	175	5	0
2016	268	1,551	1,548	3	0

Table 9. Number of EPCs checked by the administration.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

For public buildings visited by the public, a web software called *ECUS* was created to input the collected building data.

The certificate indicates the energy class of the building according to its type. This is based on the operational rating being converted into primary energy per m^2. The certificate also contains a graph showing the real consumption of electricity and combustible fuel for the last three (3) years and other specific indicators.

Statistics determining the number of buildings will be done afterwards.

2.III.iv. Implementation of mandatory advertising requirement – status

The display modes of indicators are:

- the energy label;
- E_{spec} expressed in kWh/m².year;
- E_{total} expressed in kWh/year;
- an EPC ID number

The need to display indicators and ID numbers varies depending on advertising supports (Table 10).

The display of indicators is primarily the responsibility of the owners (seller or lessor) as well as professional representatives (lawyers or real estate agents). Publishers and third-parties involved in the sales process do not have any responsibility.

Failure to display energy performance indicators in advertising is a punishable offence. This provision should be interpreted broadly, so that poor communication in achieving the regulation objectives is also punishable (e.g., having a display too small to be readable).

The decree foresees a fixed administrative fine of 500 € if the energy performance indicator(s) of the EPCs are absent from the advertisement. The fine is doubled in case of recidivism within three (3) years. Controls are performed by the Regional Administration of Energy. More than 170 real-estate agencies have been inspected since this obligation began.

	Mention to be integrated in **GRAPHIC** form	Mentions to integrate in **TEXT** format (or orally)			
	Energy Label 	**Energy Label** "**PEB : C**" "**PEB : from G to A++**"	**EPC ID** "**PEB No. ...**"	**Specifi Primary Energy Consumption** **(kWh/m² per year)** "**E spec : 123 kWh/m².y**"	**Primary Energy Consumption** **(kWh per year)** "**E totale : 12345 kWh/y**"
Ads (newspapers, magazines, etc.)					
in text format only	Not required	Mandatory	Mandatory	Recommended	Recommended
with pictures	Mandatory	Not required	Mandatory	Recommended	Recommended
Posters					
in text format only	Not required	Mandatory	Mandatory	Not required	Not required
with pictures	Mandatory	Not required	Mandatory	Recommended	Recommended
Real Estate Listings					
in text format only	Not required	Mandatory	Recommended	Not required	Not required
with pictures	Mandatory	Not required	Mandatory	Not required	Not required
Brochures and leaflets					
relating to a building, unit lot or apartment building	Mandatory	Recommended	Mandatory	Mandatory	Mandatory
Internet & mobile apps					
index pages	Mandatory	Not required	Not required	Not required	Not required
detailed pages	Mandatory	Not required	Mandatory	Mandatory	Mandatory
Direct Marketing					
emailings, newsletters	Mandatory	Recommended	Mandatory	Mandatory	Mandatory
Broadcast chanel					
	Mandatory	Not required	Mandatory	Not required	Not required
Radio					
	Not applicable	Mandatory	Not required	Not required	Not required

Table 10. Mandatory advertising requirements

2.IV Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

The choice made regarding inspections for heating and AC systems was to carry out inspections as described in sections 1, 2 and 3 of Articles 14 and 15 of the EPBD.

For heating, the inspection consists of a boiler efficiency assessment, or "periodic control", and a boiler sizing assessment, or "in-depth diagnosis". The former is mandatory at least every year for oil and solid fuel boilers, every two years for gas boilers with a rated power higher than 100 kW, and every three years for gas boilers with a rated power less than or equal to 100 kW. The latter is performed at the same time and need not be repeated for as long as the system or the heating needs of the building remain the same.

For AC, two executive orders are in force and concern, among other things, leakage checks. A a legal text modification containing energy aspects is about to be made (summer 2018).

2.IV.ii. Progress and current status on heating systems

Accreditations are managed by the Air Climate Agency (AwAC[12]). Their internal certification management system has recently been reviewed. Currently, 15 training centres are accredited for providing training to technicians inspecting liquid fuel boilers, and 12 for inspecting gas fuel boilers. At the end of April 2018, 2,872 technicians were certified to inspect gas fuel boilers, and 2,275 for liquid fuel boilers.

Participating administrations (DGO4[13] & AwAC) are currently reviewing the regulation. Wallonia plans to add a certification for solid fuel boilers and a carbon monoxide level check in the indoor air of the boiler room. The inspection reports will also be systematically computerised to simplify the control of certified technicians.

2.IV.iii. Progress and current status on AC systems

On the field, there are already professionals who audit AC systems. These inspections are not mandated by regulation.

After the new executive order is published and in force (see section I.Vi, above), accredited AC experts must complete specific training at an accredited training centre in order to be allowed to carry out energy inspections on AC systems. Energy-related trainings will complement this scheme.

Accreditations will also be managed by the AwAC to keep a simple and coherent pattern for both heating and AC inspections.

2.IV.iv. Enforcement and impact assessment of inspections

a. Enforcement and penalties

According to the Walloon Environmental Code[14], compliance control in accordance with the relevant executive orders is the responsibility of the Department of Environmental Police and Controls of the

Walloon Region. This decree also defines the penalties that may be imposed on persons violating these regulations.

The owner of a boiler is punishable for not performing inspections. The category of the infraction is set in the "*Loi relative à la lutte contre la pollution atmosphérique*"[15] (Federal Law of 28 December 1964). Sanctions are provided in the Environmental Code[16] Decree of 27 May 2004 and Executive Order of 17 March 2005. The associated penalties are: a fine ranging from 100 to 100,000 € or from 8 days to 6 months of imprisonment. The issuance of a statement for infringement is rare (about two (2) to three (3) statements per year).

Due to a lack of human resources, controls operated by the pollution repression unit of the Walloon Region up until now mainly occur in response to complaints.

b. Quality control of inspection reports

For heating, as regards inspections on specific energy aspects, inspections have not yet begun and none of the inspection reports issued in 2015 has yet been validated.

Quality assurance for AC will be the same as for heating systems, but inspections have not yet begun (see section IV. i, above).

c. Impact assessment.

No impact assessment has been made for heating inspections. The goal for Wallonia is to perform such an assessment when the new systematic electronic data input for inspection reports is operational.

No energy impact evaluation can be made regarding AC system inspections.

3. A success story in EPBD implementation

A review of the cost-optimal study is in the finalisation phase. A public tender was assigned to 3E consulting firm which has developed a partnership with the University of Liège and the software company Hemmis. A second contract was assigned to Altran, the historical developer of *EPB* software.

In addition to the report to be sent to the Commission, this study also aims to develop a software tool to automate the simulations necessary for its input. Indeed, one of the parameters influencing the accuracy and representativeness of the cost-optimal study is the number of simulations applied to the reference buildings and the number of reference buildings themselves. The encoding burdens resulting from large numbers of simulations led us to issue the development of the software tool for public tender, with such a tool allowing *EPB*-related data to be systematically analysed and cross-referenced with economic data and other parameters in order to conduct sensitivity studies. The tool makes it possible to automatically apply a large number of variants to the reference buildings modelled using the regulatory *EPB* software. It also makes it possible to extract energy performance results which are then automatically processed in a calculation cost unit. All possible simulations can therefore be tested. The tool then presents the results in terms of the global cost of the energy measures under consideration. It also allows for sensitivity studies to

be conducted by varying specific parameters within a determined range (e.g., U-value of a wall, etc.) (Figure 8).

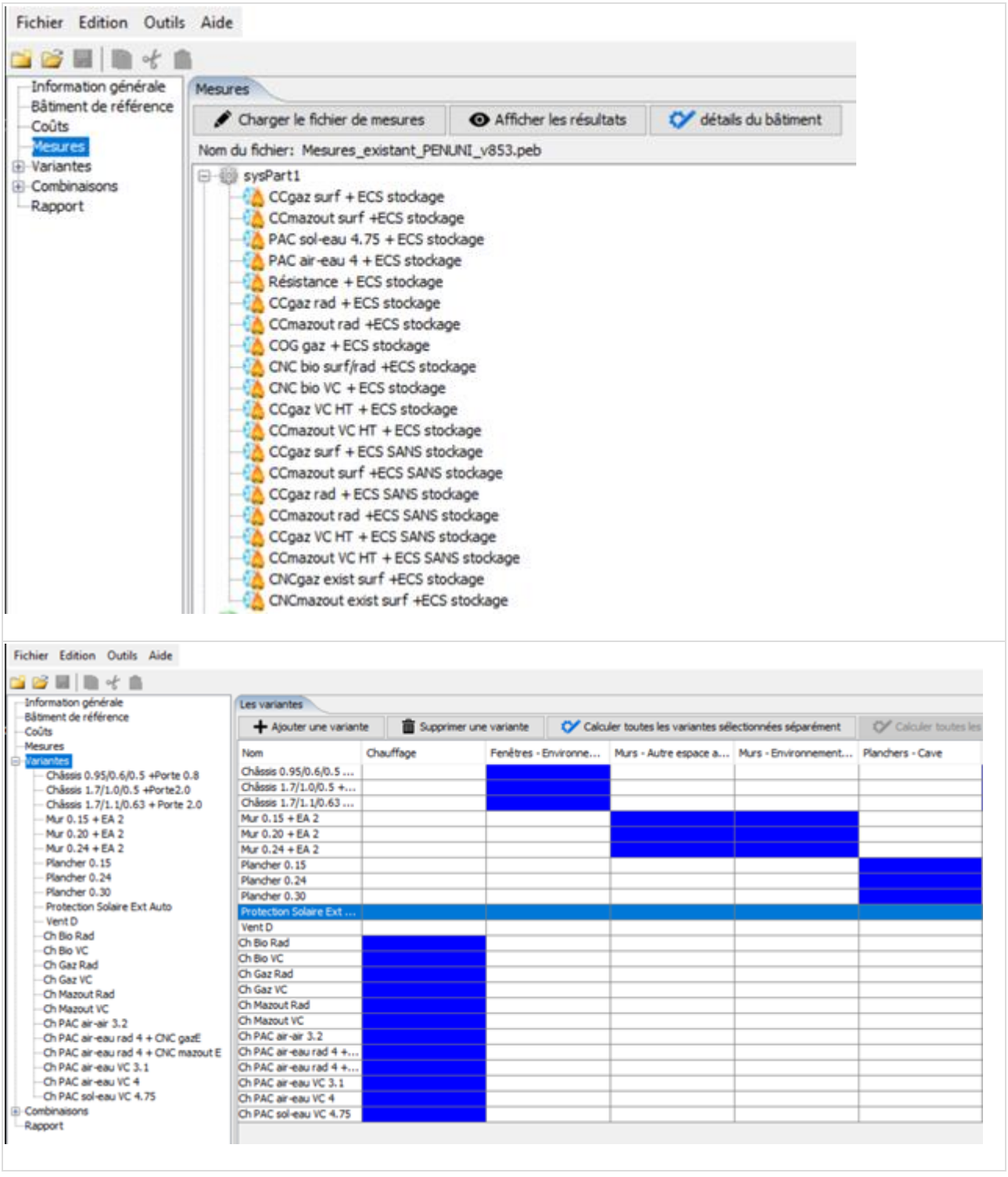




Figure 8. Cost-optimal tool software.

4. Conclusions, future plans

Since an ambitious Walloon renovation strategy has been approved by the government on 20 April 2017 and integrated into the 4th NEEAP, the Walloon Region will work on following the priorities identified in the strategy:

- adapting an incentives programme aimed at improving energy performance;
- certifying professionals related to energy efficiency improvement works;
- developing the “roadmap” and “building passport” tools, in order to allow an integrated and long-term renovation projects approach;
- ensuring that the various actions and policies currently being carried out by the administration are consistent with the objectives set by the strategy and serve the achievement of these objectives;
- defining indicators to verify the correct trajectory pursued by the administration to achieve the objectives of the strategy.

Endnotes

1. Décret relatif à la performance énergétique des bâtiments; https://wallex.wallonie.be/index.php?doc=27018&rev=30454-20809

2. Arrêté du Gouvernement wallon portant exécution du décret du 28 novembre 2013 relatif à la performance énergétique des bâtiments; https://wallex.wallonie.be/index.php?doc=28448&rev=31550-20809

3. Experts with a master's degree in architecture or engineering sciences.

4. Subsidy databases contain information such as physical characteristics and costs regarding currently constructed buildings in which the energy performance is much better than the current requirements and comparable to the foreseen NZEB requirements.

5. Arrêté du Gouvernement wallon portant exécution du décret du 28 novembre 2013 relatif à la performance énergétique des bâtiments; https://wallex.wallonie.be/index.php?doc=28448&rev=31550-20809

6. https://energie.wallonie.be/fr/strategie-de-renovation.html?IDC=9580

7. (*Procédure d'avis énergétique - PAE2*), which is a housing energy audit. (*Audit énergétique UREBA*). Concerns public buildings, educational buildings and buildings of the non-market sector.

8. www.swcs.be/

9. www.flw.be/

10. https://energie.wallonie.be/fr/trimestriel-energie4.html?IDC=9139

11. https://energie.wallonie.be/fr/trimestriel-le-reactif.html?IDC=9029

12. http://www.awac.be/

13. https://energie.wallonie.be. *Note:* For heating inspections all information is centralised on this unique page: http://www.awac.be/index.php/guichet-technique/agrements/chauffagistes

14. Code du droit de l'environnement. - Livre I^{er}. - Dispositions communes et générales; https://wallex.wallonie.be/index.php?doc=4549

15. Code du droit de l'environnement. - Livre I^{er}. - Dispositions communes et générales; https://wallex.wallonie.be/index.php?doc=4549

16. *Article D151 of Environmental Code:* «Les infractions de troisième catégorie sont punies d'un emprisonnement de huit jours à six mois ou d'une amende d'au moins 100 euros et au maximum 100.000 euros ou d'une de ces peines seulement.»

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Bulgaria

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.seea.government.bg, www.me.government.bg

1. Introduction

Actions for increasing energy efficiency have actively been applied during the last few decades in Bulgaria. This report outlines the development of the legal and technical measures to improve energy efficiency in buildings.

This report presents an overview of the application of the principles of the EPBD, Directives 2002/91/EC and 2010/31/EC. It outlines the development of regulatory measures set up to ensure mechanisms for reducing energy consumption in buildings in Bulgaria. In addition, efforts have been made to identify guidelines for future mechanisms to continue improving the energy efficiency of buildings.

The Minister of Energy is responsible for implementing all directives on energy efficiency (including the EPBD). All plans and programmes, including those in the building sector, are covered by the National Energy Efficiency Action Plan 2014-2020 (NEEAP). The Minister of Energy coordinates implementation in all sectors and produces reports on executing the NEEAP.

The Ministry of Energy is in charge of implementing state policy to increase energy efficiency in final energy consumption and in regards to the provision of energy services in Bulgaria. The Ministry of Regional Development and Public Works is responsible for developing and implementing technical rules and regulations in the field of energy performance for new and existing buildings, as well as projects for renovating buildings and improving their energy efficiency. The Sustainable Energy Development Agency (SEDA) implements the national policy on improving energy efficiency of both energy end-use and energy services.

By 2005, Bulgarian legislation had already introduced some principles of Directive 2002/91/EC. More recently, the following legislation was enacted:

- The Energy Efficiency Act, which came into force in 2008, with further amendments (repealed as of 2015);
- The Energy Efficiency Act, which came into force in 2015, and amended as of 30 December 2016, which transposed both the Directive 2002/91/EC and Directive 2010/31/EC into national legislation (http://seea.government.bg/documents/ZEE_EN.pdf).

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The Energy Efficiency Act, the Law on Spatial Planning and the relevant regulations that follow set out the legislative and technical measures that should, by law, be applied to new buildings. The energy performance of a new building, before the commissioning stage, shall be certified by an "*Energy Performance Certificate of New Building*". This is valid for six years from the date of commissioning of the building and is issued on the basis of the energy performance of the building according to the development and project design of the building. Minimum energy performance requirements have been gradually tightened since the EPBD was first implemented. At present, these requirements are set with the goal of achieving cost-optimal levels and have been defined for ten categories of buildings, depending on their assigned use. A new building meets the requirement for energy efficiency when the value of their integrated energy efficiency indicator (specific annual expenditure of primary energy in kWh/m^2) corresponds to at least the energy efficiency class "*B*".

The National Plan for Nearly Zero-Energy Buildings (NZEB), adopted in December 2015, provides the national definition and the technical parameters of NZEB and the national annual targets for construction of new NZEB by 2020.

2.I.ii. Format of national transposition and implementation of existing regulations

According to the Energy Efficiency Act and the Law on Spatial Planning, any building investment project must meet the energy efficiency requirements. Contracting entities are obliged to obtain an EPC of the building. This applies to new building projects, and, in the case of existing buildings, to reconstruction, major renovations, overhauls and refurbishments. Compliance with prescribed measures is assessed through energy audits performed by companies registered with the SEDA.

Ordinance No. 7 of 2004 on the energy efficiency in buildings, as amended in 2015, defines the cost-optimal levels of minimum energy performance requirements for buildings (or for individual building units) as well as the energy efficiency technical requirements and indicators. It also defines the methodology for calculating the indicators of energy consumption and the energy performance of buildings, including those for NZEB. When designing new buildings and reconstructing existing buildings, the investments in energy efficiency are eligible provided that the materials and the systems are in compliance with legal standards and technical specifications.

Ordinance No. RD-16-932 of 23 October 2009, on terms and conditions for inspecting the energy efficiency of boilers and air-conditioning (AC) systems, defines the framework for the compliance checking process of technical building systems. The SEDA is the authority that imposes penalties for non-compliance. Although, by the end of 2016, no penalties had yet been imposed.

2.I.iii. Action plan for progression to NZEB for new buildings

The National Plan for Nearly Zero-Energy Buildings 2015-2020 was adopted by the Council of Ministers in December 2015. The plan contains:

1. the national definition and the technical parameters of NZEB, reflecting the national conditions;
2. the national targets for increasing the number of NZEB depending on the classification of the types of buildings;
3. policies and mechanisms, including those of a financial nature, to stimulate the construction of NZEB.

The definition of NZEB is given in the Energy Efficiency Act of 15 May 2015. A NZEB is a building that simultaneously fulfils the following conditions:

1. the energy consumption of the building, defined as primary energy, complies with Class A on the scale of energy consumption classes for buildings of the relevant type; and
2. not less than 55% of the energy consumed (supplied) for heating, cooling, ventilation, domestic hot water and lighting is energy from RES produced on-site or near the building.

National targets for the construction of new buildings that satisfy the definition of the NZEB are given in Table 1. These targets are categorised according to the groups of buildings and estimated cumulative figures of end-use energy savings and emission reductions as of 2020 are provided.

Groups of buildings	Total floor area in m^2	Investments in BGN	End-use energy savings and emission reductions		
			ktoe	GWh	t CO_2
Administrative	492,895	110,907,633	8.2	95.7	11,090.2
Residential	74,570	17,474,562	1.2	13.8	3,314.9
Others	140,598	31,385,202	3.2	36.9	4,722.8
Total 2016 - 2020	**708,063**	**159,767,397**	**12.6**	**146.4**	**19,127.9**

Table 1: National targets for constructing new NZEB by 2020

The intermediate annual targets for improving the energy performance of new administrative buildings which include buildings occupied and owned by public authorities to satisfy the NZEB definition are given in Table 2. This table also includes estimated cumulative figures of end-use energy savings and emission reductions.

Year	Total floor area in m^2	Investments in BGN	End-use energy savings and emission reductions		
			ktoe	GWh	t CO_2
2016	9,092	2,045,677	0.15	1.80	204.57
2017	27,821	6,259,773	0.43	5.04	625.98
2018	66,214	14,898,259	1.00	11.63	1,489.83
2019	192,968	43,417,784	3.29	38.21	4,341.78
2020	196,800	44,286,140	3.35	38.97	4,428.00
Total 2016 - 2020	**492,895**	**110,907,633**	**8.22**	**95.65**	**11,090.16**

Table 2: National targets for constructing new administrative NZEB by 2020.

The Research Centre of the Technical University of Sofia, built in 2012, was the first NZEB in Bulgaria. The total primary energy use is 47.94 KWh/m^2 per year.



Figure 1: The first NZEB in Bulgaria, the Research Centre of the Technical University of Sofia.

2.I.iv. Requirements for systems and / or building components for new buildings

The technical building systems requirements apply to new buildings and the refurbishments and/or major renovations of existing buildings (when major renovations include all technical systems). The technical building systems requirements are specified in Ordinance No. 7 of 2004 on the energy efficiency in buildings, as amended in 2015. The special requirements relate to:

- parameters of systems for solar energy utilisation for domestic hot water;
- seasonal efficiency of heat pumps with electrically driven compressors in heating mode (specific fan power $SPF_{min} \geq 3.5$) and using thermal energy (specific fan power $SPF_{min} \geq 1.15$);
- seasonal efficiency of the air-to-air recuperators of ventilation and AC systems in heating mode $\eta_{r,min} \geq 70\%$;
- efficiency of boilers (including steam boilers and boilers burning biomass at nominal and partial load) for calculating the integrated energy efficiency indicator of the building - minimum requirements are given depending on the type and capacity of the boilers and the average temperature of the heated water;
- reference values for heat transfer through transparent enclosing structures;
- use of products in the buildings which must provide a high degree of environmental and health safety.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The Energy Efficiency Act, the Law on Spatial Planning and the relevant executive orders based on these laws set out the legislative and technical measures that must, by law, be applied to existing buildings. The "*Energy Performance Certificate of New Building*" is valid for 6 years from the date of commissioning of the building (see section I.i.). The owners of all these buildings are required to obtain an "*Energy Performance Certificate of Existing Building*" within a three-year period. This period begins three years after the date of commissioning. The energy performance of existing buildings is established by an energy audit, which is completed with the issuing of an EPC of the building. The "*Energy Performance Certificate of Existing Building*" shall be updated following any change in the energy performance of the building, for example after a change of use, deep renovation, or major renovation.

Minimum energy performance requirements for existing buildings have been gradually tightened since the EPBD was first implemented. At present, these requirements are set with the goal of achieving cost-optimal levels and have been defined for ten categories of buildings, depending on their assigned use. Existing buildings meet the requirement for energy efficiency when the value of their integrated energy efficiency indicator ("*specific annual expenditure of primary energy*" in kWh/m^2) corresponds, at least, to energy efficiency class "*B*", for buildings commissioned after 1 February 2010, or to class "*C*", for buildings commissioned before 1 February 2010.

The National Plan for Nearly Zero-Energy Buildings, adopted in December 2015, provides the national definition and the technical parameters of NZEB and the national targets for transforming refurbished state-owned and municipality-owned public buildings into NZEB by 2020.

2.II.ii. Plans to improve the existing building stock

The National Plan for Nearly Zero-Energy Buildings sets out the annual intermediate targets applicable for transforming refurbished public buildings owned by public authorities into NZEB (Table 3). These targets include the estimated cumulative figures of end-use energy savings and emission reductions. Public sector buildings are being used as pilot projects to encourage improvements in the existing building stock.

Year	Total floor area in m^2	Investments in BGN	End-use energy savings and emission reductions		
			ktoe	GWh	t CO_2
2016	0	0	0	0	0
2017	45,810	14,659,200	0.65	7.56	1,145
2018	66,214	29,318,400	1.30	15.11	2,291
2019	109,950	35,184,000	1.56	18.14	2,749
2020	137,450	43,984,000	1.95	22.68	3,436
Total 2016 - 2020	**384,830**	**123,145,600**	**5.46**	**63.49**	**9,621**

Table 3: National targets for transforming refurbished public buildings into NZEB by 2020.

The "*National Long-term Programme for Mobilising Investments in the Implementation of Measures for Improving the Energy Performance of Buildings*" is part of the NEEAP.

The Energy Efficiency Act in force provides for the adoption of:

- a long-term national programme to encourage investments in implementing measures to enhance the energy performance of the public and private national residential and commercial building stock;
- a national plan for improving the energy performance of heated and/or cooled state-owned buildings occupied by the state administration.

These plans and programmes are included as part of the NEEAP and are outlined below.

The "*Long-term national programme to encourage investments in implementing measures to enhance the energy performance of the public and private national residential and commercial building stock*" shall contain:

- an overview of the national building stock;
- the definition of cost-effective approaches to improving the energy performance of buildings, relevant to the building type and climatic zone;

- policies and measures to stimulate cost-effective deep improvement of the energy performance of buildings, including staged renovations;
- setting up a financial framework to guide investment decisions of investors, the construction industry and financial intermediaries;
- a forecast of the expected energy savings.

In addition to the above points, the "*National Plan for improving the energy performance of heated and/or cooled state-owned buildings occupied by the state administration"* shall contain the following point as well:

- a prioritised list of the buildings that, on 1 January of the relevant year, do not meet the minimum energy performance requirements.

To help reach the national energy efficiency target, at least 5% of the total floor area over 250 m^2 shall be renovated annually in all buildings which on 1 January of each year do not meet the minimum energy performance requirements.

2.II.iii. Regulation of system performance, distinct from whole building performance

The Energy Efficiency Act states that the following energy efficiency improvement measures shall be assessed as regards their technical and economic appropriateness:

- decentralised systems for energy production and use from RES;
- electricity and heat cogeneration installations;
- district or block heating and cooling, including those that are based entirely or partially on energy from RES;
- heat pumps.

These assessments are applicable for improvement measures that are recommended upon each change of use, deep renovation, or major renovation of a building (or part of a building) in use.

Energy performance must conform to the minimum regulatory requirements defined in Ordinance No. 7 of 2004 on the energy efficiency in buildings, as amended in 2015, after deep or major renovations that lead to a change in the energy performance of the building.

See also section I.iv. above.

2.II.iv. Encouragement of intelligent metering

For the time being, no special measures to stimulate the introduction of intelligent metering systems are in place in Bulgarian legislation. However, the Energy Act obligates energy companies to provide customers of energy services related to electricity or natural gas supply with detailed information on the consumption. This is for every day, week, month and year, using smart metering systems, by providing the final

customers data for a period covering not less than 24 previous months. This data can be provided to the customers via an internet portal or through the individual smart metering device in their building.

2.II.v. Financial instruments and incentives for existing buildings

The Energy Efficiency Act provides for schemes and mechanisms which may be applied to encourage energy efficiency, as follows:

1. energy performance contracts;
2. energy savings certificates;
3. financing from the Energy Efficiency and Renewable Sources Fund or from other financial intermediaries;
4. other national or European support schemes and mechanisms.

The "*National Programme for Energy Efficiency of Multi-Family Residential Buildings*" was launched in February 2015 by the Bulgarian government. The programme is being implemented across the country and has a financial resource of BGN 1 billion from the state budget. The programme can provide up to 100% of grant funding to eligible projects. Buildings eligible for support are multi-family residential buildings, provided they meet the national minimum energy performance requirements for existing buildings – energy efficiency class "*C*". There are key principles for ensuring the programme complements the Operational Programme "*Regions in Growth*" 2014-2020, which also provides grant support for renovating residential buildings (see section III for further details).

Under the Local Taxes and Fees Act, buildings which were commissioned before 1 January 2005 and which have acquired an EPC with an energy efficiency class of B, C or D are granted exemption from immovable property tax. This exemption can be for three, five, seven or ten years depending on the date of commissioning, the energy efficiency class, and whether RES is used to offset consumption of the building itself.

2.II.vi. Information campaigns / complementary policies

Targeted and specialised information campaigns, for the enhancement of the energy performance of buildings, have been conducted through several projects. These campaigns were implemented by the SEDA and NGOs within the framework of the EU-funded Intelligent Energy-Europe II programme.

Information days were held during 2015 and 2016 for beneficiaries under two grant schemes, for funding public and residential buildings, within the framework of Operational Programme "*Regions in Growth*" 2014-2020.

A list of financing mechanisms and schemes promoting energy efficiency in buildings has been published and is regularly updated on the SEDA's website (www.seea.government.bg/en). This includes information on the relevant regulations, procedures and conditions of certification, a database of auditing companies and experts, and information on training in the field of energy efficiency and existing qualification schemes. Most of the databases developed and maintained by the SEDA are also freely available, although some of

them require online registration. Nevertheless, the SEDA's regional offices currently provide information to various interested parties on the possibilities of energy efficiency measures.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

According to the Energy Efficiency Act in force, an EPC is mandatory for the purpose of selling or renting out a new or existing building (or an individual building unit). However, there are exceptions for some buildings: buildings of cultural merit, places of worship, and residential buildings with a limited annual time of use, to name a few. The energy performance of a new building, before the commissioning stage, is required to be certified by an "*Energy Performance Certificate of New Building*".

In all of these cases:

1. Upon the sale of the building as a whole, the seller shall provide the purchaser with the original EPC of the building.
2. Upon the sale of a building unit in a building, the seller shall provide the purchaser with a copy of the EPC of the building.
3. Upon renting the building, or a building unit therein, the landlord shall provide the tenant with a copy of the EPC of the building.

2.III.ii. Quality Assurance of EPCs

The verification of energy audits is performed by the SEDA through systematic or random sampling of the audited buildings. Control over the activity of the energy auditors is exercised by means of:

- checking the validity of the input data of the building used to issue the EPC, as well as the results stated in the certificate;
- checking the input data entered in the EPC and verifying the results, including the recommendations made for energy efficiency improvement;
- a full check of data, results and measures prescribed for energy efficiency improvement by an on-site visit in order to verify the validity between the data stated in the EPC and the certified building.

The total number of EPCs issued in 2015 and 2016 amounts respectively to 1,447 and 2,656, and an independent random control was carried out by the SEDA on all these EPCs.

Up to the end of 2016, no fines/penalties had been imposed.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

All existing buildings, including public and large buildings visited by the public, shall be subject to mandatory audits and certification - with the exception of some buildings of cultural merit, places of worship, and residential buildings with a limited annual time of use, to name a few.

2.III.iv. Implementation of mandatory advertising requirement – status

The owners of existing buildings with a total floor area of over 250 m^2 for which an EPC has been issued, are required to clearly display the certificate in the building. The cover page of the EPC reflects representative data, which shall be placed in a prominent location in the building, clearly visible to the public. In particular, the cover page of the EPC shall state the following results:

- the current energy performance of the building and the conformity thereof with the scale of energy efficiency class at the time of the energy audit;
- the estimated energy efficiency class, which is expected to be achieved after a package of energy efficiency measures in the building have been implemented.

Furthermore, where a building for which an EPC has been issued (or a building unit therein) is announced for sale or rental, the parameter "*Specific annual expenditure of primary energy*" in kWh/m^2, stated in the certificate, shall be noted in all advertisements. Before concluding a contract of sale or a rental agreement, the seller or landlord shall show the EPC to the prospective buyer or tenant.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Bulgaria has a full regular inspections scheme in place for heating systems with hot water boilers and AC systems in buildings. The purpose of energy efficiency inspections of these systems is to establish the level of efficiency in operation and to identify measures for improvement of the inspected system efficiency.

2.IV.ii. Progress and current status on heating systems

The Energy Efficiency Act stipulates a regular inspection of heating systems with hot water boilers of an effective rated output for space heating purposes of more than 20 kW in all types of buildings. The inspection includes the following assessments:

- the condition and functioning of the accessible parts of building heating systems, including the hot water boilers, the heat supply control systems and the circulation pumps;
- the efficiency of hot water boilers, of a single rated output of more than 50 kW;
- the sizing of the hot water boilers compared with the heating requirements of the building - in case of changes made to the heating system or the heating requirements of the building in the meantime.

Depending on the installed capacity and the type of energy used, the heating systems with hot water boilers shall be subject to mandatory periodic energy efficiency inspections every three, four or eight years. The number of systems inspected in 2015 and 2016 are shown in Table 4. The inspections are carried out by registered energy auditors listed in a special public register, which is maintained and administrated by the SEDA and promoted via the SEDA's website. The SEDA is the body responsible for the independent control of inspection reports on heating systems. A restricted access database on the condition of the heating systems is maintained by the SEDA (Table 5).

Year	2015		2016	
	Number	Installed capacity (MW)	Number	Installed capacity (MW)
Heating systems	199	119.58	132	72.08
AC systems	138	7.77	50	8.43
Total	**337**	**127.35**	**182**	**80.51**

Table 4: Inspections of boilers and AC systems in buildings, 2015-2016.

Year	2015		2016	
	Number	Installed capacity (MW)	Number	Installed capacity (MW)
Heating systems	128	102.01	109	56.35
AC systems	51	3.54	27	6.69
Total	**179**	**105.55**	**136**	**63.04**

Table 5: Registered boilers and AC systems in buildings, 2015-2016.

2.IV.iii. Progress and current status on AC systems

According to the Energy Efficiency Act, AC systems in buildings of a rated output of more than 12 kW are subject to mandatory regular energy efficiency inspection every four years. The number of systems inspected in 2015 and 2016 are shown in Table 4. The inspection includes an assessment of the condition and functioning of the accessible parts of the AC system, the efficiency of the AC system, and the sizing of the AC system compared to the cooling requirements of the building. The sizing is inspected in case of changes made to the system or the cooling requirements of the building in the meantime.

Registered energy auditors, listed in a special public register, which is maintained and administrated by the SEDA and promoted via the SEDA's website (www.seea.government.bg/en), carry out the inspections. The SEDA is the body responsible for independent control of inspection reports on AC systems. A restricted access database on the condition of the AC systems is maintained by the SEDA (Table 5).

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Control over the activity of the inspectors is undertaken by means of checks. On the basis of the results of the check, the SEDA may:

- issue mandatory requests to the inspectors, to eliminate any violations ascertained, accompanied by a time limit for compliance with the requests;
- draw up written statements recording administrative violations.

Any inspectors who fail to comply with the mandatory requests shall be liable to a fine of BGN 2,000-5,000 or to a penalty of BGN 10,000-30,000.

Up to the end of 2016, no fines/penalties have been imposed by the SEDA.

Quality control of inspection reports

The verification of inspection reports is performed by the SEDA by systematic or random sampling of all the inspection reports issued annually.

The total number of inspection reports issued in 2015 and 2016 amounts respectively to 337 and 182 (Table 4). An independent random control was carried out by the SEDA on all these inspection reports.

Impact assessment, costs and benefits

Currently, no impact assessment has been made.

So far, there have been no studies comparing the costs and benefits of inspections of heating, AC and ventilation systems. Based on the feedback received from the inspection companies, it is estimated that only a fraction of the inspections results in measures undertaken to lower the energy consumption.

3. A success story in EPBD implementation

The residential sector in Bulgaria accounts for about ¼ of the final energy consumption. Energy is used mainly in buildings and primarily for space heating (around 70% of energy use). The efficiency potential in space heating is significant. The pre-1990 buildings, which account for 90% of the building stock, are in very poor condition due to lack of maintenance, and their energy consumption is at least twice as high as in those buildings built according to current standards, mostly due to the low quality of insulation. As a result, about 45% of households report that they could not keep the home 'adequately warm' and 34% indicate that they were facing arrears on energy utility bills. These are by far the highest figures within the EU, where the respective averages were 11% and 10%.

The government's "National Programme for Energy Efficiency of Multi-Family Buildings" (Programme) was launched during February 2015 to help address the difficulties above. The Programme builds upon past efforts aiming at much higher results. The Programme is fully in line with the country's and the EU's climate and energy strategy. It aims at:

- improving energy efficiency of multi-family residential buildings;
- extending the lifetime of buildings;

- contributing to a reduction in local and global air pollution.

The Ministry of Regional Development and Public Works is responsible for the overall Programme design and coordination among government entities.

The "Programme Development Objective" is to secure better living conditions for citizens at multi-family buildings, heat comfort and better quality of the living environment through implementing energy efficiency measures.

The key characteristics of the Programme include the following:

- **Targeting:** Residential buildings of three or more floors, with six or more building units of residential use designed before 26 April 1999. Eligible buildings belong to a registered homeowners association, which would sign a contract with their respective municipalities authorising them to manage the renovation process. All 265 Bulgarian municipalities are eligible to participate in the Programme.

- **Financial support:** Up to 100% of grant support for eligible expenditures (no co-financing requirement) mainly covering measures to:

  (i) improve the energy efficiency of the buildings (thermal insulation of building envelope, improvements of the heating, electrical work, etc.) and common spaces;

  (ii) improve the structural soundness of the buildings to, amongst other things, comply with the current building code, if needed.

  Measures to be implemented should bring the energy consumption of the building to at least energy efficiency class "C" (energy use between 191 kWh/m^2 and 240 kWh/m^2) at the lowest cost.

- **Implementation mechanisms:** The Programme is administered mainly through municipalities (decentralised implementation). They not only approve project applications and sign contracts, but are also responsible for procuring and accepting all energy and structural audits, approving detailed designs, issuing construction permits and performing construction supervision. Public procurement, supervision and oversight are done in line with existing national legislation and auditing and construction standards. Regional governors in their capacity of representatives of the state have an oversight role of the Programme in their respective region.

- **Financing of the Programme:** The Programme has an overall budget of BGN 1 billion (about 500 million €) financed by the state budget with an announced potential prolongation, involving another BGN 1 billion. The Bulgarian Development Bank, acting as a paying agent, is responsible for mobilising the financing for the Programme and channelling the resources to municipalities according to signed contracts with the municipalities and regional governors.

4. Conclusions, future plans

The legal framework on the energy efficiency of buildings in Bulgaria has been expanded in conformity with the EPBD and other EU Directives. It stimulates the wider application of new financial and market mechanisms targeting energy end-users with the aim of facilitating the application of energy efficiency measures in the building stock.

Current plans and programmes in place have contributed towards the achievement of the national energy efficiency targets by 2020. These include:

- implementing the ambitious National Plan for Nearly Zero-Energy Buildings, 2015-2020;
- completing the "*National Programme for Energy Efficiency of Multi-Family Residential Buildings*";
- achieving a high level of absorption of the EU financial resources under the projects for building renovations within the framework of the Operational Programme "*Regions in Growth*" 2014-2020.

These plans and programmes will also contribute towards making further energy efficiency improvements after 2020. This process will be boosted by the upcoming adoption of the "*Long-term national programme to encourage investments in implementing measures to enhance the energy performance of the public and private national residential and commercial building stock*", and the "*National Plan for improvement of the energy performance of heated and/or cooled state-owned buildings occupied by the state administration*".

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Croatia

Status in October 2017

AUTHORS

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NATIONAL WEBSITES

www.mgipu.hr

1. Introduction

Croatia's first steps towards transposing the EPBD started in 2005; however, the Ministry of Construction and Physical Planning (MCPP) officially began implementing the EPBD in 2008, and the Ministry of Economy became responsible for transposing certain other areas of the directive. With the new Building Act (OG 153/2013), the MCPP became the sole ministry in charge of transposing and implementing the EPBD. The Building Act sets the legislative basis for the implementation of all articles of the EPBD.

In 2015, new values for the energy performance of buildings were established as follows:

- maximum annual primary energy consumption per usable floor area of a building (E''_{prim});
- maximum delivered energy per of usable floor area of a building (E''_{del});
- maximum annual energy needs for heating per usable floor area of a building ($Q''_{H,nd}$), for new buildings and for existing buildings undergoing renovation; and
- maximum E''_{prim} for NZEB and the share of RES in the total energy consumption.

Also prescribed within the Building Act are: the need for lighting, efficiency of technical building systems, energy efficiency class of the building automation and control systems. The study on the application of alternative energy supply systems is mandatory for buildings with a useful floor area of ≥ 50 m^2.

Currently, Croatia is running a test phase for implementing an electronic database for the EPCs and for reports of the regular inspection of heating and cooling/AC systems, as well as a national software tool for the calculation of the EPC.

In order to enhance the energy performance of buildings, four national programmes were adopted. Since 2014, a large number of buildings, particularly single- and multi-family buildings, have been renovated

using incentives provided by the Fund for Environmental Protection and Energy Efficiency (EPEEF). An ESCO model was used to renovate public sector buildings.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Energy performance requirements for new buildings are set for residential buildings and for various types of non-residential buildings heated to a temperature of 18 ^{o}C or higher. Furthermore, buildings heated to a temperature of 12-18 ^{o}C must meet requirements on minimum thermal protection, reduction of thermal bridges, requirements to prevent overheating, etc.

2.I.i. Progress and current status of new buildings

Based on cost-optimal analyses that were carried out in 2013 and 2014, requirements are set on individual types of buildings regarding annual energy needs for heating per usable floor area of a building ($Q''_{H,nd}$) The requirement regarding annual primary energy per usable floor area of a building (E''_{prim}) is included in the Technical Regulation on the rational use of energy and heat retention in buildings (OG 97/2014 and 130/2014) and the remaining requirements for annual delivered energy per usable floor area of a building (E''_{del}) are specified in the new Technical Regulation on the rational use of energy and heat retention in buildings, published in November 2015 (OG 128/15).

Requirements are prescribed for the maximum E''_{prim}, E''_{del}, $Q''_{H,nd}$, annual energy need for cooling per usable floor area of a building ($Q''_{C,nd}$), the maximum permitted thermal transmittance for individual building components of the building envelope (U-value), the reduction of the effects of thermal bridges (for this purpose, a catalogue of good solutions has been developed), the efficiency of technical building systems, the efficiency class of the building automation and control systems, the airtightness of buildings, and the share of RES. Provisions for indoor environmental quality (including air quality, thermal comfort, lighting and acoustics) are also provided.

2.I.ii. Format of national transposition and implementation of existing regulations

The EPBD is transposed within the Building Act (OG 153/2013), which also lays down penalties in order to ensure that all the requirements of the EPBD are fulfilled. The Building Act also sets some secondary regulations, including:

- the Technical regulation on the rational use of energy and heat retention in buildings (OG 128/2015);
- the Ordinance on energy audits of buildings and energy certification (OG 48/2014, 150/2014,133/2015, 22/2016, 49/2016, 87/2016);
- the Ordinance on individuals authorised to perform energy certifications of buildings, energy audits of buildings and regular controls of heating systems and cooling or AC systems of buildings (OG 73/2015 and 133/2015);

- the Ordinance on the control of EPCs of buildings and of reports on energy audits of heating systems and cooling or AC systems (OG 73/2015);
- the Methodology for carrying out energy audits on construction activities with the algorithm for calculating the energy performance of buildings (June 2014), which includes the algorithm for calculating the energy performance of buildings based on CEN standards, except in individual cases where CEN standards were not appropriate, in which case other solutions were used (e.g., the application of the roof standard, ventilation and AC). This algorithm is updated occasionally. For the purpose of primary energy calculations, a set of primary energy conversion factors was determined. The calculation used three-year average data from actual annual energy balances of Croatia in 2009-2011. At the moment, some of these factors are under review;
- the Ordinance on energy audits of buildings and energy certification (OG 88/2017), entering into force on 30 September 2017;
- the Methodology for carrying out energy audits of buildings, entering into force on 30 September 2017.

2.I.iii. Action plan for progression to NZEB for new buildings

The primary energy requirements for NZEB were established in 2014 as the lowest primary energy values among the analysed systems, providing they do not correspond to high global costs. The least-cost measures have been determined using the cost-optimal analysis, thus setting the optimal level of energy consumption for new and refurbished buildings. In contrast, when determining the requirements for NZEB, the range of options with the lowest primary energy consumption have been chosen to set requirements regardless of the global cost of these options (between the lowest global cost and lowest primary energy requirement).

At least 30% of the annual primary energy must be covered using RES generated on-site (i.e., by the building itself or somewhere in its vicinity); requirements for $Q_{H,nd}$ and U-values for building elements are also applied as for new buildings.

NZEB definitions were set in 2014 for all types of buildings and have recently been updated in the Technical Regulation of 2015. Values for maximum allowed E''_{prim} for some types of buildings (according to the regulations from 2014) have slightly increased due to the variety of reference geometry input when analysing cost-optimality and NZEB. In situations where values for NZEB were higher than the values obtained in the cost-optimal analysis, the values for NZEB were corrected according to the results of the geometry for cost-optimal analysis.

The number of low-energy and passive buildings increases in Croatia on a yearly basis, particularly for single-family houses, multi-residential buildings and recently constructed office buildings.

2.I.iv. Requirements for systems and / or building components for new buildings

Requirements are set:

- for buildings as a whole;
- for the U-values of the building envelope elements;
- for the reduction of the effects of thermal bridges and water vapour condensation inside building elements and on the surface of building elements;
- on the efficiency of technical building systems.

Since 2015, in addition to the previously determined U-values for building envelope elements, U-values are also prescribed for cupolas, light bars and windshields.

The designed and installed heating systems in new buildings must compensate for heat losses in order to maintain indoor thermal comfort. Among other requirements, heating systems must have thermally insulated pipeworks.

For buildings equipped with heating systems with air-to-air heat pumps, the seasonal coefficient of the performance of individual heat pumps (SCOP) should be ≥ 4.0; for heating systems with air-to-water, water-to-water and soil-to-water heat pumps, the seasonal performance factor (SPF H3) of individual heat pumps should be ≥ 3.0. SCOP includes the heat pump, regulation, auxiliary heating unit and other parts of the system, such as pumps and ventilators on the side of the heat storage tank. SPF H3 is the factor which influences the calculated limit that includes the heat pump, regulation, auxiliary heater, and all parts of the system, including pumps and fans on the side of the tank's thermal sources (air, water, soil). Air-to-air systems do not contain the listed parts (they contain freon) and have no impact on the factor.

2.II. ENERGY PERFORMANCE Requirements EXISTING BUILDINGS

Energy performance requirements for existing buildings, heated to a temperature of 18 ^{o}C or higher undergoing reconstruction are set depending on building type and the size of the reconstruction. Buildings heated to a temperature of 12-18 ^{o}C shall meet requirements on minimum thermal protection, reduction of thermal bridges, requirements to protect overheating, etc.

2.II.i. Progress and current status of existing buildings

Requirements for energy performance are prescribed for existing buildings undergoing major renovations that include more than 75% of a heated building envelope and in the case of a building extention.

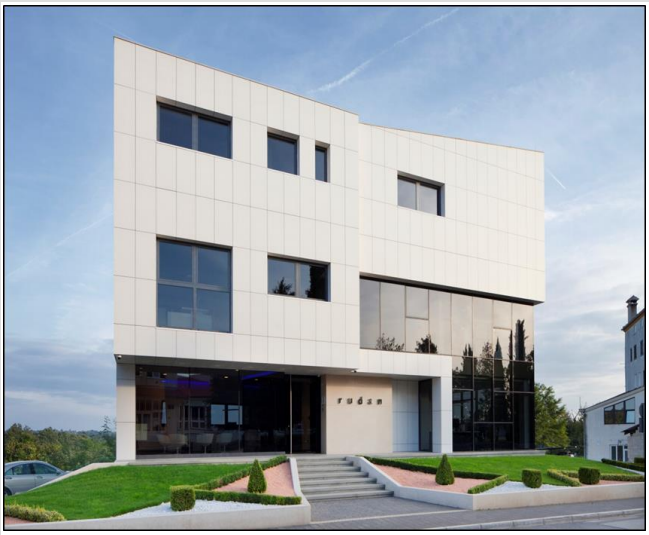
In the case where only certain building envelope elements of a heated part of the building covering an area over 25% are renovated, the U-value of the entire building element (for all types of buildings) shall fulfill the prescribed requirements.

In the case where reconstruction covers an area over 75% of the surface of the heated building envelope, requirements are set as U-values for the building elements, $Q''_{H,nd}$, E''_{del}, E''_{prim} (including energy for heating, cooling, ventilation, hot water, and lighting for non-residential buildings).

The application of highly efficient alternative systems should also be considered and taken into account in so far as they are technically, economically and functionally feasible.

2.II.ii. Plans to improve the existing building stock

Case Study



The office building in Žminj (AGM PROJEKT d.o.o.) is a reinforced concrete building with a total floor area of 802.00 m^2. The building elements include:

- external walls and walls touching the garage and attics insulated with mineral wool (20 cm);
- flat and sloping roofs above heated spaces and ceilings towards attics insulated with mineral wool (40 cm);
- ceilings above outdoor air and ceilings above garage isolated with mineral wool 25 cm;
- windows with three-layered glazing – tinted glass, double low coating, U-value = 0.9 – 1.1 W/(m^2 K).

RES in the building: PV power plant 10 kW, total energy production 13,000.00 kWh/year; solar water heating systems for low temperature underfloor heating and domestic hot water; heat pump with a coefficient of performance of 4.13. The air inside the building is exchanged via a forced recuperation ventilation system combined with a heat exchanger.

LED lighting is combined with sensor lighting. Building automation and control systems of the thermal engineering, lighting and shading opening the envelope of the building depending on day lighting throughout the year, with the task to prioritise parts of the technical building systems in order to optimise consumption of operating energy. $Q''_{H,nd}$ < 15 kWh/m^2year, electrical energy consumption is 882.65 kWh/year.

Figure 1. Office building in Žminj

The national definition of NZEB is the same for both new and renovated buildings. As a result, achieving NZEB standards in existing buildings in many cases can be difficult, specifically when fulfilling the share of RES. The main obstacles for the renovation of the national building stock into NZEB are due to financial constraints, including long periods of return on investment, different priorities for stakeholders, lengthy and complex public tenders for funding, but also the lack of information and motivation for investors, the public and stakeholders.

The National Action Plan to increase the number of NZEB by 2020 (published in 2014) covers all types of buildings, including non-residential buildings that are used by the public, e.g., offices, educational buildings, hospitals and sports facilities.

Croatia plans on increasing the number of NZEB through programmes that stimulate the construction of energy efficient renovations (e.g., the Programme for energy renovations of the public building sector).

According to the Long-Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia[1], in order to achieve targets and indicators for the period up to 2050, various measures are envisaged. These include developing renovation techniques (e.g., in relation to the type of material from which a building is built, or specifically for the renovation of historic buildings and buildings of cultural significance), training workers and certifying contracting companies. Around 1% of the building stock is forecasted to undergo holistic renovation to the NZEB standard each year up to 2020. It is then envisaged that 5% of buildings shall be renovated to the NZEB standard or to a high energy-performance level and finally, by 2050, all buildings will be NZEB or have a high energy efficiency, thus reducing greenhouse gases in buildings by 80%.

The costs for achieving the energy renovation objectives (to NZEB standards), including funds for investment and operation, are estimated to be nearly 7 billion € up to 2050.

The required energy saving level in central government buildings (774 buildings with a total floor area of 1,325,000 m^2) must be achieved using an alternative approach, in line with Article 5 of the EED. The annual savings (equivalent to renovating 3% of the buildings owned and occupied by the central government) have been calculated to reach 1.36 GWh (4.89 TJ) per year. This consumption corresponds to approximately 17 buildings being renovated annually, and represents 0.0045% of the total final consumption of all buildings in 2012 (ca. 29,777.78 GWh).

The Programme for the energy renovation of the public building sector (central government buildings are included) promotes deep renovation of the buildings, which therefore includes measures for the building envelope as well as for technical building systems. According to the National Energy Efficiency Action Plan III (NEEAP III), on an annual basis up to 2020, it is planned to arrange and implement a comprehensive energy renovation of 33,267 m^2 of total useful floor area (heated area) of central government buildings (which represents 3% of the total useful floor area).

2.II.iii. Regulation of system performance, distinct from whole building performance

Requirements are set for individual elements of buildings and for technical building systems in case of building renovation. When renovating part of the building envelope, the U-value of this part shall meet the requirements as prescribed for a new building. The prevention of overheating caused by solar radiation and air permeability of the windows, doors and skylights shall comply with the requirements specified for new buildings. When replacing, modernising or upgrading technical building systems, the same requirements apply as for the installation of these technical building systems in new buildings.

2.II.iv. Encouragement of intelligent metering

Promotion and encouragement to include intelligent metering is prescribed by the Building Act. Each building, depending on the type and purpose, must be designed and constructed so that it is possible, without significant costs, to ensure individual metering of energy and water consumption, with the possibility to have remote readings for individual and separate parts of the building.

2.II.v. Financial instruments and incentives for existing buildings

Until now, the role of the government has been crucial in the success of building energy renovation. In 2013, 2014 and 2015, the government adopted four building renovation programmes for single-family houses, multi-family houses, commercial buildings and public sector buildings.

The programmes for the energy renovation of both single-family and multi-family houses that were implemented by the end of 2016 provided financial incentives for integral renovations as well as for implementing individual measures to improve energy-efficiency.

So far, 9,574 projects for implementing energy efficiency and installing RES in single-family houses have been completed and about 476 million kuna (64.9 million €) has been disbursed from the national Environmental Protection and Energy Efficiency Fund (EPEEF).

Over 2,300 projects or requests from building managers have been approved and contracted under the programme for the energy renovation of multi-family houses and a total funding of more than 279 million kuna (37.5 million €) was approved.

Also, 170 requests for the energy renovation of commercial buildings have been received, of which 80 have been approved, and for which 46 million kuna (6.2 million €) has been secured. Of those approved projects, 43 projects have been completed, for which about 20 million kuna (2.7 million €) has been paid.

Regarding the implementation of the Programme for the energy renovation of public sector buildings, 57 public procurement procedures have been published for the provision of energy services and 20 agreements on the energy performance of buildings have been signed. The estimated value (excluding VAT) is about 364 million kuna (48.9 million €).

During 2016, a further 7 contracts for building energy performance were signed for an estimated value (excluding VAT) of 219 million kuna (29.4 million €).

Adaptation of existing programmes for energy renovation to the conditions of co-financing from the EU funds, for which 311 million euros are provided up to 2020, is in progress.

2.II.vi. Information campaigns / complementary policies

Information activities are mainly focused on the promotion of national energy renovation programmes. MCPP and EPEEF have been carrying out workshops with interest groups in many cities throughout Croatia. Information leaflets with all the rules for submitting project proposals for subsidies for energy renovations were prepared and distributed. Additionally, the EPEEF has assisted applicants in filling out and completing the forms for incentives for energy renovations.

In order to achieve the required level of energy efficiency, the Croatian Chamber of Architects, the Croatian Chamber of Civil Engineers, the Croatian Chamber of Mechanical Engineers and the Croatian Association of Building Energy Assessors provide seminars for designers and site engineers who carry out and are responsible for the execution of certain buildings works.

A national platform on energy efficiency has been established with the aim to promote energy efficiency at the national level, informing the general public about the plans, realised measures and their effects (www.enu.hr).



Figure 2. Information leaflet for the energy renovation of multi-family houses, MCPP, 2016.



Figure 3. Information leaflet for the energy renovation of public sector buildings and use of RES, MCPP, 2016.



Figure 4. Information leaflet for the energy renovation of family houses, EPEEF, 2015.

2.III. Energy performance certificate requirements

An EPC shall be issued for buildings or their particular components when it is necessary to use energy to maintain the indoor design temperature in accordance with their purpose. EPCs are issued prior to the issuing of a building use permit, or when selling, renting out or leasing a building. The validity of the EPC shall not exceed ten years from the date of its issue.

An EPC for both residential and non-residential buildings contains 5 pages. The energy class is expressed as the annual energy need for heating per usable floor area of a building {$Q''_{H,nd,ref}$ [kWh/(m^2·year)]} in the reference climate for residential buildings and as $Q_{H,nd,rel}$ (%)[2] for non-residential buildings.

In the new Ordinance on energy audit of buildings and energy certification (OG 88/2017), for both residential and non-residential buildings, the energy class shall be expressed in two ways: as the annual energy need for heating per usable floor area of a building {$Q''_{H,nd}$ [kWh/(m^2.year)]} and as the annual primary energy per usable floor area of a building {E_{prim} [kWh/(m^2.year)]}.

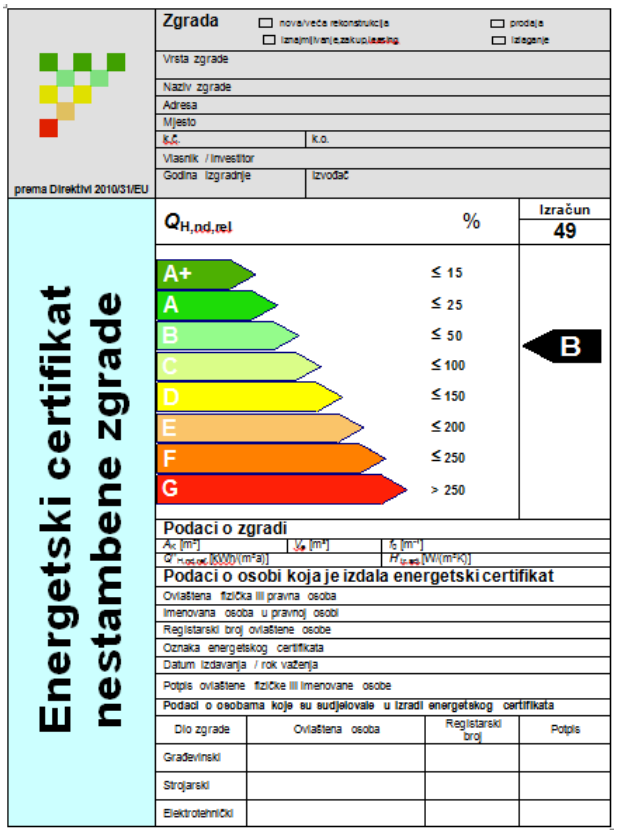


Figure 5. EPC of a non-residential building – first page.

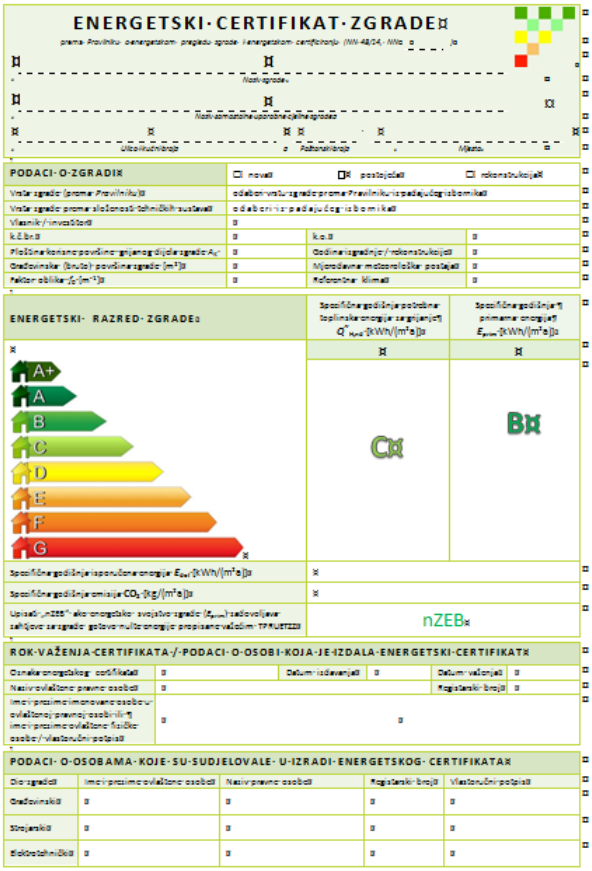


Figure 6. EPC of residential and non-residential buildings according to the new ordinance.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

As of January 2014, sale advertisements published in the media must indicate the building energy class. This obligation is commonly followed.

The law imposes penalties for owners who fail to provide an EPC at the time of selling, renting or leasing a building. Penalties are also imposed if the owner fails to deliver the EPC to the buyer, or if they fail to indicate the energy class in the sale advertisement published in the media.

2.III.ii. Quality Assurance of EPCs

All issued EPCs undergo administrative control during their entry into the database. Detailed quality control is carried out on EPCs that are randomly selected and/or based on complaints.

So far, 324 out of about 150,000 EPCs in total were checked in detail, 50 of which were declared invalid. Detailed control includes checks of the content of the report on the energy audit of the building, the validity and completeness of the input data, the accuracy of the EPC and the calculated and proposed measures to improve the energy performance of the building.

An EPC is declared invalid only if it contains calculation results, input data or proposed measures with significant (more than 30%) deviation and if the result causes a change of one or more energy classes.

Authorised persons shall be sanctioned by means of a fine or by annulment of authorisation in the case of 3 or more invalid EPCs.

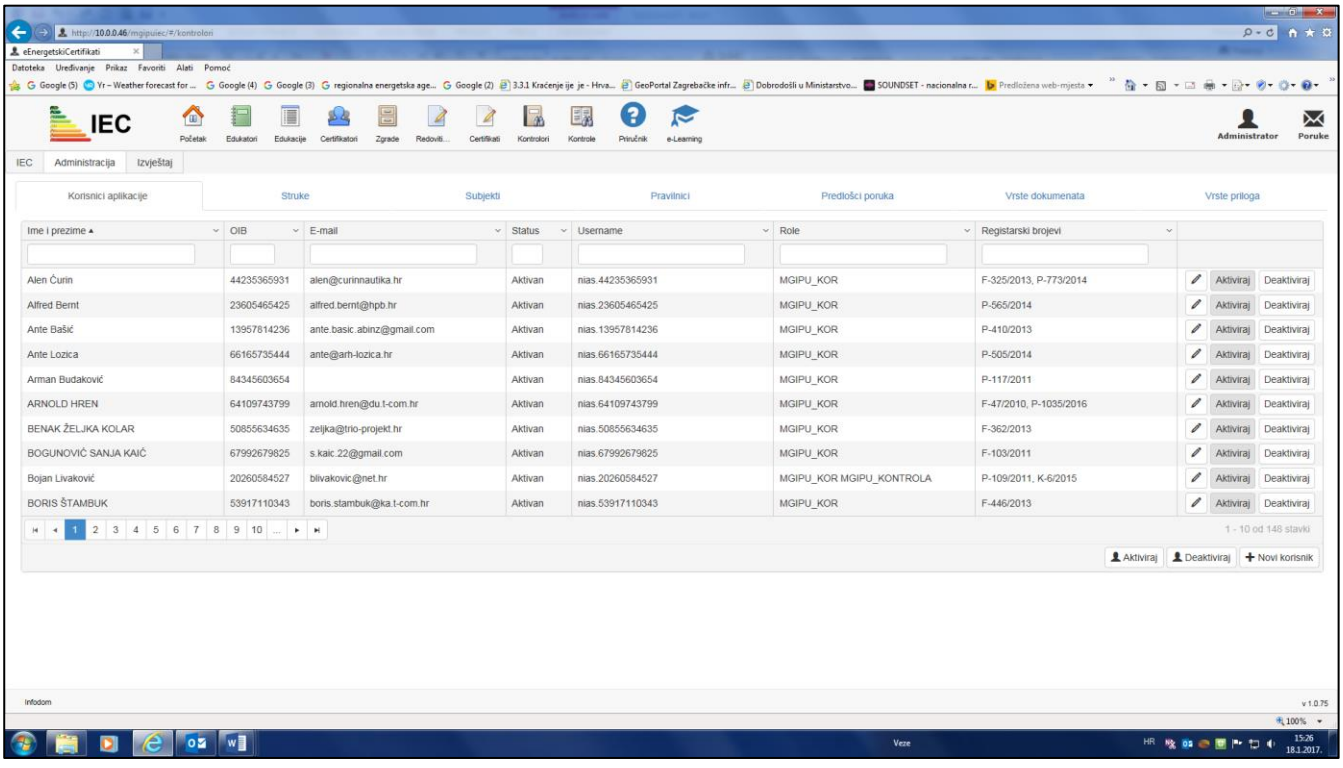


Figure 7. Screenshot of the electronic data base.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Public buildings with a total useful floor area of over 250 m^2 must display the EPC. This includes public buildings used by public authorities for performing their activities and buildings used to house specific population groups (e.g., elderly persons, children, etc.) and non-residential buildings in which a high number of people are present or are provided with a service.

Municipal services officers control whether these EPCs are adequately displayed by visiting the buildings and making a report. In the case of non-compliance with the regulation, they shall ask the owner to display the EPC.

EPCs for public buildings are in the same format as those of non-residential buildings and follow the same procedures (audit followed by issue of EPC).

Fines for public building owners who fail to display the EPC are established by law and amount 15,000 to 30,000 kuna (approximately 2,000 – 4,000 €) for legal entities, and 5,000 to 10,000 kuna (approximately 700 – 1,300 €) for natural persons. The obligation for public display of the EPC is commonly followed and no fines have yet been issued.

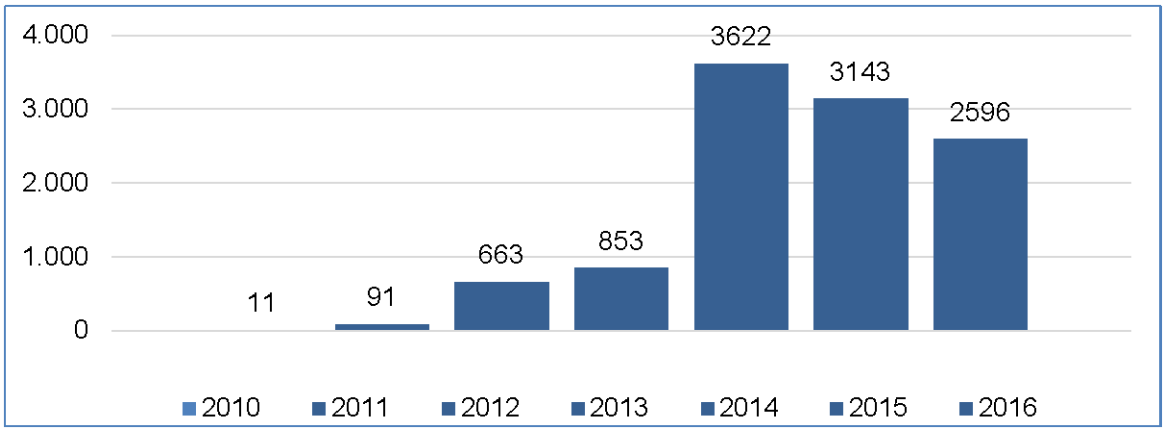


Figure 8. Display of the EPC in public buildings for the period of 2010 – 2016.

2.III.iv. Implementation of mandatory advertising requirement - status

As of January 2014, there is an obligation to indicate the energy class in the sales advertisements published in the media. Penalties are imposed by law both for owners and for authorised real estate brokers. Supervision is under the competence of the Ministry of Economy, Market Inspectorate. This obligation is commonly followed and no fines have been issued so far.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A for Heating Systems

Regular inspection of the heating system in a building must be carried out alongside the energy audit of the building for the purpose of issuing an EPC. When not concurrent with EPC issuance, heating systems with a boiler of an effective rated output of more than 20 kW are regularly inspected every 10 years. Those with a boiler of an effective rated output of more than 100 kW are inspected every 2 years, or 4 years in the case of a gas-fuelled boiler.

2.IV.ii. Progress and current status on heating systems

A regular inspection includes a visual and functional inspection of the heating system and of heated areas, the necessary measurements, an assessment of the size of the system relative to the building's needs and a proposal of measures to improve the energy efficiency of the system and/or to apply alternative solutions.

The registry of inspection reports is prepared and the database of regular inspections is currently in a test phase.

2.IV.iii. Progress and current status on AC systems

The inspection of cooling/AC systems is obligatory and must be carried out alongside the energy audit of the building for the purpose of issuing an EPC. If not established in parallel with the issued EPC, cooling systems with an effective rated output of 12 kW or more shall be regularly inspected, at least once every 10 years.

Regular inspections of cooling/AC systems in buildings include a visual and functional check of the cooling/AC system, cooled and air-conditioned space, the necessary measurements, a proposal of measures for improving the energy efficiency and/or applying alternative solutions as well as drafting a final report.

Regular inspections shall be carried out at least once every ten years. The registry of inspection reports is prepared and the database of regular inspections is currently in a test phase.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Regular inspections of heating and cooling/AC systems of a building must be performed by authorised personnel. Authorisation is granted by the MCPP for a period of 5 years to a person qualified in the field of mechanical engineering (university study), with 5 years of professional working experience and with a completed appropriate professional training programme.

Enforcement and penalties for the owner of a building are the same as for the EPC. No fine has yet been issued.

Quality control of inspection reports

The quality control of inspection reports is performed by the legal personnel authorised to carry out control checks. Quality control shall be carried out on reports that are randomly selected and based on complaints. The authorised personnel checks the completeness of the report and the proposed measures to improve energy efficiency.

The report on the regular inspection of heating and cooling/AC systems of a building is declared invalid if the control determines that the report contains less than 30% of the required data and there is no justification for this in the report. Authorised personnel who issue invalid reports shall be sanctioned by means of fines and annulment of authorisation in the case of 3 or more reports being invalid.

So far, 35 reports on regular inspections of heating systems in buildings were issued and 2 for cooling/AC systems, all as part of the report on building audits that were performed for the purpose of issuing EPCs.

Up until now no inspection reports have been controlled.

Impact assessment

Since regular inspections of heating and cooling/AC systems started recently and due to the small number of issued reports, no control has yet been performed.

3. A success story in EPBD implementation

The best example of the promotion of energy efficiency and sustainable construction is when the idea is materialised and visible, and when the results confirm assumptions. Such a best-practice example of multi-family house is the ECO-SANDWICH house. The first house, one of the twelve planned typical multi-family houses with three apartments as a new type of housing within the programme of subsidised housing construction (POS), was completed on 7 September 2016, with an energy class of A+.

The first ECO-SANDWICH house is the first realisation of the prefabricated ventilated facade system ECO-SANDWICH, which is the result of the cooperation between Croatian scientific institutions (Construction and Architecture, University of Zagreb) and Construction industry (Beton Lucko Ltd., Knauf Insulation Ltd., Eurco dd), and was approved to be funded under the EU programme CIP-EIP-Eco-Innovation 2011. As an innovative product, ECO-SANDWICH was also recognised by the EPEEF, which co-financed the project.

The project objectives go beyond energy efficiency alone; the project also encourages the recycling of construction waste, increasing the efficient use of existing resources and increasing the possibility of using construction and demolition waste. The promotion of the use of thermal insulation materials is based on ECOSE[3] technology, which does not contain harmful substances such as formaldehyde, phenols, pentane, butane and acrylics, and the production of which requires 70% less energy than in the case of conventional mineral wool using a binder in base oil.

The ECO-SANDWICH wall panels were casted out of concrete containing 50% of recycled aggregates, and thus they contribute to resource efficiency goals, together with the energy efficiency goals. Additionally, the project ECO-SANDWICH promotes the application of prefabricated panels that reduce embedded energy in the product, as well as greenhouse gas emissions and harmful by-products from the production. Environmental Product Declaration (EPD) was produced for the ECO-SANDWICH wall panels in cooperation with Pre consultants from The Netherlands, according to the EN 15804 standard. During the construction of

the residential building in Koprivnica, green public procurement was performed for the design as well as construction phase.





The technical details for the multi-family house in Koprivnica, Lenišće are as follows:

- useful floor area of the heated part of the building = 267.82 m2;
- $Q''_{H,nd}$ = 14.95 kWh/m^2.year;
- $Q''_{C,nd}$ = 10.86 kWh/m^2.year;
- E''_{prim} (for heating, cooling and domestic hot water) = 39,50 kWh/m^2.year;
- natural gas is used for domestic hot water;
- space heating is by air-to-air heat pump.

Figure 9. Multi-family house in Koprivnica, Lenišće

4. Conclusions, future plans

The combination of requirements set for new buildings, renovated buildings and NZEB, and subsidies that were assigned to the improvement of the energy efficiency of existing buildings will bring significant energy savings over the coming years. The recommendations in the EPCs serve as good guidelines to help owners decide on implementing some of the possible energy improvements. The number of qualified experts necessary for issuing EPCs and for regular inspections of technical systems is sufficient to cover all the market needs.

The national calculation tool has been developed and is in a test phase; due to complex calculation procedures it will only cover the most commonly encountered combinations of RES and combined heat and power systems, so there is a need for a more comprehensive calculation tool to complement this tool.

The future plans are:

- To strengthen the existing quality assessment scheme and increase the number of EPCs to be controlled, which currently stands at 0.3% of issued EPCs.
- To implement a new scheme for the EPC in which the energy performance indicator for building classification shall be expressed in primary energy (including energy for space heating, cooling, ventilation, domestic hot water and lighting), and the energy class shall be based on the reference energy performance. The ordinance has been published and shall enter into force on 30 September 2017 along with the methodology for carrying out energy audits of buildings.
- To continue information campaign and develop a new campaign to raise awareness on the benefits of building energy renovations and the purpose of energy certification and regular inspection of heating and cooling/AC systems.

- To continue improving the informatics platform that supports the issuing of the EPCs and collecting reports on the regular control of heating and cooling/ AC system.
- To improve and simplify the calculation methodology and software tool for the calculation of the energy performance of buildings.
- To perform a new cost-optimal analysis.
- To implement programmes for the energy renovation of buildings up to 2020, for which 311 million € from EU funds are available and to develop new and improved support schemes for building energy renovation as well as for the construction of buildings to the NZEB standard.

Endnotes

1. http://ec.europa.eu/energy/sites/ener/files/HR-Art4BuildingStrategy_en.pdf
2. The relative value of the annual thermal energy needs for heating for non-residential buildings, $Q_{H,nd,rel}$ [%], is the ratio of the specific annual energy needs for heating in the reference climate, $Q'_{H,nd,ref}$ [kWh/m³.year] and the permitted specific annual energy needs for heating for reference climatic data, $Q'_{H,nd,dop}$ [kWh/m³.year], and is calculated according to the following expression: $Q_{H,nd,rel} = Q'_{H,nd,ref} / Q'_{H,nd,dop} \times 100$ [%].
3. ECOSE technology means production of mineral wool in which natural resins (sugars) are used as the binder which polymerise and bind the fibers of mineral wool at a temperature of approximately 200-250 °C.

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Cyprus

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.mcit.gov.cy

1. Introduction

As the building sector is responsible for more than 30% of the final energy consumption in Cyprus and the existing building stock is lacking in energy efficiency, the energy performance of buildings plays a vital role in implementing an energy policy that will be beneficial to almost all stakeholders. Therefore, Cyprus aims to reduce the building sector's energy demand to a very low level, for both new and existing buildings, by implementing all financially and technically feasible measures of energy efficiency.

The first initiative to promote energy efficiency in buildings was initiated in 2004 with the "*Grant Scheme for Promoting Renewable Energy Sources and the Conservation of Energy*". The scheme included subsidies for thermal insulation, double-glazing, efficient lighting and RES. However, the decisive step was the implementation of minimum energy performance requirements in 2007 and the launch of the national scheme to certify the energy performance of new and existing buildings two years later[1].

Cyprus transposed Directive 2010/31/EU into their national legislation by amending their law that regulates the energy performance of buildings in December 2012. Based on this new legal framework, technical requirements for NZEB were defined, detailed requirements for technical building systems were issued and minimum energy performance requirements have since been twice revised, based on the calculation of cost-optimal levels. The new minimum energy performance requirements were implemented on 1 January 2017 and are considered to be the final step for leading Cyprus into a smooth transition towards NZEB. The overall responsibility of the implementation of the EPBD in Cyprus lies with the Ministry of Energy, Commerce, Industry and Tourism (MECIT). This report is an overview of the current status of the EPBD implementation in Cyprus.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

The first minimum energy performance requirements for new buildings have been adopted on 21 December 2007, whereby maximum permissible U-values for new buildings were determined for the first time, making thermal insulation of the building envelope and the installation of double-glazed windows virtually mandatory[2]. In 2010, energy class B for the EPC was added to the minimum requirements[3]. The results of calculating the cost-optimal levels of minimum energy performance requirements, which took place in 2013, have been the catalyst for further tightening these requirements.

2.I.i. Progress and current status of new buildings

The results of the calculation for setting the minimum energy performance requirements at cost-optimal levels have indicated that, while energy class B was at the optimal level, requirements regarding insulation and RES were much less efficient than the optimal levels. At the same time, the economic benefit of shading (for all buildings) and improving lighting (in office buildings) has been made apparent by the results of the calculation.

In order to set minimum requirements at cost-optimal levels by 2017, in December 2013 the maximum U-values were reduced by approximately 15%, and a maximum shading factor for windows was introduced. This factor is the product of the solar radiation reduction factor of fixed shading, external removable shading, and transmission of solar radiation through glazing. Also, according to the requirements for non-residential buildings, at least 3% of the total energy consumption should come from RES[4].

From 1 January 2017, the U-values of the building envelope will be reduced even further, closely approaching the requirements for NZEB. Additionally, the minimum proportion of total energy consumption that should come from RES, both for residential and non-residential buildings, has significantly increased[5].

2.I.ii. Format of national transposition and implementation of existing regulations

The methodology for calculating U-values is documented in the "*Guide of Thermal Insulation of Buildings*" issued by the MECIT, which is necessary to show compliance regarding building envelope minimum requirements and/or to use them as an input for assessing the overall energy performance of a building. The guide also provides the methodology for calculating effective thermal mass as well as general information about different insulating methods. The "*Methodology for Calculating the Energy Performance of Buildings*" issued by the MECIT documents all the algorithms and assumptions used to calculate energy consumption and to issue an EPC. It includes the calculation of heating, cooling, ventilation, domestic hot water and lighting energy use, expressed in terms of primary energy, based on which the energy class is assigned to the building. The methodology was revised in 2015, mainly in order to address issues in certifying existing buildings. Both documents are based on CEN standards, and they are both mandatory, to be used to calculate the energy performance for all types of buildings, existing and new.

The MECIT checks implementation of minimum energy performance requirements through random on-site visits of the construction sites. In the case where appointed inspectors find no compliance with minimum requirements the building owner is notified of the infringement and a deadline is given to comply. If the building owner does not comply within the deadline, then legal action is taken. In 2015 and 2016, 1,443 inspections of construction sites have been done.

2.I.iii. Action plan for progression to NZEB for new buildings

The national action plan for increasing the number of NZEB, which was issued in 2012 and revised in 2016, identifies a number of actions to be taken up to 2020. The first step towards NZEB is considered to be the issuance of the "Requirements and Technical Characteristics of the NZEB Ministerial Order of 2014 (Κ.Δ.Π. 366/2014)". The order provides, in a legally binding document, both mandatory requirements by 2020 and a high energy efficiency standard that can already though voluntarily be implemented in new and renovated buildings. The requirements for NZEB specify lower U-values, maximum heating demand for residential buildings, maximum lighting power installation for office buildings, maximum primary energy consumption and a minimum contribution of RES. The requirements differ only between residential and non-residential buildings, but the same requirements apply for new and existing buildings.

In order to assist building designers in the design of NZEB, the MECIT issued "The Technical Guide for NZEB" in 2015, which documents how architectural design, building envelope, technical building systems and RES are optimally combined. Furthermore, other educational measures are taken in order to improve technical knowledge regarding NZEB. The Cyprus University of Technology has undertaken the training of a small group of instructors who in turn will train other engineers/architects on the topic. To date, there are 14 instructors which have trained 120 engineers and architects in NZEB design.

The University of Cyprus is running a similar programme which aims at increasing knowledge and skills regarding NZEB. The educational activities of the programme include a university course (graduate level), e-learning and webinars, as well as training sessions and workshops on actual case study buildings. From January 2016 until today, more than 60 professionals in the building sector have been trained in Cyprus, and more than 120 in total have updated their skills through participation in the project activities. The University of Cyprus envisages the creation of an innovative interdisciplinary educational training programme that focuses on real building situations.

2.I.iv. Requirements for systems and / or building components for new buildings

Since the implementation of the EPBD in Cyprus, emphasis was given on improving the building envelope of new buildings. Thus, maximum U-values were established for roofs, walls, windows and floors in contact with the external environment. These U-values have been gradually tightened over the last ten (10) years in an attempt to reduce energy demand for heating and cooling in new buildings. Furthermore, the introduction of a maximum shading factor for windows in 2013 was the first minimum requirement purely set to address cooling energy demand. As far as technical building systems are considered, the only current requirement is the installation of solar water heaters for domestic hot water in new residential buildings according to the "*Technical Guide for the Installation of Solar Heaters*", which specifies the size of the system according to the size of the house. Another requirement will be in force from 1 January 2017 as maximum mean power installed for lighting is set for new office buildings.

2.II. Energy performance requirements: EXISTING BUILDINGS

As mentioned above, the rules for calculating U-values and energy performance are the same for new and for existing buildings. The requirements defined in NZEB regulation are also identical for both new builds and for that part of the existing building stock which undergoes major renovations.

2.II.i. Progress and current status of existing buildings

The minimum energy performance requirements include requirements for existing buildings. The first minimum energy performance requirements issued in 2007 mandated that buildings over 1,000 m² that undergo major renovations shall be insulated at the same level as a new building. From January 2010, the minimum category B on the EPC was added to requirements for buildings over 1,000 m² that undergo major renovations. In December 2013, maximum U-values have been reduced and also implemented for building elements of an envelope that are replaced or retrofitted. In order to reach cost-optimal levels, as of 1 January 2017 all buildings that undergo major renovations should reach at least energy class B as far as it is technically and financially feasible. Additionally, all building elements that are replaced or retrofitted have to reach the same U-value requirements as new buildings.

2.II.ii. Plans to improve the existing building stock

Most of the existing building stock has a relatively poor energy performance, as the majority (94% for the residential sector and 83% for the tertiary sector), was built before the implementation of minimum energy performance requirements. Implementing energy efficiency measures has been mobilised mainly through financial incentives, though since 2015 the trend has been for deep renovations rather than single measures.

In April 2016, by decision of the Cabinet of Ministers, the Commission for the Energy Performance of Buildings of the Central Government Authorities was established. It consists of the relevant departments of the Ministry of Transport, Communications and Public Works, which is responsible for public buildings and the MECIT. The committee, as part of its mission, seeks to upgrade the energy efficiency of buildings owned and used by the central government, in order to implement the obligations of Article 5 of Directive 2012/27/EU, as well as to propose measures for promoting NZEB for public buildings in the best economic and technical way. For the renovation of public buildings, 20 million € has been secured from the EU structural funds of the 2014 – 2020 period.

2.II.iii. Regulation of system performance, distinct from whole building performance

Requirements for building elements had originally been implemented for maximum U-values and only for buildings of more than 1,000 m^2 that undergo major renovations[6]. Requirements for building elements regardless of renovations were set in 2013[7]. These requirements set maximum U-values for roofs, walls and windows that were replaced or retrofitted or were part of an extension to an existing building. At the same time, requirements were set for the efficiency of boilers, AC systems with a rated output of power of less than 12 kW, solar water heaters and ventilation systems with a capacity bigger than 500 litres per second that were replaced or installed in existing buildings[8].

In 2016, these requirements were revised, and as of 1 January 2017 new, more stringent U-values will be required for envelope building elements installed in existing buildings[9]. For technical building systems, new comprehensive requirements were issued in 2016 that cover almost all conventional technical building systems installed in buildings[10]. The requirements are described in two documents, one for residential and another for non-residential buildings, and cover requirements for not just the whole system, but also for individual parts. The requirements are also supplemented by recommendations of best practices.

2.II.iv. Encouragement of intelligent metering

In the framework of the SmartPV project, smart meters have been installed in 247 households where there is also on-site electricity production by PV systems[11].The aim has been to thoroughly investigate the consumption profile of these consumers – producers (prosumers) and their change in behaviour as well, based on some incentives given through the programme. The results of the SmartPV project are to be used to evaluate the installation of another 3,000 smart meters. Also, the scheme "*I save – I upgrade*", managed by the MECIT, provides subsidies for installing smart metering as part of the deep renovations of a building[12].

2.II.v. Financial instruments and incentives for existing buildings

For the last three years, the main financial incentive for renovating the existing building stock has been the scheme "*I save – I upgrade*". The scheme provides grants for renovating homes and business buildings if they reach specific energy-related criteria[13]. Eligible costs include insulation, windows, high-energy performance technical building systems, lighting, and RES for heating, cooling and domestic hot water. The percentage and maximum amount of subsidies increases with the level of energy upgrade, in order to stimulate deeper energy renovation.

Another incentive is the establishment of the 5% extra building space allowance for buildings that reach A class, with at least 25% of their primary energy consumption coming from RES, established in 2014. Most of the interest for this incentive comes from developers of large buildings. This incentive can also be used in the construction of new buildings.

2.II.vi. Information campaigns/ complementary policies

The MECIT is informing the public through leaflets and advertising flyers about EPCs, NZEB, and the inspection of central heating and AC systems. Additionally, the annual exhibition "*SAVENERGY*" is likely the most important public event in the energy efficiency of buildings. The exhibition started in 2004 and is co-organised by the MECIT and the Cyprus Employers and Industrialists Federation. It gives the public an opportunity to come in direct contact with the companies that sell and install energy saving and RES systems, mainly in the building sector.

The MECIT organises and/or participates in seminars and presentations especially directed at professionals in the building industry, such as engineers, construction companies and real estate agents. In the last two years, such events have been targeting professionals of the financial sector in order to stimulate their involvement in the energy efficiency of buildings.

2.III. Energy Performance Certificate requirements

The EPC scheme in Cyprus commenced in 2010 and underwent revisions in 2013. The changes were based on the four-year experiences of implementing it. The majority of EPCs issued so far are for new buildings and new building units. This is mainly due to the fact that the majority of existing homes are not for sale or rent, as they are owner-occupied. Another factor for the limited use of EPCs in existing buildings is believed to be the lack of information for prospective buyers or tenants. A boost in the use of EPCs in existing buildings was given by the scheme "I save – I upgrade", as it is a prerequisite for providing financing for deep renovations. Further penetration of EPCs in existing buildings is expected from 1 January 2017, as energy class B is to be the minimum requirement for all buildings that undergo major renovations.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

EPCs for buildings that are for sale and rent have been mandatory since 2010. In late 2015 it became mandatory for the central government to buy and rent only high energy-efficient buildings, meaning only energy class B or better. This is expected to increase the awareness regarding EPCs and the energy efficiency of buildings, especially for office buildings.

2.III.ii. Quality Assurance of EPCs

In 2015, the MECIT has checked 9% of all EPCs issued, which is considered to be a statistically relevant sample. Samples for checking purposes are drawn from four categories: new residential buildings, existing residential buildings, new non-residential buildings and existing non-residential buildings. Ten (10) specific input parameters are checked, most notably U-values, efficiencies of heating and cooling systems, and window size. If the input parameters alter the energy class of the building, the EPC is cancelled. In that case the qualified expert has to issue a new, corrected EPC by a specific deadline. If the EPC is not issued then the building permit authority is notified in order to take measures within its jurisdiction, such as the cancellation of the building permit. Only 1% of the EPCs checked in 2015 were cancelled, though in another 8%, specific problems were spotted and the qualified experts that issued them were notified.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The central government owns and uses 179 buildings, and 93 of them have an EPC. The Department of Electrical and Mechanical Services has the overall responsibility for issuing EPCs for these buildings, and the issuing of an EPC for buildings that the government rents is the sole responsibility of the owner and follows the structure of EPCs used by other non-residential buildings. In order to check compliance with the display of EPCs, 19 inspections have been carried out in buildings used by the central government, the local authorities and other public bodies. In 10 cases the EPC was not displayed and the relevant public authorities were notified.

2.III.iv. Implementation of mandatory advertising requirement – status

In 2014, the ministry commenced sample checks on the implementation of this requirement. The MECIT has initially focused on building development companies and real estate agents. To date, fines have been imposed in 22 cases. The result of these actions is that the energy class now appears in advert boards, newspaper adverts and other commercials in media related to renting or selling buildings.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Cyprus has chosen option A and has established regular inspections of heating systems with boilers and of AC systems.

2.IV.ii. Progress and current status on heating systems

The inspection of heating systems has to be performed according to "The Guide for the Inspection of Heating Systems with Boilers" issued by the MECIT. The document specifies the method for measuring combustion efficiency, heat losses from the chimney and how to check the boiler for over-dimensioning. It also provides guidance for possible recommendations regarding the improvement of all parts of the heating system. The frequency of the inspections varies according to the size of the boiler and the type of the fuel used.

Boiler rated output of the heating system	Frequency of inspection
More than 20 kW and less than100 kW	Every five (5) years
More than 100 kW (gas)	Every four (4) years
More than 100 kW (liquid or solid fuel)	Every two (2) years

2.IV.iii. Progress and current status on AC systems

The inspection of AC systems is mandatory, to be performed for systems with an effective rated output above 12 kW or when the sum of all AC systems installed exceeds 50 kW of total output in the same building or building unit. The inspection is mandatory every five (5) years for systems of more than 12 kW and less than 250 kW, and for systems in which the total installed capacity in a building is more than 50 kW. For systems of more than 250 kW, inspections have to take place every three (3) years. Inspections have to be performed according to "*The Guide for the Inspection of Air Conditioning System*" issued by the MECIT, which describes the steps that have to be followed by the inspector as well as a checklist that has to be completed during the inspection.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

A fine of up to 30,000 € can be implemented in the case of a central heating system not being inspected. However, no fine has been implemented so far. At this stage efforts are focused on informing the public about the benefits of inspections.

Quality control of inspection reports

At the end of each year, the MECIT requires all inspectors to submit the reports they conducted during the year. The reports are then checked to see if they have been completed appropriately and include recommendations. For 2015 checks, it has been concluded that the reports for AC systems are satisfactory, though for heating systems the recommendations in many cases dealt with only the boiler and not other parts of the system. The MECIT has issued notifications to the inspectors of heating systems in order to take corrective measures.

Impact assessment, costs and benefits

It is estimated that a heating system inspection in a house requires three (3) working hours, and the inspection of a heating or an AC system in a medium-sized commercial building a whole working day. Benefits for the owner occur when they apply the recommendations suggested by the inspector in the inspection report, which can either be of no cost, e.g., correctly setting a thermostat, or of a larger cost, e.g., replacing the boiler. The owner has the right to decide whether or not to apply the recommendations and when to do so if they choose to. It is estimated that the application of inspections may result in a total energy savings potential in buildings of around 10%.

3. A success story in EPBD implementation

A new grant scheme was put in place in 2014 in order to encourage households and Small and Medium-sized Enterprises (SMEs) to adopt energy efficiency and renewable energy measures. The scheme, titled "*I save – I upgrade*", is the follow-up of the completed "*Grant Scheme for Promoting the Renewable Energy Sources and the Conservation of Energy*" that ran for buildings in the 2004-2013 period and is based on the same financial model: the provision of grants for direct investments, partly covering the purchase and installation costs of listed energy efficiency measures and technologies. It targets renovations of existing buildings, with a total budget of 15.3 million € during the 2014-2020 period for SMEs and 16.5 million € for households. The new scheme is co-financed by EU structural funds, and the responsibility of its implementation lies with the MECIT.

The scheme provides 50% of investment costs to upgrade a building to energy class B or to reduce energy consumption by at least 40%, and 75% of investment costs for renovating to NZEB level. The maximum grant is 25,000 € for households and 200,000 € for enterprises. In all cases, an EPC has to be issued before and after the implementation of energy efficiency measures, in order for savings to be verified. For buildings above 1,000 m², an energy audit has to be performed before renovations in order to better assess the available technical and financial options. In some exceptions, households of vulnerable consumers can get subsidies for thermal insulation, windows and solar water heaters without requiring the building to reach a certain level of energy performance. To date, 654 homes have been approved to participate in the scheme, which will result to an annual savings of 31.5 GWh. In total, the first call of "*I save – I upgrade*",

which recently closed, is expected to result in around 1,000 residences and 150 tertiary buildings being upgraded.

The scheme has been successful in linking financial support and EPCs. The minimum class to be achieved on the EPC scale, or the energy savings which will be verified through the EPC, together with mandatory pre- and post- upgrade submissions of EPC documentation, provide a boost to the EPC market, raising awareness among the public about its benefits and harnessing its market potential as a driver for energy efficiency upgrades. It has also been successful in raising awareness about NZEB, as more than 45 buildings will be renovated to NZEB level as a result of this first call.

However, delays in disbursing money due to bureaucracy issues, as well as "*free–riders*"[14], are considered to be major drawbacks. In order to optimise incentives for existing buildings, which can be achieved by simplifying existing processes and further leveraging private funds, discussions are underway between the MECIT, the banking sector, and other stakeholders. The aim is to revise the "*I save – I upgrade*" scheme in order to address existing hurdles, but also to design specialised financial products that could operate together or independently of "*I save – I upgrade*".

4. Conclusions, future plans

The implementation of the EPBD in Cyprus has been successful in reducing energy consumption in new buildings by an estimated 50% compared to the pre-EPBD period. NZEB are expected to reduce consumption by more than 75%. However, all estimates are based on calculation models that do not consider the quality of works or any flaws that occur during operation. The establishment of a registry for energy auditors in 2013 has partially closed this gap, while more efforts are focused on training installers. Since 2015, a certification for small-scale RES installers has already been put in place and, concurrent to that, the MECIT has prepared draft legislation for setting up a certification system for technical building system installers. The new legislation is expected to be discussed in the Cypriot Parliament in 2017.

Upgrading existing buildings still remains the biggest challenge for Cyprus in order to fulfil its goals for 2020. The recent financial scheme *"I save – I upgrade*" has shown that there is great interest among households, but also for other groups to implement energy efficiency measures, and the industry is keen to seize on this opportunity. Thus, it is recognised that more commercial financing has to be streamlined within the sector. The MECIT's efforts are focused on developing new financial products for the energy efficiency of buildings and the development of the ESCOs market that will mobilise private funds.

Endnotes

1. The law that regulates the energy performance of buildings (N(I) 142/2006, first issued in 2006), is the fundamental legislation by which minimum requirements, the energy performance certification scheme and other provisions of the EPBD have been implemented through regulations and ministerial orders. The law was revised in 2009 and 2012.
2. "*Minimum Energy Performance Requirements Ministerial Order of 2007 (Κ.Δ.Π. 568/2007)*".
3. "*Minimum Energy Performance Requirements Ministerial Order of 2009 (Κ.Δ.Π. 446/2009)*".

4. "*Minimum Energy Performance Requirements Ministerial Order of 2013 (Κ.Δ.Π. 432/2013)*".
5. "*Minimum Energy Performance Requirements Ministerial Order of 2016 (Κ.Δ.Π. 119/2016)*".
6. "*Minimum Energy Performance Requirements Ministerial Order of 2007 (Κ.Δ.Π. 568/2007)*".
7. "*Minimum Energy Performance Requirements Ministerial Order of 2013 (Κ.Δ.Π. 432/2013)*".
8. "*Requirements for TBS Installed in Existing Buildings or Building Units and for TBS that are Replaced or Upgraded Ministerial Order of 2013 (Κ.Δ.Π. 386/2013)*".
9. "*Minimum Energy Performance Requirements Ministerial Order of 2016 (Κ.Δ.Π. 119/2016)*".
10. "*Requirements for TBS Installed in Existing Buildings or Building Units and for TBS that are Replaced or Upgraded Ministerial Order of 2016 (Κ.Δ.Π. 231/2016)*".
11. www.smartpvproject.eu
12. www.mcit.gov.cy
13. A 50% subsidy is provided for buildings that are renovated in order to achieve at least 40% savings or energy class B, and a 75% subsidy is provided for buildings that are renovated to NZEB.
14. People who would perform upgrades regardless of subsidies.

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the Czech Republic

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.mpo.cz

1. Introduction

The Czech Republic's building market presents great potential for energy savings that can be largely achieved through implementing the EPBD, a responsibility of the Ministry of Industry and Trade. The EPBD has been transposed through the *Energy Management Act* No. 406/2000 Coll[1], with the last amendment coming into force in 2015. The *Energy Management Act* sets the obligation to increase the energy performance of buildings and the obligations related to EPCs; it also sets rules, conditions and educational standards for EPC issuers and heating and AC systems inspectors. The most recent amendments to the act relate to the obligation to show energy performance indicators in advertisements for the sale or rental of buildings via estate agencies, as well as to specify exemptions regarding where to process the EPC and the number of EPCs to be controlled each year. A new amendment to the act is currently under preparation. Improving the buildings' energy performance and increasing energy savings are high priorities in the Czech Republic. This report presents an overview of the progress and current status of the EPBD implementation in the Czech Republic.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Regarding new building constructions, the builder is obliged to fulfil the legislative requirements for building energy performance. When applying for a building permit for making changes to the construction before its completion, which impact the building's energy performance, the builder must prove through the EPC that the building's energy performance meets cost-optimal levels. The assessment of the technical, economic and environmental feasibility of the local energy supply system of energy from RES, combined heat and power generation, thermal energy supply systems and heat must also be covered. Decree 78/2013 sets seven energy performance indicators:

1. total primary energy per year;
2. non-renewable primary energy per year;
3. total delivered energy per year;
4. partial delivered energy for technical building systems;
5. average U-value;
6. U-value on each construction on the system boundary;
7. energy efficiency of the technical building systems.

In order for the new building to be built, the builder must document that it meets the minimum values for non-renewable primary energy per year, total delivered energy per year and the average U-value. The total delivered energy indicator must reach level C, which is set as a minimum requirement for the building to be constructed. This is valid for all types of buildings (residential, non-residential, public, etc.). Decree 78/2013 also sets the minimum parameters for technical building systems.

2.I.i. Progress and current status of new buildings

See section above.

2.I.ii. Format of national transposition and implementation of existing regulations

The main act covering buildings' energy performance is, as already defined, the *Energy Management Act*. The energy performance is further covered by several decrees that specify technical issues:

- Decree 78/2013 Coll.[2] on building energy performance defines the methodology for calculation, energy performance indicators, parameters of the reference building, primary energy factors and appearance of the EPC;
- Decree 193/2013 Coll.[3] on AC systems inspections defines the methodology and frequency of AC systems inspections;

- Decree 194/2013 Coll.[4] on heating systems and hot water distribution defines the methodology for heating systems dimensioning and definition of efficiency, as well as the methodology and frequency of heating systems inspections.

The energy performance calculation must be based on standards including:

- ČSN EN 73 0540[5] on thermal protection of buildings, which specifies technical requirements for the design and verification of buildings including indoor environmental characteristics during their use (Table 1).

- Technical normalisation information, as TNI 73 0331[6], which contains typical energy efficiency parameter values and intervals of technical building equipment efficiency, typical profiles of building uses (operational hours, ventilation, lighting and hot water preparation), computated climate data, etc.

Description of the building component	Construction type	Required U-values	Recommended U-values
Flat and pitched roof pitch up to 45° included Floor above external space Ceiling below the unheated attic and the roof without thermal insulation Floor and wall with heating	light	0.24	0.16
	heavy		
External wall Steep roof with the roof pitch exceeding 45°	light	0.3	0.2
	heavy		
Floor and wall in contact with the soil* Ceiling and internal wall from a heated to an unheated space		0.6	0.4
Ceiling and internal wall from a heated to a partially unheated space		0.75	0.5
Windows and other 'opening fillers' in the envelope of the heated space, including the respective frame		1.8	1.2
Door, gates and other fillers from partially heated spacess to unheated spaces of heated building		3.5	2.3

Table 1. U-values set in the standard ČSN 73 0540.

2.I.iii. Action plan for progression to NZEB for new buildings

The *Energy Management Act 406/2000* Coll. defines as NZEB a building with very low energy performance whose energy consumption is to a very significant extent covered by RES. The exact proportion of energy that should come from RES is not defined. There are several conditions that must be fulfilled by the builder/designer for the building to be categorised as NZEB. Energy indicators to be met are the same as for new buildings. However, in the case of NZEB, the Czech legislation demands a gradual decreasing of the non-renewable primary energy for the reference building. The assessed building must meet this stricter requirement either by increasing the share of RES or by improving the building envelope. The NZEB must then meet the non-renewable value requirement, reduced by 25% for family houses, 20% for apartment

buildings, and 10% for other buildings. The legislation consists of a two-step requirements approach: the cost-optimal level requirements, which came into force on 1 April 2013, and the gradual tightening of requirements towards NZEB depending on the size and type of the building, which will be coming into force between 1 January 2016 and 1 January 2020.



Figure 1. Example of a NZEB; Koti Hyacint project (passive standard) located in Prague.

Methodology	Floor area	Demand for heating	Total delivered energy	Primary energy consumption
	m^2	kWh/m^2year	kWh/m^2year	kWh/m^2year
PHPP* methodology	1,963	15	-	68
TNI 73 0330	2,321	9	-	68
78/2013 Coll.	2,511	12	37	48

* Passive House Planning Package

Table 2. Energy Values according to different methodologies for the Koti Hyacint project

2.I.iv. Requirements for systems and / or building components for new buildings

Any new building must comply with the energy performance requirements of the *Energy Management Act*, which includes minimum energy efficiency requirements of technical building systems. These minimum values are defined in Annex 1 of Decree 78/2013 on building energy performance applied to the reference building.

Parameter	Symbol	Unit	Reference value
Heating			
Heat generation efficiency factor	$\eta_{H,gen,R}$	%	80
Heat distribution efficiency factor	$\eta_{H,dis,R}$	%	85
Emission efficiency factor	$\eta_{H,em,R}$	%	80
Cooling			
Energy efficiency ratio	$EER_{C,gen,R}$	W/W	2.7
Energy efficiency ratio of other cooling sources	$EER_{C,gen,R}$	W/W	0.5
Efficiency distribution factor for cooling	$\eta_{C,dis,R}$	%	85
Emission efficiency factor for cooling	$\eta_{C,em,R}$	%	85
Delivered energy for family and apartment houses (or zones with this operation)	$Q_{fuel,C}$	kWh	0

Table 3. Example of requirements for new or changed building systems.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

Existing buildings have to meet strict energy performance requirements in case of major or other renovations. In this case, the builder, owner or association of unit owners must fulfil the requirements given by the implemented legislation, Decree 78/2013 Coll., that sets the minimum parameters and energy performance indicators. The EPC must demonstrate that the cost-optimal levels are met for the changed building envelope and/or building technical systems, and that the assessment of the alternative energy delivery system as well as recommendations for decreasing the energy performance have been provided. The EPC must be part of the building permit application.

Number of building floors	Total number of family houses	Single-family houses	Semi-detached houses	Detached houses
Total	1,554,794	1,163,655	133,877	257,262
1	584,075	456,246	38,885	88,764
2	861,774	630,737	86,757	144,280
3	45,995	24,753	4,783	16,459
n.a.	62,950	51,739	3,452	7,759

Table 4. Number of family houses in the Czech Republic.

2.II.ii. Plans to improve the existing building stock

Implementing the Directive 2012/27/EU on energy efficiency, the "*Renovation Strategy of Buildings*" study[7] concerns renovations of the whole building stock in the Czech Republic. This study calculated the possible savings potential of all building renovations in the Czech Republic, including renovation costs, renovation models, and different scenarios of gradual renovations. The study calculated the savings potential for all buildings, especially for residential buildings, and including service and agricultural buildings. Other buildings were differentiated according to their age, size and thermal insulation properties of the building envelopes. The percentage of buildings renovated was taken into account, being 25% for single-family houses and 40% for apartment buildings. The study calculated the energy savings for heating, hot water preparation and lighting, and also took energy savings from shallow to deep renovations (to reach the passive standard) into account.

In 2001, the final energy consumption for households was 252 PJ. The total possible savings in buildings was 92 PJ (36.5%) in the case of moderately deep renovations, and 155 PJ (61.5%) in the case of deep renovations.

The study included five possible scenarios on how to achieve energy savings:

- business as usual;
- quick but shallow renovations;
- slow but deep renovations;
- quick and deep renovations;
- hypothetical renovations (3% of renovated buildings each year).

The study also estimated the investment cost for renovations of the building stock on the level of meeting recommended values for walls, roofs and floor insulation. The costs not only covered the price of the used material and work but also costs for the design work, costs on scaffolding, waste disposal, etc.

The total investment necessary for the building envelopes of family houses was estimated at 654 billion Czech crowns (24.5 billion €) to meet the recommended values, and 777 billion Czech crowns (29.2 billion €) to reach the passive standard. In the case of apartment buildings, the total investment for envelope insulation was estimated at 261 billion Czech crowns (9.8 billion €) to meet the recommended values, and 304 billion Czech crowns (11.4 billion €) to reach the passive standard. Considering also renovation of other building types, the study showed that 1.5 trillion Czech crowns (56.4 billion €) is needed to reach the recommended values, and 2.1 trillion Czech crowns (78.9 billion €) is needed to reach the passive standard.

2.II.iii. Regulation of system performance, distinct from whole building performance

The *Energy Management Act* sets an obligation in the case of improvements other than major renovations of either an existing building or a completed one, during which the requirement to improve the energy performance must be achieved for the altered structural elements of the building envelope or technical building systems. If improvements are performed within ten (10) years from issuing the EPC of the building,

the building owner or association of unit owners are obliged to comply with the energy performance requirements for buildings set in Decree 78/2013 Coll., and the construction must meet the energy performance requirements for either the altered structural elements of the building envelope or the altered technical building systems, also set in Decree 78/2013 Coll. This must be proved by copies of documents relating to an altered structural element of the building envelope or an altered technical system, required to be kept for five (5) years.

2.II.iv. Encouragement of intelligent metering

Smart metering in the field of heat and electricity in the Czech Republic is on a voluntary basis. Currently, 61% of electric meters in the Czech Republic are smart meters with continuous metering. There are currently no incentives supporting the installation of smart meters.

2.II.v. Financial instruments and incentives for existing buildings

The main financial incentives for building renovations in the Czech Republic are direct subsidies from operational and national programmes. There are three main operational programmes that provide financing for building renovations, targeting a wide range of potential applicants from the public and private sectors: *Operational Programme Environment*, *Integrated Regional Operational Programme*, and *Operational Programme Enterprise and Innovation for Competitiveness*. The national programme *New Green Savings*, funded from the profits of the sale of emissions allowances, is focused on improving the energy efficiency of residential buildings, the construction of new energy-efficient buildings, the replacement of heating systems and the use of RES.

The Czech Republic is launching a pilot financial instrument in energy efficiency – *Programme ENERG*[8] – a soft-loan programme for financing energy efficiency measures for small- and medium-sized enterprises. The programme aims to facilitate SMEs in the capital city of Prague in securing financing for their projects through soft loans aimed at reducing energy intensity in their activities, in order to achieve savings in their final energy consumption. The purpose of the programme is to fill the gap as regards financing enterprises, which cannot apply in the operational programmes in the capital city due to high GDP per capita The programme is funded from the profits of the sale of emissions allowances for 2014.

2.II.vi. Information campaigns / complementary policies

The Czech Republic runs energy consulting and information centres. Energy consulting is provided as a free service to the public, which serves to support the implementation of energy savings and RES. It is designed for citizens, public administrations, businesses and entrepreneurs. The information centres are represented in all regions of the country and provide advice from qualified energy consultants. Financial support for these centres comes from the Ministry of Industry and Trade programme *EFEKT*[9] – a state programme that promotes energy savings and the use of RES.

As already mentioned, the Ministry of Industry and Trade coordinates the programme *EFEKT*. It is aimed at realising energy savings, increasing energy efficiency and reducing energy consumption. Minor investment and non-investment projects are promoted throughout a five-year period; these assist with energy consulting, implementing energy management, preparing energy efficiency projects, hosting events and

providing books and pamphlets, all of which are free to the public. The *EFEKT* programme also supports the EPC system, for example, by providing essential books as learning materials for applicants who wish to obtain a licence to issue EPCs and inspect heating and AC systems. The programme also supports energy auditors.

2.III. Energy performance certificate requirements

The obligation to obtain an EPC is set in the *Energy Management Act* for all buildings that are covered by this Act before construction (in the process of getting the building permit), major renovations, sale and rental, as well as when a builder submits a request for building changes before building completion. The *Energy Management Act* covers all residential, commercial and public buildings and defines the following exemptions as regards the issuance of the EPC:

- buildings with a total floor area of less than 50 m^2;
- buildings that are considered to be historic buildings or are located in a conservation area;
- buildings used as places of worship and for religious activities;
- residential buildings which are used or intended to be used for a limited time annually and with an expected energy consumption of less than 25% of what would be the result of all-year use;
- industrial sites, workshops and non-residential agricultural buildings with energy consumption of less than 700 GJ;
- intelligence service buildings;
- buildings important for state defence;
- buildings built before 1947 to be sold or rented and which have not undergone major renovations since, and the seller/lessor and the buyer/tenant agree on not issuing the EPC.

The EPCs can only be issued by *energy specialists* having a licence from the Ministry of Industry and Trade. The Ministry of Industry and Trade maintains a database of all approved *energy specialists* on its website. Further to the *energy specialists*, the database also includes boiler and AC inspectors. The *energy specialist* is obliged to register all issued EPCs in *ENEX*, the electronic database maintained by the Ministry. It is the obligation of the building owner to obtain the EPC. In case the EPC is processed by an expert from a different Member State, the building owner is obliged to inform and present the licence of the expert to the Ministry.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The building owner covered by the *Energy Management Act* must show and hand over the EPC or its verified copy when selling or renting the building, either as a whole or in part. The handover must happen at the latest when signing the contract; this applies for all building types. An EPC issued for an apartment building serves as an EPC for each apartment unit within the building. In case of sale or rental of an apartment unit, the *Apartment Owners Association* must provide the EPC to the apartment unit owner.

If the building owner does not fulfil these obligations, a penalty can be imposed by the *State Energy Inspection*.

The price of the EPC can typically range between 120 € and 150 € for an apartment or for a single-family house, and may go up to 2,000 € – 3,000 € for hospitals or large apartment buildings.

2.III.ii. Quality Assurance of EPCs

The *State Energy Inspection* is annually required to check at least one in twenty EPCs issued in the previous calendar year. In 2016, the *State Energy Inspection* performed 279 controls of *energy specialists* from a total of 1,429 *energy specialists* (20% of *energy specialists* controlled). These controls covered 1,305 EPCs to verify whether they were processed objectively, truthfully and completely, as the *Energy Management Act* requires. The controls identified several law violations, and penalties were imposed on the 178 relevant *energy specialists*. So far, penalties applied for wrongly processed EPCs total more than 13,000 €.

In addition, 213 controls checked the obligations of constructors and building owners regarding major renovations, and of building/unit owners, owner associations, and third parties regarding the proper display of EPCs in the event of a rental or sale. The resulting penalties imposed were 30,700 € in total.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The Czech Republic runs a database called the *Central Register of Administrative Buildings*[10]. This register keeps records of 5,000 buildings that are properties of the state. The *Energy Management Act* §7a; sets the obligation for public authorities and owners of buildings occupied by public authorities to have the EPC issued by 1 July 2013 for buildings with a total floor area of over 500 m^2, and by 1 July 2015 for buildings with a total floor area of over 250 m^2. The EPC has the same format as that for non-public buildings and must be displayed in a prominent place where it is clearly visible to the public. The EPC must be recalculated as soon as it expires (within 10 years), or in case of major building renovations.

2.III.iv. Implementation of mandatory advertising requirement – status

When a building or an apartment is offered for sale or rent, the energy performance indicator from the EPC should be included in the advertisements in commercial media. The obligation to present the energy performance indicator in advertisements started on 1 January 2013. When the sale or rental is advertised by a third party (e.g., an estate agency), the owner must provide the graphical part of the EPC to the third party that displays the energy performance indicator in the advertisement. If the building owner does not provide the EPC, the third party displays class G to fulfil the obligation; however, the building owner can nevertheless be fined if they did not provide the graphical part of the EPC to the third party.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

The Czech Republic implemented an obligation for mandatory inspections of heating systems over 20 kW and hot water distribution systems in line with Articles 1-3 of the EPBD. This provision was implemented into Article 6a of the *Energy Management Act*. This article defines inspections of heating systems in buildings with business purposes. Inspections relating to family houses are defined by the *Air Protection Act*[11], or 458/2000 Coll.[12], the *Energy Act* and Decree 85/1978 Coll.[13] on inspections, revisions and tests of gaseous heat sources.

The Czech Republic also coordinates energy consultancy and information centres which give advice for heat sources that are not covered by the EPBD, as well as for AC systems, energy efficiency and RES, as mentioned in Section II vi.

2.IV.ii. Progress and current status on heating systems

According to the *Energy Management Act*, all heating systems (with a boiler running on natural gas, liquid or solid fuels with a rated output power of above 20 kW) must be subject to regular efficiency inspections in compliance with Decree 194/2013 on the inspections of boilers and hot water supply (formerly Decree 276/2007). This decree sets the scope, manner and frequency of the inspections of heating systems as well as the form and content of the inspection reports, including:

1. documentation assessment;
2. visual inspection and a check of the operability of the accessible heating system;
3. evaluation of maintenance of the heating system;
4. evaluation of the dimensioning of the heating system in comparison with the heating requirements of the building;
5. evaluation of the efficiency of the heating system;
6. recommendations for financially feasible improvements of the heating system and thermal energy distribution.

The inspection report must be uploaded to the national database *ENEX* and can be subject to control.

2.IV.iii. Progress and current status on AC systems

Similarly to heating systems, the *Energy Management Act* requires AC systems with a rated cooling output above 12 kW to undergo regular efficiency inspections in compliance with Decree 193/2013 on the inspection of AC systems (formerly Decree 277/2007), resulting in a written report on the AC systems inspections. The decree also sets out the inspection methodology. The inspection of the AC systems consists mainly of:

1. documentation assessment;

2. visual inspection and a check of the operability of the accessible AC units;
3. evaluation of maintenance of the AC system;
4. evaluation of the dimensioning of the AC system in comparison with the cooling requirements of the building;
5. evaluation of the efficiency of the AC system;
6. recommendations for financially feasible improvements of the AC system.

The inspection report must be uploaded to the national database *ENEX* and can be subject to control.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Both the inspection and the inspection report can be issued only by *energy specialists* licensed to perform heating systems and thermal energy distribution or AC systems inspections. The report must be objective, complete and correct. If the inspection report is improperly processed, a penalty of up to 185,000 € can be imposed from the *State Energy Inspection*.

In 2016, 196 controls checked whether the building owner fulfilled the obligation for heating or AC system inspection. Penalties imposed for not fulfilling this obligation amounted up to 17,700 €.

Quality control of inspection reports

The *State Energy Inspection* checked 64 heating and AC systems inspection reports. It was discovered that 10 out of the 27 energy specialists violated the law. The administrative process to impose the relevant fines is still ongoing.

3. A success story in EPBD implementation

In 2016, the Czech Republic launched an information campaign to raise public awareness for the EPC on a national level. A broad range of texts were prepared, highlighting the importance of the EPC and explaining its parts, including who can issue an EPC and where complaints can be filed in case of improper processing. Energy savings calculations were done to show what role the EPC can play when considering a rental or house bargain. Finally, it also included requests for public advertisement.

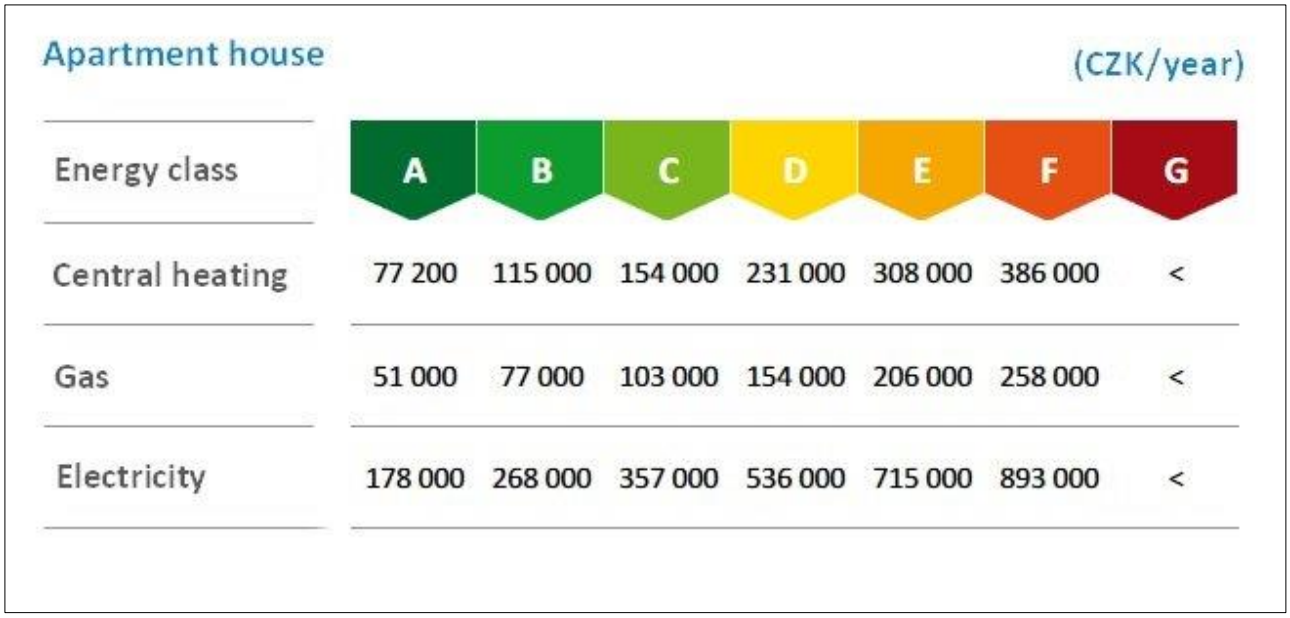
A relevant web page[14] was created to contain all the necessary information in an 'easy-to-understand' format. The campaign was based on two model houses commonly used by the public – a family house and an apartment house – in order to present different costs using different sources of energy and different energy classifications. The family house model costs were calculated for heating and hot water preparation using natural gas, heat pumps and electricity.

Family house with gas boiler (Czech crowns/year)

ENERGY CLASS	A	B	C	D	E	F	G
HEATING, HOT WATER	15 600	23 400	31 200	46 800	62 400	78 000	<
LIGHTING	3 600	5 400	7 200	10 800	14 400	18 000	<
TOTAL COSTS	**19 200**	**28 800**	**38 400**	**57 600**	**76 800**	**96 000**	<

Figure 2. Example of costs for different energy classes in case of a family house with gas boiler.

The energy sources used in the apartment model include gas, electricity and a central heating system. The costs are referenced for a building unit with a total floor area of 65 m^2.

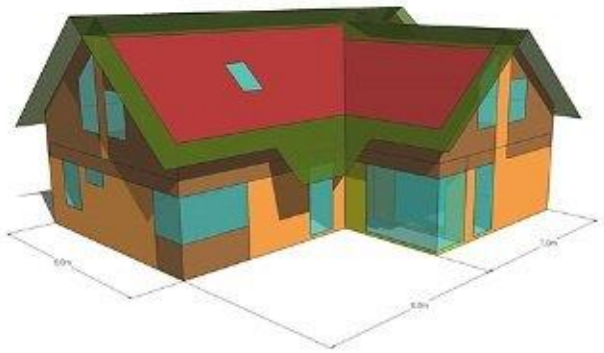


Apartment house (CZK/year)

Energy class	A	B	C	D	E	F	G
Central heating	77 200	115 000	154 000	231 000	308 000	386 000	<
Gas	51 000	77 000	103 000	154 000	206 000	258 000	<
Electricity	178 000	268 000	357 000	536 000	715 000	893 000	<

Figure 3. Example of costs for different energy classes in case of an apartment house with different energy sources.

As another example, a single-family house with different energy classes (B, C and G) was used to display savings under different conditions based on the EPC. The total floor area was 233 m^2, and the home design was L-shaped with wooden windows with double-glazing and wooden doors with partial glazing. Different conditions were chosen: a simple construction without any insulation, a construction with insulated walls and roof, a construction to reach level C, and the same example to reach level B.



Original state	Variant 1	Variant 2
uninsulated building with original double glazing (energy class G)	Facade, roof and construction insulation on level C	Facade, roof and construction insulation on level B

How much can be saved on heating costs

Annual saving	Variant 1 B	Variant 2 C
Electricity (MWh)	53	63
Gas (MWh)	68	78
Electricity (CZK incl. VAT)	**123 992**	**147 387**
Gas (CZK incl. VAT)	**92 484**	**106 087**

Figure 4. Difference in family house costs for heating in B or C energy class

The web page also contains an FAQ section on EPCs as well as the possibility to ask questions using the web interface. In order to reach the wider public, a TV commercial was prepared and broadcasted on the main TV channels within the Czech Republic during prime time. Promotional banners were also prepared and displayed on different web servers, with newspapers referring to the web page. The campaign lasted approximately six months. Both the TV and newspaper advertisements are no longer in circulation and the web page is also no longer in operation and cannot be accessed by the public.

4. Conclusions, future plans

In the Czech Republic, much attention is devoted to the energy performance of buildings, and the country is continuously transitioning towards NZEB in construction standards. Many seminars, webinars and lectures are currently taking place in order to assist architects, builders and designers with this transition.

In 2017, the Czech Republic was preparing to launch a project called "*Energy Savings Wisely*"[15]. This project is one of the key tools for increasing energy savings in buildings. It is focused on quality preparation and the development of energy saving measures without the use of investment subsidies, and it complements other subsidy programmes supported by European Union structural funds. The programme aims to increase the quality of energy saving projects and promote the implementation of energy saving projects in housing and the public and private sector, leading to a broadly efficient use of energy.

The core of the programme involves an energy assessment of the work done by *energy specialists* via a feasibility study which examines the appropriateness of buildings. The specialists offer a combination of complex energy efficiency measures, including specifications of investment costs and the energy saving potential of each measure.

The attention will be on:

- the complexity of proposed measures and the form of the upcoming project;
- the effectiveness of invested funds;
- the long-term and sustainable benefits that can be achieved by decreasing future operating costs related to energy consumption, at least for the specific measure's lifetime (with a minimum of 15 years, and in case of building insulation even longer);
- the reduction of the negative impacts on the environment.

The basis for the preparation of the energy saving project is the documentation of all potential measures. The building owner should then have the opportunity to compare which measures are feasible, how much investment is needed, how much of a reduction in operating costs can be acheived, and what length of payback period can be expected, to decide accordingly which measure(s) to pursue.

The goal of the programme is to promote the standardisation of quality during the preparation and implementation of energy efficiency measures in a natural way – in other words, without relying on subsidies – so that the primary focus is mainly on achieving real energy savings and less on the development of and reliance on subsidy schemes.

Endnotes

1. https://portal.gov.cz/app/zakony
2. https://portal.gov.cz/app/zakony
3. Ibid
4. Ibid
5. https://csnonline.unmz.cz/
6. Ibid
7. The Strategy is a part of the National Action Plan according to energy efficiency directive 2012/27/EU and can be found at https://www.mpo.cz/cz/energetika/energeticka-ucinnost/strategicke-dokumenty/narodni-akcni-plan-energeticke-ucinnosti-cr--150542
8. www.cmzrb.cz/produkty-a-sluzby/zvyhodneny-uver-v-programu-energ?lang=1
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12. Ibid
13. Ibid
14. www.vitekolikusetrite.cz
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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD Implementation in Denmark

Status in December 2016

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NATIONAL WEBSITES

www.ens.dk, www.sbi.dk, www.trafikstyrelsen.dk, www.bygningsreglementet.dk, www.sparenergi.dk, www.boligejer.dk

1. Introduction

This report presents an overview of the current implementation status of the EPBD and relevant initiatives planned in Denmark. The report addresses the energy performance requirements for buildings, including an outline of the national plan for NZEB and Danish requirements for technical building systems. It also provides an update on the implementation of the EPC and the inspection requirements for heating and AC systems.

The "*Building Class 2020"*, equivalent to the Danish NZEB definition, is under revision and expected to be finalised in spring 2018. As of 18 August 2011, the "*Building Class 2020"* was already designated as a voluntary class via the Statutory Order *("Bekendtgørelse")* No. 909. An early introduction of future requirements is tradition in Danish building policy and regulation, since it gives the building industry as well as building owners an opportunity to prepare, develop and experiment with the building of tomorrow. The method has been a successful way to push the Danish building industry in an ambitious direction and has ensured new buildings to be highly energy efficient at a cost-efficient level. It is also tradition that future requirements are evaluated before they become final and binding.

Responsible for implementing the EPBD in Denmark is the Danish Energy Agency, under the Danish Ministry for Energy, Utilities and Climate.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The current energy performance requirement methodologies for new residential and non-residential buildings were implemented through the *2006 Danish Building Regulation* as an implementation of Directive 2002/91/EC.

Denmark has focused on reducing energy consumption in new buildings for many years. The energy consumption in new buildings has steadily declined since the introduction of the first energy requirements in building regulations in 1961. Since 2006, requirements have been set for a building's overall energy consumption in accordance with the EPBD. In 2008, the Danish government entered an energy agreement on reducing energy needs of buildings by 25% in 2010, 25% in 2015 and another 25% in 2020 - a total reduction of 75% compared to the 2006 requirements-, which was supported by a broad majority of political parties in the Danish Parliament. In 2010, the first steps were taken with the introduction of *Building Regulation 2010* (*BR2010*), in which the energy requirements were tightened by about 25% and a voluntary energy class was revised and renamed "*Low-energy Class 2015 (Lavenergiklasse 2015)*". Already in 2011, the new "*Building Class 2020"* was introduced – also as a voluntary building class – due to requests from the Danish building industry to have sufficient time for developing new products for the future.

In July 2016, the previously voluntary "*Low-energy Class 2015*" became final and binding and was named the "*Danish Building Regulation 2015"* (*BR2015*). The *BR2015* sets minimum energy performance requirements for all types of new buildings. In addition to the minimum requirements, the *BR2015* also sets requirements for a voluntary low-energy class, "*Building Class 2020*" (equivalent to NZEB level). If the voluntary class of 2020 becomes the minimum requirement in 2020 as planned, it will represent the last step in implementing the *Energy Agreement 2008* as regards energy requirements for new buildings.



Figure 1. Danish Building Regulations 2015. The Danish Building Regulation (current and historic) can be found at: http://bygningsreglementet.dk.

2.I.ii. Format of national transposition and implementation of existing regulations

The *BR2015* sets minimum energy performance requirements for all types of new buildings, including NZEB requirements.

The minimum energy performance sets the limit in terms of maximum allowed primary energy demand for a building, including, e.g., thermal bridges, solar gains, shading, infiltration, ventilation, heat recovery, cooling, lighting (for non-residential buildings only), boiler and heat pump efficiency, electricity for

operating the building as well as sanctions for overheating. The overheating penalty is calculated as a fictive energy demand, equal to the energy demanded by an imaginary mechanical cooling system in order to keep the indoor temperature at 26 °C. This additional energy demand is included in the calculated overall energy consumption of the building by the monthly based compliance checking tool, "*Be15*" (www.sbi.dk/be15).

Renewable energy is included in the calculation. However, for all buildings, the maximum electricity production to be factored in from RES, e.g., solar cells and wind turbines, corresponds to a reduction of the need for supplied energy of 25 kWh/m² per year in the energy performance framework (primary energy).

For buildings to comply with the *BR2015* and the voluntary low-energy class, it must be proven that they have a good thermal indoor climate during hot periods. The indoor temperature in residential buildings must not exceed 27 °C for more than 100 hours per year, and 28 °C for more than 25 hours per year. This can be done either through "*Be15"* or via a dynamic simulation tool. In non-residential buildings, the building owner decides the temperature limits, and summer comfort must be proven using a dynamic simulation tool. Additionally, the airtightness for a building to fall under the voluntary "*Building Class 2020"* must be proven through a pressurisation test, by meeting a maximum airflow rate (0.5 l/s.m² at a pressure difference of 50 Pa).

The minimum energy performance for the *BR2015* requirements (A2015) is:

30 + 1,000 / A [kWh/m^2.year] for residential buildings, and

41 + 1,000 / A [kWh/m^2.year] for non-residential buildings.

The minimum energy performance for the voluntary Building Class 2020 (NZEB - A2020) is:

20 [kWh/m^2.year] for residential buildings, and

25 [kWh/m^2.year] for non-residential buildings.

2.I.iii. Action plan for progression to NZEB for new buildings

The Danish national plan for NZEB (2011)[1] lists the initiatives and policies that will increase the number of NZEB. Examples of strategies and policies include:

- The energy-saving initiative for energy supplying companies: The government has developed a comprehensive strategy for upgrading the energy performance of the existing building stock. Danish supply companies are obliged to provide an energy saving corresponding to 2.6% of the national energy consumption (exclusive transport) in 2013-2014, and 3.0% in 2015-2020. Compared with 2010-2012, in 2013 and 2014 the obligation to provide energy saving has increased by 75%.
- The NZEB level for new buildings is encouraged through information campaigns and building guidelines have been drawn up for contractors, architects and engineers who wish to build in an energy-efficient manner.
- Changing over to RES: As a general rule, oil and natural gas boilers are no longer allowed in new buildings as of 2013.
- Public action: Reducing the energy consumption in public buildings by 14% in 2020 compared to 2006 levels.

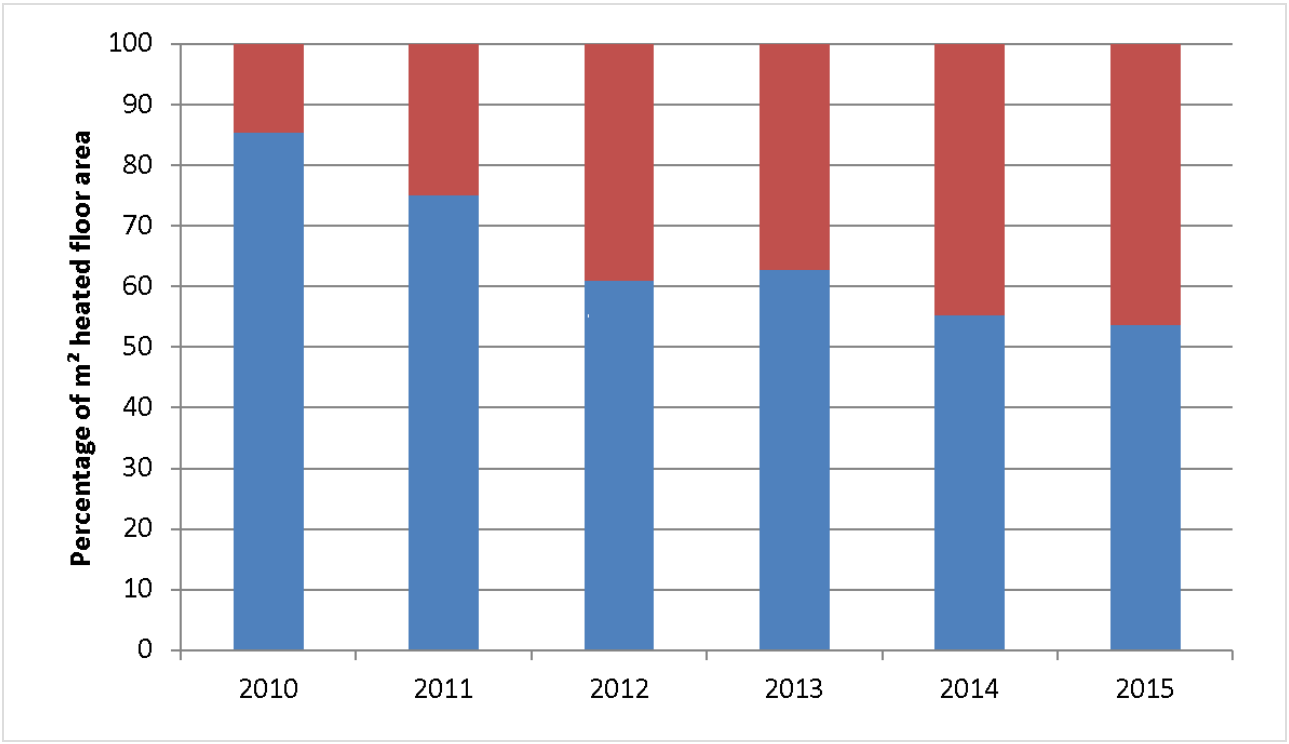
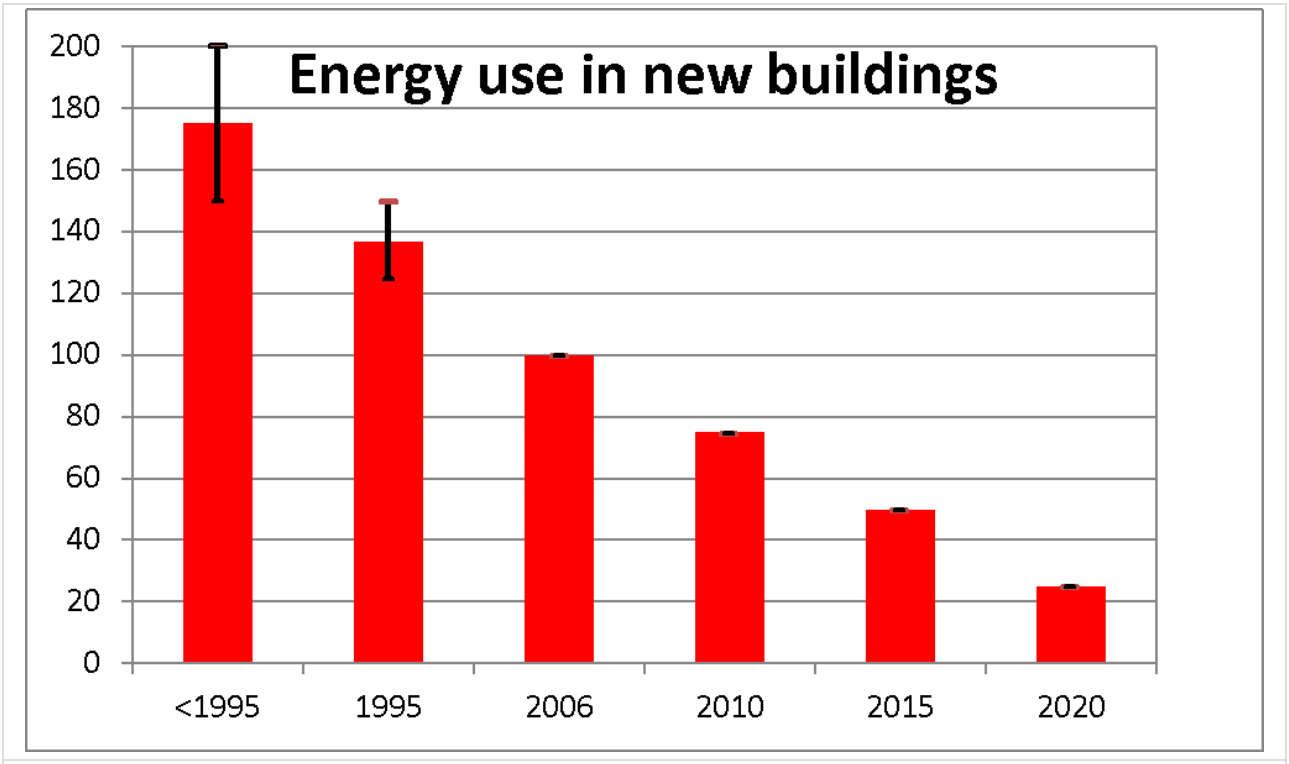


Figure 2. Share of low-energy buildings (red) compared to buildings meeting the various minimum requirements in the Danish Building Regulations (blue). Low energy buildings are those energy performance classes which were valid (have changed over time) in the respective years.



Notes:

1) Index 100 corresponds to 2006 requirements;

2) The range shown on the top of the first two columns indicates that it is not possible to give a precise value compared to the reference, as the method to set a target was different then.

Figure 3. Development of relative energy use in new buildings.

2.I.iv. Requirements for systems and / or building components for new buildings

The Danish Building Regulations include requirements for a wide range of technical building systems.

There are specific energy-related requirements for boilers based on coal, biomass and similar fuels. Boilers operating on coal, biofuels and biomass should, as a minimum, meet the energy requirements of boiler class 5 in the standard EN 303-5.

The Ecodesign Regulations include requirements for ventilation units, combined heat & power appliances, oil/gas boilers, heat pumps and circulation pumps for installations. These requirements replace the former requirements for individual components in the "*Danish Building Regulation 2010*" and are included in the "*Danish Building Regulations 2015"*. In the long term these references will be phased out, as it will be the duty of the owner to stay up-to-date on existing and new requirements in EU regulations.

Individual building elements must be insulated to a level ensuring that the heat losses through them do not exceed the values included in the following table:

Building element	**U-value** [W/m²K]
External walls and basement walls in contact with the soil.	0.30
Suspended upper floors and partition walls adjoining rooms/spaces that are unheated or heated to a temperature which is 5 °C or more below the temperature in the room concerned.	0.40
Ground slabs, basement floors in contact with the soil and suspended upper floors above open air or a ventilated crawl space.	0.20
Suspended floors below floors with underfloor heating adjoining heated rooms/spaces.	0.50
Ceiling and roof structures, including jamb walls, flat roofs and sloping walls directly adjoining the roof.	0.20
External doors without glazing.	1.40
External doors with glazing.	1.50
Doors and hatches to the outside or to rooms/spaces that are unheated and these as well as glass walls and windows to rooms that are heated to a temperature which is 5°C or more below the temperature in the room concerned.	1.80
Skylight domes.	1.40
Insulated sections in glazed external walls and windows.	0.60
Suspended upper floors and walls against freezer rooms.	0.15
Suspended upper floors and walls against cold stores.	0.25
Building element	**Linear losses**
Foundations around spaces that are heated to a minimum of 5 °C.	0.40
Foundations around floors with underfloor heating.	0.20
Joint between external wall and windows or external doors and hatches.	0.06
Joint between roof structure and roof lights or skylight domes.	0.20

Table 1: Maximum U-values and linear losses.

Additionally, the energy balance of windows and glazed outer walls must not be less than -17 kWh/m²/year (equal to a B-label window in the voluntary Danish window labelling scheme). The energy balance through roof lights and glazed roofs must not be less than 0.0 kWh/m² per year. The energy balance is calculated for a standard sized window with standardised outdoor conditions.

New buildings must be built such that the design transmission loss does not exceed 4.0 W/m² of the building envelope in the case of single-storey buildings, 5.0 W/m² for two-storey buildings and 6.0 W/m² for buildings with three storeys or more. The calculation does not take into account the area of windows and doors, nor transmission loss through them.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The *BR2015* tightened the energy performance requirements for individual building components for all building types. This applies to the replacement of components and to major renovations. Measures must be economically plus technically feasible, i.e., they must have a simple payback time of less than 75% of their expected lifetime as defined in the Danish Building Regulations. In case of the full replacement of a component (e.g., a new roof, new window, new outer wall), the new component must meet the requirements set in the BR2015, regardless of profitability.

All existing buildings	Changed use and extensions	Single component requirements for new / replaced parts	Holiday homes	Minimum requirements*
U-value requirements [W/m²K]				
External walls and basement walls towards ground	0.18	0.15	0.25	0.30
Slab on ground, etc.	0.10	0.10	0.15	0.20
Loft and roof constructions	0.12	0.12	0.15	0.20
Windows	-	1.80 (doors)	1.80	-
Roof windows	-	-	1.80	-
Thermal bridges [W/(m K)]				
Foundations	0.12	0.12	0.15	0.40/0.20
Joints between windows and walls	0.03	0.03	0.03	0.06
Joint between roof structure and windows in the roof	0.10	0.10	0,10	0.20
Minimum energy gain [kWh/m².year]				
Facade windows	-17	-17	-	-17
Roof windows	0	0	-	0

Note: Minimum requirements are primarily set to eliminate the risk of surface condensation and hence mould growth. Applies for both new and existing buildings being renovated.

Table 2. U-values and thermal bridges requirements for existing buildings – examples.

As an alternative to the component analyses, two voluntary low-energy classes have been introduced:

- A residential building may be classified as "Renovation Class 2" when the total demand for energy supply for heating, ventilation, cooling and domestic hot water per square meter of heated floor area does not exceed 110 kWh/m² per year plus 3,200 kWh per year divided by the heated floor area.

- A residential building may be classified as "Renovation Class 1" when the total demand for energy supply for heating, ventilation, cooling and domestic hot water per square meter of heated floor area does not exceed 52.5 kWh/m² per year plus 1,650 kWh per year divided by the heated floor area.

Requirements for non-residential buildings are presented below. Verification must be on the basis of SBi's *"Energy demands of buildings" ("SBi Direction 213 Bygningers energibehov")*[2] where the energy demand for the whole building must be calculated.

To comply with the renovation classes, the requirement for supplied energy must be improved by at least 30 kWh/m² per year. To obtain "*Renovation Class 1"*, the requirements for the indoor climate for new buildings must be observed as well.

The energy performance framework for the voluntary "*Renovation Class 2"* (Energy label C) is:

110 + 3,200 / A [kWh/m^2.year] for residential buildings, and

135 + 3,200 / A [kWh/m^2.year] for non-residential buildings

The energy performance framework for the voluntary "*Renovation Class 1"* (Energy label A2010) is:

52.5 + 1,650 / A [kWh/m^2.year] for residential buildings, and

71.3 + 1,650 / A [kWh/m^2.year] for non-residential buildings

2.II.ii. Plans to improve the existing building stock

For existing buildings, the government has developed a comprehensive strategy for the energy upgrading of the building stock. The implementation of the initiative started in 2014, including the analyses of the energy requirements for the *BR2015*.

The requirements for conversion may be met through component requirements mentioned in Table 2 or through compliance with the energy performance frameworks for existing buildings corresponding to the calculation for new buildings. The use of the energy frames mentioned in section I for existing buildings is a voluntary option for owners that engage in deep energy renovation projects. This method is intended to increase the number of NZEB, as the owner has the possibility to look at the buildings' energy performance in a more holistic way.

Denmark has committed to reduce the energy consumption in buildings owned and used by the government by 14% by 2020, with 2006 as the base year. This initiative targets the energy efficiency in public buildings and it will also ensure implementation of the EED Article 5, which Denmark has chosen to implement using the alternative approach, and has committed to obtain energy savings equivalent to 148,192 MWh from 2014-2020, corresponding to a reduction target of 9.1% for this period. The initiative is a continuation of a long-term Danish effort since 2006 to reduce the energy consumption in buildings used by the government.

2.II.iii. Regulation of system performance, distinct from whole building performance

There is a general requirement in the Danish Building Regulations that services have to be built in a manner that prevents unnecessary energy consumption. This means, for example, that heating systems must be designed and built for energy-efficient operation, including the components, which must be compatible with one another and suited to the intended use of the building and building systems.

Heating and cooling systems must be sized, designed, controlled and operated as specified in the Danish Standard DS 469 "Varme - og køleanlæg I bygninger" ("*Heating and cooling systems in buildings*"), which has different functional requirements for the commissioning of heating and cooling systems as well as additional requirements for use, operation and maintenance. Ventilation systems must be designed, installed, fully commissioned and handed over as stated in DS 447 "Ventilation i bygninger - Mekaniske, naturlige og hybride ventilationssystemer" ("*Ventilation for buildings – Mechanical, natural and hybrid ventilation systems*").

All technical building systems must be insulated as required by DS 452 *"Termisk isolering af tekniske installationer"* ("*Thermal insulation of technical installations"*).

2.II.iv. Encouragement of intelligent metering

Technical systems with significant energy consumption must have individual meters installed if energy consumption exceeds a certain level.

System	Minimum annual energy use triggering metering
Heat pumps / cooling plants	3,000 kWh electricity
Server rooms	Always
Ventilation units	3,000 kWh electricity for air transport
Heating coils	3,000 kWh electricity or 10,000 kWh heat
Domestic hot water	10,000 kWh heat for heating and circulation of domestic hot water

Table 3. Minimum annual energy use that triggers metering for individual parts of technical building systems.

2.II.v. Financial instruments and incentives for existing buildings

Financing of energy efficiency in buildings is primarily privately funded in Denmark. Building owners have easy access to capital for improving their buildings through the well-functioning Danish mortgage system. The system gives owners of new as well as existing buildings the opportunity to borrow money at attractive rates and conditions.

On an annual basis, between 10 and 13 billion € – equivalent to 2.1-2.7% of the value of the building mass – is invested in various forms of renovations and other investments in buildings. There are no specific public support schemes for projects related to energy efficiency in buildings, but rather a wide range of national schemes which aim to boost investments in energy efficiency.

Among these initiatives are:

1. A tax-deduction scheme[3] for deducting salary expenses for works in relation to green initiatives in private buildings. The initiative is planned to come to an end by the end of 2017.

2. The "*BetterHouses*" ("*Bedre Bolig*")[4] initiative, a one-stop shop for assisting home owners as regards cost-optimal energy savings. As of 2017, the scheme has been extended to include apartment blocks and large buildings.

3. Between 2016 and 2019, an interesting scheme is aimed at supporting partnerships between public and private partners regarding energy efficiency in buildings, mainly with support in developing new business models and fostering cooperation between multiple partners such as municipalities, regional units, utility companies, banks, housing associations, businesses, etc. Based on a tender, the nine best-qualified projects have obtained public funding. The total value of the tender is 1 million € to cover up to 50% of the expenses of the selected projects[5].

4. Finally, the establishment of a market for energy services targeting the replacement of fossil-fuel-based heating with heat pumps is supported. This is done by providing initial financial support for the purchase of heat pumps by a number of energy service companies. These heat pumps are installed and operated in private homes, which in turn pay for their consumption of heat from the heat pump.



Figure 4. The "Bedre Bolig" ("BetterHouses") campaign - www.BedreBolig.dk.

2.II.vi. Information campaigns / complementary policies

Information initiatives to reduce the energy consumption in the existing building stock are one of the key elements in the Danish Energy Agreement of 22 March 2012. Previous and current activities aim at producing cost-efficient information material in cooperation with relevant actors that deal with energy saving. The importance of the local perspective and private ownership is a significant part of the activities.

The Danish Energy Agency hosts websites containing both general and specific information on energy savings in buildings as well as on the EPC. The main website of the information campaign, www.SparEnergi.dk, contains a variety of tools, information and knowledge that supports energy saving.

The Danish Government has recently launched an initiative with free-of-charge telephone support and email advice, as well as information activities about available energy consulting services for private households.

Furthermore, a number of initiatives have been launched to promote the EPC and reduce energy consumption in buildings, e.g., "*BetterHouses*". "*BetterHouses*" is a Danish national consultancy scheme, which is voluntary and market-driven. It extends the EPC scheme and aims to promote refurbishment of private residential buildings by removing barriers and making it easier and more manageable to refurbish and reduce the buildings' energy consumption through counselling during the building process.

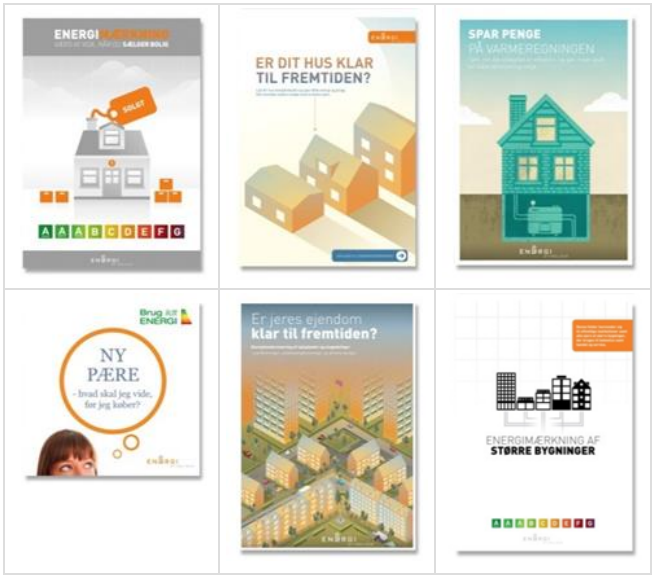


Figure 5. Guides and EPC-information.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The Danish Energy Agency is responsible for implementing the EPC system. All EPCs are registered in a central database and displayed on the public website www.sparenergi.dk. In Denmark, a total of around 60,000 new EPCs are registered annually (Table 4).

Year	2010	2011	2012	2013	2014	2015	2016*
Single-family	50,774	41,904	41,359	43,493	44,524	48,903	40,473
Multi-family	8,891	5,466	5,312	4,758	4,383	5,179	3,627
Non-residential	6,567	3,256	3,099	4,347	3,557	3,212	2,895
Holiday houses	4,418	389	726	824	871	886	647
Total	70,650	51,015	50,496	53,422	53,335	58,180	47,642
* period from January to September							

Table 4. Number of yearly issued EPCs for private buildings (2010 to 2016).

It is estimated that the compliance level is high due to few complaints by tenants and buyers.

A survey from 2016 reveals a high awareness about the EPC in Denmark. Nine out of 10 respondents recognise that they have received an EPC in connection with the purchase of their property. In addition to that, 92% have read parts of the report, and more than half have read the entire report.

The survey also showed that the recommendations in the EPC report are particularly relevant to owners with properties marked as either D, E, F or G. Among these, 39% have acted on the proposals in the EPC report to make energy-efficient renovations.



Figure 6. Labels used in the Danish building energy performance certification scheme.

2.III.ii. Quality Assessment of EPCs

Every year, 0.25% of the newly issued EPCs are randomly selected for an independent quality control. In addition to that, the Danish Energy Agency conducts quality control based on complaints received from owners. Annually, a total of approximately 150 EPCs are reviewed.

In Denmark, three different levels of penalties are foreseen:

1. In case of error, companies must correct the certificate.
2. In case of serious errors, the company will get a warning notice and the certifying accreditation agency is informed.
3. In cases where errors are serious and/or repeated, a public notice will be made available online as a "*name and shame*" sanction. The certifying accreditation agency is informed and is able to suspend the certification of the company if they find it appropriate. Companies must carry out their own quality control according to DS/EN ISO 9001.

EPCs may not differ by more than +/-10% of the total calculated energy demand of the building.

The Danish Energy Agency has worked systematically to increase the overall quality of the EPCs with a special effort regarding, e.g., education and enforcement.

Denmark is currently implementing a seven-step plan that entails:

1. tightening supervision and quarantine and requiring consultants who make serious and/or repeated errors to take new exams;
2. shortening the time from error to learning, with a focus on case-handling time;
3. initiating further dialogue with stakeholders regarding quality efforts;
4. revising the regulatory framework,
5. developing educational standards with stricter requirements;
6. applying a user-friendly energy labelling scheme;
7. implementing a user satisfaction survey.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

An EPC for a public building or a large building often visited by the public has the same format, content and validity as an EPC for any other building type. In addition, it is required that the EPC is placed somewhere visible to the public. Key information about the certificate is available on www.boligejer.dk, where it is possible to find the calculated consumption as well as the name of the energy expert and the certified company who issued the certificate.

The Danish Energy Agency has initiated a review of the current EPC scheme for public and large buildings in order to gather information about the progress and current status of EPCs in this category. The overall goal is to develop an EPC scheme that is more relevant and applicable in the administration of their buildings.

2.III.iv. Implementation of mandatory advertising requirement – status

In July 2012, a new act implemented mandatory advertising requirements and provided sanctions in case of non-compliance.

When a building is sold or rented out, the commercial media advertisement must display the EPC label. If the advertising requirement is not adhered to, the seller can be fined DKK 2,000 (268 €).

In 2014, the Danish Energy Agency performed a random check of private sales on the internet, which showed a compliance rate of 60%. Furthermore, an initiative has been launched relating to internet sales without the use of a real estate agent. The goal is – in collaboration with the owners of these websites – to develop a technical solution that blocks advertisements without the required EPC.

As of November 2017, three fines have been issued with another few fines currently being processed.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Until 2011, Denmark was implementing Article 14 of the EPBD through mandatory regular inspections of heating systems. However, it was then estimated that the use of regular inspections was not cost-effective within the Danish legislative framework. Therefore, since 2012, the Danish implementation of Article 14 is done through a number of activities such as advisory service, tax benefits and requirements to use RES for building heating, each of which contributes to increasing efficiency or phasing out oil and natural gas boilers. The Danish implementation of Article 14 should be seen as part of a long-term political goal to phase out fossil fuels. Thus, the initiatives for oil-fired boilers are mainly focused on replacement of these boilers with other heating sources, e.g., heat pumps, district heating, or solar energy.

To ensure the maintenance of heating systems which are not phased out, a number of measures contribute either to the efficiency or the phasing out of oil-fired and natural gas boilers. These measures include campaigns to increase building owners´ awareness of the potential value of service checks, as well as the promotion of qualified service providers.

2.IV.ii. Progress and current status on heating systems

As alternatives to inspections, the following initiatives have been implemented to help ensure a higher energy efficiency of heating systems in Denmark

- *Advisory services for craftsmen and building owners* ("*Videncenter for Energibesparelser i Bygninger"*).This service targets craftsmen and provides information and guidelines about how, e.g., to improve heating systems.
- *Tax deduction for craftsmen's labour costs* related to renovations of buildings ("*Bolig-job-ordning"*).The tax deduction has allowed building owners to include the cost of labour for renovations in their tax return forms, thereby giving them incentives to undertake renovation works such as the replacement of heating systems.
- *Obligations for energy service companies* to implement energy savings for their customers.
- *Reduced energy taxes for heat pump owners* compared with owners of other kinds of heating systems. The tax reduction makes electricity-based heating such as heat pumps more economical compared to oil or other fossil fuels.
- *Requirements for the use of RES* in certain types of buildings *and efficiency requirements for boilers*. *In new buildings*, heating with oil or gas is no longer allowed, which means that district heating, heat pumps and other heating systems with high efficiency are promoted. In *existing buildings*, old heating systems must be replaced with district heating, natural gas boilers or RES if the building is placed within a district heating or natural gas grid.
- Finally, in Denmark, the efficiency requirements for newly installed boilers are higher than those required by the ECO-design Directive (2009/125/EC).

2.IV.iii. Progress and current status on AC systems

Denmark has adopted regular inspections for the implementation of Article 15 of the EPBD. The scope of the inspection scheme has been expanded to include all AC and ventilation systems with an effective rated output of more than 5 kW. Certain AC systems for industrial use, as well as systems operating less than 500 hours/year are excluded. The AC and ventilation systems must undergo an inspection every 5 years. Promotion of these inspections is made via the website of the Danish Energy Agency.

The inspection consists of a basic recording of data, e.g., the type of system, effective rate and composition, as well as an indication of the condition of the system. Moreover, the functioning and efficiency of the system are examined during the inspection. Finally, the Danish Energy Agency gives recommendations on energy efficiency with respect to retrofitting, maintenance and adjustment of the system to the owner in a report.

Data from the inspections is submitted to a database in the Danish Energy Agency.

2.IV.iv. Enforcement and impact assessment of inspections

It is the responsibility of the owner of an AC installation to get the required inspections to confirm whether conditions are met. If the mandatory energy measurement or inspections are not carried out, the owner of the AC may face fines. There have been no systematic compliance checks by energy authorities due to the lack of a common registry of ventilation systems in Danish buildings, and no fines have been imposed.

In 2013, 131 inspections of AC and ventilation systems were carried out and reported. Of those, 27 inspection reports where controlled by the Danish Accreditation and Metrology Fund.

Currently, no impact assessment has been made.

3. A success story in EPBD implementation

Common database with information of the existing building stock

In Denmark it has been mandatory to have an energy certification scheme since 1997. Information on the physical stage of the existing building stock is collected by energy experts while carrying out an energy audit for issuing an EPC. All data from the certification scheme is gathered in a common database, so a wide range of information is available with respect to the building stock. This knowledge is used in many ways, e.g., in numerous analyses of energy saving potential. The first comprehensive analyses were made in 2004 and the most recent was published in November 2017. Some results show that it is possible to obtain a reduction of the heat demand of approximately 28% until 2050 if buildings that are being renovated due to end of service life would simultaneously undergo an energy upgrade.. In the analyses, it is assumed that the buildings are thermally upgraded in accordance with the requirements stated in the "*Danish Building Regulations 2010*".

The available data offers a snapshot of the energy standard in the Danish building stock and has been made accessible for research. The analyses have been used for different purposes in the government's strategies for energy upgrading of the existing building stock. The most recent analyses of the Danish building stock and its energy-saving potential are available in the report "*Potential heat savings during ongoing renovations of buildings until 2050*", SBI 2016:04[6], and has been used as part of the foundation for the Danish strategy for energy performance upgrading of the existing building stock, "*The road to energy efficient buildings in the future*" ("*Vejen til energieffektive bygninger i fremtidens Danmark*").

Furthermore, a new analysis has just been conducted based on the available data[7]. The purpose was to analyse the extent to which it is necessary to include RES in the energy performance calculation, in order to compensate for the fact that some buildings may have higher energy needs than the average building due to architectural requirements or limitations from local plans. How and to what extent RES are used as a buffer in such cases is investigated.

These examples show that data of the existing building stock and energy conditions can be used for many useful analyses and is essential to form future national energy strategies.

4. Conclusions, future plans

The transposition of Directive 2010/31/EU – EPBD was completed in Denmark in June 2012. The energy requirements in the Danish Building Regulation for new buildings have been tightened by using a step-by-step approach and by introducing the new requirements as voluntary energy classes before they become mandatory, as is tradition in the Danish Building Regulation. The "*Building Class 2020*", which was introduced in 2011, meets the obligations stipulated in the EPBD regarding NZEB and is currently under evaluation to reflect the actual cost-optimality of the class before introducing it as a mandatory standard. The Danish National Plan for NZEB includes a number of initiatives and policies which will increase the number of NZEB and reduce energy consumption in existing buildings, including energy saving initiatives carried out by energy supply companies, a strategy for the energy renovation of the existing building stock, a changeover to RES, information campaigns and public action.

Since transposing the Directive 2010/31/EU in 2012, a large effort has been made by the Danish Energy Agency and others to raise public awareness concerning energy use. Information campaigns, web-based interactive tools regarding energy saving measures, etc. have been widely distributed, and public awareness has risen considerably. Denmark has succeeded in making the EPC visible, rendering it a clear sales parameter in the market. Denmark is currently implementing a seven-step plan to ensure that EPCs are uniform and of high quality.

The "*BetterHouses*" initiative targets single-family houses and is aimed at accelerating the energy renovation of private homes. The scheme introduces a one-stop shop for private homeowners who wish to renovate the energy efficiency of their homes and is designed to be market based.

As for initiatives targeting the energy efficiency in public buildings, Denmark has committed to reduce the energy consumption in buildings owned and used by the government by 14% by 2020, with 2006 as the base year. The initiative is a continuation of a long-term Danish effort since 2006. In parallel, existing voluntary agreements between the government and local/regional authorities to enhance energy efficiency in the buildings they use will be revised to reflect the EED. The commitment to reducing energy consumption by 14% by 2020 will at the same time complete the Danish implementation of Article 5 of the EED.

Endnotes

1. The Danish national plan for NZEB can be found at http://eur-lex.europa.eu/legal-content/DA/TXT/HTML/?uri=CELEX:52013DC0483R(01)&from=EN.
2. www.sbi.dk/be15
3. http://skat.dk/skat.aspx?oid=2234759
4. https://sparenergi.dk/forbruger/vaerktoejer/bedrebolig
5. https://sparenergi.dk/offentlig/kommuner/tilskud-til-partnerskaber
6. http://sbi.dk/miljo-og-energi/energibesparelser/potential-heat-savings-during-ongoing-renovations-of-buildings-until-2050
7. http://sbi.dk/miljo-og-energi/vedvarende_energi/vedvarende-energi-i-energirammen/vedvarende-energi-i-energirammen

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in **Estonia**

Status in December 2016

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NATIONAL WEBSITES

www.mkm.ee/en/objectives-activities/construction-and-housing-sector, www.kredex.ee/energy-efficiency

1. Introduction

In Estonia, the implementation of the EPBD is the overall responsibility of the Ministry of Economic Affairs and Communications. Improving the energy efficiency of buildings has been one of the priorities of the governmental energy and housing policy in Estonia. The amendments of the Building Act[1], which transposed the main elements of Directive 2002/91/EC, came into force in October 2006. However, the regulations transposing all the EPBD requirements were finalised in January 2009[2], and the main regulations[3], in compliance with Directive 2010/31/EU, came into force in January 2013. The Ministry of Economic Affairs and Communications plans to adopt even more strict energy performance requirements in 2018. Before the EPBD requirements, there were no specific legal obligations, e.g., thermal transmittance values, or requirements for technical building systems.

In 2015, a new renovation grant scheme[4] started for apartment buildings. During 2015 – 2018, a total of 102 million € will be used to renovate existing apartment buildings in Estonia.

This report presents an overview of the current status of implementing and improving the EPBD in Estonia. It addresses certification, minimum requirements and inspection systems as well as quality control mechanisms, training of qualified experts, information campaigns, etc.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

The minimum energy performance requirements are expressed as a primary energy performance indicator calculated for the building according to its standardised use, and applied to the building as a whole. Data for standardised use include a description of occupants, small power equipment and lighting usage profiles, operation times as well as indoor climate requirements. The energy performance calculation takes into account the energy needs for space heating, domestic hot water, cooling, lighting, ventilation, and electrical appliances. The minimum energy performance value characterises the primary energy use of the building; in other words, the delivered energy is multiplied by the primary energy factors (Table 1) of the energy carriers, and the exported energy multiplied by the same factors can be deducted (Figure 1).

Renewable energy (wood, biofuel)	0.75
District heating	0.9
Electricity	2.0
Fossil fuels (oil, gas, coal)	1.0

Table 1. Primary energy factors.

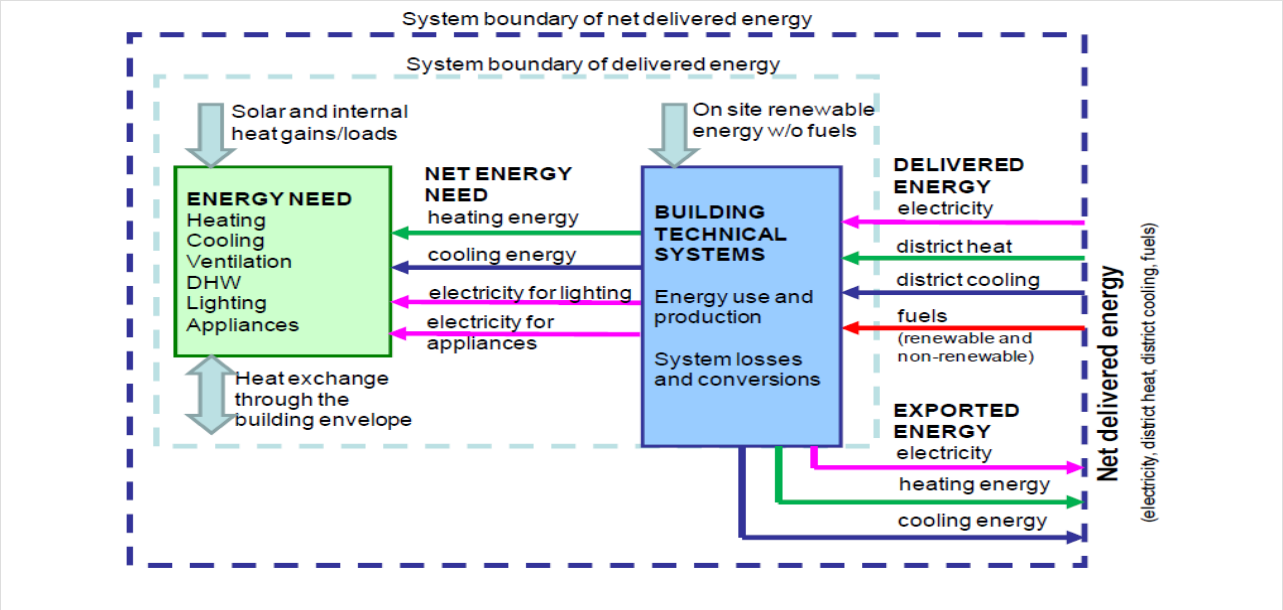


Figure 1. System boundary of minimum energy performance requirements.

Compliance with the minimum energy performance requirements must be proven through an energy calculation of the building, using the prescribed methodology. The calculated energy performance value must not exceed the maximum energy performance value set by legislation. Energy calculations for non-residential buildings must be executed by use of a dynamic energy simulation. For residential buildings, the monthly methodology is also accepted. All the input data, including requirements for the calculation tool, are specified in the Act of Minimum Requirements[5].

2.I.i. Progress and current status of new buildings

The minimum energy performance requirements are expressed as a primary energy performance indicator. The maximum primary energy values are listed in Table 2. Estonia has not set minimum requirements for U-values. The building has to meet the minimum energy performance requirements as a whole.

For detached and terraced houses, compliance with the minimum energy performance requirements can also be demonstrated by a simplified calculation of the specific heat loss through the building envelope. This method requires only envelope heat transfer coefficients (U) to be subjected to heat loss calculations for conduction and infiltration losses, and can be used if a mechanical supply and exhaust ventilation system with specified heat recovery and specific fan power is used. Depending on the heat source, specific heat loss values are set, so that they comply with minimum energy performance requirements. With this method, no further energy calculation is required. For example, the maximum specific heat loss value to be fulfilled in the case of a ground source heat pump serving as the heat source is 1.0 W/(m^2.K), and in the case of a gas boiler, it is 0.6 W/(m^2.K). It is important to note that these values are not U-values, but specific conduction (average U-value of building envelope including thermal bridges) and infiltration heat loss values calculated per heated floor area.

No.	Building type	Energy performance requirements (kWh/m^2)
1	Detached houses	160
2	Apartment buildings	150
3	Office buildings and libraries	160
4	Commercial buildings	210
5	Public buildings	200
6	Shopping malls and terminals	230
7	Schools, universities	160
8	Kindergartens	190
9	Hospitals and other medical buildings	38
Energy services included in energy performance requirements are shown in Figure 1.		

Table 2. Primary energy requirements for new buildings.

Requirements are also set for summer thermal comfort in buildings. For residential buildings, this requirement is defined as the hourly mean indoor temperature in excess of the maximum limit of 150 degree-hours (ºCh) over +27°C during the summertime period (from 1 June to 31 August). For compliance assessment, detailed procedures are described in regulation “Methodology for calculating the energy performance of buildings”[6]. Temperature calculations are needed for typical living rooms and bedrooms that are most likely to encounter overheating. The verification is to be conducted considering rooms as single zones, and by using dynamic simulation software.

2.I.ii. Format of national transposition and implementation of existing regulations

The energy performance requirements for new buildings and major renovations of existing buildings are regulated by three acts:

- The “Minimum Energy Performance Requirements”[7] Act. This act applies for new buildings and buildings undergoing major renovations, and includes the main requirements, e.g., maximum allowable primary energy consumption, general recommendations and requirements for building envelope elements and technical building systems, and requirements for energy calculation tools. General recommendations include a thermal comfort-based U-value recommendation (0.5 W/(m^2.K), a building leakage rate recommendation (q_{50} < 1.0 m^3/(h.m^2)) and some requirements for technical building systems, e.g, for mechanical ventilation and some individual metering requirements. In addition to these, there are no specific component-based requirements for new buildings and for buildings undergoing major renovations. Numeric energy performance requirements are set only for the building's primary energy consumption. Some recommendations for building envelope elements and technical building systems are given in the regulation, to be used as initial values in the design in order to help the designer achieve the requirements for primary energy consumption, while clearly stating that the final values depend on design solutions and exact values for these solutions. Besides that, the regulation gives the definition and primary energy performance value for low-energy buildings and NZEB. This act also includes primary energy factors of different energy carriers.

- The ”Calculation Methodology for Building Energy Performance Calculations” Act[8]. This act includes all the necessary information about the calculation of the energy performance, e.g., efficiencies of heating and ventilation systems, infiltration airflows, tabulated values of thermal bridges and standardised patterns of use of the nine (9) different building types and other energy calculation input data, as well as detailed calculation formulas and guidelines for energy calculations. Basically, this act provides guidance on how to run dynamic energy simulation that results in energy needs as well as calculation rules and methods from energy needs to energy usage for delivered, exported and primary energy.

- The “Requirements for Technical Building Systems” Act[9]. This act applies for buildings where smaller, rather than major, renovations will be performed. It specifies system performance requirements for building service systems that will be installed or replaced (heating, domestic hot water, ventilation, cooling and lighting).

2.I.iii. Action plan for progression to NZEB for new buildings

The current energy performance legislation includes the definition of low-energy buildings, NZEB and net zero- energy buildings. A low-energy building is a building that is characterised by sound engineering solutions, considering the current best practices without the on-site renewable electricity production, and meets the set primary energy performance requirements (Table 3). A NZEB is a building that is characterised by sound engineering solutions, considering the current best practices, on-site energy production by RES (the share of energy by RES is not fixed) and meets the set primary energy performance requirements (Table 3). The regulation defines also a net zero-energy building, for all building types, as a building whose primary energy performance indicator is 0 kWh/m^2.year. Delivered energy may be imported to a net zero-energy building if this is offset by energy fed into energy networks. Requirements for the NZEB and net zero-energy building are fully based on the primary energy indicator. There are no component-based requirements.

No.	Building type	NZEB	Low-energy building
1	Detached houses	50	120
2	Apartment buildings	100	120
3	Office buildings and libraries	100	130
4	Commercial buildings	130	160
5	Public buildings	120	150
6	Shopping malls and terminals	130	160
7	Schools, universities	90	120
8	Kindergartens	100	140
9	Hospitals and other medical buildings	270	300
Energy services included in energy performance requirements are shown in Figure 1			

Table 3. Energy performance requirements, (kWh/m^2).

The final update of the NZEB requirements will be issued in 2018. After 31 December 2018, all new public buildings should be NZEB, and after 31 December 2020, all new buildings must be NZEB.

2.I.iv. Requirements for systems and / or building components for new buildings

Estonia has not set minimum requirements for systems and / or building components for new buildings.

2.II. Energy performance requirements: EXISTING BUILDINGS

Primary energy requirements apply to renovations that fall under the definition of “major renovations”'. As major renovations are defined any renovations involving more than 25% of the construction cost of a similar new building.

For renovations not falling under the definition of major, no minimum requirements for building envelope elements apply. Only the requirements set for technical building systems (i.e., when a system is replaced or a new system is installed), and the performance requirements for these systems (for heating, domestic hot water, cooling, ventilation and lighting systems) must be followed (see chapter II.iii.).

2.II.i. Progress and current status of existing buildings

The minimum energy performance requirements are expressed as a primary energy performance indicator calculated for the building according to its standardised use, and applied to the building as a whole. The maximum primary energy values are listed in Table 4.

Estonia has not set minimum requirements for U-values. The building has to meet the minimum energy performance requirements as a whole.

No.	Building type	Energy performance requirements (kWh/m^2)
1	Detached houses	210
2	Apartment buildings	180
3	Office buildings and libraries	210
4	Commercial buildings	270
5	Public buildings	250
6	Shopping malls and terminals	280
7	Schools, universities	200
8	Kindergartens	240
9	Hospitals and other medical buildings	460
Energy services included in energy performance requirements are shown in Figure 1		

Table 4. Primary energy requirements for existing buildings.

2.II.ii. Plans to improve the existing building stock

Estonia has not set a separate definition for NZEB for existing buildings. At the moment, there are no national plans for renovating the existing building stock towards NZEB standards. Renovation of residential buildings is mainly guided through renovation grants that require major renovation or achievement of new building energy efficiency levels.

2.II.iii. Regulation of system performance, distinct from whole building performance

The “Requirements for Technical Building Systems” Act specifies system performance requirements for building service systems that will be installed or replaced when a renovation meets the major renovation requirements. Performance requirements are set for installing or replacing the heating and the hot water system's heat source, cooling systems, AC and ventilation systems, and air-handling units.

For the heating and hot water systems, the requirement is that the heat source's primary energy efficiency (the efficiency or performance coefficient of the heat source divided by the primary energy factor of the energy carrier) must be at least 0.8.

For the cooling system, the performance requirement is that the AC to be installed must have a SEER[10] of at least 5.1.

For the ventilation system, the requirement is that the performance efficiency of the heat recovery must be at least 70%. If the ventilation system requires the use of a liquid-coupled heat exchanger, then the efficiency of the heat recovery must be at least 50%. Specific fan power of the air-handling unit may not exceed 2.5 $kW/(m^3/s)$.

2.II.iv. Encouragement of intelligent metering

In new buildings or existing buildings undergoing major renovations with more than one owners, metering equipment must be installed in the heating system to determine the use of heating energy in the different parts of the building. Intelligent metering does not factor in the energy efficiency calculations or requirements.

2.II.v. Financial instruments and incentives for existing buildings

Financial grants are available for renovation of apartment buildings and detached houses. Grant schemes are managed by *Fund KredEx*.

Existing apartment buildings fall usually into EPC Classes F or G (Figure 2).

A 15% grant can be given when, after the completion of a minor renovation work, EPC Class E will be achieved (Primary Energy (PE) ≤ 220 kWh/(m^2.year). A 25% grant can be given when, after the completion of a major renovation work, EPC Class D will be achieved (PE ≤ 180 kWh/(m^2.year)), and finally, a 40% grant can be given when EPC Class C will be achieved (PE ≤ 150 kWh/(m^2.year).

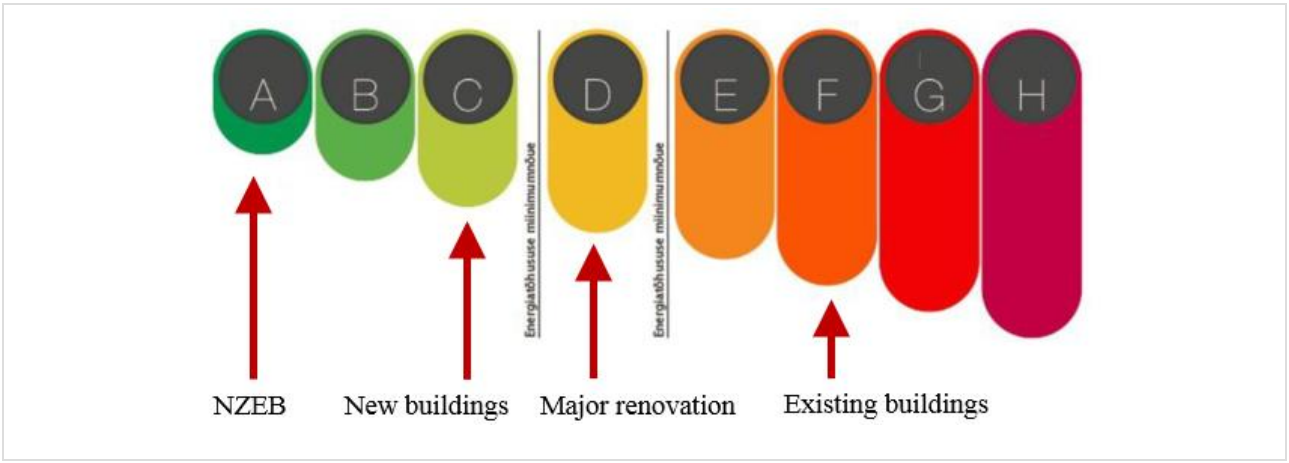


Figure 2. EPC classes for apartment buildings.

For detached houses, a 30% grant can be applied when energy efficiency renovation is performed. In that case, achievement of prescribed EPC Class is not required.

2.II.vi. Information campaigns / complementary policies

Public awareness for energy efficiency and energy certification systems is at a quite good level in the case of renting or buying buildings. People generally ask for the EPC, and the building law states that, in the case where a buyer or tenant enquires about the EPC, the seller has to provide it.

Fund KredEx and the Ministry of Economic Affairs and Communications, together with the *Tartu* Regional Energy Agency organise a national energy week once a year. *Fund KredEx* has also carried out several other information campaigns, mostly targeted at apartment buildings, as their share is roughly 70% of the total

residential building stock. These campaigns have been organised on an annual basis to inform tenants of apartment buildings about energy saving measures and the potential magnitude of the savings, in order to give expert advice and to inform them about support provided by the state (subsidy programmes). Several methods have been used in these campaigns. Information has been distributed through TV, radio, print media, internet, street advertisements, training courses for persons responsible for building maintenance, etc. As a result of these campaigns, energy saving activities have taken off and renovation grants have become very popular among apartment associations and detached house owners.

The Estonian Technical Surveillance Authority is responsible for an information campaign about the requirement to add information about the EPC to the property rental or sale advertisement.



Figure 3. Information campaign on adding information about the EPC to the property rental or sale advertisement.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Estonia has one central public building register, named “Register of Construction Works”[11], through which experts issue EPCs. All the EPCs issued, including related data, calculations and other information available, are compiled into this database, which is publicly available to all citizens.

2.III.ii. Quality Assurance of EPCs

The Estonian Technical Regulatory Authority makes random checks on EPCs and deals with complaints. This authority has the power to impose penalties for deviations from the building act. A total of ten (10) EPCs for existing buildings were checked in 2013, the launch year for the EPC central database and the new regulations. In 2014, the number of EPCs checked rose to 115. In 2015 and 2016, the number of EPCs checked rose to 120 each year. Out of the ones inspected, 10-15 EPCs each year contained different types of small mistakes (i.e., mistakes in the calculation of degree days or weighting factor, etc.). The energy auditors who issued these EPCs were informed of the shortcomings by letter and, as a result, all the mistakes have been corrected. So far, all the shortcomings are corrected by letter and no precept or penalty payment have been applied. In case the mistakes are not corrected, it is also possible to apply penalty payment up to 64,000 € for a company, or 6,400 € for individuals, until the shortcomings are corrected.

EPCs for new buildings are checked before issuing a building permit, and form the basis of evaluation as to whether or not a building meets the minimum energy performance requirements. The building permits are issued by the local government authority. This is why EPCs for new buildings are submitted to the local government authority for inspection. A building permit is given only in the case that the energy performance requirements are met.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Current legislation requires an EPC for every public building used by the government that has a floor area larger than 250 m^2. The EPC must be placed in a location visible to visitors.

In 2015, the Technical Regulatory Authority focused on central government buildings, so that by the end of 2015, 90% of them, where required (exceptions are in place for, e.g., historical buildings, etc.) had an EPC.

In the period 2016-2017, the Technical Regulatory Authority has been focusing on local government buildings. By the end of 2016, all local governments were reminded of the certification obligation. Almost 1/3 of local governments have already complied, whereas 2/3 of them plan to comply with the EPC requirements by the end of 2017. The Technical Regulatory Authority's goal is that, by the end of 2017, 80% of local government buildings will have EPCs placed where it is required.

After the central and local governments' buildings have EPCs, the focus will be on private sector public buildings, starting in 2018.

2.III.iv. Implementation of mandatory advertising requirement – status

Current regulations require an EPC for renting and/or selling of buildings, since January 2013. The National Building Act also requires advertisements to include at least the building energy class and the primary energy consumption per heated area. The compliance rate for advertisements has risen from 3% in 2013, to 10% by the end of 2014.

In the period 2015-2016, the Technical Regulatory Authority worked intensely to increase the information provided on EPCs in the real estate sector. With information provided directly to different stakeholders

(real estate agents and companies, real estate sales portals) and seminars, the compliance rate for advertisements has risen from 3% in 2013 to 58% by end of 2016.

2.IV. Inspection requirements – heating systems, air conditioning

Estonia has adopted the alternative approach (model B) instead of mandatory inspections for heating and AC systems.

The role of on-site heat generation in water-based heating systems is significantly lower than the heat supply from district heating. At the same time, the data of on-site heat generation devices that are being used, or even data of companies that are selling and installing the devices, was incomplete and unreliable, as it has not been recorded systematically. With these restrictions in place, it was obvious that at the time of the inspection scheme's scheduled implementation, the requirement would be difficult to enforce. Therefore, for boilers, Estonia adopted option B of Article 14 of the EPBD. Instead of implementing the inspection scheme, three specific measures were developed:

- Requirements were set in legislation for conducting energy audits of residential buildings. Energy audits have been conducted voluntarily, but at the same time, conducting an audit is one of the reconstruction activities subsidised by *KredEx* as part of the reconstruction grant. *KredEx* has also had different versions of grants in place for small residential houses, for the renewal of the heating system.
- The building act includes a requirement for boiler sellers to provide advice on energy demand to consumers whenever a new boiler is installed or an existing boiler is replaced. Provision of advice on energy demand may include an on-site inspection of the system. If such an inspection is carried out, the inspection report should include information on options for boiler replacement, on other modifications to the heating systems as well as on alternative solutions that would enable the energy-efficient operation of the system.
- In order to gain a better overview of the heating devices that are being used, the boiler must be registered when it is sold, and its rated output, efficiency and type of fuel must be recorded. The selling company must register the boiler in the National Building Register if its output is higher than 20 kW.

2.IV.i. Progress and current status on AC systems

The use of AC systems is not widespread in buildings, due to the prevailing cold climate in Estonia. In cases where an AC system is installed, it usually concerns small devices (heat pumps) with a rated output lower than 12 kW. Larger systems are usually installed in new buildings that must fulfil the minimum energy performance requirements according to the current regulations. The Estonian Building Act establishes similar rules for AC systems as those for boilers, when their rated power is above 12 kW.

3. A success story in EPBD implementation

A new grant scheme, managed by *Fund KredEx*[12], started in 2015 to renovate existing apartment buildings, and is strongly linked to the EPC system. A 15% grant can be applied when EPC Class E (minor renovation) will be achieved after the completion of renovation works. A 25% grant can be applied when EPC Class D (major renovation), and a 40% grant can be applied when EPC Class C (energy efficiency requirement for new apartment buildings) will be achieved after the completion of renovation works. In addition to the EPC class, requirements are also in place for thermal transmittance in the building envelope, the heating system, and the ventilation system. Requirements for the thermal transmittance levels are shown in Table 5. Fulfilling the thermal transmittance requirements for external walls usually means the creation of an insulation layer that is 150-200 mm thick. Fulfilling the thermal transmittance requirements for the roof usually means 300-400 mm of insulation layer. The 40% grant also has a requirement for the window and external wall thermal bridge. Windows must be moved into the insulation layer or insulate the window jamb with an insulation layer that is at least 50 mm thick. The requirements for windows are only for those windows that are going to be replaced. A 15% renovation grant does not come with any additional requirements for the building envelope. A heating energy reduction of at least 20% is required.

Renovation grant share levels	15%	25%	40%
Thermal transmittance of external walls, W/(m^2·K)	-	0.25	0.22
Thermal transmittance of the roof, W/(m^2K)	-	0.15	0.11
Thermal transmittance of windows, W/(m^2K)	-	1.1	1.1
Linear thermal bridge in connection of window and external wall, W/(mK)	-	-	0.05

Table 5. Requirements for thermal transmittance in the building envelope.

The heating system has only two requirements: the system must be balanced, and radiators have to be equipped with thermostats in order to allow room-based indoor temperature control.

Special attention was paid to the requirements regarding the ventilation system. The 15% and the 25% grant have the following requirements for the new / improved ventilation system:

- continuous ventilation (for each apartment) 0.5 1/h;
- supply air flow rates 10 l/s in bedrooms, with sound levels that are no more than 25 dB(A);
- extract air flow rates at least 10 l/s in the WC, 15 l/s in the bathroom, and 8 l/s in the kitchen.

The 40% grant generally has the same requirements, with one principle addition: the requirement of a mechanical supply and exhaust ventilation with heat recovery. An exhaust ventilation system with an exhaust air heat pump for heat recovery was previously used in standard renovation work practices. A new solution for renovation in Estonia is a central air-handling unit with ventilation ducts inside the facade insulation layer.

The process of renovation can be divided into three steps:

1. Preparation:
   - an energy audit and an EPC for the building;
   - a renovation work decision being taken by the apartment association - with a simple majority of 50% +1 in a general assembly meeting;
   - a qualified technical consultant for steering the process;
   - a designer for the developed buildings design (including the calculated EPC);
   - a building permit;
   - an estimation of the renovation cost;
   - a preliminary credit decision from the bank.
2. Grant application:
   - the grant application;
   - a review of developed design documents by third party experts;
   - a revision of improved developed design documentation, if required;
   - a funding decision if all requirements are met;
   - tendering with contractors (consisting of at least three tenders);
   - a credit decision from the bank.
3. Renovation work:
   - construction;
   - commissioning protocols for ventilation rates and the heating system;
   - loan payments;
   - grant payments in two parts;
   - an EPC based on measured use after one year in operation.

Approximately 400 apartment buildings will be renovated with the help of the new grant scheme by the end of 2018. Grant applications and calculated energy performance certificates show that over 90% of those renovations should meet the energy efficiency requirements of new apartment buildings. On average, over 60% of the heating energy use is reduced after the renovation.

The execution of the renovation work grant schemes in Estonia has shown that extensive integrated renovation is possible in situations in which buildings are managed by apartment associations, where apartment owners have to agree on the extent and budget of the renovation work. New innovative solutions can be implemented and it seems that apartment owners are willing to invest in order to renovate their apartment and building. Financial support keeps the cost of renovation work to an acceptable level. The grant scheme also allows requirements to be set out for the measures involved in any renovation work, thus promoting extensive integrated renovation work.

4. Conclusions, future plans

The EPBD, Directive 2010/31/EU, has already been fully transposed into national legislation in Estonia. Updated requirements and new acts came into force in January 2013. Estonia will continue conducting information campaigns and seminars to improve the level of knowledge of building owners, designers, architects as well as specialists working in the municipalities. The next update of the energy performance requirements started in 2016, and will provide the final update before the main NZEB objective in 2018-2019.

Endnotes

1. www.riigiteataja.ee/akt/12742131
2. www.riigiteataja.ee/akt/12903585
3. www.riigiteataja.ee/akt/105092012004, https://www.riigiteataja.ee/akt/118102012001
4. www.riigiteataja.ee/akt/113042017004
5. www.riigiteataja.ee/akt/128022017002
6. www.riigiteataja.ee/akt/109062015021
7. www.riigiteataja.ee/akt/128022017002
8. www.riigiteataja.ee/akt/109062015021
9. www.riigiteataja.ee/akt/109112012012
10. SEER – Seasonal Energy Efficiency Ratio (net energy need for cooling / electricity used for cooling)
11. www.ehr.ee
12. http://kredex.ee/en/apartment-association/

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Finland

Status in December 2016

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NATIONAL WEBSITES

www.ymparisto.fi, www.energiatodistusrekisteri.fi, www.motiva.fi/energiatodistus

1. Introduction

The Ministry of the Environment is responsible for transposing and implementing the EPBD in Finland, where building energy efficiency regulations have been in place since 1976, as part of the National Building Code. These regulations have been tightened several times since, in part due to implementing the EPBD.

EPCs were introduced at the beginning of 2008, based on the Energy Certification of Buildings Act.

Due to Directive 2010/31/EU, minimum energy performance requirements for the construction of new buildings have been revised and minimum requirements have been developed for existing buildings undergoing renovations and retrofitting. The detailed definition and regulation for NZEB has been finalised, and the revision of the Land Use and Building Act came into force on 1 January 2017. The new regulations ensure the implementation of Directive 2010/31/EU.

For boiler and AC system inspections, Finland's parliament has chosen to use alternative measures (instead of compulsory inspection) in response to Articles 14 and 15 of the Directive 2010/31/EU.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Energy performance requirements are valid for new buildings under the regulations of the National Building Code of Finland.

2.I.i. Progress and current status of new buildings

Finland's National Building Code has set minimum requirements for the thermal insulation and ventilation of new buildings since 1976. These requirements have been amended and enhanced several times to improve the energy efficiency of buildings.

The requirements for the overall energy consumption of buildings are set with the new building code that will come into force on 1 January 2018 for all new buildings. The aim of the new regulations is to set the level for NZEB in Finland. The development of the requirements is shown in Table 1.

Year of building permit	1976	1978	1985	2003	2007	2010	2012	2017[4]
U-values for building components (W/(m²K)								
Walls	0.4	0.29	0.28	0.25	0.24	0.17 0.40 logwall	0.17 0.40 logwall	0.17 x 1.10/1.15 for massive wood structure walls
Roof	0.35	0.23	0.22	0.16	0.15	0.09	0.09	0.09
Floor	0.40	0.40	0.36	0.25	0.24	0.09/ 0.16/ 0.17[1]	0.09/ 0.16/ 0.17[2]	0.09/ 0.16/ 0.17[2]
Windows	2.1	2.1	2.1	1.4	1.4	1.0	1.0	1.0
Doors	0.7	0.7	0.7	1.4	1.4	1.0	1.0	1.0
Other base values								
n_{50}-value	6	6	6	4	4	2	q50[3]=4	q50[3]=2
Annual efficiency for heat recovery systems	0	0	0	30 %	30 %	45 %	45 %	55 %
Maximum specific fan power of a mechanical exhaust air system kW/(m³/s)							1,5	0,9
Maximum specific fan power of air-conditioning system kW/(m³/s)							2	1,8

[1], [2] Base floor bordering on outside air =0.09 W/(m²K), building component against the ground = 0.16 W/(m2K), base floor bordering on crawl space =0.17 W/(m2K).

[3] q50 is the air leakage value of the building envelope.

[4] The 2017 code, status is draft

Table 1: Development of minimum requirements for new buildings (all building types).

The overall energy consumption is calculated using standard user profiles and primary energy factors (weighting factors) for different energy sources (Table 2). For single-family homes and apartment buildings an alternative method was introduced that is based on requirements for building components.

	Weighting factor for energy source in the new building code of 2017
Fossil fuels	1.0
Electricity	1.2
District heating	0.5
District cooling	0.28
Renewable fuels	0.5

Table 2: Primary energy factors.

2.I.ii. Format of national transposition and implementation of existing regulations

The minimum energy performance requirements have been revised for the construction of new buildings due to the EPBD (Directive 2010/31/EU). The approach is based on overall energy consumption, which takes the energy source (primary energy factor) into account.

The current minimum performance calculations for new buildings are based on a national calculation method that follows the main principles of CEN standards. Both CEN standards as well as other, more detailed calculation and simulation methods can be used. However, the calculation and simulation methods must be documented for possible review.

Requirements are given as a fixed value (kWh_E/m^2 - primary energy).

The National Building Code of 2017 sets maximum values for overall energy consumption (E-values) calculated using the primary energy factor (Table 3; for weighting factors, see Table 2). The maximum values depend on the building type and, for single-family houses, on the area of the building. The new building code does not exclude any heating sources; however, the code encourages the use of RES and district heating, which have better primary energy factors than other energy sources. Other renewables (e.g., solar heating and power) are taken into account when calculating a building's primary energy needs. For single-family homes and apartment buildings it is possible to show compliance with the building code if the energy efficiency of the building components is within a set standard; set values are given for building components (walls, windows, etc.) as well as system performance, and for the building's heating systems.

Calculations also include thermal comfort requirements, indoor-air quality requirements and infiltration, thermal bridges and shading devices. Evaluation of infiltration is either based on a site test or on an accepted building industry quality control method.

Type of building	Maximum value for energy consumption per year, primary energy (calculated with weight factors of energy source)		
Single-family houses	*Heated net area, A_{net} m^2*	*E-value $kWhE/m^2$ per year*	*Massive wood construction maximum values*
	A_{net}<150 m^2	200 - 0.6 A_{net}	(200 - 0.6 A_{net}) x 1.15
	150 $m^2 \leq A_{net} \leq$ 600 m^2	116 - 0.04 A_{net}	(116 - 0.04 A_{net}) x 1.15
	A_{net}> 600 m^2	92	92 x 1.15
Row houses		105 kWh_E/m^2 per year	105 x 1.10
Apartment buildings		90 kWh_E/m^2 per year	90 x 1.10
Offices		100 kWh_E/m^2 per year	100 x 1.10
Shops etc.		135 kWh_E/m^2 per year	135 x 1.10
Hotels, motels etc.		160 kWh_E/m^2 per year	160 x 1.10
Schools and day care centres		100 kWh_E/m^2 per year	100 x 1.10
Sports halls		100 kWh_E/m^2 per year	100 x 1.10
Hospitals		320 kWh_E/m^2 per year	320 x 1.10
Other buildings	Energy consumption has to be calculated but no limit values		-

Table 3: Maximum values for primary energy consumption (E-value) in different building types.

Cost optimality

In the national report submitted to the European Commission in 2013, the average cost-optimal level of energy efficiency of buildings and building components for new buildings is 7% more efficient than the corresponding National Building Code regulations as set in the Ministry of the Environment Decree 2/11 (given in 2011). For renovations and retrofitting of existing buildings, the cost-optimal level of energy efficiency for buildings and building components is 8% more efficient than the National Building Code regulations as set in the Ministry of the Environment Decree 4/13 (given in 2013). The calculations were conducted for single-family homes, apartment buildings, office buildings and commercial buildings.

Table 4 presents the variation range between the cost-optimal level and energy regulations. The difference is calculated by weighting the result with the number of new and renovated buildings. The cost-optimal level is slightly more efficient than the demand of the regulations for both new buildings and renovated buildings. Differences are within the set 15% tolerance margin.

Reference building	Cost-optimal tolerance (E-value) kWhE/m^2	Regulations in force for reference buildings (E-value) kWhE/m^2	Difference (weighted by numbers of buildings)
New construction	114–211	119–247	-7 %
Renovation and retrofitting	122–289	136–335	-8 %

Table 4: Summary of cost-optimal tolerances in reference buildings, according to primary energy.

Building inspection authorities

An applicant for a building permit has to ensure that the construction will fulfil the requirements. This is done through calculations whereby the results must be shown in the building permit documentation submitted to the municipal building inspection authorities responsible for inspecting the compliance of building permit applications.

2.I.iii. Action plan for progression to NZEB for new buildings

In 2012, the Ministry of the Environment launched an intensive process to gather the necessary input for the preparation of the national plan for NZEB. Based on this process the national plan for increasing the number of NZEB was drawn up and submitted to the European Commission in October 2012. The aim was to give technical recommendations for NZEB in 2015.

As the Land Use and Building Act sets the base for the building code, the changes to set requirements for NZEB were made in autumn 2016 and the revision of the Land Use and Building Act came into force on 1 January 2017. Based on regulations given by the Ministry of the Environment, the new National Building Code will be applied to new buildings as of 1 January 2018.

Finland has long encouraged energy-efficient construction, and there are many examples of energy-efficient single-family homes, apartment buildings, day care centres and shopping centres (Figure 1). As the new regulations come into force for new buildings on 1 January 2018, there are no examples of NZEB meeting the new standards.



Figure 1: Luhtaa Day Care Centre in Tampere represents energy efficient modern construction.

2.I.iv. Requirements for systems and / or building components for new buildings

The requirements for systems and/or building components for new buildings are given in the building code that is based on regulations given by the Ministry of the Environment. The building code defines requirements for heat losses, summertime temperatures, specific fan power (SFP) of ventilation and AC as well as for energy consumption metering. Details are shown in Table 1.

For residential buildings (single-family homes, row houses and apartment buildings) it is alternately possible to show compliance with the building code (energy performance of the building) using the structural energy efficiency method in which the building must adhere to set values for structural energy efficiency (U-values), maximum heat losses as well as the efficiency of the technical systems. The method limits the use of heating sources to district heating, ground source heat pumps or air-to-water heat pumps. The information must be ascertained with documentation.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

Minimum energy performance requirements have also been developed for existing buildings undergoing renovations and/or retrofitting that is subject to a building permit, when the use of a building is altered, or technical systems are repaired.

The approach to improving energy efficiency is chosen in the planning phase of the renovation or retrofitting project, and it dictates the calculation methods as well as minimum energy requirements to be used. The three approach options are depicted in Figure 2.

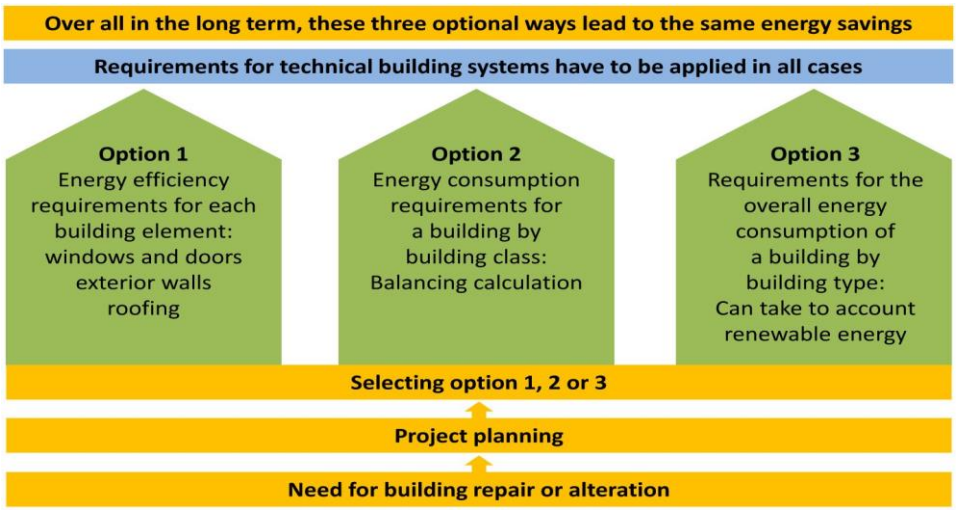


Figure 2: Three approaches to improving energy efficiency in existing buildings.

2.II.ii. Plans to improve the existing building stock

The feasibility of measures to improve the energy efficiency of an existing building are assessed on the basis of technical, operational and financial considerations. Energy efficiency improvements can be done using three alternative ways (as shown in Figure 2):

1. energy efficiency requirements for each building element;
2. energy consumption requirements for a building by building type; or
3. E-value requirements of a building by building type.

In the long term, these three options lead to the same overall energy savings. An example of the energy efficiency requirements for each building element is depicted in Table 5.

Minimum energy requirements by building element

Building element	Calculated requirement for a building built in late 1970s*	Limit
Exterior walls		
In renovation	Original U-value 0.40 W/(m^2K) x 0.5 = 0.20	No more than 0.17 W/(m^2K)
In changing use of building	Original U-value 0.40 W/(m2K) x 0.5 = 0.20	At least 0.6 W/(m^2K), or better
Roof		
In renovation	Original U-value 0.35 W/(m^2K) x 0.5 = 0,175	No more than 0.09 W/(m^2K)
In changing use of building	Original U-value 0.35 W/(m^2K) x 0.5 =0.175	At least 0.6 W/(m^2K), or better
Base floor	No set requirement, energy efficiency to be improved if possible	
Windows and doors		
New windows and doors	U-value 1.0 W/(m^2K), or better	
Renovated windows and doors	No set requirement, heat retention to be improved when possible	

*Original U-values according to Building Code 1976.

Table 5: Example of minimum energy requirements by building element, for energy efficiency improvements in a late 1970s building.

The Finnish national strategy on renovation of buildings, based on Article 4 of Directive 2012/27/EU (EED), focuses less on developing a set of requirements and instead seeks ways to initiate energy efficiency improvements in public and private residential and commercial buildings, to be implemented during both planned and corrective maintenance. This involves innovative means related to decision making, services, and financing of renovations, which are initiated through communication measures, as well as training and improving the know-how of building professionals.

Finland has chosen to implement voluntary measures instead of relying on the 3% renovation requirement set in Article 5 of the EED. These alternative measures are calculated to achieve similar savings as the set requirement. The types of measures include projects for reducing tenant electricity use, setting premiums/sanctions in contracts with building management and service companies, energy efficiency improvements as part of routine building maintenance, support and information for building users to improve energy efficiency, energy efficiency measures included in renovation projects (set in the building code, see Figure 2), as well as improving space efficiency in buildings owned and used by the government. Voluntary measures also include the voluntary energy efficiency agreement schemes for the property sector and municipalities. Energy efficiency agreements have no direct link to the EPBD, but they contain many measures that enhance the energy efficiency of buildings, e.g., energy audits and consumption monitoring.

2.II.iii. Regulation of system performance, distinct from whole building performance

The Finnish National Building Code states that, when the technical systems of any type of existing buildings are renovated, modernised or replaced, the following requirements must be met:

1. The minimum annual efficiency of heat recovery must be at least 45%.
2. The maximum specific fan power (SFP) of a mechanical supply and exhaust system is 2.0 kW/(m^3/s).
3. The maximum specific fan power (SFP) of a mechanical exhaust air system is 1.0 kW/(m^3/s).
4. The maximum specific fan power (SFP) of an AC system is 2.5 kW/(m^3/s).

5. The efficiency of heating systems must be improved where possible when the related equipment and systems are renewed. After renewal, the ratio between efficiencies of the building's main heating system and the main heat distribution system must be at least 0.8. The ratio is the quotient of the annual efficiencies of the heating system and heat distribution system. This is to ensure that the overall heating efficiency is improved.

There are also requirements set for other technical systems, e.g., for different temperature levels of Domestic Hot Water (DHW) systems or for apartment-specific water meters.

2.II.iv. Encouragement of intelligent metering

Intelligent metering (hourly-based metering) has been introduced almost everywhere in Finland following the introduction of legislation on the energy markets in 2009. This legislation sets requirements for companies operating in the production and distribution of energy to offer end-users up-to-date information on energy consumption as well as services to improve end-user energy efficiency.

A standing recommendation for energy metering (electricity) exists in the energy production industry. From the beginning of 2016, 97-98% of metering points are metered hourly and read remotely (automatic meter reading). In district heating 90-95% of heat sales are read remotely and 80-85% are metered hourly.

By law, it has been mandatory to install individual meters for cold and warm water in new buildings since 2011. It is not mandatory to use the readings as a basis for billing. The same applies to the renovation of buildings.

Intelligent metering enables the collection of more useful data that can be shown in EPCs. Meters relate to the building as a whole and do not target individual HVAC systems.

Requirements (for e.g., cooling and ventilation systems, electricity or AC metering) enable active energy-savings control.

2.II.v. Financial instruments and incentives for existing buildings

To encourage energy-efficient renovation, the Finnish government has introduced various financial instruments and incentives. For public and private sector buildings there are financial subsidies available for investments for energy efficiency as well as energy auditing. For households, certain repair and renovation works, e.g., the repair and/or installation of a heat pump, etc., are tax deductible, which enables households to engage professionals for repairs to improve energy efficiency, among other things.

The Housing Finance and Development Centre of Finland (ARA) can grant interest subsidy loans for new construction, renovation and purchase of housing, mainly for rental and social housing. Renovation and energy subsidies and subsidies for the elimination of health hazards, as well as special-needs investment subsidies for improving the housing conditions of various population groups, are granted from state funds.

In recent years, joint procurement and green procurement funding has started to make headway in Finland. The largest joint green procurement project is underway; several municipalities have joined with green funding providers to purchase solar panels. There are also other types of green funding to promote the uptake of renewable technology.

2.II.vi. Information campaigns / complementary policies

Finland has information campaigns and advice programmes in place for both energy efficiency as well as renovation. "*Eneuvonta*" (energy advice programme) is aimed at homes and households and promotes energy efficiency and RES in housing as well as transport, with advisors in several regions featured on a comprehensive website, www.eneuvonta.fi (Figure 3). The advisory programme is nationally funded by the Energy Authority of Finland.



Figure 3: Information and advisory campaigns on energy efficiency in construction and housing target consumers.

Renovation advice is distributed through www.Korjaustieto.fi; there is also a network of local advisors, with special emphasis on advice to elderly people (*Vanhustyön Keskusliitto*). The renovation advice programme is coordinated by the Ministry of the Environment.

In 2016, the Ministry of the Environment launched an information campaign with several prominent actors in the housing sector that targets housing companies. The aim of the campaign is to help implement simple and affordable energy efficiency measures. The campaign is featured on the website www.energiahukka.fi, where advice and information is given according to building type (Figure 4).

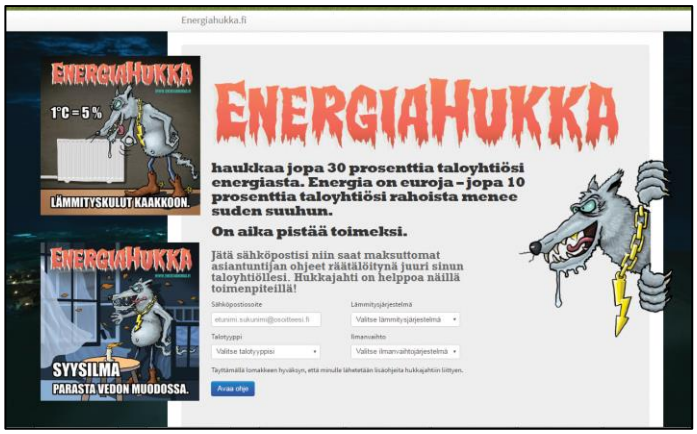


Figure 4: National campaign on energy efficiency in housing companies,"Energiahukka".

In addition, the Ministry of the Environment is co-funding several smaller projects targeting both housing companies and single-family homes that aim to improve the energy efficiency of existing buildings. Projects center on themes such as heating systems, building automation, etc.

Improving the energy efficiency of existing buildings is also very much at the centre of the voluntary energy efficiency agreements in the property sector (rental housing and commercial buildings). The third term of the energy efficiency agreement starts in 2017, continuing the success of the previous 2008-2016 term (Figure 5).

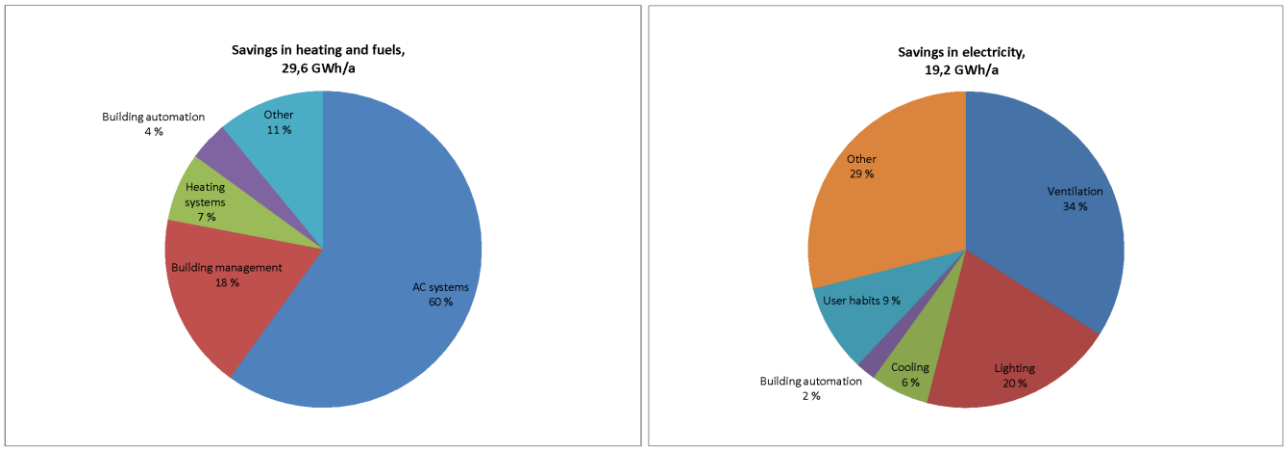


Figure 5: Yearly heating and fuel savings and electricity savings by type of measures, reported in the Property Sector Voluntary Energy Efficiency Agreement in 2015.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

EPCs are required for all new buildings and for the sale or rental of existing buildings (requirements for older single-family homes come into force on 1 June 2017). Some building types are excluded by default (as stated in the Land Use and Building Act and the Energy Performance of Building Act).

Legislation to implement the requirements of the EPBD (Directive 2010/31/EU) was adopted at the beginning of 2013 and came into force in June 2013. All requirements apply to private and public buildings (residential, commercial and public).

EPCs are needed for all new buildings, along with the building permit application. For existing buildings, an EPC is needed when the building (or a part of a building, e.g., an apartment) is sold or rented. Energy performance certification extends to the whole building or a significant portion of the building if the building has multiple usage areas. Single apartments are not certified separately.

For residential apartment buildings and single-family houses built during or after 1980, the requirement took effect in June 2013; for row houses, offices and commercial buildings in July 2014; and for institutional care, assembly and educational buildings in July 2015. For single-family homes built before 1980, the requirement will take effect on 1 July 2017. New building types were included on 1 June 2017; an EPC is now also required for swimming halls, indoor skating rinks, warehouses, logistics buildings and motor vehicle buildings (garages over 50 m^2).

The Ministry of the Environment is responsible for legislation and guidelines regarding EPCs, EPC templates and other instructions concerning the issuance of certificates.

The EPC is produced by a qualified expert. The ARA is the administrative authority ensuring the quality of certificates and qualified experts and the appropriate preparation and use of the EPCs. As the responsible authority, it can also make compliance checks of issued EPCs.

Format and content of the EPC

The current EPC layout is shown in Figure 6.

Certification requirements, as well as the format and content of the EPC, are the same for residential, non-residential and public buildings. The energy label classifies buildings on an efficiency scale, ranging from A (high energy efficiency) to G (poor energy efficiency). As an example, the efficiency scale for apartment buildings (2013) is shown in Table 6.

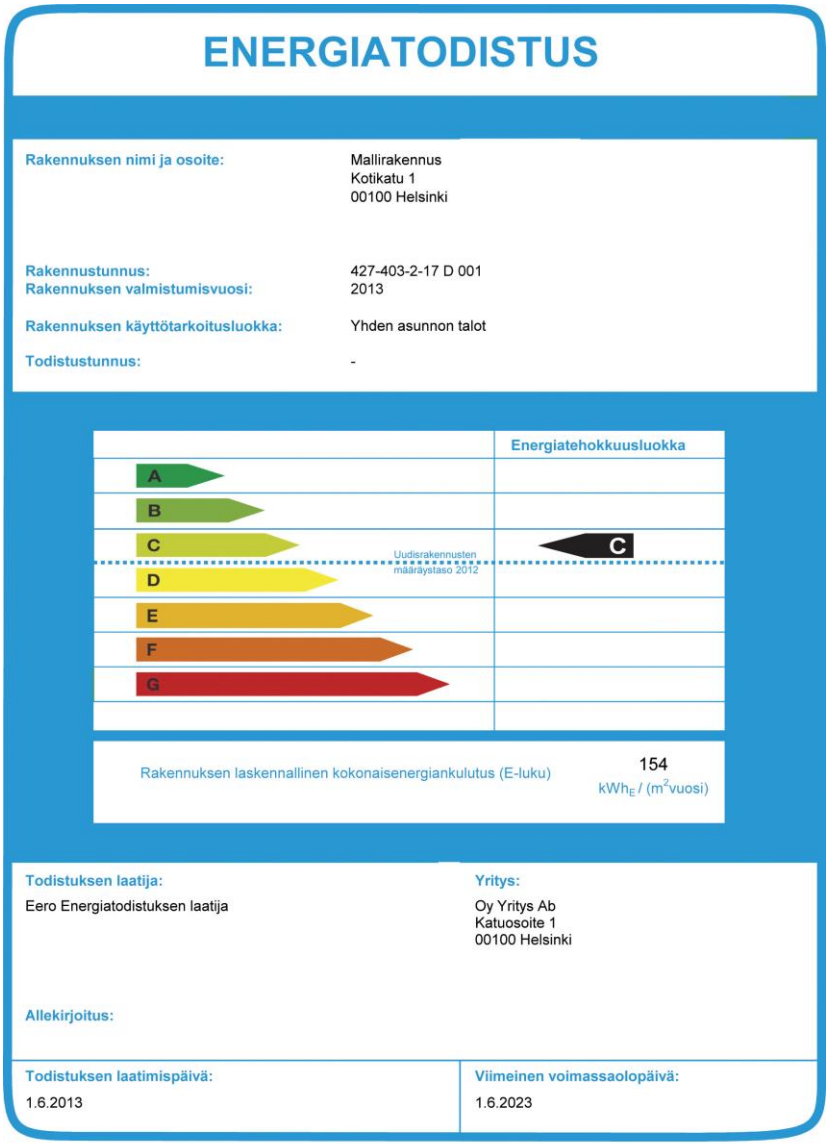


Figure 6: Current format of the EPC in Finland.

Energy efficiency class	Total energy consumption, E-value (kWh_E/m^2, year)
A	E-value ≤ 75
B	76 ≤ E-value ≤ 100
C	101 ≤ E-value ≤ 130
D	131 ≤ E-value ≤ 160
E	161 ≤ E-value ≤ 190
F	191 ≤ E-value ≤ 240
G	241 ≤ E-value

Table 6: Efficiency scale for apartment buildings.

Energy performance is based on overall primary energy consumption (kWh_E/m^2.year), taking the energy source (primary resource factor) into account. Primary energy factors for energy sources are fixed in the National Building Code as described previously in Table 2.

The EPC is always based on calculated energy consumption, which makes it possible to compare different buildings instead of different users. For existing buildings, information on the available measured energy consumption has to be reported alongside the calculated energy consumption if the information is available. A qualified expert must inspect the renovated building and assess the energy efficiency of the building elements and components as well as the technical systems (external walls, doors, windows, heating and DHW systems, ventilation systems, lighting and other electrical systems, e.g., electrical heating systems). An on-site inspection is required.

The qualified expert must suggest targeted cost-effective energy saving measures to be included in the EPC. Savings in kWh_E/year must be calculated in detail for each measure.

The EPC is valid for ten (10) years. However, it is recommended, though not required, that the certificate is updated following a major reconstruction of the building envelope or of the technical systems, even if the works take place before the expiry date.

EPC activity levels

Since the legislation changed in June 2013, about 62,672 EPCs have been sent to the ARA, of which 34,034 have been produced in 2015. In addition, in 2016 over 22,000 EPCs were produced via the national database. At the beginning of 2017, there were 39,740 EPCs in the EPC database.

Typical EPC costs

The cost of the EPC depends on the building type and size. The price of an EPC for a new single-family house is about 150 - 200 €, and for an existing single-family house, 300 - 360 €. Costs of EPCs for larger residential and for non-residential buildings are not available, but the costs vary according to building size and type as well as other factors such as location and materials available (energy consumption, etc.).

Assessor corps

The Ministry of the Environment has designated two accreditation bodies, "*FISE ry*" and "*Kiinteistöalan Koulutussäätiö ry*", to approve qualified experts. There are two levels of qualified experts, with the higher level needed for buildings requiring dynamic simulations (e.g., for new buildings with cooling facilities).

To apply for accreditation, the expert must have adequate training and a suitable educational background (e.g., a degree in building technology or architecture or, for the higher level, a master's degree in building

technology or a related field), the lack of which can be compensated with work experience. The qualification has to be approved by a test administered by the accreditation bodies, and is valid for seven (7) years, after which it needs to be renewed. Qualification and accreditation for qualified experts is the same for all building types, public and private. There are altogether 970 registered qualified experts, of which 711 possess base level qualifications, and 259 possess higher level qualifications.

2.III.ii. Quality Assurance of EPCs

The ARA is the administrative authority ensuring the quality of EPCs and qualified experts and the appropriate preparation and use of the certificates. The ARA controls EPCs based on the EPBD (Directive 2010/31/EU), Article 18, Appendix II, and partly checks the input of the building information data, the accuracy of the presented calculations, and the appropriateness of the suggestions given for improving energy efficiency.

Additionally, the ARA can initiate enforcement measures in case of negligence on the part of the building owner or the qualified expert. Measures are administrative, not penal, and include requests, warnings, orders, conditional fines, and suspension of the qualified expert.

The national database for EPCs was established on 1 May 2015 and has been used to control certificates ever since. All EPCs are produced and electronically signed through the database, which automatically checks the input data to ensure the quality of the EPCs produced. Altogether, there are currently 39,740 EPCs in the national database, of which 22,690 were produced in 2016.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

According to legislation from 1 July 2015, the EPC must be displayed so as to be visible to the public in buildings where over 250 m^2 of total useful floor area is occupied by public authorities and visited by the public. In addition, the EPC must be displayed so as to be visible to the public in all buildings that already have an energy certificate and that have over 500 m^2 of total useful floor area visited by the public.

The display regulation is controlled by the ARA who has sent out its first control survey to the ten largest cities in Finland; results are not yet available.

Information on EPCs displayed in public buildings owned and occupied by public authorities such as municipalities is also received through the Finnish energy efficiency agreement scheme. The latest information is from 2015; EPC monitoring is reported in 32 municipalities altogether, but the number of buildings is not monitored (Figure 7). The energy efficiency agreement scheme coverage in the public sector is high, as the communities involved represent close to 80% of the population of Finland and, respectively, nearly 80% of the overall building volume of service buildings in the sector.

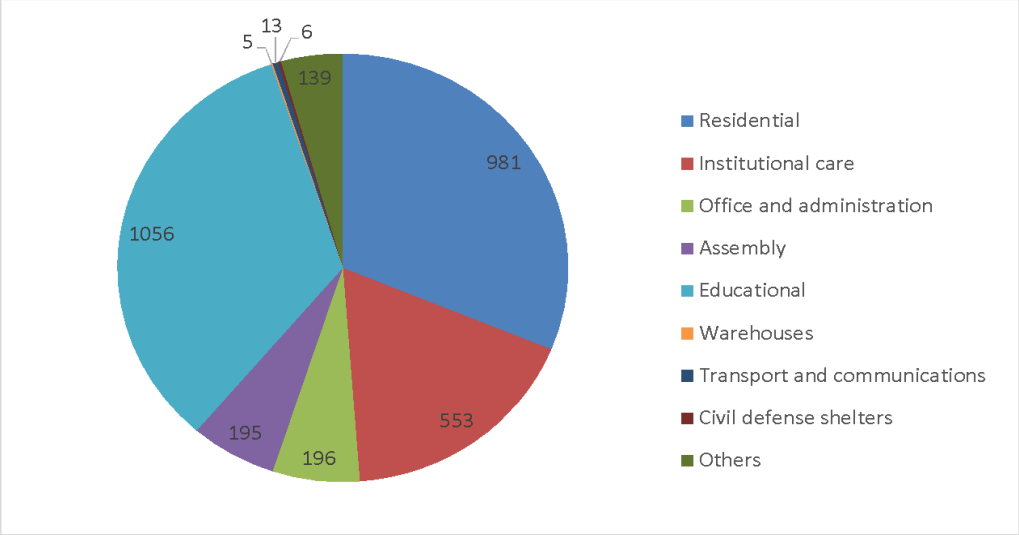


Figure 7: Public buildings, EPCs by building type, 2008-2015.

2.III.iv. Implementation of mandatory advertising requirement

Real estate agents are required to ensure that the energy class of a building that is being sold or rented is posted with advertisements and other marketing materials, and that the EPC can be viewed by potential buyers or tenants during the transaction process.

The mandatory requirement to display the energy class of the building in commercial advertisements is included in the new legislation on the energy performance of buildings that came into force on 1 June 2013 and applies to different building types in accordance with the schedule set by the legislation.

As the authority responsible for the control of the mandatory advertising requirement, the ARA made 80 information requests in 2016 to real estate agents and building owners pertaining to real estate advertising. By the end of 2016, no penalties or warnings were yet issued to building owners by the ARA.

The Ministry of the Environment, together with the ARA and the Regional State Administrative Agencies, who control the real estate agents, are in good cooperation with the real estate sector, represented by two major organisations – the Central Federation of Finnish Real Estate Agencies (*Kiinteistöalan Keskusliitto ry*) and the Finnish Association of Real Estate Agents (*Suomen Kiinteistönvälittäjäliitto ry*) – to influence the real estate trading regulations and standards to ensure compliance with legislation.

2.IV. Inspection requirements - heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Finland has adopted the alternative approach for enhancing the efficiency of boiler-based heating systems (oil-, biofuel-, biomass- and gas-fired) since the implementation of the EPBD in 2007. Upon implementing the EPBD (Directive 2010/31/EU) in 2013, the alternative approach has also been adopted for AC systems.

2.IV.ii. Progress and current status on heating systems

The activities in improving the energy performance of heating systems are divided by system type: measures have been planned for oil-, biofuel-, biomass- and gas-fired boilers. Activities are centred on voluntary energy efficiency agreements in the oil sector "*Höylä*", the bioenergy sector "*Kutteri*" and the gas sector. Through the agreement schemes, information and advice on selecting and using boilers as well as encouraging regular maintenance measures is passed on through leaflets, articles and guides aimed at both consumers as well as professionals working in the field (Figure 8). Savings are based on measures (numbers of actions per year) reported in the energy efficiency agreements, with examples listed in Table 7 (for *Höylä*).



Figure 8: Information on 'Höylä' is distributed to consumers via the magazine 'Lämmöllä' ('with warmth').

Measures	2015	2014	2013	2012	2011	2010
Overhaul, EPBD-advice given	90360	89870	94050	63,525	83,260	78,200
Repairs suggested	25960	19954	19500	19,727	13,950	19,300
Boiler replacement	2208	1990	2112	2,600	3,430	3,600
Burner replacement	5355	5128	5688	5,920	7,578	8,000
Regulator replacement	7117	6171	4873	4,499	7,030	5,900
Other repairs	5712	5240	4972	4,961	17,260	6,700
Repairs planned	2090	1105	1408	1,155	1,820	2,100

Table 7: Measures (numbers of actions per year) reported in the 'Höylä' energy efficiency agreement (EEA).

In the oil sector, a voluntary efficiency inspection method for oil-fired boilers is available, as well as recommendations for a heating system condition survey for small family homes. The main advocates are the Finnish Petroleum Federation and Heating Energy Association (*Lämmitysenergiayhdistys ry*).

In the bioenergy sector, information and advice on selecting and using wood-fired boilers is available through a guidebook and a website produced by *Motiva Oy* (Figure 9). Chimney sweeps conduct metering of wood-fired boilers during yearly visits and a voluntary inspection method for biofuel boilers has been produced and will be published in early 2017.



Figure 9: Materials on energy efficiency for wood-fired boilers.

Gas-fired boilers are a distinct minority in Finland, amounting to only 5% of heating energy consumption of single-family homes. Information on gas heating as well as guidelines on gas heating systems is available through the Finnish Gas Association.

2.IV.iii. Progress and current status on AC systems

The alternative approach to enhance the energy efficiency of AC systems was implemented in 2013. This approach consists of specific advisory measures, the uptake of the voluntary energy efficiency inspection of ventilation systems, and many other measures that support the enhancement of energy efficiency of AC systems, e.g., building codes, tax reductions, voluntary energy efficiency agreements, energy audits and EPCs.

Starting from autumn 2014, the Ministry of the Environment has commissioned *Motiva Oy* to act as the coordinator to implement the various measures, initiate communication and gather necessary monitoring information.

Information on the energy efficiency of cooling in both households and offices has been distributed in various ways. For households, videos on the proper use of air-to-air heat pumps, a guidebook for holiday homes, and advice on summertime cooling (including use of ventilation in cooling and proper use of fans) were produced. For offices and other commercial buildings, a guide on energy-efficient cooling was produced, with information for designing, building, and maintaining AC systems (Figure 10). Through press releases, articles, seminars and training sessions, over 420,000 contacts were made.

A voluntary inspection method for ventilation and AC systems was developed and technical guides for building professionals were produced. Since 2014, over 40 inspectors have been trained as ventilation and AC inspectors and over 50 inspections have been completed. As of 2016, the ventilation and AC inspectors are under a national certification scheme operated by the FISE Qualification of Professionals in Building, HVAC and Real Estate Sector in Finland (*FISE Oy*) and The Finnish HVAC Association (*Suomen LVI-liitto SuLVI ry*).

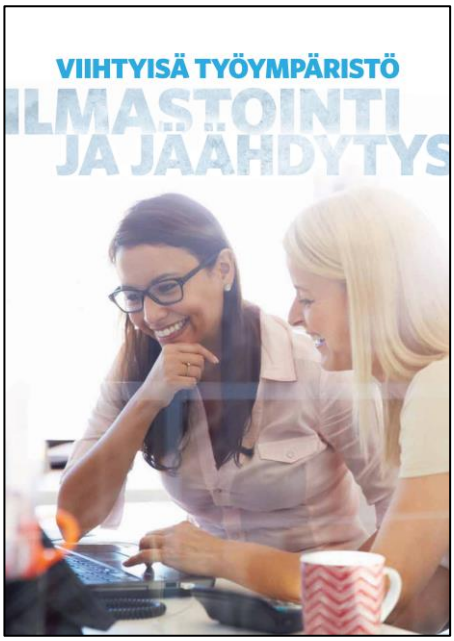


Figure 10: Energy efficiency guide on AC systems in commercial and public buildings was published in 2016.

2.IV.iv. Enforcement and impact assessment of inspections

Not applicable in Finland as option B is used.

3. A success story in EPBD implementation

Finland has implemented the many aspects of EPBD (Directive 2002/91/EC) into Finnish legislation and building culture, in close cooperation with the significant parties (stakeholders) in the construction and building maintenance fields.

In particular, the close cooperation has continued throughout the finalisation phase of the Finnish National Building Code, as professionals and major organisations in the field have been consulted and have taken an active part in the work through various studies and several consultation forums organised by the Ministry of the Environment.

The involvement of professionals is also visible in the implementation of the EPCs. Organisations from the building ownership and building maintenance sectors are involved in developing the national transposition and disseminating EPCs. Through workshops and networking forums, the Finnish authorities are in constant communication with the professionals to ensure compliance and quality of EPCs. For example, together with *Motiva Oy*, the Ministry of the Environment and the ARA organise a networking day for EPC qualified assessors twice a year to inform the experts on EPC related developments and to discuss key issues.

The involvement of stakeholders helps to ensure support and acceptance of the new legislation and implementation of initiatives. This is further supported by specific information activities and active voluntary energy efficiency agreements. The Ministry of the Environment encourages both energy-efficient new constructions and renovations by funding development projects as well as advisory programmes and campaigns. One major factor in ensuring energy efficiency in existing buildings is the continuation of the

Finnish national voluntary energy efficiency agreement scheme that has achieved very good results, especially in the property sector. The commercial properties sector has thereby reached a total annual energy savings of 229 GWh with annual cost savings of nearly 16 million € during the 2011-2015 period. The new agreement period is scheduled for 2017-2025.

4. Conclusions, future plans

Energy use in buildings covers approximately 40% of the Finnish energy end use. This means that all possible measures must be taken to achieve the energy efficiency objectives.

The EPBD will be fully implemented in Finland when the new National Building Code has been finalised. To ensure the uptake of the new measures, access to information and tools necessary to enable compliance with the legislation must be made available. Detailed guidebooks, practical examples, and comprehensive training are essential for consumers as well as professionals. Naturally, this means continuous work in the future.

Well-tried practices, such as energy efficiency agreement schemes and existing web portals, have proved to be an excellent basis for providing information on training programmes and advisory services as well as monitoring and reporting, and will continue to be so in the future.

As the development of the EPBD continues within the EU, Finland will tap into its strengths to meet future demands: cooperation between government and the building sector, voluntary measures in implementing energy efficiency goals, and know-how in energy efficiency construction and renovation.

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in France

Status in December 2016

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NATIONAL WEBSITES

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1. Introduction

In France, the implementation of the EPBD has been the responsibility of the French Ministry for an ecological and solidary transition and the Ministry of territory cohesion. With as aim to replicate the successful transposition of Directive 91/2002/EC, France has been working on implementing Directive 2010/31/EU since 2010. Law 2010/788 of 12 July 2010[1] and the regulation that followed have significantly improved the energy performance certification process, while the implementation of the new thermal regulation, RT 2012[2], has brought energy efficiency of new buildings to NZEB level. Lastly, the Energy Transition for Green Growth Act (*LTECV*) of 17 August 2015[3] provided also new tools, e.g., requirements for insulating envelope parts in case of restoration, aiming at increasing thermal renovation.

This report is giving an overview of the current status of the implementation of the EPBD, structured around four main topics:

- requirements on energy performance for new buildings;
- requirements on energy performance for existing buildings;
- EPCs and
- inspection for heating and AC systems.

Finally, one last additional part highlights the setting of the Energy plus Carbon minus (E+ C-) testing scheme, which serves a preparatory function for the future thermal regulation, considered in France a success.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The current thermal regulation in response to the EPBD is the *RT 2012* (*Réglementation Thermique 2012*)[4]. It has been mandatory only for some public buildings since the end of 2011, and for all new buildings since 2013. This regulation is the result of a two year-long dialogue with all stakeholders, including seven consultative conferences, where the work in progress was presented. The next thermal regulation is planned for 2020 and it will contain even more ambitious objectives, since it will also include environmental requirements, most likely based on a life-cycle analysis. In order to anticipate this new regulation, a testing scheme called "E+C- (standing for Energy plus Carbon minus) was launched for volunteering contractors in late 2016.

2.I.ii. Format of national transposition and implementation of existing regulations

The structure of *RT 2012* is based on three performance requirements:

- The requirement for minimum energy efficiency of buildings, which imposes a limitation on energy demand (heating, cooling and lighting) based on the bioclimatic conception (B_{bio}) of the project, whereby the B_{bio} value has to be lower than a maximum value called B_{biomax}.
- The requirement for primary energy consumption, which imposes a limitation on primary energy consumed (C_{pe}) for the combined use of heating, cooling, domestic hot water, lighting and auxiliaries (pumps and fans), whereby the C_{pe} has to be lower than a maximum value called C_{pemax}.
- The requirement for summer comfort, where the ambient indoor temperature of the building, reached after the 5 hottest days of the year (T_{ic}), cannot exceed a reference level calculated for each project, whereby T_{ic} has to be lower than a maximum reference value called T_{icref}.

These three coefficients are calculated through TH-BCE[5], a dynamic hourly methodology (calculations are run every hour of a full year), which describes each component of the building envelope, as well as its energy systems.

The values of B_{biomax} and C_{pemax} are absolute values, based on standard benchmarks depending on the building type (Table 1) and are modulated by local climate, altitude and immediate environment factors.

Additionally, in order to ensure that residential buildings are correctly built, qualified experts have to check that airtightness upon their completion does not exceed 0.6 $m^3/h/m^2$ for single-family houses and 1 $m^3/h/m^2$ for apartment buildings.

Finally, the RT 2012 includes requirements for renewable energy use. It takes different forms depending on the energy type (for example a minimum of for solar panels), but it should amount to at least 5 kWh_{EP}/m^2.year.

Type of building		B_{biomax}	C_{pemax} (kWh/m².year)
Individual House	EC1	60	50
	EC2	80	60
Apartment building	EC1	60	90
	EC2	90	105
Office building	EC1	70	70
	EC2	140	110
Secondary education building (day time)	EC1	40	55
	EC2	50	70
Secondary education building (night time)	EC1	60	90
	EC2	90	105
Shop	EC1	140	320
	EC2	250	520
Catering 2 meals/day 6 days a week	EC1	75	110
	EC2	85	125
Hospital (day time)	EC1	230	270
	EC2	270	330
Hospital (night time)	EC1	120	130
	EC2	180	190

EC1: AC not required | EC2: AC required

B_{biomax}: Maximum bioclimatic need (without unity) | C_{pemax}: Maximum primary energy consumption

Table 1. B_{biomax} and C_{pemax} for various new buildings' typologies.

2.I.iii. Action plan for progression to NZEB for new buildings

n France, the title "Low Consumption Energy Buildings" (*Bâtiments Basse Consommation* - BBC) is used to describe buildings with very low energy consumption (NZEB), and in the case of individual residences also includes a great proportion of RES. Since 2013, all new buildings, including public buildings are mandatorily NZEB, since requirements for Low Consumption Energy Buildings are the same as in RT2012. Therefore, the cost-optimal level for NZEB has been evaluated along with the RT2012 one. The future regulation, based on the E+C- testing scheme will bring energy performance for new buildings one step further towards NZEB.

Three hundred thirty five thousand (335,000) new houses (300,000 apartments and 35,000 individual houses) were certified NZEB before the RT 2012 enforcement. In addition, there have been approximately 900,000 new houses certified since the enforcement of RT 2012. Hence, the current number of new NZEB houses can be estimated to be approximately 1.2 million.

2.I.iv. Requirements for systems and / or building components for new buildings

As explained before, the thermal regulation for new buildings sets general performance objectives. Therefore, it does not include any requirements on systems efficiency nor on building components. However, the requirements on B_{bio} entail a minimum performance of the envelope, which is different for every construction project. Indeed, B_{bio} is a modulated combination of the energy needs of the envelope for heating, cooling and lighting.

2.II. ENERGY PERFORMANCE Requirements EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

There are two thermal regulations for existing buildings. The first one, called *"RT par élément"* (Regulation by Building Component), was published in late 2007 and the second one, called *"RT globale"* (Global Thermal Regulation), in April 2008. Figure 1 shows how to determine the necessary regulation, depending on the renovation type (major or minor). Both regulations were reviewed in 2016 and the new requirements are set to come into force in 2018, followed by supplementary requirements in 2023 for envelope components.

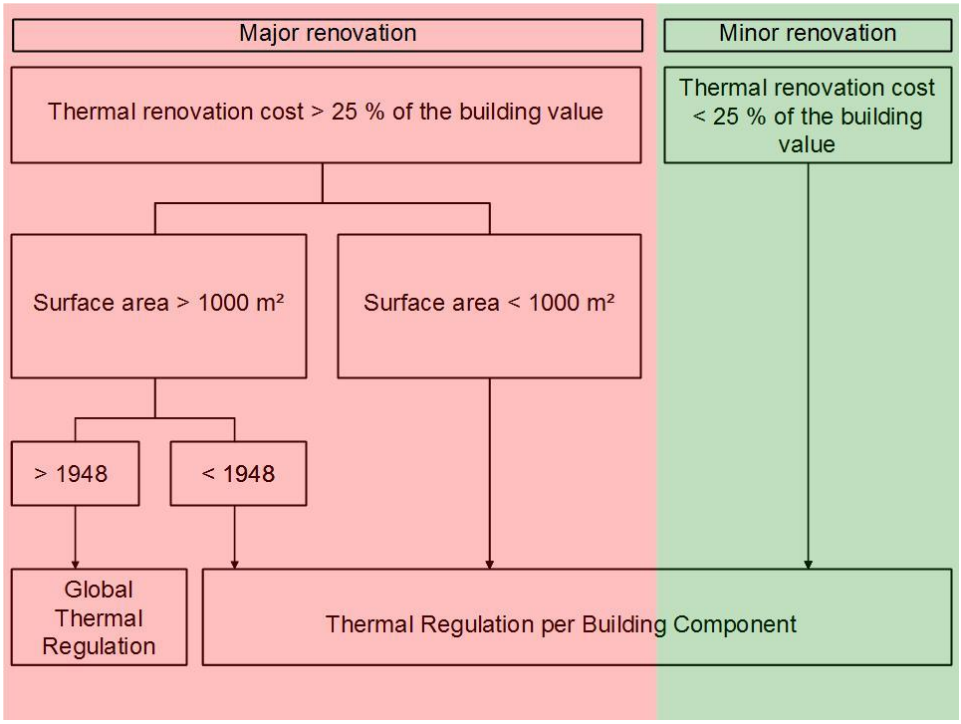


Figure 1. Thermal Regulations for existing buildings.

The Global Thermal Regulation is based on the overall consumption with minimum requirements for each component of the building (envelope and technical systems). Energy performance is assessed using a complex hourly methodology, called TH-CE ex[6], based on the new buildings' methodology. The TH-CE-ex methodology is currently under review, the main purpose being to make it consistent with the Th-BCE methodology for new buildings.

2.II.ii. Plans to improve the existing building stock

Although regulations for the renovation of existing buildings are quite ambitious, they are still below NZEB requirements, so that renovated buildings do not systematically reach the NZEB level. The French Government has therefore developed several quality seals in order to encourage owners to go beyond the regulation requirements.

For existing residential buildings there are two quality seals: "High Performance Energy 2009" (HPE 2009), demanding a level of 150 kWh/m².year, and "Low Energy Consumption Renovation 2009" (BBCR 2009), demanding a level of 80 kWh/m².year.

For existing non-residential buildings there is only one quality seal also called "Low Energy Consumption Renovation 2009" (BBCR 2009). It certifies that the consumption of energy of the renovated building is at least 40% less than the reference building (the same building, with specified envelope and systems).

By the end of 2016, 56,000 residential buildings and about 1.35 million renovated m² of non-residential buildings were given the "Low Energy Consumption Renovation 2009" quality seal.

Furthermore, in 2013, the National Plan for Housing Thermal Renovation[7] was launched. It is based on 3 pillars:

- assisting private individuals with free of charge independent advice;
- improving financing by optimised grants based on households incomes;
- raising the skills in the construction sector to handle the cost and quality of renovations.

Concurrently with this national plan, local authorities made more than 80 project proposals in order to work closer with both private and public landlords. The best projects have been nationally promoted as good examples of local work.

Regarding non-residential buildings, a charter[8] has been signed by the French Government and major companies, showing a commitment for energy efficiency by everyone involved.

To encourage professionals to build-up their skills, there is some financial support to owners whose renovations are made by certified workers. This certification, called *RGE*[9] (standing for recognised environmental guarantor), is proof that workers are fully qualified to carry out renovation work.

Finally, in order to provide motive for investments, a fund will be established, which will serve as guarantee of loans with higher risk and will reimburse banks in case of non-payment.

In order to implement Article 5 of the EED, France has chosen an alternative option. Indeed, in the "*Grenelle de l' Environnement*" laws (voted in 2009 and 2010), there is a goal for a 40% primary energy reduction by 2020 for all the buildings owned by the French Government. Based on the results of energy

audits on a representative sample of the relevant building stock, this would represent 10,131 GWh (primary energy) saved. In comparison, the 3% renovation proposed in the EED would lead to only 2,477 GWh (primary energy) saved.

Three types of action will help to reach this ambitious goal:

- renovation carried out by French authorities;
- a better use of the buildings;
- selling the unused buildings in order to have them renovated by a private landlord.

2.II.iii. Regulation of system performance, distinct from whole building performance

As previously described, there are two regulations for existing buildings. The appropriate regulation to be implemented is determined by the building size and the extent of the renovation (see Figure 1, where the Regulation by Building Component is based on minimum requirements for the different components of the building (envelope and systems)). Table 2 shows current and future maximum U-values for envelope elements.

Component	Climatic zone	Maximum U-Value (W/m².K)		
		2016	**2018**	**2023**
External opaque walls	H1, H2	U = 0.44	U = 0.35	U = 0.31
	H3	U = 0.5	U = 0.45	U = 0.45
Terrace roof	H1	U=0.4	U=0.3	U=0.22
	H2	U=0.4	U=0.3	U=0.23
	H3	U=0.4	U=0.3	U=0.25
Attic floor	H1, H2, H3	U=0.22	U=0.21	U=0.19
Roof	H1	U=0.25	U=0.22	U=0.19
	H2	U=0.25	U=0.23	U=0.22
	H3	U=0.25	U=0.25	U=0.25
Windows	H1, H2, H3	Uw=2.6	Uw=1.9	Uw=1.9
France is divided in 3 climatic zones from the coldest H1, to the warmest H3				

Table 2. Current and future maximum U-values for envelope elements in the Regulation by Building Components.

These two regulations have some rules in common, especially regarding domestic hot water, setting maximum heat loss depending on the boiler size, and giving European Norms 89 and 26 as a reference for some systems' performance.

The Regulation by Building Component sets a minimum efficiency around 90% for boilers and a coefficient of performance of 3.2 for heat pumps on heating mode. For AC units below 12 kW the energy efficiency rating should be at least 3.0. For other AC systems the efficiency should be between 2.6 and 3.0. Ventilation unit consumption should not exceed 0.25 Wh/m^3 for residential buildings, and 0.3 Wh/m^3 for non-residential buildings. These requirements are set for systems with nominal power not covered by the Ecodesign Directive 2009/125/EC.

2.II.iv. Encouragement of intelligent metering

Intelligent meters for both electricity ("*Linky*") and gas ("*Gazpar*") are being widely deployed, with a target of full national coverage by 2021. The deployment is carried out by the Electricity Network of France (*Enedis*) and the Gas Network of France (*GRDF*). There are no requirements for intelligent metering for individual technical building systems.

Wide installation of these meters has started in mid-2015 and by the end of 2016, 2,7 million meters were installed. *Enedis* set a target of 7 million meters installed by the end of 2017.

2.II.v. Financial instruments and incentives for existing buildings

The energy transition credit tax (*CITE*)[10] is a tax benefit following the purchase of the most efficient materials and equipment in terms of energy saving and reduction of greenhouse gas emissions. The amount of the credit depends on the system type and its price (deduction of 30% of the price). The only proof needed to get the tax benefit is the sales receipt, provided it has been installed by an installer holding the required qualification/certifications (*RGE*).

In response to Article 7 of the EED energy suppliers have to promote and support energy savings among consumers (Energy Saving Certificates Scheme). These Energy Saving Certificates can be awarded for complying with the energy saving standards, or they can be more specific, and often imply heating system based action, e.g., financing of a heating system refurbishment.

Since 2009, the 0% Eco-Loans (loans with a 0% interest rate) have enabled financing of building renovations, in particular to improve heating systems. In order to access the 0% Eco-Loans, the renovation must be substantial (roof or wall insulation, replacement of at least half of the windows, installation of a high-performing HVAC system, RES heating or domestic hot water system), or achieve a minimum energy performance of the building. These loans are designed for property-owning individuals to finance major renovation works. The maximum amount is 30,000 € over a 15-year period.

In addition to that, financial support provided by the National Agency for Housing Improvement (Anah)[11] is helping low-income households to finance renovation works if they reduce their energy consumption by at least 25%. The level of financial support varies depending on the income of the beneficiaries (35% - 60% of the investment can be funded), with a maximum amount of 20,000 € (50,000 € for deep renovations).

Finally, a reduced VAT (5.5%) applies for renovation works in residential buildings. To take advantage of this VAT reduction, materials used must respect technical characteristics adopted by a ministerial order[12].

2.II.vi. Information campaigns / complementary policies

For all new regulation or financial incentives, the ministry and the *ADEME* (the French Energy Agency) publish guides which aim either at providing information about financial schemes or at facilitating the understanding of the regulation. There is also a support network of "regional energy renovation platforms" covering the whole country, aiming at supporting households carrying out renovation works.

As a complementary policy, there is an obligation to insulate the roof or the facade whenever other restoration works are undertaken. This obligation aims at lowering the cost of a thermal renovation by including it in a package of planned renovation work. However, this obligation does not apply in case of light restoration (such as cleaning), or when the façade is of remarkable architectural or patrimonial value.

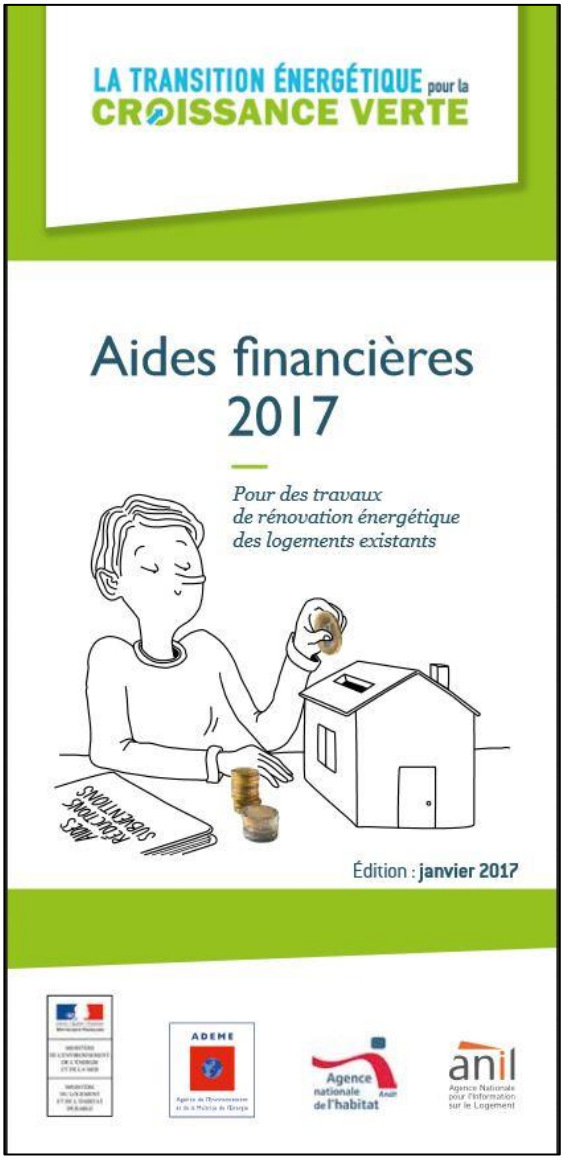


Figure 2. Example of information guide about financial incentives.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The French EPC, called "*Diagnostic de Performance Energétique" (DPE),* was introduced in 2006 and is issued by a qualified expert. Issuing an EPC for both existing and new buildings requires the qualified expert to assess the thermal efficiency of the building following an on-site visit, by inspecting the envelope, HVAC and domestic hot water systems. Once issued, the EPC is automatically sent to the EPC national database (mandatory since 2013), and is valid for 10 years. The energy performance can either be estimated (using a calculation methodology) or measured (using energy bills), depending on the building's type.

	Residential building						**Non-residential** building
	EPC for the **whole** building or house		**Flat** with **collective heating system** when there already is an **EPC for the whole building**	EPC not concerning the whole building			
				Flat with individual heating system		**Flat** with **collective heating system**	
	Building built **before 1948**	Building built **after 1948**		Building built **before 1948**	Building built **after 1948**		
Performance **assessed**		X	**EPC** for the **whole building**		X		
Performance **measured**	X			X		X	X

Table 3. Methods used for assessing compliance with EPC standards.

Type of Building	Individual House	Flat	Apartment Building	Non Residential	Total
Number of EPCs issued since 2013	1,655,379	1,771,271	215,091	132,483	3,774,224
New building	239,711	422,841	37,239	5,296	705,087
Existing building	1,415,668	1,348,430	177,852	127,187	3,069,137
Public buildings	-	-	-	10,000	

Table 4. Total number of EPCs issued since 2013.

The precise number of EPCs issued as of April 2013 can be determined based on the data provided by the national EPC database. Table 4 shows a total of nearly 3.8 million EPCs registered on the database. The number of EPCs before 2013 can only be estimated.

The total figure (before and after 2013) is estimated to circa 9 million EPCs for all building types, which represents nearly a third of the national building stock.

2.III.ii. Quality assessment of EPCs

According to a regulatory requirement, the work of each qualified expert must be checked on a continuous basis. 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. Table 5 shows the type and number of checks performed on each expert by its certifying body.

The certifying body must verify that each point of the regulation is abided by and it can withdraw the expert's certification temporarily or permanently in case some fields in the EPC are not properly filled.

The EPC database is also a useful tool for landlords, allowing them to check the accuracy of their EPC.

Finally, there is a directory of qualified experts available, so landlords can assure that the qualified expert is certified.

	First certification cycle		Re-certification cycle
Number of EPC reports checked	4 (during the first year)	4 (between the second and the fourth year)	4
Number of EPCs checked on-site	1	1	

Table 5. Number and types of checks on each expert.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Since 2007, all buildings over 1,000 m² occupied by public authorities and frequently visited by the public must have a valid EPC. The threshold was successively lowered to 500 m² in 2013 and to 250 m² in 2015. Once issued, the EPC must be displayed near the entrance point of the building clearly visible by the public.

As for the general activity level, the exact number of EPCs issued for each type of building since April 2013 is determinable (Table 4). Since August 2015, a 1,500 € fine can be imposed to non-compliant building administrators.

2.III.iv. Implementation of mandatory advertising requirement - status

Since 1 January 2011, it is mandatory for real estate agencies to include some information provided by the EPC in their advertising. Every type of advertising is affected, but not in the same way. Advertisements published in newspapers should display at least the energy class letter, while advertisements published on the internet or at the real estate office must display the full energy label. The picture of the label should be at least 180 X180 pixels on the internet and should occupy at least 5% of the advertisement displayed at the real estate office.

In case of non-compliance there are two types of sanctions: based on the civil law, the client can demand the cancellation of the sale; based on the criminal law, the sale can be considered as fraudulent and can lead to a prison term of two years without remission and to a 37,500 € fine imposed by the "General Directorate of Competition, Consumption and Fraud Repression" (*DGCCRF*). Such penalties have not been applied so far. A simple call to order has always been enough to bring non-compliant parties to compliance. Yet, the *DGCCRF* estimates that in 15% of the real estate dealings the EPC is not displayed.

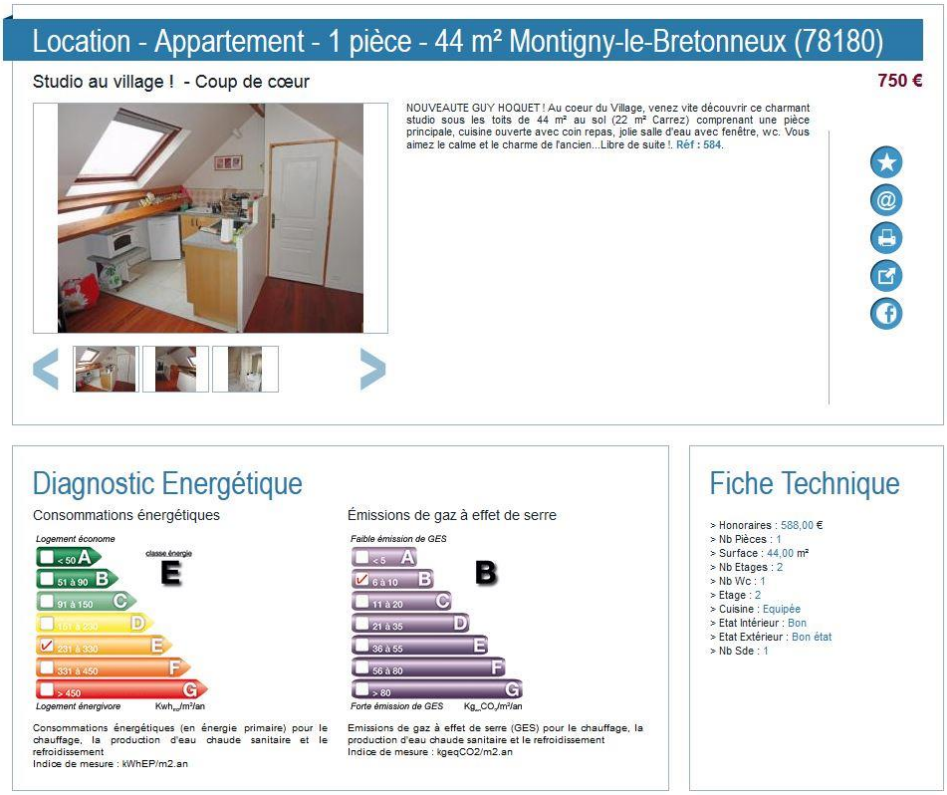


Figure 3. Example of property advertising on the internet including information provided by the EPC.

2.IV. Inspection requirements - heating systems, air conditioning

To transpose Article 15 of the EPBD about AC systems, France has chosen to adopt the default approach, which consists of a periodic inspection scheme for AC systems above 15 kW and reversible heat-pumps above 12 kW. The same approach has been chosen for boilers of more than 400 kW.

For boilers between 4 and 400 kW, alternative measures involving an annual maintenance visit have been taken according to Paragraph 4 of Article 14 of the EPBD.

	Boilers between 4 and 400 kW	Boilers of more than 400 KW	AC systems and reversible heat pumps of more than 12 kW
Periodicity	Annual maintenance visit	Inspection every two years	Inspection every five years

Table 6. Number and types of checks on each system.

2.IV.i. Report on equivalence of model A and B for Heating Systems

The alternative measures were chosen for boilers between 4 and 400 kW, after comparing the hypothetical inspection scheme (the reference scheme) and the annual maintenance visit (alternative scheme). The main differences between the two calculations were the following:

- The scope is larger for the alternative scheme (for the default approach, only boilers of more than 20 kW are targeted, while maintenance concerns boilers of more than 4 kW).
- Inspections will not systematically lead to renovation work and thus energy saving, whereas a maintenance visit would because the person in charge can act directly on the system.

The alternative measures applied in France allow more than twice the energy saving resulting from the implementation of a regular inspection scheme, as explained in the report submitted in the context of Article 14 of the EPBD.

2.IV.ii. Progress and current status on heating systems

Boilers between 400 kW and 20 MW: inspection scheme

Boilers between 400 kW and 20 MW are subjected to inspection at least every 2 years. During the inspection visit the qualified expert must check and measure the same elements as regard to boilers from 4 – 400 kW. But for boilers of more than 400 kW a “boiler-room handbook” has to be kept, recording all information about the system.

These requirements are listed in a ministerial order[13] from 2009, and in articles R.224-21 to R.224-30 of the environment code[14].

Boilers between 4 and 400 kW: alternative measures

Alternative measures that have been taken to improve the energy performance of heating systems under 400 kW, are the following:

- An annual maintenance visit by any professional in the field of maintenance. During the maintenance visit, the professional must check the boiler (clean and tune it if necessary), measure the concentration of CO, evaluate the energy performance of the boiler, provide advice on best use, improvement of the

boiler and of the heating system in place, and issue a certificate of maintenance within 15 days after the visit.

- The Ministry of Energy together with the French Energy Agency (*ADEME*), have prepared a guide for the public[15] in order to explain the new provisions regarding the annual maintenance of boilers. They also conduct publicity campaigns in relation to the most efficient heating systems and to financial support for replacement (see information website "Energy Info Sites"[16]).

Systems with high energy performance are financially supported by national and local programmes that are described in paragraph II.v. of this report.

2.IV.iii. Progress and current status on AC systems

The French regulation on AC systems (imposed by one decree[17] and two ministerial orders) has been in force since 16 April 2010. France has chosen to implement Article 15 of the EPBD by inspecting of AC systems and reversible heat pumps with an output of 12 kW or more, at least every 5 years. The person responsible for the inspection is the owner or the manager of the building.

A report is issued within one month after the inspection with the results and advice on best use. Two ministerial orders have been published in December 2016, in order to improve the inspection scheme. The inspection should include:

- inspection of the AC handbook;
- assessment of system performance;
- assessment of the sizing of the system in relation to the cooling requirements of the building;
- provision of the necessary recommendations concerning proper use of the system in place, possible improvements to the installation as a whole, any benefit from its replacement and other potential solutions.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Penalties are set in the regulation (Art L.226-2 et L.226-8 of the environment code). Controls can be performed by officers of the General Directorate for Competition Policy, Consumer Affairs and Fraud Control. If the regulation has not been properly adhered to, the relevant authority can apply several types of measures:

- to carry out a new inspection of the AC system at the owner's expense;
- to oblige the owner to deposit the equivalent of the inspection cost as a guarantee until compliance is achieved, whereby the sum is returned;
- to oblige the owner to pay a fine;
- to force the owner to stop the AC system.

Quality control of inspection reports

Experts are certified (for 5 years) by certifying bodies, which are accredited by *COFRAC*[18] (French committee for accreditation) according to ISO standard 17024 "General requirements for bodies operating certification of persons".

During this period the accredited body has to:

- check at least that the inspector establishes one report per year;
- check the quality of at least one report between the beginning of the 2nd year and the end of the 4th year of his certification;
- accompany the expert during at least one of his on-site inspections between the beginning of the 2nd year and the end of the 4th year of his certification.

The COFRAC checks if the accredited bodies meet the requirements of the standard. A total of 214 reports were controlled in 2015, for around 227 inspectors, and 3 accredited bodies.

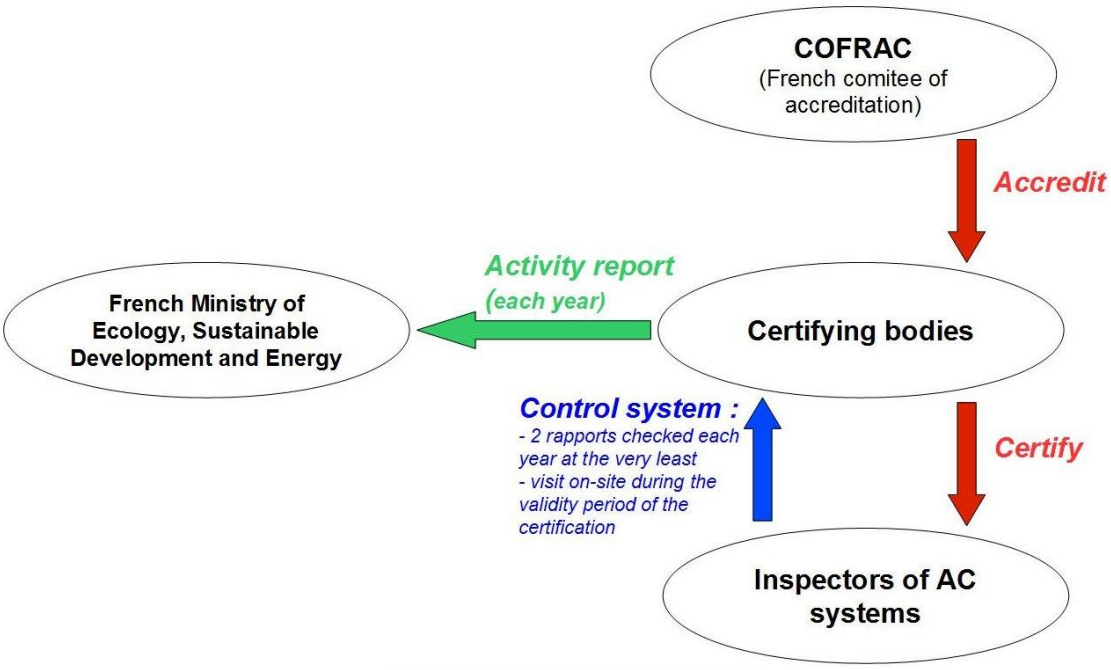


Figure 4. Schematic approach of the interaction of participants in the AC inspection scheme.

Impact assessment, costs and benefits

AC inspection reports are not collected in a central database so it is challenging to assess precisely the impact of the inspection scheme. The extent of energy saving may vary, it depends first on the decision of the owner to do something or not, and then on the extent of the work.

Concerning cost-effectiveness of the inspections, an expert needs one day to perform an inspection, which costs 600 €. Given that inspections occur every five years, this is equivalent to 120 €/year. Energy saving is closely linked to the actions of the owner after an inspection, making it very difficult to assess the impact and the cost-efficiency of the scheme.

3. A success story in EPBD implementation

France's success story lies in the manner the future regulation for new buildings is being planned. Following the *LTECV* (Energy Transition for Green Growth Act) and the Paris agreement, French authorities and stakeholders have been collectively building an ambitious new regulation based around two major points:

- wide spread of positive energy buildings, going further than NZEB;
- spread of low carbon buildings.

Yet, after the setting of the previous thermal regulation (RT 2012), stakeholders expressed mixed feelings towards an even more ambitious regulation, stating that the current one was already quite complicated and burdensome. Thus, there was a strong need to bring stakeholders together from the beginning. This led to the creation of a testing scheme called "E+ C-" (standing for Energy plus Carbon minus), for voluntary developers, which started in late 2016.

Developers will test the technical and financial feasibility of building construction in accordance with future regulations. In this respect, public developers intend to pave the way by integrating renewable electricity production systems into their buildings and by developing low-carbon construction processes. A test observatory will collect feedback and best practices to refine indicators and establish future regulatory thresholds.

To reward the first buildings constructed under the new regulations, the Government has introduced a new label that is awarded after the assessment of the technical and economic feasibility of the new requirements. Intended to distinguish positive energy buildings in the same way as low-carbon buildings, this label will incorporate several performance levels.

There are four different levels based on the energy consumption and two on the carbon footprint set by the scheme. The energy performance assessment relies on the currently used calculation methodology, with the first two levels corresponding to the energy performance expected by the RT 2012 but with a higher share of RES. The third level involves a higher energy performance than the current regulation and the fourth level matches the positive energy building (meaning that the energy performance is lower than zero).

The carbon footprint assessment is based on a complete life cycle analysis, from the manufacture of components to the recycling of rubble. The first level of the label is easy to reach and aims at having all the stakeholders involved in the construction to implement an overall reflexion on the environmental impacts of a building. The second level is however more challenging and requires a real decrease of the carbon emissions of the building.

The setting of the E+C- scheme has been a long-term endeavour that included numerous stakeholders working in a common direction. Having such a result is truly a success, since it ambitiously paves the road for the new regulation on two combined aspects. Firstly, it pushes the technical and environmental requirements further than ever. But, secondly, the testing scheme will enable the assurance that the future regulation requirements will be effectively attainable, which is considered as most important.

4. Conclusions, future plans

Even though the EPBD is fully transposed, France has the will to continue to position itself at the forefront of energy performance in buildings, and plans to make sustainable development the driving force of national growth. This will has been expressed by several measures that could be considered beyond the scope of the EPBD.

Preceding the Paris Agreement by a few months, the Energy Transition for a Green Growth Act was signed in August 2015, containing many provisions relating to energy and the environment, some of which concern buildings' performance. This act tackles the subject of energy performance, but also matters like electric mobility, fuel poverty, or even data collection in buildings.

Of course, the E+C- scheme will play a predominant role in defining the future of the French thermal regulation for new buildings. It is already set to be a major new step since it will combine energy performance and environmental requirements. There is also a continuous assessment of the tools and measures by the ministries with studies evaluating the reliability of the calculation, or through constant contact with professionals, with the goal to identify and correct any dysfunctional points in the EPBD implementation. This will lead in the near future to the revision of the thermal regulation for new buildings.

Endnotes

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Germany

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.bbsr-energieeinsparung.de/EnEVPortal/EN/Home/home_node.html, www.bmwi.de/Redaktion/EN/Dossier/enhancing-energy-efficiency-in-buildings.html, www.bmub.bund.de/en/topics/climate-energy/energy-efficiency/general-information/?cHash=708635c8a9f766bc5d0c165b53867c44, www.kfw.de/inlandsfoerderung/Privatpersonen/index-3.html, www.dena.de/en/topics-projects/energy-efficiency/buildings/

1. Introduction

A holistic approach to energy efficiency in buildings was first introduced by Germany in 2002 with the Energy Saving Ordinance (*EnEV*[1]). The *EnEV* replaced the legislations on thermal insulation of buildings (*WschV*[2]) and system requirements for central heating (*HeizAnlV*[3]), which had been in place for 25 years. For the replacement to be successful, a method for calculating the heat requirement of a building was developed as a national pre-standard, widely based on the former European standard EN 832. In order to implement the EPBD, Directive 2002/91/EC, the German standardisation institute DIN developed and published in 2005 the calculation standard DIN V 18599[4] for overall energy performance of buildings, which covers a wide range of use patterns and – in addition to heating, ventilation and domestic hot water - cooling, lighting and component interaction and building services. The second edition of this standard, published in 2007, was used as a compulsory calculation method for non-residential buildings. Two years later, the energy efficiency requirements were strengthened with the Energy Saving Ordinance 2009[5]. At the same time, the percentage of use of RES for new buildings was legally introduced with the Renewable Energies Heat Act (*EEWärmeG*[6]), which was amended in 2011 to extend the requirements in case of major renovations of public buildings.

The current Energy Saving Ordinance (EnEV) 2013[7] implements the new requirements of the EPBD, Directive 2010/31/EU. Furthermore, strengthened minimum requirements, which are seen as a step towards NZEB, were fixed and came into force for all new buildings from 1 January 2016 (application for

building permit). The requirements are linked to compulsory calculation methods (DIN V 18599: 2011-12 and, alternatively for residential buildings without AC, the old method according to DIN V 4701-10: 2003-08). Both methods include mandatory boundary conditions. In order to facilitate the application of the two different methods for residential buildings and a wide range of use patterns for zones of non-residential buildings, the requirements are expressed by a reference building method rather than by fixed values. A simplified method[8] using a model building approach, applicable to a broad range of residential buildings, came into force in 2016.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

The main energy performance requirements for new buildings are defined in the Energy Saving Ordinance (*EnEV*) 2013[9] comprising:

- a maximum non-renewable primary energy demand, which is determined individually for each building using a reference building with similar building geometry, orientation and use, but with a certain quality of all energy-relevant systems and components;
- a minimum requirement for the energy performance of the building's thermal envelope, which is determined:
    - for residential buildings, using the reference building approach as well;
    - and for non-residential buildings, by a certain set of maximum mean U-values for opaque and transparent elements respecting the design indoor temperature of the building's zones;
- a minimum percentage of RES used for heating (Table 1), domestic hot water and cooling; the percentage is different for the various technologies.

Options to comply with the Renewable Energies Heat Act

	Option according to annex	Minimum share
Renewable Energies	Energy from **solar radiation** (collectors)	15 %
	or default collector size for residential buildings ≤ 2 dwellings (m² collector aperture area per m² living space) > 2 dwellings	0.04 [m²/m²] 0.03 [m²/m²]
	Geothermic energy or **ambient heat** by heat-pumps (performance requirements given for heat-pumps)	50 %
	Biomass from sustainable sources (proof by bills required)	
	• **Gaseous** (mostly restricted to use in CHP-appliances only)	30 %
	• **Fluid** (best affordable boiler technology)	50 %
	• **Solid** (minimum efficiency values given for boilers)	50 %
Substitute measures	Heat from **waste combustion**	50 %
	CHP plants	50 %
	District heat with substantial share of RES / waste / CHP	100 %
	Measures to save energy in buildings	EnEV-req. -15 %
	Combinations of several measures	$\sum_i \frac{share_i}{share_{min,i}} \geq 1$

Table 1. Options to comply with the Renewable Energies Heat Act.

Furthermore, a set of requirements addresses technical building systems or system components. New public buildings are so far treated similar to any other new non-residential building.

2.I.i. Progress and current status of new buildings

As a first step towards NZEB, the requirements for new buildings were tightened in January 2016 (Table 2). The maximum primary energy demand now equals 75% of the 2014 value, whereas the requirements addressing the thermal envelope were strengthened by 20%. The German report[10], as required by Article 5 section 2 of the EPBD, proved the 2016 requirements to be cost-optimal. Additional measures to further implement the NZEB level are currently in preparation.

Component	Reference design / value	2nd requirement
Strengthening factor January 2016	$Q_{p,max,2016} = 0.75 \cdot Q_{p,ref,2009}$	$H'_{T,max,2016} = 1.0 \cdot H'_{T,ref,2009}$
	Reference 2009	
External walls, Floors	U = 0.28 W/(m²·K)	$H'_{T,max,2009} \cong 1.25 \cdot H'_{T,ref,2009}$ [requirement 2009 is legally defined by tabled values according to situation and size of the building]
Floor, basement structural element	U = 0.35 W/(m²·K)	
Roof, upper ceiling	U = 0.20 W/(m²·K)	
Windows incl. French windows	U = 1.3 W/(m²·K) (Skylight U = 1.4 W/(m²·K))	
Entrance doors	U = 1.8 W/(m²·K)	
Boilers	Condensing boilers	Requirements for pipe insulation and controls
Hot water	Central, with solar system	
Cooling	None	Thermal protection in summer
Ventilation	Central exhaust fan, demand-controlled	large systems: SFP_{max}, heat recovery

Table 2. Requirements for new residential buildings: reference construction to determine the maximum primary energy demand and additional requirements to building envelope and system performance.

2.I.ii. Format of national transposition and implementation of existing regulations

The regulations concerning the percentage of RES use – including possible substitute measures – are subject of the Renewable Energies Heat Act[11], last amended in 2010. All other efficiency requirements for new buildings are given by the Energy Saving Ordinance[12], which was subject to a major amendment in 2013. In course of the amendment 2013, the current requirements that came into force in January 2016 were already fixated.

The Energy Saving Ordinance refers to the German pre-standard DIN V 18599, version 2011-12, as the compulsory method for the proof of compliance and the calculation of the values for the EPC. Some international standards (e.g., EN ISO 13790, EN ISO 13789, EN ISO 6946) are included in the method; others are addressed by the ordinance in order to define additional requirements (e.g., EN ISO 13779 for AC

system performance). The majority of boundary conditions and primary factors (Table 3) are given in the calculation standard as well.

Calculations of energy performance of new buildings are performed by experts using advanced software solutions. The "Quality Community 18599"[13] comprised of the software companies, performs regular quality control of the software products. This is also a prerequisite for any software used for application in *KfW* funding schemes. In case that – on purpose or because of serious neglect – false calculations are performed or the building's real design is different from the calculations, the expert risks a penalty up to 50,000 €. Calculations performed during construction of new buildings are checked – mostly as samples – by the local authorities in charge.

Energy carrier [1]		Primary Energy Factor	
		total	non-renewable fraction
Fossil fuels	Light fuel oil	1.1	1.1
	Natural gas (grid)	1.1	1.1
	Liquid gas	1.1	1.1
	Coal	1.1	1.1
	Brown coal	1.2	1.2
Bio fuels	Biogas [2]	1.5	0.5
	Liquid bio fuel [2]	1.5	0.5
	Wood	1.2	0.2
District heat from CHP [3 4]	Fossil fuel (default)	0.7	0.7
	Renewable fuel (default)	0.7	0.0
District heat from heating plant [4]	Fossil fuel (default)	1.3	1.3
	Renewable fuel (default)	1.3	0.1
Electricity	Grid-Mix (2014)	2.8	2.4 [5]
	Grid-Mix (2016)	2.8	1.8 [5]
	Substitution mix [6]	2.8	2.8
Environmental energy	Solar energy	1.0	0.0
	Ground heat, geothermal energy	1.0	0.0
	Ambient heat	1.0	0.0
	Ambient cooling	1.0	0.0
Waste heat	from (industrial) processes on-site	1.0	0.0

[1] Reference: calorific value
[2] restricted to on-site / nearby generation
[3] default values for CHP ≥ 70 %
[4] calculation of local PE-factors foreseen
[5] Values given by the Energy Saving Ordinance (deviation from standard)
[6] used for electricity delivered by CHP-plants to the public grid

Table 3. Primary Energy Factors; non-renewable fractions for use in energy performance calculations.

2.I.iii. Action plan for progression to NZEB for new buildings

With the strengthening of the new building requirements valid from 1 January 2016, Germany took a step towards the future NZEB-level. Compared to the former performance values, the maximum primary energy demand was reduced by 25%, and the requirements to limit the heat transfer by an average of 20%. This level was identified as cost-optimal.

The Energy Saving Act[14] was amended in 2013 with a verbal description of the NZEB (in accordance with the EPBD) and the obligation to comply with this level, for new buildings owned and occupied by public authorities by 1 January 2019 and for all other new buildings by 1 January 2021. Furthermore, the act obliges the government to specify the NZEB-level for new public buildings in an ordinance issued before 2017, and for all other buildings in another ordinance issued before 2019.

The government decided to use the aforementioned amendment not only to specify the NZEB-level, but also for a significant simplification of the existing regulations, mainly by combining the – so far separate – legislation on the RES use percentage with the energy efficiency regulations. This project needed a lot of preparatory studies and negotiations and is currently still under preparation. For new public non-residential buildings, the draft legislation "*Gebäudeenergiegesetz*" foresees an NZEB-level commonly known in Germany as "Efficiency House 55"[15]. This level means a strengthening of the current (2016) primary energy demand by 26%, and of the requirements for the building shell (mean U-values) by 12%.

In 2009, a typical kindergarten was completed in Weilimdorf (close to Stuttgart). The building has a net internal area of 1,127 m², with a heated volume of 4,626 m³. The relation of area to volume of 0.47 m^{-1} is representative for kindergartens in Germany[16] (Figure 1).



Figure 1. Kindergarten Weilimdorf.

Today's minimum energy requirements for non-residential buildings are determined by a maximum primary energy demand of the building and a set of maximum U-values for the envelope. The kindergarten in Weilimdorf was realised with a 20% lower primary energy demand and a 30% better energetic quality of the building envelope than presently required (using the reference building as of 1 January 2016). All parts of the envelope add to the high energy performance (roof 0.20 W/(m².K); wall 0.20 W/(m².K); window 1.1 W/(m².K); ground floor 0.35 W/(m².K)). The low primary energy need is achieved by covering the heat demand of the building through district heating. The available heat grid partly uses RES and has therefore a low primary energy factor. The calculated payback period for the higher energetic quality is 21 years.

2.I.iv. Requirements for systems and / or building components for new buildings

The overall performance requirement (non-renewable primary energy demand) is accompanied by a requirement that limits the overall specific heat transmission coefficient[17]. This requirement might be the main issue in case of systems with a major share of RES.

The heating and cooling load of new buildings must be at least partially covered by systems that use RES. There are specific percentages given for the different RES-based systems, which can be combined. Exemptions are given in case of district heating and combined heat and power systems and, for new buildings, with an energy performance at least 15% better than required (substitute measures).

The requirements for technical building systems described below for existing buildings (II. iii.) are valid for new buildings as well.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

Germany does not have a database describing the energy efficiency features of the building stock as a whole. For residential buildings – mainly for apartment buildings – the consumption and the development of the normalised average are known from several studies performed with data derived from individual heating-cost billing. The current average consumption of existing buildings was reduced from 230 kWh/(m².year) in the 1990s to 155 kWh/(m².year). Details about the German stock of residential buildings can be found in a study from 2010[18]. More than 7,500 completed questionnaires from a representative sample of existing residential buildings give details of their current condition and implemented refurbishment measures: e.g., 60% of roof surfaces of these buildings had already been equipped with thermal insulation. The reduction of average consumption is not only due to refurbishment, but partly also a result of rising awareness and actions caused by mandatory individual heat billing and increased energy prices.

Requirements to upgrade the building stock comprise conditional requirements in case of relevant refurbishments, mandatory update requirements to be met without any triggering measures (e.g. insulation of the highest floor slap) and requirements in case of extensions (Figure 2).

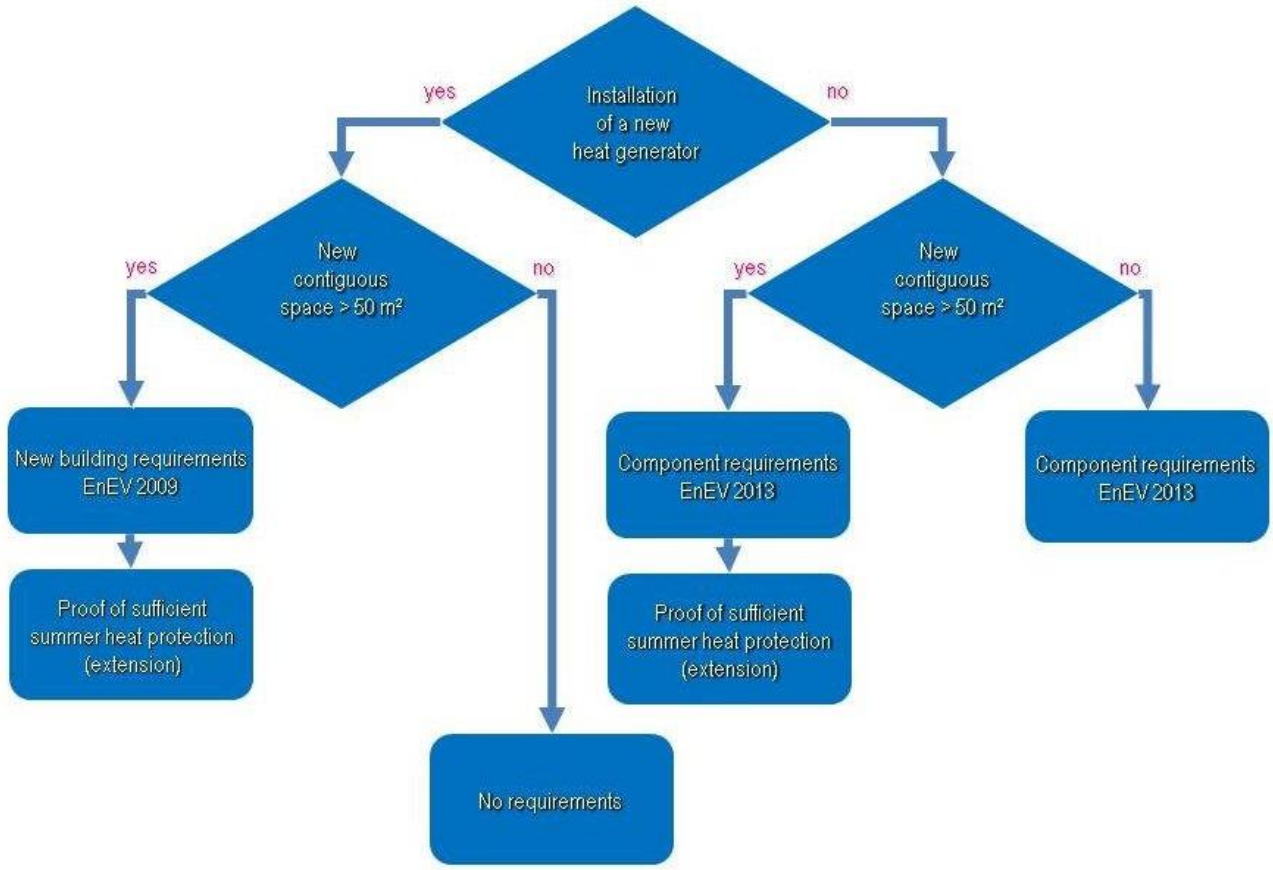


Figure 2. Requirements in case of extensions of existing buildings.

2.II.ii. Plans to improve the existing building stock

The energy strategy of the Federal Government of Germany foresees an energy-neutral building stock by 2050[19]. To reach that goal, the non-renewable primary energy demand of the building stock needs to be reduced by 80%. The three instruments considered to be used in that strategy are regulatory law, financial incentives, as well as information and advice.

Whenever relevant refurbishment is done, the minimum requirements given by the Energy Saving Ordinance have to be met. The requirements of the ordinance can be fulfilled in two ways:

- either by meeting specific energy performance requirements for building elements and installations;
- or by attaining 140% of the performance requirements for a new building (calculated using the reference building status 2014).

Due to a number of policies that promote energy efficiency and provide financial support, a lot of buildings are retrofitted to a higher energy performance level than required. Programmes like the *KfW* programme for residential and non-residential buildings, the incentives programme for energy efficiency (*APEE*)[20] and the incentives programme for heating with RES (*MAP*)[21] contribute to the goal of an energy-neutral building stock. In the past 10 years, for example, the *KfW* has accepted about two million applications for financial support for the retrofitting of residential buildings.

Germany has chosen an alternative approach to renovating 3% of the total floor area of buildings owned and occupied by its central government as required by Article 5 (6) EED. Therefore, cost-efficient measures are carried out including extensive retrofitting and measures to change user behaviour. The national energetic retrofitting schedule for federal property (*Sanierungsfahrplan Bundesliegenschaften* (ESB)) was established in 2011. To reach the 3% goal, federal government buildings need to get refurbished to an energetic quality as required by the Energy Saving Ordinance.

The refurbishments that were completed in 2015 led to a reduction of 7,008 MWh/year in 2016 (in comparison, refurbishments completed 2013 resulted in a reduction of 7,366 MWh/year in 2014, and those completed in 2014 in a reduction of 8,556 MWh/year in 2015, respectively). Further refurbishments are currently carried out or are in the preparation stage.

2.II.iii. Regulation of system performance, distinct from whole building performance

Several requirements address the performance of technical building systems in existing buildings.

The following requirements have to be met, even without the "trigger" of a relevant modernisation:

- Water-based central heating systems have to be equipped with controls that adjust the temperature of the heating medium based on time and outside temperature, and which shut down circulating pumps accordingly; there are exemptions.
- Water-based central heating systems have to be equipped with room-temperature controls; there are exemptions for small rooms with floor heating, old floor heating and for non-residential buildings, where rooms of similar type and use may share controls.
- AC systems with more than 12 kW output and due to influence humidity must have controls with separate set-points for humidification and dehumidification.

The following requirements must be met in case of relevant changes to the system:

- Circulation pumps in water-based heating systems with more than 25 kW heat output must be controlled automatically; there are exemptions.
- Circulation pumps in domestic hot water systems must have a time-control.
- Newly installed heating and domestic hot water pipes, as well as cold water pipes in AC systems must be insulated; there are exemptions especially for heating pipes in a heated space.
- AC systems with more than 12 kW output and ventilation systems with more than 4,000 m^3/h supply air must meet the following requirements in case of first-time installation and major changes:
    - the specific fan power (SFP) value may not exceed class SFP 4 (EN 13779: 2007);
    - the air-flow must be controlled automatically according to thermal and sensible load if the hourly flow exceeds 9 m^3/m^2; there are exemptions;
    - the systems must be equipped with heat recovery units of class H3 (EN 13053: 2007) or better.

2.II.iv. Encouragement of intelligent metering

The Act on the Digitisation of the Energy Transition (2016) bridges the gap between providing the energy sector with a reliable framework for investment and achieving wider acceptance for smart meters among consumers. It sets out clear rules stipulating who is required to use smart meters, and who can use smart meters as an option.

For consumers, this depends on the amount of electricity that is consumed annually, and for producers, this depends on the amount of capacity that is installed. Not all consumers and producers will be required to install smart meters right away. Small-scale consumers and producers will be required to install smart meters by 2020 at the earliest, so they can benefit from the lessons learnt by those groups that have introduced smart meters right from the start.

New rules on price caps play a crucial role. These price caps will ensure that the costs and benefits of installing and operating a smart meter will be proportionate. They are based upon the potential benefits that accrue from the use of smart meters, as calculated by the Federal Ministry for Economic Affairs and Energy in its cost-benefit analyses[22].

This helps achieve wider acceptance for smart meters among consumers and plant operators by keeping costs at a proportionate level, whilst providing grid operators with a reliable framework for devising their rollout strategy.

2.II.v. Financial instruments and incentives for existing buildings

The *KfW*[23] promotional programme "Energy Efficient Refurbishment"[24,] funded by the Federal Ministry for Economic Affairs, is the most significant provider of financial incentives for more energy efficiency in the German housing sector. The programme aims to promote energy savings and greenhouse gas reductions as well as to encourage investments and create or safeguard jobs.

The level of financial support available is linked to the ambition of the refurbishment. There are in total six deep retrofit promotional levels: starting with the *KfW* Efficiency House 55 as the most ambitious level, followed by *KfW* Efficiency House 70, 85, 100 and 115 as well as a separate level for heritage buildings (Table 4). The figures indicate in % how much of the maximum primary energy requirement specified by the Energy Saving Ordinance 2013 the house consumes.

The incentive, in terms of partial debt relief, is starting at 12.5% and reaching 27.5% debt relief for the most ambitious level, Efficiency House 55. The maximum loan amount is 100,000 € per housing unit. Alternatively, there is the option to apply for a grant for investment[25] (maximum 30,000 € per housing unit).

For those customers who do not target a comprehensive refurbishment of their building or housing unit, *KfW* offers promotional loans for packages of measures and single measures such as windows, heating systems or insulation (maximum 50,000 € per housing unit). There is also the option to apply for a grant (7,500 € for a heating or ventilation package; otherwise a maximum of 5,000 € per housing unit).

The promotional programmes are available for all private investors in the residential building sector in Germany as well as housing companies at equal conditions.

Standard	annual primary energy demand *	specific transmission heat loss*	repayment subsidy	alternative: grant for investment
KfW Efficiency House 55	55 %	70 %	27,5 %	30 %
KfW Efficiency House 70	70 %	85 %	22,5 %	25 %
KfW Efficiency House 85	85 %	100 %	17,5 %	20 %
KfW Efficiency House 100	100 %	115 %	15 %	17,5 %
KfW Efficiency House 115	115 %	130 %	12,5 %	15 %
KfW-Efficiency House Monument	160 %	175 %	12,5 %	15 %
Combined single measures	-	-	12,5 %	15 %
Single measures	-	-	7,5 %	10 %

* compared to the corresponding value of the EnEV-reference-building

Table 4. KfW-Efficiency-House-Standards defined by comparing to the corresponding value of the reference building of Germany's Energy Saving Ordinance; repayment subsidy in % of the maximum loan amount; grant for investment in percentage of a maximum investment of 100,000 € in case of KfW-Efficiency-House, and 50,000 € in case of single measures.

2.II.vi. Information campaigns / complementary policies

The Federal Government financially supports the advice given by energy experts to building owners. The Federal Office for Economic Affairs and Export Control (*BAFA*) supports on-site-advice ("*Vor-Ort-Beratung*") for residential buildings and energy advice for medium-sized enterprises ("*Energieberatung Mittelstand*"). The advice of listed energy efficiency experts can also be financially supported by the *KfW*.

In addition, the "*Verbraucherzentrale*" (publicly supported organisation providing advice to consumers) provides information and Energy-Checks for households.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The requirement to show or hand out the EPC is compulsory at latest when showing a flat or building to the prospective buyer or tenant. In case of non-compliance, a penalty can be issued to the owner of the building by the local authorities named by the regions (normally: building authority). A special German market instrument, the "cease and desist letter" ("*Abmahnung*"), issued by private stakeholder organisations or by competitors, helped to achieve a high level of compliance, especially among estate agents and housing companies.

2.III.ii. Quality Assurance of EPCs

The independent control system works efficiently and allows keeping both efforts and costs as low as possible. It works without general data storage in a central database. A commissioned and authorised body (*"Deutsches Institut für Bautechnik – DIBt"*) holds a central EPC register without generally collecting the contents of the issued EPCs. The register collects data from the assessor concerning the type of EPC issued and the location of the building. Each EPC receives an individual registration number and is part of the random quality checks. The contents of the EPC and additional input data are only collected for EPCs that are drawn as part of the random samples. For the purpose of a later long-time storage in a database, and after all the checks are done, the datasets have to be anonymised to secure data privacy for property owners, which is held in high esteem in Germany.

The first step of plausibility checks is carried out automatically by *DIBt* on behalf of the local authorities. The current Energy Saving Ordinance came into force on 1 May 2014 and introduced the registration of EPCs. So far, 1,146,691 registration numbers were allocated, out of which 56,999 got into the random first step check. The results are communicated to the local authorities (location of the building) and the assessor. Further and more detailed controls (2nd and 3rd level check) are the responsibility of local authorities, as they are also enabled to impose fines in case of breaches of the regulations, e.g., incorrect issuing of EPCs, refusal to issue or to submit an EPC, or deliberately include incorrect information in EPCs. Since the beginning of registration, approximately 6,500 EPC data files have been passed on to the local authorities for 2nd and 3rd level checks.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Concerning the format and content of EPCs, the German legislation does not discern between public and large private buildings visited by the public, and other non-residential buildings. The display form (Figure 3) is provided by the printing tool as an integrated part of every EPC for a non-residential building. Thus, a display form is at hand in case that the display gets compulsory for the building in question in future, or in case that the owner wants to put out a voluntary display. In case that an EPC was issued under former legislation, a new display based on this EPC must mention the applied version of the ordinance.

2.III.iv. Implementation of mandatory advertising requirement – status

The obligation to include an energy performance indicator in advertisements in commercial media was introduced accordingly with the current Energy Saving Ordinance. In order to provide comprehensive information, the advertisements have to state:

- the year of construction of the building;
- the value of consumption or demand of delivered energy;
- the main energy carrier used for heating and domestic hot water;
- the type of EPC (based on calculated or measured consumption) the information was taken from;

and in addition:

- for residential buildings, if applicable, the efficiency class;
- for non-residential buildings, the delivered energy value for electricity.

Because of the extent of the required information, most major newspapers provide a standardised system of abbreviations for their advertisement customers.

The requirement applies to buildings that have an EPC. Since an EPC has to be presented at the time of viewing, the necessary information should be included at least in most advertisements for existing buildings. Non-compliance can be fined with a penalty up to 5,000 €. Professional estate agents are also aware that, in case of non-compliance, they might be sued by competitors or consumer organisations using a procedure which is common in German competition law. The impact of penalties or sued cases on the obliance to publish the EPC data in commercial advertisments has not yet been evaluated.

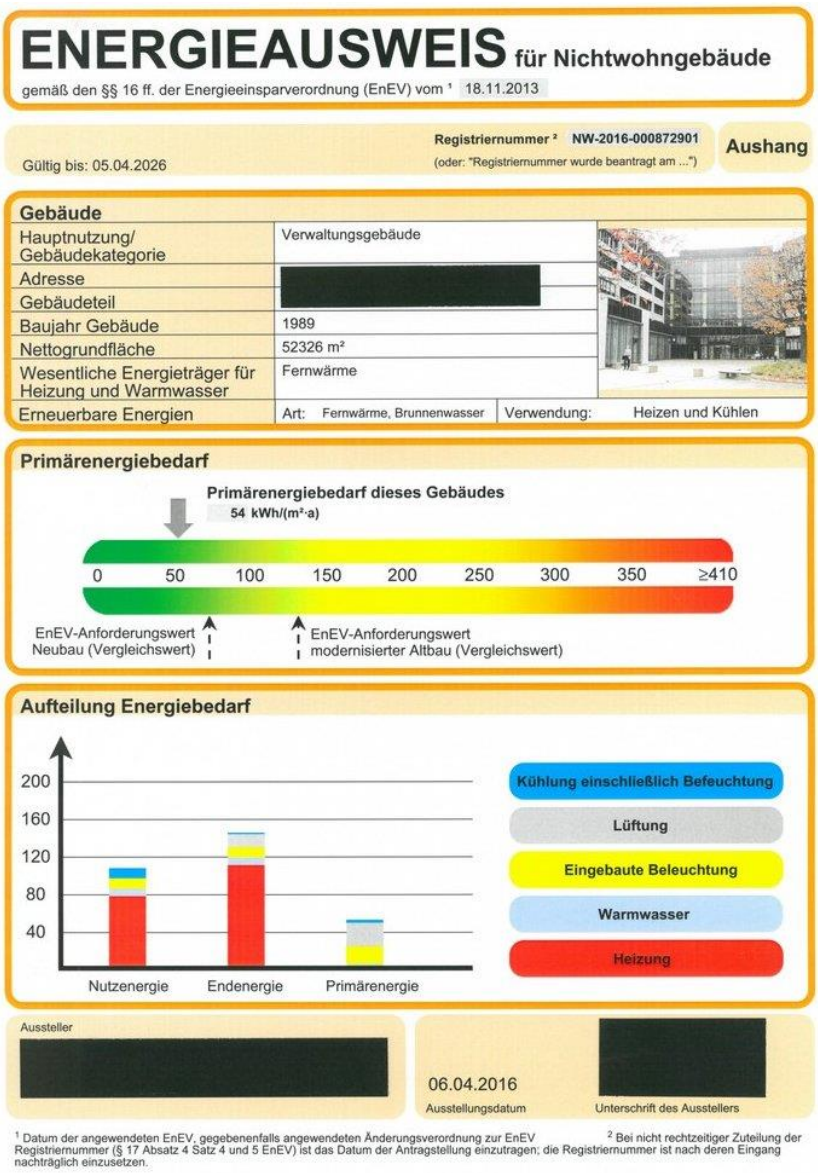


Figure 3. Example of a filled-in display form (anonymised)

2.IV. Inspection requirements – heating systems, air conditioning

Concerning heating systems, Germany has chosen the equivalence approach. This choice was made considering:

- the long tradition of system requirements in Germany (thermostatic valves, pipe insulation, time- and weather-driven controls);
- the compulsory measurement scheme for flue gas losses and pollutants of boilers, established since 1982;
- and the mandatory update requirements concerning the replacement of old boilers and the insulation of heat distribution- and hot water pipework.

Since these measures were already in place when the EPBD was due for transposition, a further inspection scheme was not considered necessary.

On the other hand, due to the climate in Germany, AC systems are not a common feature in buildings. Therefore, a tradition of requirements comparable to those for heating systems does not exist for AC systems. Considering this, a combination of recurrent inspections and compulsory regular maintenance was established in 2007. The provisions in the Energy Saving Ordinance were amended in 2013 to introduce a registration and control system for inspection reports.

2.IV.i. Report on equivalence of model A and B for Heating Systems

The most recent equivalence report according to EPBD Article 14 shows, for the period 2013 (ex-post) and 2014 to 2015 (ex-ante), that the impact of equivalent measures exceeds by far the possible impact of inspections combined with recommendations. The three most effective equivalent measures described and evaluated in the report are:

- the taking out of service of old boilers;
- the recurrent measurement of flue gas losses and several pollutants of boilers combined with compulsory taking out of service in case of non-compliance;
- the funding programmes addressing the replacement of boilers (mainly by systems based on RES) and the improvement of heating systems.

2.IV.ii. Progress and current status on heating systems

Shareholders – a consortium comprising heating component manufacturers and organisations of the relevant trades – have developed a voluntary Heating Control inspection scheme known as "*Heizungs-Check*". This scheme is (in addition to the recurrent measurement of flue gases and pollutants) described in the German National Annex to EN 15378[26]. This annex is currently under revision to fit the 2014 draft of EN 15378.

2.IV.iii. Progress and current status on AC systems

In 2007, a compulsory inspection scheme was introduced for AC systems combined with compulsory maintenance. The combination with regular maintenance allows longer intervals for the inspections, currently 10 years (i.e., twice during normal lifespan).

The Energy Saving Ordinance defines the subject and extent of inspections very close to the wording of the EPBD, but, with respect to the diversity of AC systems, it does not give any details. As guideline for the experts, DIN (Deutsche Industrie Norm) has developed a German specification as National Annex to the current European inspection standard EN 15240[27]. This specification is under revision in order to fit the revised European Standard. The Federal States have issued an official interpretation to clarify the system boundaries for the inspection requirement in certain special cases[28].

The eligibility of experts is defined by the Energy Saving Ordinance and comprises different possible combinations of fields of study in engineering combined with specific minimum practical experience concerning ventilation- and AC systems. Since May 2014, the experts have to obtain a registration number for each inspection report. For this purpose, they need to set up a personal account with the registration authority *DIBt*. As many experts are entitled to do both inspections and certificates, it is not possible to determine how many of the 26,466 registered experts actually perform AC inspections.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

The person or entity in charge of operating an AC system can be fined up to 5,000 €, if the inspection is not commissioned in time or not at all. A person who performs an inspection without being entitled to do so (i.e., without having the required professional education and experience) can be fined with such a penalty, as well. Since the local authorities are in charge of the penalty system, there are no general numbers indicating the activities for Germany as a whole.

Quality control of inspection reports

The control system for inspection reports for AC systems was launched on 1 May 2014. In 2014, 2015 and 2016, a total of 7,880 new inspection reports were registered. The Federal States have established their individual system of authorities or entities in charge of the sample controls. It is their responsibility to define the samples. The registration authority *DIBt* provides the control authorities with the addresses of the experts whose inspection reports are drawn as samples. Since the start of the system, 940 reports were subject of control. As result of a common project, the Federal States have introduced an electronic tool to aid the control process in order to get comprehensive and comparable results. Reports by the Federal States about the results of the sample controls are due every three years, the first being due in March 2017.

Impact assessment

An impact assessment has not yet been performed officially. Proposals for improvement resulting from a private study – commissioned by interested parties – are currently under consideration, e.g., by linking the inspection scheme with the EPC-scheme, it might be possible to improve the compliance and, thus, the impact on energy performance.

3. A success story in EPBD implementation

Involving banks in energy efficiency financing

KfW is Germany's state owned promotional bank and is mandated by law to carry out its promotional activities[29]. *KfW* acts in close cooperation with the Federal Ministry for Economic Affairs.

The objective of the programme "Energy Efficient Construction and Refurbishment" is to provide financing by soft loans and grants for energy efficient construction and refurbishment activities for the German residential sector.

Key principles of promotion

In order to benefit from financial support, it is a precondition that the efficiency standards achieved are better than the requirements set up in the German Energy Savings Ordinance. Individual or combined measures, as well as complete packages seeking to achieve a *KfW* Efficiency House are promoted.

Who are the key people involved?

Customers usually file the application for the promotional loans at the banks or insurance companies of their preference, as *KfW* does not have a branch network (the so called on-lending principle involves financial intermediaries). The application for grants however is processed directly by *KfW*.

The involvement of an energy consultant is mandatory in the process of application for promotional loans or grants. It is the consultant's responsibility to check whether the construction or refurbishment project is properly designed to achieve the targeted efficiency level by using an internet-based tool to compare the technical details of the project with the targeted efficiency level.

What were the key achievements?

The promotional programmes have a proven and very positive impact on climate and economy:

- during the period between 2005 to 2015, the programmes led to a reduction in total of 6.4 million tons CO_2-equivalents per year;
- high volume of investment triggered;
- high number of jobs created or conserved;
- in 2015 alone, 237,000 housing units were refurbished to more energy efficient levels and 142,000 energy efficient housing units were newly built with support of the programmes (roughly every second newly built housing unit in Germany);
- well established programme structure and distribution network;
- benefit for public households.

What were the key lessons learned?

The more transparent and simple the structure of the overall promotional scheme, the more understandable by all parties involved and the easier to distribute.

The mandatory involvement of an energy expert from the beginning of the application process until completion of the construction or refurbishment project is very important to:

- provide confidence to the investor regarding his energy efficiency project;
- assure a high degree of quality and reliability regarding the energy efficiency level reached;
- assure target-oriented use of public funds;
- assure high degree of reliability regarding the promotional effects.

What makes this a good practice example?

The promotional scheme provides a win-win situation to all parties involved:

- customers benefit from very attractive promotional conditions;
- commercial banks benefit from an enhanced product spectrum for their clients which improves cross-selling potential, as well as from additional liquidity without refinancing cost and with an attractive margin;
- public budget benefits from additional income (tax and social security contributions);
- economy benefits from job positions creation particularly in small- and medium-sized enterprises due to the volume of investment triggered;
- environment benefits from high volume of CO_2 savings.

In addition:

- a high number of housing units are reached and a high number of investors are incentivised to invest in energy efficient construction and refurbishment measures;
- the scheme is transparent and attractive for customers (provides a high and increasing level of demand);
- it comprises a standard setting with wide acceptance;
- provides systematic and comprehensive quality control;
- includes the mandatory involvement of energy experts;
- secures the continued development of energy efficiency in society.

4. Conclusions, future plans

Currently, the requirements on energy performance of buildings and the requirements on the minimum percentage of RES used for heating and cooling of buildings are the subject of different legal acts:

- the Energy Saving Ordinance (in pursuit of the Energy Saving Act) regulates the energy performance of new and existing buildings;
- the Renewable Energies Heat Act ("*Erneuerbare-Energien-Wärmegesetz*") sets an obligation to use a minimum percentage of RES to cover the demand of heating, domestic hot water and cooling of new buildings, as well as existing public buildings subject to certain major renovations.

The Federal Government intends to combine these two legal sectors in order to simplify their application. This is foreseen in a new legal act, the "*Gebäudeenergiegesetz*", which also includes the concrete definition of the NZEB-level for public buildings; the current verbal definition does not give details on the required value. If this legal act is accepted by both chambers of the German parliament, it should come into force by the beginning of 2018.

The German calculation method DIN V 18599 was amended in October 2016 and a simplified method for residential buildings will be issued in April 2017. The applicability of these new standards in course of required energy performance calculations depends on the above mentioned legal process, since the current Energy Saving Ordinance refers to the 2011 version of the method. An application of the revised standard is also necessary for better coverage of advanced technologies.

Endnotes

1. Energy Saving Ordinance (*Energieeinsparverordnung*) 2002: www.bbsr-energieeinsparung.de/EnEVPortal/DE/Archiv/EnEV/EnEV2002/2002_node.html

2. Thermal Insulation Ordinance (*Wärmeschutzverordnung*): www.bbsr-energieeinsparung.de/EnEVPortal/DE/Archiv/WaermeschutzV/wschv_node.html

3. Heating Appliance Ordinance (*Heizungsanlagen-Verordnung*): www.bbsr-energieeinsparung.de/EnEVPortal/EN/Archive/HeatingAppliances/heatingappliances_node.html; www.bbsr-energieeinsparung.de/EnEVPortal/DE/Archiv/HeizanlV/heizanlv_node.html

4. DIN V 18599 "Energy efficiency of buildings - Calculation of the net, final and primary energy demand for heating, cooling, ventilation, domestic hot water and lighting"; first edition 2005-07, current version 2016-12. All DIN Standards mentioned in this report – as well as German editions of EN and ISO standards – are available at www.beuth.de/en. A special collection of standards used in course of the EPBD-implementation is available at www.enev-normen.de (German language)

5. Energy Saving Ordinance (*Energieeinsparverordnung*) 2009: www.bbsr-energieeinsparung.de/EnEVPortal/EN/Archive/EnEV/EnEV2009/2009_node.html; www.bbsr-energieeinsparung.de/EnEVPortal/DE/Archiv/EnEV/EnEV2009/2009_node.html

6. *Erneuerbare-Energien-Wärmegesetz* (German only): www.erneuerbare-energien.de/EE/Navigation/DE/Recht-Politik/Das_EEWaermeG/das_eewaermeg.html

7. Energy Saving Ordinance (*Energieeinsparverordnung*) 2013: www.bbsr-energieeinsparung.de/EnEVPortal/EN/EnEV/EnEV2013/EnEV2013_node.html; www.bbsr-energieeinsparung.de/EnEVPortal/DE/EnEV/EnEV2013/EnEV2013_node.html

8. Model building approach (abridged "*EnEV* easy") / *Modellgebäudeverfahren*: www.bbsr-energieeinsparung.de/EnEVPortal/EN/EnEV/NewBuildings/Residential/Residential-node.html; www.bbsr-energieeinsparung.de/EnEVPortal/DE/EnEV/Neubau/Wohngebaeude/Wohngebaeude-node.html

9. www.bbsr-energieeinsparung.de/EnEVPortal/EN/EnEV/EnEV2013/EnEV2013_node.html

10. https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

11. "Erneuerbare-Energien-Wärmegesetz"; more (German language only): www.erneuerbare-energien.de/EE/Navigation/DE/Recht-Politik/Das_EEWaermeG/das_eewaermeg.html

12. "Energieeinsparverordnung"; more: www.bbsr-energieeinsparung.de/EnEVPortal/EN/EnEV/enev_node.html

13. "18599 Gütegemeinschaft"; more (German language only): www.18599siegel.de/

14. Energy Saving Act (*Energieeinsparungsgesetz*) (EnEG): current version with English introduction: www.bbsr-energieeinsparung.de/EnEVPortal/EN/Regulation/EnEG/eneg_node.html; current version with German introduction: www.bbsr-energieeinsparung.de/EnEVPortal/DE/Regelungen/EnEG/eneg_node.html; former versions: www.bbsr-energieeinsparung.de/EnEVPortal/EN/Archive/EnEG/eneg_node.html

15. more about "Efficiency House" levels see section 2. II. v

16. The compactness indicator depends on size and layout of a building. It influences the resulting energy demand value for the individual building via the reference building scheme and has an impact on economic issues of the different possible solutions to fulfil the requirements.

17. The specific heat transmission coefficient (mean value of heat transmission per Kelvin and square meter of building surface) of a new residential building since January 2016 may not exceed the heat transmission coefficient of the reference building (u-values see Table 2).

18. Diefenbach, Nikolaus et al. "*Datenbasis Gebäudebestand*"; more (report in German language, English summary): www.iwu.de/forschung/energie/ongoing-projects/epi-soho/

19. "*Energeeffizienzstrategie Gebäude*"; download English version: www.bmwi.de/Redaktion/EN/Publikationen/energy-efficiency-strategy-buildings.html

20. "*Anreizprogramm Energieeffizienz*"; more (German language only): www.bafa.de/DE/Energie/Heizen_mit_Erneuerbaren_Energien/Anreizprogramm_Energieeffizienz/anreizprogramm_energieeffizienz_node.html

21. "*Marktanreizprogramm*"; more (German language only): www.erneuerbare-energien.de/EE/Navigation/DE/Foerderung/Marktanreizprogramm/marktanreizprogramm.html

22. www.bmwi.de/Redaktion/DE/Downloads/Studien/variantenrechnungen-von-in-diskussion-befindlichen-rollout-strategien.pdf?__blob=publicationFile&v=1 (German language only)

23. More about *KfW* promotional bank: see section 3

24. "*Energieeffizient Sanieren – Kredit*", www.kfw.de/151

25. "*Energieeffizient Sanieren – Investitionszuschuss*", www.kfw.de/430

26. National Annex included in DIN EN 15378: 2008-07 "Heating systems in buildings - Inspection of boilers and heating systems; German version EN 15378:2007", for availability see endnote 4.

27. DIN SPEC 15240: 2013-10 "Ventilation for buildings - Energy performance of buildings - Inspection of air-conditioning systems", for availability see endnote 4.

28. Text of the official interpretation (German language only): www.bbsr-energieeinsparung.de/EnEVPortal/DE/EnEV/Auslegungen/Auslegungen/XIX09raumlufttechnisch.html?nn=738208

29. More about *KfW*'s structure, basis and activities: www.kfw.de/kfw.de-2.html.

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Greece

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.ypeka.gr, www.buildingcert.gr

1. Introduction

The responsibility of the implementation of the EPBD in Greece lies with the Ministry of Environment and Energy (YPEN). The adoption of the Directive 2010/31/EU was approved by the Greek Parliament in February 2013 under Law 4122/2013. From 9 July 2015, Law 4122, among others, reduces the limit of floor area to attain an EPC in public buildings to 250 m^2 (in force since 9 July 2015) and sets control mechanisms for quality control of the issued EPCs and inspection reports.

Law 4342/2015 transposes the EED into national legislation and sets the obligation to renovate 3% of the total floor area of heated and/or cooled public buildings each year to meet at least the minimum energy performance requirements.

New qualifications and training requirements of energy auditors were included in Law 4409 (July 2016) together with the energy auditors' classification into three categories.

Management and quality control is performed by the Departments of Energy Inspection (of Northern and Southern Greece) of the Directorate of Environment, Construction, Energy and Mines Inspections, which are entities within the ministry, established for this purpose.

This report presents an overview of the progress and current status of the EPBD implementation in Greece.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

New buildings or building units must meet minimum energy performance requirements set out in the "Regulation on the Energy Performance of Buildings" (*KENAK*) (class B). In combination with the obligation set in Law 4122/2013, these regulations ensure that every new building of the public sector, from 1 January 2019 should be NZEB. This obligation applies also for all new buildings constructed after 1 January 2021.

At the stage of issuing a building permit for new buildings or building units, there must be additional documentation prepared and submitted to the relevant Building Office Authority. This documentation accompanies the energy study and contains the technical, environmental and economic feasibility of the installation of at least one of the following alternative energy supply systems:

- decentralised energy supply systems based on RES;
- combined heat power (CHP);
- heating or cooling systems in the region or block;
- heat pumps that meet the minimum eco-labelling requirements[1].

For new buildings or building units, it is obligatory, since 2011, to cover part of the hot water needs from solar, thermal or other RES/CHP systems. The minimum percentage of the solar share on an annual basis is set at 60%. Non-application of the above rate requires adequate technical documentation in accordance with current legislation and the prevailing conditions.

A cost-optimal study is under preparation and will determine the minimum energy performance requirements for new buildings or building units so that the maximum energy savings are achieved with the lower cost impact. Part of the study that covers new single-family buildings and multi-family buildings (covering over 75% of the building stock) has been completed, and resulted in a proposal for more strict minimum energy requirements for new buildings. With regard to the tertiary sector, the study is expected to be finished within the first trimester of 2017.

2.I.ii. Format of national transposition and implementation of existing regulations

The study of the cost-optimal levels of minimum energy performance requirements for buildings and building elements (Directive 2010/31/EU, Article 5) is coordinated by a steering committee, formed by the *YPEN*, and consists of experts from the academic and scientific community, assisted by individual thematic working groups.

The steering committee has completed the report for the "single-family" building use and has sent it to the EC in late May 2016, whereas the report for the "multi-family" building use was sent in December 2016. The committee is currently carrying out the study for buildings of the tertiary sector (offices, hotels, educational buildings, hospitals, sports facilities and restaurants) and this last report is expected to be finalised by March 2017.

After the completion of the cost-optimal study for the single-family and multi-family buildings, the committee has proceeded to compare their results with the current minimum energy performance requirements and the *YPEN* has prepared the revision of the *KENAK*. These new requirements are expected to be issued in April 2017. After the completion of the study for the tertiary sector buildings, the committee will decide whether the regulation needs to be revised, and will set new minimum energy performance requirements for the energy use in these types of buildings.

Along with the review of the regulation, the revision of the technical guidelines of the Technical Chamber of Greece (*TOTEE*) is also under way and is related to the upcoming changes for the building components and systems. The guidelines take into account all the existing CEN standards related to the energy performance of buildings.

2.I.iii. Action plan for progression to NZEB for new buildings

The preparation of a national plan for increasing the number of NZEB (according to Directive 2010/31/EU, Article 9) is on-going and is also the responsibility of the steering committee mentioned above. The study for the definition of NZEB will:

- define the technical characteristics of buildings with almost zero-energy consumption, taking into account national, regional or local conditions, and including a numerical indicator of primary energy use in kWh/m^2 year;
- set intermediate targets for improving the energy efficiency of new buildings;
- provide information on the policies and financial or other measures taken to promote NZEB, including details of national requirements and measures concerning the use of energy from RES in new buildings and existing buildings which undergo major renovation.

The study will provide:

- the characteristics of the national building stock;
- the evolution, through time, of the national requirements related to the energy performance of buildings;
- the energy characteristics of the buildings with nearly zero-energy consumption;
- policies and measures to encourage improvements in the energy efficiency of buildings so as to meet the requirement that, from 1 January 2021, all new buildings are to be NZEB;
- policies and measures to transform existing buildings through deep renovation to NZEB.

The study is expected to be ready during 2017 and will have an effect on the transposition of the national legislation according to the new energy requirements for new and existing buildings under energy renovation.

2.I.iv. Requirements for systems and / or building components for new buildings

No further requirements have been issued for systems and/or building components for new buildings since December 2014. According to the final results from the cost-optimal study, new energy performance requirements are expected to be implemented for both the building components and electromechanical systems for heating, cooling and ventilation, taking also into account the Ecodesign Directive (Directive 2009/125/EC).

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

Regarding existing buildings, the definition of major renovation is set in Law 4122/2013, after being amended in Law 4409/2016, Article 49 (A' 136). A renovation is considered as major when the total cost relating to the building envelope or the TBS is higher than 25% of the value of the building, excluding the value of the land upon which the building is situated.

Law 4342/2015 (A' 143), which is the transposition of the EED into national legislation, sets the obligation that, from 1 January 2014, 3% of the total floor area of heated and/or cooled buildings owned and occupied by the central government must be renovated each year so as to meet at least the minimum energy performance requirements. The list of the central government buildings includes 82 buildings with a total area of 309,712 m^2. The refurbishment of these buildings is included in the national structural funds programmes. The *YPEN* has initiated an official communication with all central government organisations, in order to update that list with buildings with a floor area greater than 250 m^2, and to acquire all necessary information. This initiative is currently at the stage of collecting and processing data.

The energy requirements for existing buildings have not been altered since the end of 2014. The energy performance of an existing building that undergoes major renovation should be of an energy class B or better, unless it can be proven, through a technical report, that this is technically, functionally and economically not feasible.

2.II.ii. Plans to improve the existing building stock

The definition of NZEB in existing buildings has been set in Law 4122/2013 and its application will be determined in the national NZEB study, which is currently on-going (see section I.iii). The study also sets the plans to renovate the existing building stock towards NZEB.

The *YPEN* approved, in December 2015, the study[2] of the long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings (according to the provisions of EED, Article 4). The basic goal set out by this study for the year 2050 is that 80% of the existing building stock will be of high-energy performance. Five different scenarios have been examined. These scenarios consist of different mixtures of renovation types and renovation rates. More specifically, four different renovation types have been introduced:

- low renovation that achieves 20% savings;
- medium renovation with 40% savings;
- total renovation with 60% savings;
- NZEB renovation with 80% savings.

The “business as usual” scenario, where no additional measures are taken, shows that, by 2050, only a very small share of renovations will be of the type “total renovation”, while type “NZEB renovations” will be non-existent.

For a transformation of the existing building stock by 2050, it is necessary to foster a mixture of fiscal and economic incentives. Greece must proceed to regulatory framework developments and focus on capacity building and good practices.

Three different phases have been identified in order to reach the aforementioned goal.

The first one, called “initial phase” reaches until 2020. All regulatory aspects necessary for the required mechanisms and structures to be developed must be prepared in this period. Also, awareness on energy efficiency must be raised and economic incentives and pilot projects must be launched.

In the second phase, the so-called “acceleration phase” (period 2020-2040), a further development of technological innovation of products and techniques is foreseen, leading to a gradual cost-reduction of energy efficiency measures and a better understanding of the additional gains of a total renovation.

Finally, in the third phase, the “stability phase” (period 2040-2050), the energy market of building renovation is expected to be mature enough to include mobilisation of investments from the private sector as well (e.g., through Public Private Partnerships).

2.II.iii. Regulation of system performance, distinct from whole building performance

The *KENAK* has set minimum requirements (maximum U-values) for the building elements, as well as for energy losses and gains for the whole building envelope (max. $U_{building}$) and minimum requirements for the efficiency of heating, cooling and hot water production systems. These are set for all building uses, together with lighting requirements for the tertiary sector buildings.

2.II.iv. Encouragement of intelligent metering

Law 4342/2015 foresees that final customers for electricity, natural gas, district heating, district cooling and domestic hot water are provided with competitively priced individual metering devices that accurately reflect the final customer’s actual energy consumption, providing information on actual time of use. Such meters shall be provided whenever an existing meter is replaced or a new connection is made, unless this is technically impossible or not cost-effective in relation to the estimated potential savings in the long term.

In Greece, according to the provisions of Law 4001/2011, the responsible body for the electricity meters is the Hellenic Electricity Distribution Network Operator (HEDNO S.A). HEDNO S.A. has already installed

electronic meters for all medium voltage consumers and around 60,000 meters for low voltage consumers with high consumptions (large consumers). Also, HEDNO S.A has launched an open tender procedure (tender ND207), which, among other things, foresees the installation of 170,000 electronic meters in residential and small commercial buildings, with a total budget of 41 million €. The procedure of the evaluation is still on-going, and is expected to be finalised in 2017.

2.II.v. Financial instruments and incentives for existing buildings

National programmes have been established to facilitate the uptake of energy efficiency measures in buildings.

- The "Energy Savings in Households" ("*Eksikonomisi kat' Oikon"*) programme, was launched by the former Ministry of the Environment, Energy and Climate Change (*YPEKA*), to promote energy retrofit of existing buildings. This programme offers a set of financial incentives for household owners to implement energy efficient technologies that focus on the building envelope, the heating and cooling systems, and DHW systems. The programme was accepting beneficiaries to participate in the relevant energy renovation measures up to the end of 2016 and afterwards closed.

- The national programme "SAVE I" ("*Eksikonomo I"*), addressed to municipalities with over 10,000 inhabitants, provides subsidies for the implementation of energy efficient technologies in buildings owned/used by municipal services. The subsidy provided was up to 70% of the cost of the energy efficiency measures. A total budget of 82 million € was allocated during the first phase of the programme (2009 - 2012). The proposed measures included building envelope measures, equipment for efficient heating, lighting, ventilation, cooling, and control systems. This first phase proved to be successful and was positively accepted by local authorities. The programme was therefore extended and is still on-going.

In order to receive financing in the above mentioned programmes, it is required to issue an EPC before the application for funding, and then a second one after the implementation of the measures are completed in order to verify the energy benefit.

2.II.vi. Information campaigns / complementary policies

Information material on the *KENAK*, the EPC and the energy efficiency of buildings has been produced by the YPEN and is found at the ministry's website http://www.ypeka.gr/Default.aspx?tabid=282&language=el-GR. Additionally, the implementation of the financing scheme "Energy Savings in Households" (see previous section) provides information related to EPCs.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The legal requirement in Greece that each new rental or sale transaction must be accompanied by an EPC still remains[3]. The only change, according to Law 4342/2015, Article 58, paragraph 3, is that, from 9 November 2015, all new rentals must adhere to the unique protocol number of the EPC being inserted into the electronic platform of the General Secretariat of Information Systems of the Ministry of Finance (www.gsis.gr).

Issued EPCs

Until the end of 2016, a total number of 946,700 EPCs have been issued according to the Energy Inspections Department. In 2015 alone, 282,462 EPCs were issued. The number of EPCs according to the reason of issuance is presented in Table 1. The Departments of Energy Inspection have developed a web platform, which provides statistical data of the issued EPCs (http://www.ypeka.gr/Default.aspx?tabid=907&language=el-GR) (Figure 1).

Reason of issuance	Number of EPCs	Total area (m^2)
Sale	135,282	16,522,900.20
Rent	647,999	66,405,197.51
New and renovated building	4,556	1,473,126.44
Existing residential buildings: first energy audit for “Energy Savings in Households” programme	99,374	10,703,829.78
Existing residential buildings: second energy audit for “Energy Savings in Households” programme	47,354	5,135,641.40
Public school buildings: first energy audit	155	230,009.51
Public school buildings: second energy audit	30	64,009.02
Local public buildings programme	2,242	1,608,124.71
Other reason	9,708	4,677,981.50
Total	946,700	106,820,820

Table 1. EPCs according to the reason of issuance.

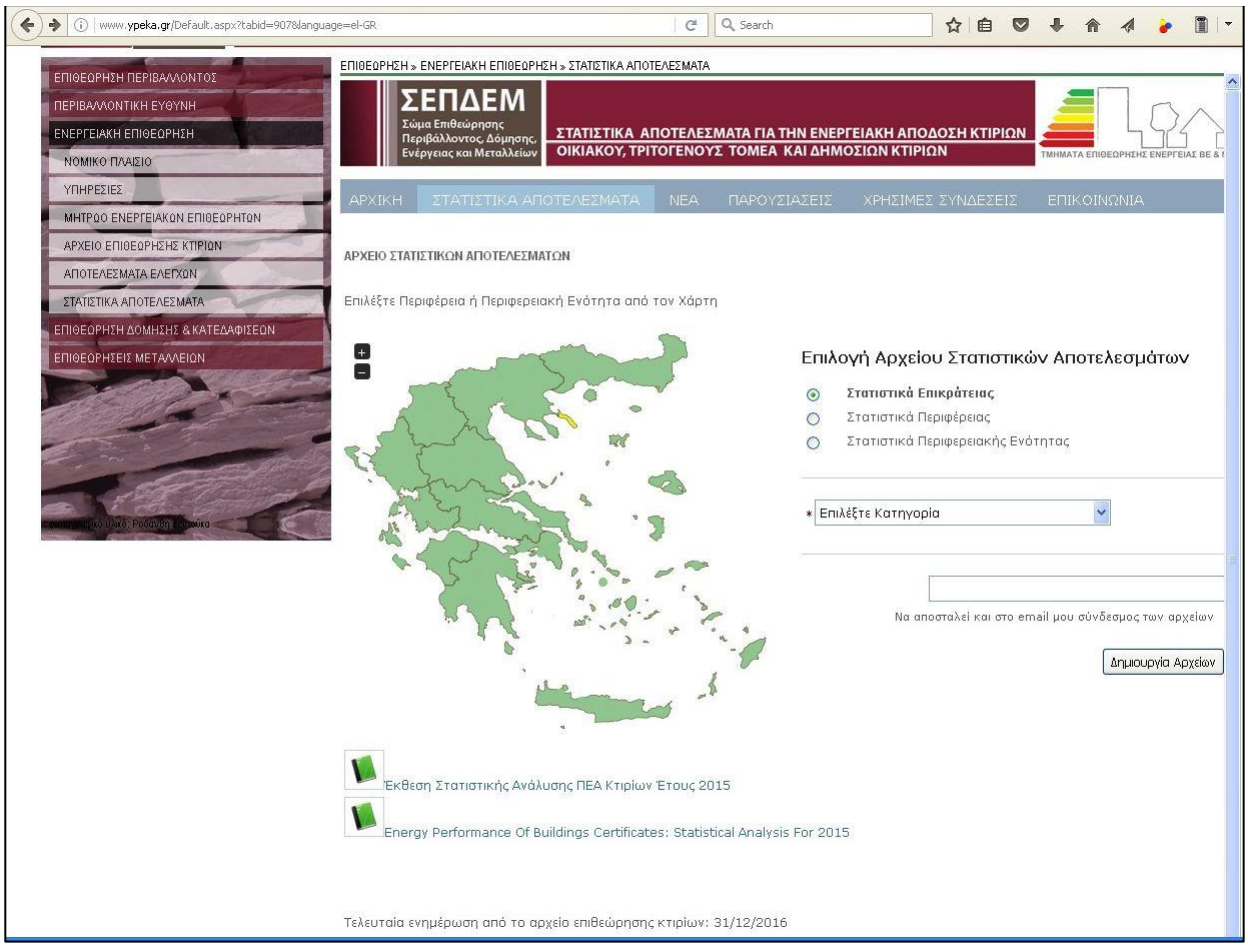


Figure 1. Statistics on EPCs (YPEN web site).

Energy auditors, inspectors' qualifications

The required qualification of energy auditors and their classification in three categories was recently set with Law 4409/2016 (part 3, Article 52), approved by parliament on 28 July 2016. According to this law, the energy auditors are classified in three categories: Class A, Class B and Class C.

Class A: energy auditors/inspectors that belong to Class A can perform audits and inspections for the following categories:

- building audits for buildings or building units with a total area lower than 250 m^2;
- heating systems inspections for heating systems with a heating capacity lower than 50 kW;
- AC system inspections for AC systems with a cooling capacity lower than 50 KW.

Eligible: all auditors/inspectors already registered in the national registry.

Class B: auditors/inspectors in Class B can perform audits and inspections for:

- buildings or building units from 250 m^2 to 1,000 m^2;
- heating systems with a heating capacity from 50 kW to 400 kW;
- AC systems with a cooling capacity from 50 kW to 400 kW.

Eligible: auditors falling under class A who have conducted at least 30 audits of Class A, 20% of which for non-residential buildings with heating systems or AC systems larger than 15 kW.

Class C: auditors in Class C can perform audits and inspections for:

- buildings or building units above 1,000 m^2;
- heating systems with a heating capacity above 400 kW;
- AC systems with a cooling capacity above 400 kW.

Eligible: auditors that have successfully passed the examination foreseen by Presidential Decree 100/2010, in Article 9 or auditors that fall under Class B who have already conducted at least 10 Class B audits.

At the end of 2016, the total number of energy auditors/inspectors registered in the National Registry for Energy Auditors was 16,858. Table 2 classifies them by type of inspections.

Category	Quantity
Building energy auditors	13,635
Inspectors for heating systems	2,589
Inspectors for AC systems	2,012

Table 2. Energy auditors/inspectors by type of inspections.

2.III.ii. Quality Assurance of EPCs

The Departments of Energy Inspection are responsible for carrying out random EPC control checks and checks on specific EPCs after complaints.

The checks include:

a. control of the data inserted in the electronic database used for the EPC calculations;

b. on-site inspection of the building in order to verify the data used for the EPC.

The quality check procedure utilises a tolerance of 5% from the total primary energy consumption of the existing building or a variation of more than one energy class. Penalties to energy auditors are calculated according to a specially developed algorithm from the Departments of Energy Inspection of the *YPEN*, and covers all types of issued penalties (according to Law 4409/2016, Article 56).

The penalties foreseen in case of non-compliance remain the same since 2013 and include fines and temporary or permanent suspension or permanent exclusion of the auditor, depending on the severity of the violation, the consequences, the building floor area and the possibility of reoccurrence. Law 4409/2016 (Article 49, paragraph 4) introduced a new range for the fines, amounting from 200 € to 10,000 €, instead of the previously defined (by Law 4122/2013) range of 1,000 € to 10,000 €.

In the period from 2011 until the end 2015, there were 9,425 EPCs randomly checked, for 88 of which there was an on-site check performed. Additionally, 16,119 EPCs were checked using the database, either for reasons of revocation or for verification in the framework of the programme “Energy Savings in Households”, thus, reaching a total number of 25,544 checked EPCs.

Until the end of 2016, penalties were given to 36 energy auditors (a combination of fines and yearly suspensions).

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

According to the provisions of Law 4122/2013, from 9 July 2015, the requirement that all buildings used by the public sector and visited by the public must ensure an EPC is issued and publicly displayed[4], accounts also for buildings with a total area of 250 m^2 or more. Since no official registry for public buildings exists in Greece, the necessary information on public buildings is difficult to access. In 2014, a list of 82 public buildings, owned by the organisations of the central government, with a total useful floor area over 500 m^2, was prepared. At the moment, the list is extended to all buildings with more than 250 m^2 floor area and the data provided are currently being processed. No controls are foreseen regarding the issuance and public display of EPCs.

2.III.iv. Implementation of mandatory advertising requirement – status

Law 4122/2013 states the mandatory inclusion of EPC energy classes in advertisements for sales or rentals of buildings or building units that already have an EPC. However, since the EPC is only required at the moment of sale or rental and not before, in most cases, for existing buildings, there is still no EPC class reference when the building or flat is advertised. Therefore, many advertisements still do not include information on the energy rating. In the case of newly constructed buildings, where the issuing of the EPC has already been done, the advertisement includes the EPC energy class. No fines are foreseen so far for non-compliance with this requirement.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

It was decided to nationally adopt the inspection scheme (model A) for heating systems. The inspectors for heating systems perform the on-site inspection and prepare a report to assess the system characteristics, operation, size and efficiency. They also provide instructions and recommendations regarding the maintenance/ replacement of the heating system or parts of it, and other alternatives. The inspection reports are submitted on-line to the same platform used for the registration of the EPCs: www.buildingcert.gr. Quality control procedures for heating systems inspection reports are the same as those for EPCs.

2.IV.ii. Progress and current status on heating systems

The official launch of the registry of the heating systems inspection reports was in January 2016. All provisions are covered by the *KENAK* together with the relevant technical guide issued by the Technical Chamber of Greece, which describes in great detail the procedure to inspect boilers and heating systems.

After each inspection, a report is issued, which is provided to the owner, manager or tenant of the building dependent on ownership and use. Screenshots of inspection reports for heating systems are found in Figure 2. The inspection report contains the results of the inspection performed, and includes recommendations for the cost-effective improvement of the energy performance of the system inspected or replaced.

The heating systems should be inspected:

a) at least every five (5) years for boiler systems with a total effective rated output power 20 - 100 kW;

b) at least every two (2) years, for boilers with a total effective rated output > 100 kW and, if they are heated with gas fuel, at least every four (4) years.

By the end of 2016, very few inspection reports for heating systems had been issued.

Έντυπο Ενεργειακής Επιθεώρησης Συστήματος Θέρμανσης

1. Γενικά Στοιχεία Κτιρίου	
Χρήση Κτιρίου:	
	Τμήμα Κτιρίου ☐ **Αριθμός Ιδιοκτησίας:** .....
Όνομα Ιδιοκτήτη:	
ΑΦΜ	
ΚΑΕΚ	
Α.Π. Δήλωσης & Κωδικός Ιδιοκτησίας	
Ιδιοκτησιακό καθεστώς	Δημόσιο ☐ Δημόσιο Ιδιωτικού ενδιαφέροντος ☐ Ιδιωτικό ☐ Ιδιωτικό Δημοσίου ενδιαφέροντος ☐
Ταχυδρομική Διεύθυνση:	
Στοιχεία επικοινωνίας υπευθύνου:	Ιδιοκτήτης ☐ Διαχειριστής ☐ Ενοικιαστής ☐ Τεχνικός υπεύθυνος ☐
Ονοματεπώνυμο:	
Τηλέφωνο / Fax:	
Ηλεκτρονικό Ταχυδρομείο:	
Οικοδομική άδεια: **Πολεοδομικό γραφείο:** **Έτος:** **Αριθμός:**	
Έτος ολοκλήρωσης κατασκευής:	

2. Γενικά Χαρακτηριστικά Κτιρίου & Εγκατάστασης				
Αριθμός κτιρίου: _____ *(σε περίπτωση συγκροτήματος κτιρίων)*				
Έτος λειτουργίας:	.....	.....	.....	
Περίοδος λειτουργίας:	**Ημερήσιο πρόγραμμα (h/ημέρα):**		.....	
	Εβδομαδιαίο πρόγραμμα (h/εβδομάδα):		.....	
	Ετήσιο πρόγραμμα: από ..... μήνα έως ..... μήνα			
Συνολική επιφάνεια (m^2):		**Ύψος (m):**		
Συνολικός όγκος (m^3):				
Θερμαινόμενη επιφάνεια (m^2):		**Όγκος θερμαινόμενων χώρων (m^3):**		
Εξωτερικές συνθήκες σχεδιασμού **Θερμοκρασία (°C):** _____ **Σχετική Υγρασία (%):** _____				
Διάγνωση υφιστάμενης κατάστασης θερμομόνωσης των δομικών στοιχείων :		Ανεπαρκής	Μερικώς μονωμένα	Επαρκής
	Οροφή/Δώμα:	☐	☐	☐
	Εξωτερική Τοιχοποιία:	☐	☐	☐
	Φέρον οργανισμός:	☐	☐	☐
	Δάπεδο pilotis:	☐	☐	☐
	Δάπεδο επί εδάφους:	☐	☐	☐
	Δάπεδο επί μη θερμαινόμενου χώρου:	☐	☐	☐
	Κουφώματα:	☐	☐	☐
Αλλαγή χρήσης:	Μερική ☐ Ολική ☐ Περιγραφή: _____			
Αριθμός συστημάτων :				

7. Διάγνωση Υφιστάμενης Κατάστασης Λέβητα / Καυστήρα *(για κάθε μονάδα)*		
Διαθέσιμα Στοιχεία στο Ημερολόγιο Λεβητοστασίου	Οδηγίες Λειτουργίας & Συντήρησης Λέβητα & Καυστήρα	☐
	Αρχείο Φύλλων Συντήρησης – Ρύθμισης Λειτουργίας	☐
	Θεωρημένο Βιβλίο Καταγραφής Μετρήσεων	☐
	Κατασκευαστικά Σχέδια Εγκατάστασης	☐
	Τιμολόγια καυσίμου	☐
Χωροθέτηση λεβητοστάσιου - λέβητα	Θέση λεβητοστασίου σε Εσωτερικό χώρο Εξωτερικό χώρο	 ☐ ☐
	Ευκολία πρόσβασης στο λεβητοστάσιο	☐
	Ευκολία στη συντήρηση – επισκευή λέβητα	☐
Οπτική Επιθεώρηση:	Διαρροή καυσαερίων	☐
	Διαρροή καυσίμου	☐
	Διαρροή νερού / ατμού / λαδιού / αέρα	☐
	Επαρκής θερμομόνωση λέβητα	☐
	Θερμομόνωση καπναγωγού χωρίς φθορές	☐
	Θερμομόνωση καπνοδόχου χωρίς φθορές	☐
	Κατάσταση λειτουργίας καπναγωγού & καπνοδόχου	☐
	Υγροποιήσεις στην καπνοδόχο	☐
	Καπνοθυρίδα καθαρισμού σε λειτουργία	☐
	Ξεχωριστή αποχέτευση συμπυκνωμάτων (αν απαιτείται)	☐
	Επαρκής αερισμός λεβητοστασίου	☐
Διαθέσιμο δίκτυο ΦΑ		☐

8. Τεχνικά Χαρακτηριστικά Λέβητα / Καυστήρα *(για κάθε μονάδα)*		
α/α Μονάδας: _____ _____		
Τελική Χρήση:	Θέρμανση χώρων ☐	
	Θέρμανση χώρων & Ζ.Ν.Χ. ☐	
	Ζεστό Νερό Χρήσης (Ζ.Ν.Χ.) ☐	
Τεχνικά Χαρακτηριστικά Λέβητα		
Εταιρεία Κατασκευής **Τύπος (Μοντέλο)** **Σειριακός Αριθμός**	_____ _____ _____	**Έτος Κατασκευής: _____ _____** **Έτος Εγκατάστασης: _____**
Ονομαστική Ισχύς:	_____ (kW) _____ (kcal/h)	
Ενεργειακή απόδοση (ΠΔ 335/93):	Αριθμός αστεριών:	Δεν υπάρχει σήμανση ☐
Σήμανση CE:	☐	
Λέβητας συμπύκνωσης :	☐ Περιγραφή: _____	
Είδος λέβητα :	Χαλύβδινος ☐ Μαντεμένιος ☐ Άλλο ☐	
Επιτρεπόμενη πίεση :	Λειτουργίας: 4 bar ☐ 6 Bar ☐ Άλλο _____ ☐	Αντοχής: 6 bar ☐ 8 Bar ☐ Άλλο _____ ☐
Καύσιμο σχεδιασμού:	Πετρέλαιο ☐ Φυσικό αέριο ☐ LPG ☐ Άλλο _____ ☐	
Θερμικό Μέσο	Νερό ☐ Ατμός ☐ Λάδι ☐ Αέρας ☐	
Τεχνικά Χαρακτηριστικά Καυστήρα		
Εταιρεία Κατασκευής **Τύπος (Μοντέλο)** **Σειριακός Αριθμός**	_____ _____ _____	**Έτος Κατασκευής: _____** **Έτος Εγκατάστασης:_____**
Καυστήρας ενσωματωμένος στον Λέβητα:	☐	
Ισχύς:	Μέγιστη ..... (kW) Ελάχιστη ..... (kW)	
Καύσιμο λειτουργίας:	Πετρέλαιο ☐ Φυσικό αέριο ☐ LPG ☐ Άλλο ☐	

Figures 2a, b, c. Heating system inspection report format.

2.IV.iii. Progress and current status on AC systems

Similarly to the heating systems, the official launch of the registry of the AC systems inspection reports was in January 2016. The information supplied for the heating systems inspection is also applied for the AC inspection procedure.

The AC systems should be inspected at least every five (5) years if their total capacity exceeds 12 kW.

Again, by the end of 2016, very few inspection reports for AC systems had been issued.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

The control and monitoring of the process, and the quality of inspection reports on heating and AC systems, fall under the jurisdiction of the Directorate of Environment, Construction, Energy and Mines Inspections of the *YPEN*. The Directorate is also the authority responsible for controlling the performance of the functions of the energy inspectors, and the compliance and application of the related provisions.

Checks are performed automatically and are randomly sampled at a rate of at least 5%, or after complaints of an inspection report. They consist of:

- checking the validity and accuracy of input data submitted by an electronic data form file on the archive of inspection reports, including recommendations;
- on-site inspection of the building to verify the correctness of the inspection reports.

Energy inspectors, and the owners, managers or tenants of buildings must provide all necessary information, access to the building and its facilities, and any other possible assistance for carrying out the inspections, otherwise they shall receive a fine (Law 4122/2013, Article 20).

By the end of 2016, no penalties were issued regarding the inspection reports, and no statistics are available.

Quality control of inspection reports

The Departments of Energy Inspection of Northern and Southern Greece are responsible for the operation of the inspection scheme and the quality control of inspection reports. However, since the official launch of the inspection scheme (at the beginning of 2016), a very small number of inspection reports have been registered, and, as a result, no quality control checks have been carried out yet.

Impact assessment, costs and benefits

Regarding the impact assessment of the heating and AC system inspections, since very few data exist after the scheme was put into operation, no study on the impact has been performed so far. Additionally, no studies are available related to the cost and benefit of the operation of the scheme.

3. A success story in EPBD implementation

A very successful programme for energy renovation measures in the residential sector is the “Energy Savings in Households” (Figure 3). It is a national programme that offers financial support, coming from structural and national funds, for interventions in the building envelope, the heating/cooling systems, and the installation of RES for DHW production.

When first launched in 2011, the programme provided subsidies ranging from 15% to 70 %, while the remaining investment was provided in the form of zero-interest loans. The maximum eligible measures (inclusive VAT) should not exceed 15,000 €. Due to its large acceptance rate, the programme lasted until the end of 2016.

The programme includes buildings, which have a building permit and which are:

- located in areas with an average zone price lower than or equal to 2,100 €/m^2;
- are of residential use;
- their owners meet specific income-related criteria;
- are classified as low energy efficiency buildings.

The programme offers incentives for citizens to carry out the most important interventions, aimed at improving their houses’ energy efficiency, while at the same time contributing to the achievement of Greece’s energy and environmental targets; once completed, the programme will contribute energy savings up to 1 billion kWh/year.

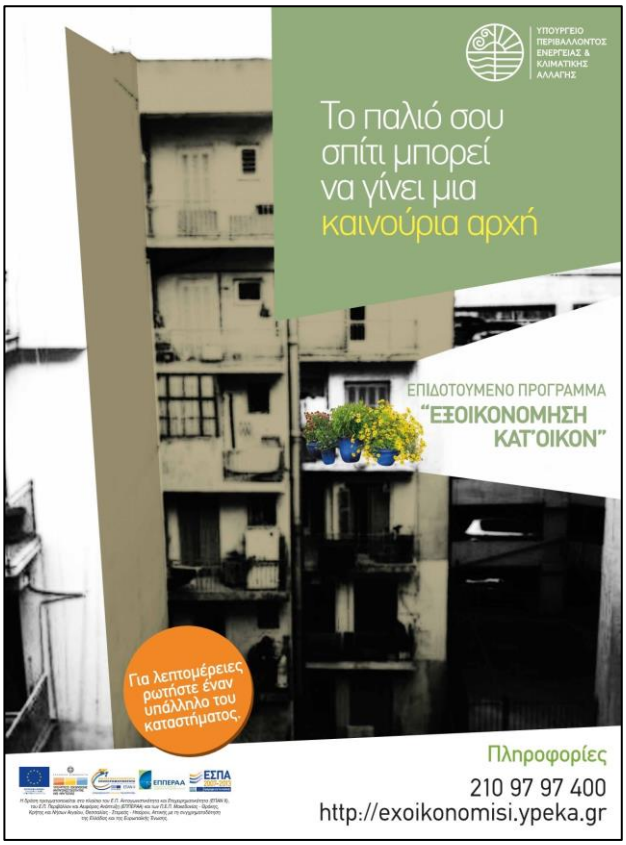


Figure 3. "Energy Savings in Households" programme brochure.

The main supported actions/measures include:

- building envelope (including thermal insulation, windows & glazing, exterior wall, doors, ceiling, etc.);
- equipment (including efficient heating, efficient lighting systems, ventilation, cooling, control systems, etc.);
- energy audits, consultancy costs, labour costs, education and training activities, etc.

Eligible for participation in the programme are only natural persons who have the right of (full or bare) ownership, or usufruct to an eligible residence and meet the income-related criteria set.

The programme's goal is to result in:

- energy savings (approximately 1 billion kWh/year);
- public awareness concerning the rational use of energy and environmental protection;
- improving the living conditions in buildings, cities and the urban environment;
- mobilising market forces towards developing sustainable communities.

The initial budget of the programme outlined by the state was 396 million € coming from structural and national funds, where 241 million € were revolving funds. The programme was based on a collaboration between major banks and the former YPEKA ministry. At the end of 2015 the actual budget of the programme was 385 million € and the banks provided another 130 million €, leading to a total actual budget of about 0.52 billion €.

Until December 2015**,** over 200,000 applications have been submitted to the banks and about 50% of them have received an initial approval for a loan. Out of them, 50,041 applications received the final programme approval and 35,185 applications were pending. Finally, 45,403 applications out of the 50,041 approved applications proceeded to the implementation phase (the owners of the remaining applications decided not to proceed for various reasons).

During 2016, the *YPEN*, in cooperation with all stakeholders, has taken the necessary steps to ensure national resources from unused allowances of greenhouse gas emissions, and proceeded in financing about 8,500 applications of the 35,185 pending applications, with a total budget of 85 million €.

Regarding the interventions, the most preferable measures were the replacement of windows (83%), followed by the upgrade of the heating system and domestic hot water production (71%), and the position of thermal insulation on the building envelope (54%). The achieved energy savings (based on the completed 45,403 projects) amount 753.91 GWh per year of primary energy according to the calculations performed from the issued EPCs before and after the intervention.

4. Conclusions, future plans

A national registry system for issuing EPCs and heating and AC systems inspection reports is fully operational. The system is centrally operated by the *YPEN*. Quality control of EPCs and inspection reports is performed in two stages: in the first stage through calculation of the EPC and checks on the inspection reports data provided from the national database, and in the second stage through on-site visits and new collection/check of data/inputs.

All energy auditors and inspectors are qualified engineers who, according to their ability and experience, are classified in three categories. Generally, the level of knowledge of the auditors/inspectors is high.

The use of EPCs has been fully implemented in the building market and its existence in building transactions is obligatory. The uptake of EPC recommendations is a challenge, which is currently being addressed on a state level through financial incentives, information campaigns, and with national and European programmes.

The full implementation of the energy inspections of heating and AC systems started in January 2016. However, until the end of 2016, very few inspection reports have been issued, which, in turn, caused delays in the implementation and control of energy efficiency measures for these systems.

The transposition law related to Directive 2010/31/EU (Law 4122/2013) has been modified with issues regarding the energy auditors' qualifications, fines, and the operation of the control authorities, while the EED was officially adopted in November 2015 by Law 4342/2015.

The outcome of the cost-optimal study for new and existing buildings in Greece is in the last stage of development and its results are expected to lead to new minimum requirements for the new buildings. The full study is expected to be ready in the first trimester of 2017. Additionally, the revision of the current building energy regulation is almost finalised and should be officially published by April 2017. Finally, the study for the definition of NZEB, their technical characteristics and the policies adopted to increase their number is currently on-going and should be available in 2017.

Endnotes

1. Established by decision 2007/742/EC of the European Commission of November 9, 2007, as amended.
2. www.ypeka.gr/LinkClick.aspx?fileticket=XLqxHeSJDdA%3d&tabid=282&language=el-GR
3. Since 2013, Law 4122, Article 12.
4. The EPC needs to be issued by an approved energy auditor.

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Hungary

Status in December 2016

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1. Introduction

In Hungary, most of the articles of the EPBD (Directive 2010/31/EU) were implemented between 2012 and 2015. For buildings that receive public funding, the energy performance requirements were upgraded to the cost-optimal level at the beginning of 2015. The cost-optimal requirements will be introduced as mandatory requirements in 2018, whereas NZEB requirements will come into force in 2019 for buildings used by authorities, and in 2021 for all new buildings, respectively.

Due to a change in administration, the EPBD transposition became the responsibility of the Prime Minister's Office. The office updated the national rulebook in 2015 introducing significant changes. The new version is in force since the beginning of 2016. It has introduced new category bands of labelling and, thus, all existing EPCs have been reclassified. Further, it gives an exact definition of the NZEB requirements with an impact on the EPCs issued since 2016.

The National Building Energy Strategy adopted in 2015 envisages very ambitious renovation goals until 2020 and, in particular, an exemplary role for public buildings. Hungary has adopted alternative measures for inspection of heating and AC systems. Support programmes have rather focused on public buildings, except for the non-refundable funds of the "*Warmth of Home Programme"* focusing on reconstruction of residential buildings (approximately 10 billion HUF per year since 2015 by the Ministry of National Development In the near future (mid 2017) the "*GINOP*[1] *8"* programme shall provide refundable funds for the retrofit of the residential stock with a budget of more than 100 billion HUF provided by the Ministry of National Development[2]. Information campaigns have been carried out with special attention to cost-optimal renovation solutions.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The first ministerial order to transpose Directive 2002/91/EC (7/2006. (V. 24) Decree about Determination of Energy Efficiency of Buildings) was issued in May 2006 and has been in force since 1 September 2006, although the decree has been modified several times. New cost-optimal requirements had to be applied from the beginning of 2015 for buildings supported by public funds and for any construction projects financed by the state budget. The same requirements will be generally introduced for all new buildings (with exceptions allowed by the EPBD) and those undergoing major renovations with a commissioning date of 2018 (or later). The fulfilment of the cost-optimal level requirements is the precondition of any subsidy.

Requirements of NZEB, defined by the rulebook since 2016, are to be widely introduced in 2019 for public buildings and in 2021 for all new buildings. The NZEB threshold of the specific primary energy consumption for residential buildings is 100 kWh/m^2.year; in case of installed air-conditioning it rises to 110 kWh/m^2.year.

2.I.ii. Format of national transposition and implementation of existing regulations

The requirement system has three facets, as far as new buildings and major renovations are concerned. Maximum permitted U-values are set for elements, as well as the specific heat loss coefficient (W/m^3.K) that is a function of the surface to volume ratio. The losses from thermal bridges (using either the simplified or the detailed procedure), passive solar gains and the effects of shading devices are also considered. Finally, the specific yearly primary energy must not exceed the set limit depending on the type and use of the building. In Table 1 maximum permitted values are given for a few typical uses (residential, school, office), whilst in the case of mixed use, comparison with a reference building is to be used[3]. The requirement of the specific yearly primary energy need for NZEB will not depend on the surface to volume ratio any more, only on the building function.

Function of the building	Ep, Specific yearly primary energy need (kWh/m^2.year)
Residential (without lighting)	100
Office (including lighting)	90*
Educational (including lighting)	85

* If mechanical cooling is applied, additional 10 kWh/m^2.year can be counted.

Table 1. The maximum values of the yearly Ep's as function of the building.

The primary energy needs include: heating, domestic hot water, cooling, ventilation, and for non-residential buildings also lighting needs. Airtightness measurements are not required, but the quality of

windows is examined visually by experts on-site and the estimated infiltration is taken into account in the calculation. For new buildings and major renovations, thermal comfort and minimum requirements on fresh air supply are set, but these values are not included in the calculation procedure for certification. The calculation procedure refers to several European standards. NZEB level requirements are presented below in detail and the method of calculations is the following:

- At least 25% of the energy need of the building should be covered from RES, that is, compared to the calculated value of the specific yearly primary energy need. The "*renewable share*" is defined as the quotient of renewable/non-renewable energy. During the calculation of the value of the energy need, the renewable primary energy need is not taken into account. Even if the specific primary energy consumption is less (e.g., half) than the threshold value, the building is not approved as NZEB unless the above 25% is fulfilled, which leads to extra measures in order to further decrease the non-renewable energy consumption; the utilised passive solar gain is to be taken into account while calculating the "*renewable share*" (this can lead to double counting).

- Regarding the primary energy factors, some cases are defined on national level for district heating. If the level of co-generation is at least 50% and the source of heat is gas, coal, oil, nuclear, other renewable, non-biomass waste, then e=0.83; under 50% co-generation e=1.26.

- If the level of co-generation is at least 50% but the source of heat is biomass, wood pellets, agricultural pellets, biogas, other renewable, landfill gas or sewage sludge, then the primary energy factor is e=0.5, under 50% co-generation e=0.76. For off-peak grid electricity the primary energy factor is e=1.8. In case of heat pumps, the primary energy conversion factor of electric energy is excluded from the calculation of the renewable energy share. Unless it is based exclusively on biomass, the energy from district heating is not counted as renewable unless: a) there are other renewable sources, too, and b) the systems are typically bivalent, combining renewable and non-renewable sources (the precise data of most of the Hungarian systems are available, e.g., for 13 systems only in Budapest); for the calculation of the renewable share the following RES factors should be used: e_{RES}=0.1 if the national electric grid is used; moreover e_{RES}=1 if firewood, biomass, biogas, pellets or agripellets as well as solar, wind, water, geothermal, hydrothermal energies are used (Table 2).

For NZEB, detailed calculation or dynamic simulation is compulsory – these match the already available CEN standards.

The most detailed and comprehensive technical guidance document for energy experts is the book "*Building Energetics*"[4]. This book is a step-by-step guide for professionals including legislative background, the calculation process of the asset method, the certification process and an analysis of existing buildings. A new up-to-date version of the book will be published in early 2017. In addition, the Prime Minister's Office publishes technical guidance documents[5] (Figure 1).

Mains gas	LPG	Oil - general	Diesel or heating oil	Fuel oil	Coal - general	Biomass - general	Wood - general	Wood pellets	Grid Electricity	District heating - general
1		1	1	1	1	0.6	0.6	0.6	2.5	1.26

Table 2. The primary energy factors in Hungary.

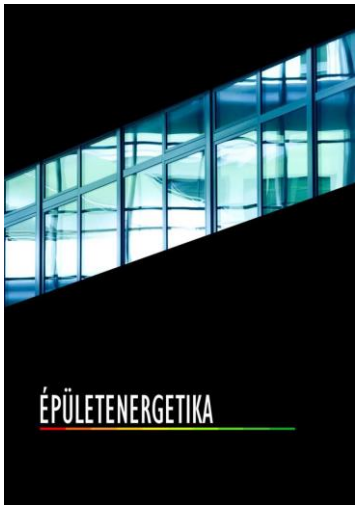


Figure 1. Cover of the book "Building Energetics" (Zöld, A. and others, ISBN: 978-963-7298-31-8).

2.I.iii. Action plan for progression to NZEB for new buildings

Since 2016, new energy labels have been introduced in the certification scheme: "*BB*" means NZEB, and there are three even more ambitious levels. The NZEB requirements will become obligatory after 2018 and 2019 as prescribed by the EPBD.

The national plan on NZEB was adopted in 2015 by the Prime Minister's Office. It contains the NZEB requirements that were later transposed by the national rulebook on the energy efficiency of buildings (Decree 7/2006). It envisages initiatives on the improvement of energy efficiency of the existing building stock, but also on renewable energy systems that can be applied in new buildings. Since 1 January 2017, a new support system for the use of renewables is valid in Hungary, which is called "*Renewable support system*" (*METÁR*[6]). It is a new support system for the produced electricity in Hungary. By using this system, Hungary should fulfil the previously undertaken 14,65%[7] renewable share. The possible applications of the use of renewables will be supported by public funds, and new subsidy programmes will be available.

There are no reliable statistics available on the number of existing NZEB. According to the Hungarian Passive House Association, there are approximately 100 to 300 existing NZEB. Most of them are single-family houses or public buildings, which have been renovated with the support of the Environmental and Energy Efficiency Operative Programme. As an example, a new NZEB kindergarten is presented, called "Fabulous Passive House Kindergarten" ("*Meséskert Passzív ház óvoda*")[8], located in Budapest.

In the framework of the Environmental and Energy Operative Programme of the Hungarian Government and the European Union, a NZEB was built in the Kassai Campus of the University of Debrecen[9] (Figure 2). This building, with a 300 m^2 floor area, was built in 2013, both for education purposes and for demonstration of the use of RES. The total (overall) cost was 35,000 €. The design U-values are 0.16, 1.1, 0.15 and 0.22 $W/m^2.K$ for walls, doors and windows, roofs and ceilings, respectively. Heat is delivered by a combination of district heating, a heat pump and solar collectors. In summer, unused solar energy is supplied back to the district heating network. The performance goes beyond the NZEB requirements (it is AA++) and about 30% of RES use was measured.



Figure 2. Sustainable Building Energy Information Centre, University of Debrecen.

Focusing only on the NZEB requirements, the structure of the regulation is the following:

1. Elements. The maximum U values of walls, windows, etc. are defined. In addition, there are requirements on balancing, control, pumps, airtightness of ventilation ducts, but these requirements are not ambitious. Directive 2009/125/EC on EcoDesign requirements for energy-related products (ErP directive)[10] has a more significant impact on technical building systems.

2. Building envelope. Maximum limits for the specific heating output ($W/m^3.K$) are set, depending on the surface to volume ratio. This output takes into account the transmission losses, the passive solar gains (through which indirectly the effect of thermal mass), thus data depending only on the building itself. For heavy buildings, the NZEB requirement is the same as the cost-optimal level, for light buildings, NZEB is more ambitious.

3. Thresholds for the specific yearly primary energy consumption are set (Table 3, Figures 3 & 4).

4. Minimum of "*renewable share*" is set to 25%.

Building element	2016 general requirement	foreseen requirements in 2015, 2018, 2019, 2021
Exposed wall	0.45	0.24
Flat roof	0.25	0.17
Attic floor slab	0.30	0.17
Floor slab over basement	0.50	0.26
Window, non-metal frame	1.60	1.15
Window, metal frame	2.00	1.40
Entrance door	3.00	1.45
Glazing	-	1.00

Table 3. Maximum U values (W/m².K) of building elements of 2016, cost-optimal and NZEB levels.

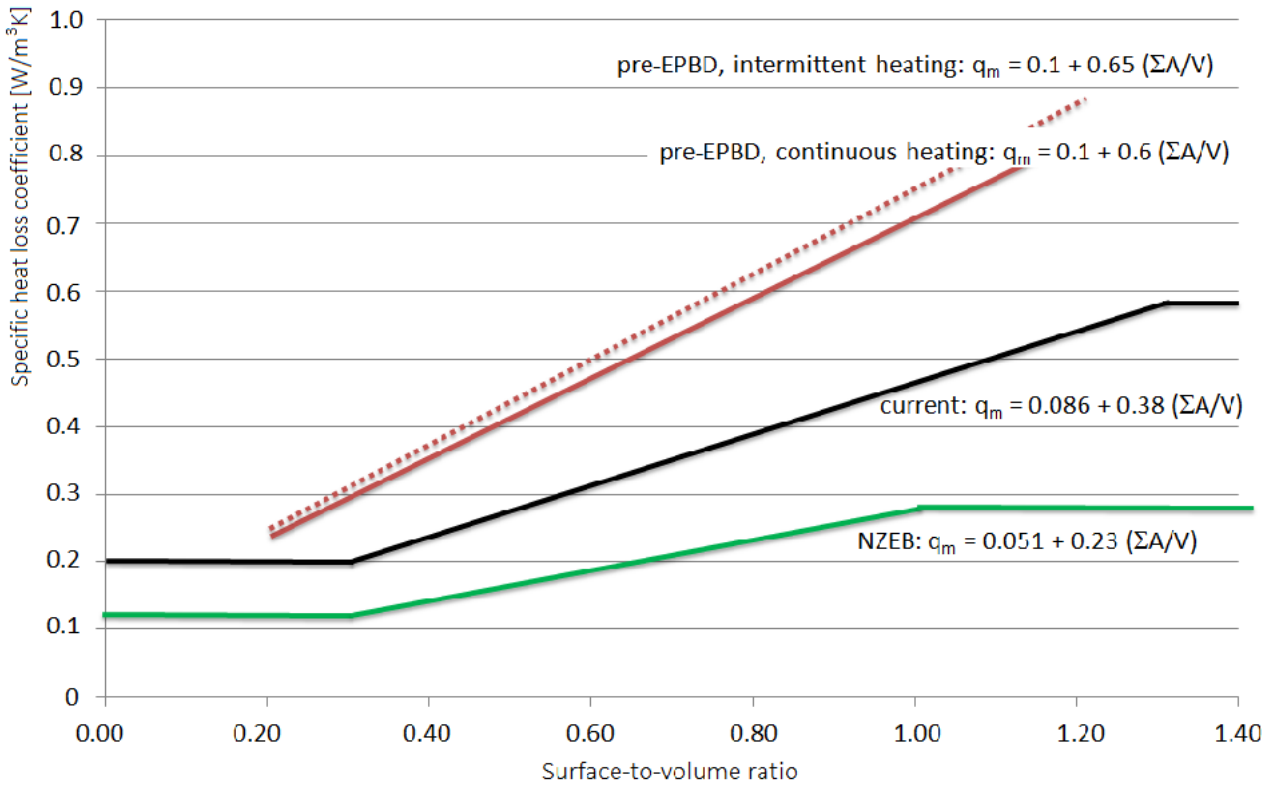


Figure 3. The specific heat loss coefficient [W/m³.K] before (pre-EPBD) and after 2006 (in force until the end of 2017) and the cost-optimal requirements that were introduced in 2015 for buildings receiving public funding. It will apply to all buildings in 2018.The foreseen NZEB requirements for the specific heat loss coefficient is identical to the cost-optimal requirement except for light buildings.



Figure 4. The 2006-2014 and 2018 (in some cases 2015) cost-optimal requirements for the specific yearly primary energy need. The NZEB requirements will be 100 kWh/m^2.year for residential, 90 kWh/m^2.year for office and 85 kWh/m^2.year for educational buildings (not indicated on the diagram).

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

Since 2006, major renovations have to follow the same requirements as for new buildings. Other renovations are regulated since 2013 and only requirements for individual elements have to be fulfilled (both envelope and technical building elements). From 2016, major building extensions are considered as new buildings and all requirements are relevant, but in case of minor extensions only requirements for individual elements are defined. After 2018, cost-optimal requirements shall be obligatory for both renovations and extensions. NZEB requirements are not planned to become mandatory for retrofits.

2.II.ii. Plans to improve the existing building stock

Renovation targets are set in the National Building Energy Strategy for the period 2015-2020 with an outlook to 2030. In total, a target on 49 PJ/year primary energy savings is set for 2020; from that, 40 PJ/year comes from the residential, 4 PJ/year from the public and 5 PJ/year from the tertiary sector. By 2030, the target is set to 111 PJ/year.

Current policies focus mostly on cost-optimal levels rather than on NZEB. Although NZEB requirements shall apply only to new buildings, the support of the use of RES is prioritised in practice.

The implementation of the EED Articles 4 and 5 are laid down in Law 2015/LVII on energy efficiency. Three percent (3%) of the total floor area of heated and/or cooled buildings owned and occupied by the central government are to be renovated each year.

Approximately 15,000 m^2 of floor area have to be retrofitted annually, which is equivalent to 3-5 buildings according to cost-optimal requirements. The list of the selected buildings is published on the website of the Ministry of National Development and the necessary budget is already allocated by a governmental decree.

2.II.iii. Regulation of system performance, distinct from whole building performance

The regulations include requirements on technical building systems elements (e.g., on balancing, control, pumps, airtightness of ventilation ducts). The rulebook does not set any direct system performance requirements; only the upper threshold of the total primary energy consumption of the building is defined.

The requirements of the ErP directive on gas boilers, water tanks, heat pumps, pumps, ventilations systems, etc., have a much more significant impact on the construction sector than element requirements set in the rulebook.

2.II.iv. Encouragement of intelligent metering

In the frame of a demonstration project[11], more than 60,000 smart meters are being installed in Budapest and 5 other cities in Hungary. This is carried out by the *KOM Központi Okos Mérés Ltd*[12] project company in cooperation with several energy service provider companies. Within the project, software and mobile apps shall be developed so that end users can monitor their water, gas, heat and electricity consumption. The project budget is 21 million € and is financed from the CO_2 quota incomes.

2.II.v. Financial instruments and incentives for existing buildings

In Hungary, there are different subsidy programmes for supporting the energy efficient refurbishment of buildings. The *KEHOP*[13] programme focuses on public buildings mostly, with 100% subsidy of costs. The *GINOP*[14]*/VEKOP*[15] programme supports energy efficiency and renewable energy systems of buildings used by SMEs (the budget is approximately 300 million €). A residential retrofit programme is under preparation providing loans with 0% interest rate with a budget of approximately 400 million €. A bottleneck is that programmes are mainly ad-hoc, often restructured, and funds run out quickly.

2.II.vi. Information campaigns / complementary policies

The Ministry for National Development has adopted the *Action Plan to Improve Awareness for Energy Efficiency and Climate Protection in 2015*. It sets communication and education actions as well as monitoring mechanisms to control the implementation of the action plan. The plan envisages several opportunities to submit applications for the implementation of awareness-raising programmes to be co-financed by the EU, which are also able to contribute to numerous programmes to encourage the reduction of energy consumption.

To mention an example, within the frame of a *TÁMOP*[16] research project (*Sustainable Energy with Optimal Integration of the Renewable Sources*) the University of Debrecen was supported with approximately 1.6 million € from EU funds (Figure 5). As a result of the project, more than 100 articles and notes have been published on different fields related to RES (e.g., energy efficiency in buildings, environmental, climatic and legal aspects, cost-optimality).

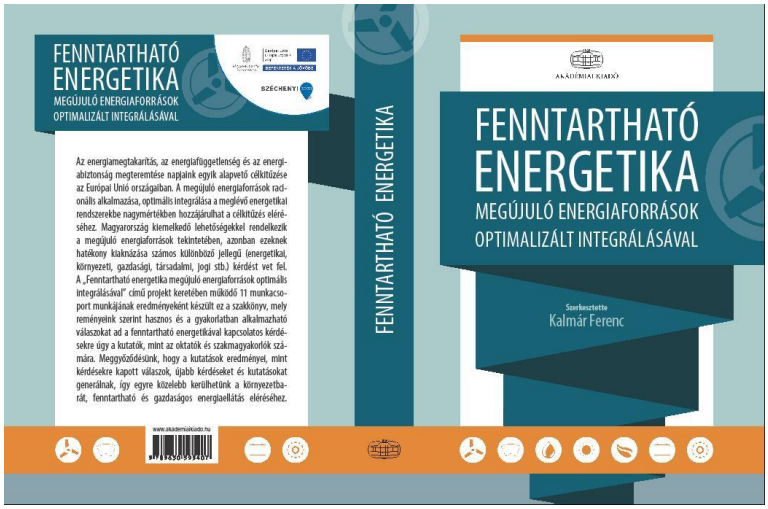


Figure 5. The book cover of the TÁMOP project: Sustainable Energy by Optimal Integration of Renewable Energy Sources.

2.III. Energy Performance Certificate requirements

Starting from January 2012, all existing residential and non-residential buildings need to be certified when sold. The owner must present a valid EPC to the buyer, when the sale contract is agreed upon. For rentals, the EPC is obligatory only since 2015.

In 2016, the energy performance classes were rescaled. The new labels are marked by double letters to differentiate them from the old labelling system. The reference value of the scale is the NZEB requirement on total primary energy performance. Building units meeting the NZEB requirements can get label "*BB*" or better. EPCs issued before 2016 have been automatically rescaled, but unfortunately owners are not automatically informed about the change because of technical barriers of the database.

EPCs are valid for 10 years unless the building undergoes a major renovation, in which case a new EPC is required.

The EPCs are issued by independent experts who have passed the necessary exam at the Hungarian Chamber of Engineers or at the Hungarian Chamber of Architects.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Since January 2013, EPCs are registered in a central database operated by the *Lechner* Non-Profit Organisation. The database is partly public. In the public part, a building´s energy performance class can be searched by using its address. Statistical information from the database is also publicly available, but only a limited number of searching criteria are allowed. Detailed statistical analysis is only for internal use. The licences for the certified experts are issued by the Hungarian Chamber of Engineers and the Chamber of Architects. The Chamber of Engineers runs the control system of the EPCs.

The EPC assigns an energy performance label to residential and non-residential buildings or building units, and it lists cost-effective measures for improving their energy performance. The energy label classifies the buildings on an efficiency scale ranging from AA++ (high energy efficiency) to HH (poor efficiency). The classification is based on the specific yearly primary energy need. The labels of the new EPC's are presented in Figure 6.

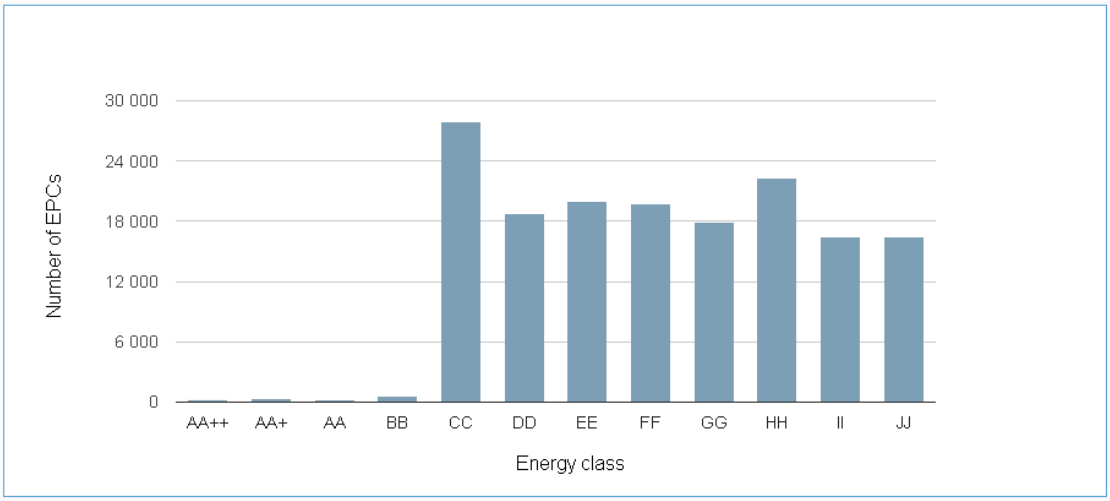


Figure 6. Number of EPCs in function of energy class registered in the electronic system in 2016.

The cost of a certificate[17] for an apartment unit is set by law (40 € + VAT per unit). The same price applies for single-family houses. This cost has often been criticised by experts as unrealistically low and it thus has a strong negative impact on the quality of the certificate. For non-residential buildings, there is no legally defined amount of the cost of an EPC.

2.III.ii. Quality Assurance of EPCs

An EPC electronic registration system has been in operation since 2013. An EPC is only valid after upload into the online system. Roughly, 150,000 EPCs are issued annually.

The online system also serves as a first level of quality control: first, it automatically checks the permit of the energy expert. Following this step, the system checks for unrealistic figures.

The second and third control levels are performed by the Hungarian Chamber of Engineers. Randomly selected, 2.5% of the EPCs are verified by an office check and 0.5% (20% of the 2.5%) are verified on-site. Both controls are carried out by independent experts and all control results are registered in an electronic database. From the beginning of 2017, targeted controls are also possible.

If the quality control detects a miscalculation leading to a difference of more than two energy classes, the expert loses his licence for 3 years. Since 2017, further sanctions can be applied, including fines and penalties.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

In Hungary, the definition of a public building includes every state-owned non-residential building. Initially, only the larger buildings (exceeding 1,000 m^2 floor area) were required to display their EPC, making it visible to the public. Since 2015, the EPC is obligatory for all public buildings and large buildings open to the public exceeding 250 m^2 floor area, and the EPC must be displayed in a visible place. For the display itself, there is no effective control and sanction system in operation.

The cost of an EPC for public buildings must be determined on the basis of real cost reports and is generally between 100 and 1,500 € depending on the size and complexity of the building.

2.III.iv. Implementation of mandatory advertising requirement – status

According to the Governmental Decree 176/2008 (VI. 30.), as of 9 January 2013, the energy categories must be displayed in all commercial advertisements for all buildings or building units, (including individual apartments in blocks of flats, single-family houses and non-residential buildings) when sold or rented, if the EPC is available. In most cases, the EPC is not available in the period of advertising, but only at the moment of sale or rental. As of January 2017, it is neither controlled nor sanctioned if the mandatory advertising requirement is obeyed or not.

2.IV Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Hungary has adopted alternative measures for inspection of heating systems and AC systems. This means that the inspection system will be replaced by other alternative actions, such as information campaigns on the replacement of obsolete or low-efficiency boilers, AC and heating systems. Such campaigns are integrated in the *Action Plan to Improve Awareness for Energy Efficiency and Climate Protection*[18, 19].

2.IV.ii. Progress and current status on heating systems

The government has initiated several programmes to subsidise the installation of new condensing boilers to replace obsolete low-efficiency boilers and water heaters. The *Environmental and Energy Efficiency Operation Programme* supported heating system modernisation actions and the integration of renewable energy systems for public buildings in recent years. The applicants can select from several renovation packages, including complex renovation and different combinations of 2 or 3 retrofit measures. No further results are available yet.

2.IV.iii. Progress and current status on AC systems

Only 3.8% of the EPCs reported existence of an AC system in buildings or building units. This means that AC systems are rarely used in Hungary, particularly not in the residential sector. In 2015, 270 TJ was the total used energy for cooling of the households, which was 0.1% of the total used end energy of the households.

The support of AC systems is therefore not a priority of the Hungarian energy policy actions. Instead of subsidising AC systems, the installation of shading devices is preferred. In the "*window exchange*" programme for single-family houses and small residential apartment buildings, the installation of shading devices was a priority[20]. No further results are available yet.

2.IV.iv. Enforcement and impact assessment of inspections Enforcement and penalties

As mentioned above, Hungary has adopted alternative measures for the inspection of heating and AC systems. Therefore, the issue of enforcement and penalties is not relevant.

Three per cent (3%) of the 1.2 million boilers operating in Hungary have capacities below 20 kW, 80% have capacities between 20 and 30 kW, and 17% have capacities above 30 kW. Overall, 1,116 million boilers are affected by the EPBD requirement for on-site inspections. The share of household boilers is 90%, while the share of boilers in commercial and public institutions is 10%.

In 2013, the Ministry for National Development sent the report on relevance of equivalent measures to the European Commission. The evaluation of this report is still ongoing.

3. A success story in EPBD implementation

A success story is the energetic refurbishment of 20 educational buildings in Debrecen. Within the framework of the *New-Phoenix Plan*[21], the technical building systems and the building elements of 20 educational (elementary and high school) buildings in Debrecen (Hungary) were refurbished with focus on improving energy efficiency. The project was financed by the Norwegian Fund (eea grants)[22] and Debrecen obtained about 17 million € for the renovation activities. The windows and doors of all buildings were changed with plastic framed ones, the external walls of the buildings were insulated with 20 cm thick polystyrene insulation, the heating systems of the buildings were modernised, and thermostatic valves were installed. Eighty (80) panels of photovoltaic solar cells were used with 20 kWp electric power potential. For the operation and maintenance, a smart-building automation system was built-in as well.

From the design stage, for the *István Hatvani* elementary school, about 661 MWh/year energy savings are expected, and for the *Endre Ady* secondary grammar school, about 563 MWh/year energy savings are expected. Unfortunately, actual measured values are not available yet (Figures 7, 8, 9).



Figure 7. Refurbished educational buildings in Debrecen 1.



Figure 8. Refurbished educational buildings in Debrecen 2.



Figure 9. Refurbished educational buildings in Debrecen 3.

4. Conclusions, future plans

The 2018 EPBD requirements for new buildings and major renovations will bring important energy savings in the near future and in the long term, although new and renovated buildings only represent a small share of the entire building stock in Hungary (around 4.4 million dwellings and single-family houses in total). To mention a positive trend, although between 2008 and 2012 the number of new apartments has decreased from 35,000/year to around 10,000/year, a boom has been experienced in 2016 due to the governmental support programme *CSOK*[23] on new residential buildings for families with children. The number of building permissions was 2.5 times higher than in the previous year, which is still only 0.6% of the existing households. In these projects, the cost-optimal requirements have to be applied. *CSOK* gives support to families for building or buying new houses or flats, with one, two and three children. Families with at least three children can get about 32,000 non-refundable financial support and can have a loan of the same value. For one and two children, the loan is not entitled and the support is significantly lower, too.

The National Building Energy Strategy envisages a significant reallocation of funds and support for the building sector for the period 2015-2020. In spite of the difficulties, the introduction of energy performance requirements on partial renovations since 2013 and the introduction of cost-optimal requirements in 2015 for buildings that obtain public funding can have a remarkable effect. According to current trends, savings will be expected mainly in the public sector. Hopefully, new subsidy programmes will appear in the future, the first one being the on-going *METÁR*.

In the medium term (after 2018), the introduction of the cost-optimal requirements for all kinds of buildings and the NZEB concept after 2019 and 2021 will become the factors determining the construction market. It is not easy to estimate the effect of a new or extended EPBD.

The defensive features of buildings (thermal insulation, airtightness, shading) are approaching the rational limits. Regarding biomass as renewable energy the problem of transport will override the exaggerated expectations. Perspectives in the fields of smart metering, electric cars, national grid, co-generation are more promising however these items are beyond the competence of the designers of individual buildings.

CEN standards can be applied in the final stage of the design. Nevertheless, before elaborating the final construction drawings, a building permit is to be issued on the basis of overview plans. In this stage, many details of the construction are not fully defined yet and, as a consequence of the lack of input data and due to the inevitable changes during the later stages of design and construction, the application of the CEN standards is put under question. From building permit until commissioning (which may take years), the market conditions, e.g., availability and cost of some elements, may change: this is why reliable but simplified calculation tools are and will be necessary in the early stage of design (application for building permit), when lack of input data does not facilitate the application of many standards.

Endnotes

1. *GINOP*: Economic development and innovations operative programme (www.palyazat.gov.hu)
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23. *CSOK*: Reduced fare for building and buying family houses

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Ireland

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.seai.ie, www.housing.gov.ie/; www.dccae.gov.ie/en-ie/Pages/default.aspx

1. Introduction

Ireland is transposing the EU requirement for NZEB and major renovations.

The *Building Regulations* for dwellings (residential buildings) are already at an advanced level following updates in 2005, 2008, 2011 and 2017 including mandatory RES contribution for domestic hot water heating, space heating or cooling.

Ireland's cost-optimal calculations and gap analysis report for buildings other than dwellings (non-residential buildings) identified a gap of more than 15% between the current 2008 requirements and cost-optimal energy performance.

The *NZEB Interim Specification for Public buildings owned and occupied by public authorities* was issued in December 2016 for buildings commencing design from early 2017.

Draft Building Regulations and Technical Guidance Documents[1] were published in 2017 for public consultation. The amended *Building Regulations* will require a minimum of 50 - 60% improvement in energy efficiency, air permeability testing and 20% of final energy consumption from RES onsite or nearby

or 10% where the whole building energy performance is improved by 10% compared to the 2008 *Building Regulations*. The improvements and RES requirements calculations use primary energy.

The *Building Regulations* will require energy performance improvement of the building to cost-optimal level where an existing building undergoes a major renovation.

The final *Building Regulations* are planned for publication in November 2017.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

The EPBD energy performance requirements for new and existing buildings are transposed into Irish law through the *EC Energy Performance of Buildings Regulations 2006 – 2017*. *Technical Guidance Document Part L* provides detailed guidance for designers, specifiers and other building professionals on compliance with the requirements. The *Dwelling Energy Assessment Procedure (DEAP)* and *Non-dwelling Energy Assessment Procedure (NEAP)* methodologies and software calculate primary energy use and associated CO_2 emissions for space heating and (where applicable) cooling, ventilation, associated motive power and lighting under standardised conditions of use.

2.I.i. Progress and current status of new buildings

Overall maximum permissible energy performance and CO_2 emissions requirements were introduced for residential buildings in 2005, non-residential and public buildings in 2008.

The *Energy Performance Coefficient* and *Carbon Performance Coefficient* are defined as the ratios of calculated primary energy consumption and corresponding CO_2 emissions for the proposed building relative to a reference building.

The *Maximum Permitted Energy Performance Coefficient* and *Maximum Permitted Carbon Performance Coefficient* for new residential buildings are given in Table 1.

Year	2005	2008	2011	2017
Maximum Permitted Energy Performance Coefficient	1.0	0.6	0.4	0.3
Maximum Permitted Carbon Performance Coefficient	1.0	0.69	0.46	0.35

Table 1: Maximum Permitted Energy Performance Coefficient and Maximum Permitted Carbon Performance Coefficient for new residential buildings. The 2017 values are expected to apply from 2020.

Energy from RES is mandatory for new residential buildings since 2008. The minimum requirement is 10 kWh/m^2/year thermal energy or 4 kWh/m^2/year electrical energy.

The *Maximum Permitted Energy Performance Coefficient (MPEPC)* and *Maximum Permitted Carbon Performance Coefficient (MPCPC)* for new non-residential buildings are given in Table 2.

Year	2008
Maximum Permitted Energy Performance Coefficient	1.0
Maximum Permitted Carbon Performance Coefficient	1.0

Table 2: Maximum Permitted Energy Performance Coefficient and Maximum Permitted Carbon Performance Coefficient for new non-residential buildings.

The requirements for new non-residential buildings are under review to provide detailed NZEB guidance and include major renovation performance requirements, which are expected to be finalised in November 2017. Key components of performance requirements will include performance improvement in the order of 60% over the 2008 minimum standards, improved fabric specification, advanced services and lighting specification and 20% of energy to be from RES.

2.I.ii. Format of national transposition and implementation of existing regulations

The *Building Regulations* and accompanying *Technical Guidance Documents* are published by the *Department of Housing, Planning and Local Government*. The *Building Control* section in each local authority is responsible for administrating the *Building Regulations*. The *Sustainable Energy Authority of Ireland* (*SEAI)* is the issuing authority for the administration of the *Building Energy Rating (BER)* or EPC scheme.

DEAP and *NEAP*, compliant with EN 13790, serve the dual purpose of demonstrating compliance with *Part L (Conservation of Fuel and Energy)* of the *Building Regulations* and the generation of the *Energy Performance Certificate (EPC)* and *Advisory Report*.

In *DEAP* the electricity primary energy and CO_2 factors are calculated using forecasts from *SEAI's Energy Modelling unit*.

From	To	Electricity Primary Energy Factor	Electricity CO_2 Factor (kg/kWh)
14th June 2017	Present	2.08	0.409
7th January 2016	13th June 2017	2.19	0.473
17th December 2014	6th January 2016	2.37	0.522
11th December 2013	16th December 2014	2.45	0.555
11th December 2012	10th December 2013	2.42	0.524
1st December 2011	10th December 2012	2.58	0.556
Pre 30th November 2011	30th November 2011	2.7	0.643

Table 3: Electricity primary energy and CO_2 factors used in DEAP.

For non-residential buildings, the *NEAP* electricity primary energy and CO_2 factors are given in Table 4. The factors will be updated to the current *DEAP* factors as part of the software update planned for 2017.

From	To	Electricity Primary Energy Factor	Electricity CO_2 Factor (kg/kWh)
2008	Present	2.7	0.643

Table 4: Electricity primary energy and CO_2 factors used in NEAP.

The cost-optimal calculations and gap analysis for the EPBD were completed in 2013. The requirements for new residential buildings are in the cost-optimal range and are informing the upcoming NZEB requirements. The energy performance levels for existing residential buildings are set on a component basis and were last updated in 2011. The energy performance levels for new non-residential buildings were last revised in 2008 and the *Regulation and guidance* is currently undergoing a review process to be completed in October 2017. The major renovation requirement is in place for existing residential buildings and will be added for existing non-residential buildings before the end of 2017.

Quality assurance and disciplinary procedure audits are an important tool in safeguarding the integrity of EPCs through continuous enforcement of assessors' compliance with the *Code of Practice*. SEAI is finalising a comprehensive audit selection module providing automated support for audit selection activities.

Building control officers in local authorities are empowered to carry out inspections and, where necessary, undertake enforcement action in order to ensure compliance. Penalties include a fine of up to 5,000 €, or up to three months in prison, or both. Enforcement is complemented by a "*rights based"* approach, focussed on creating a compliance culture.

2.I.iii. Action plan for progression to NZEB for new buildings

The *Building Regulations* for new residential buildings are already at an advanced level. The typical energy performance of new residential buildings is expected to be 45 kWh/m^2/year or less with an *Energy Performance Coefficient* less than or equal to 0.3 and a *Carbon Performance Coefficient* of less than or equal to 0.35. Renewable energy continues to be required. Approximately 2% of all new and existing residential buildings achieve the NZEB standard as shown in Table 5. Sixty four percent (64%) of the new homes built in the 2010-2017 period may be considered NZEB.

													% of row
Period of Construction	Energy Rating												Total
	A	B1	B2	B3	C1	C2	C3	D1	D2	E1	E2	F	G	
1700-1899	0	0	1	2	2	3	4	7	10	9	10	14	38	17,535
1900-1929	0	0	1	2	2	3	4	7	10	9	10	14	37	36,637
1930-1949	0	0	1	3	4	5	7	9	12	10	10	13	26	33,092
1950-1966	0	0	1	3	5	6	8	11	14	11	11	13	17	51,684
1967-1977	0	0	1	3	6	9	12	16	17	11	9	9	8	68,661
1978-1982	0	0	1	3	8	13	15	18	18	10	6	5	3	46,803
1983-1993	0	0	1	4	9	13	16	20	18	9	5	4	3	76,569
1994-1999	0	0	1	5	10	15	19	20	15	7	5	3	1	82,730
2000-2004	0	0	1	7	15	22	22	15	9	4	3	2	1	124,731
2005-2009	1	3	11	21	23	17	9	6	4	2	1	1	0	121,610
2010-2017	64	17	10	5	2	1	1	0	0	0	0	0	0	19,492
Total	2	1	3	7	11	13	13	13	12	7	5	5	7	679,544

Table 5: Number of residential buildings at NZEB standard.

The *Building Regulations* for new non-residential buildings are undergoing review and will be finalised in 2017. RES will become mandatory following the publication of the *2017 Building Regulations*. One percent (1%) of all non-residential buildings may be considered at or near the NZEB standard based on an analysis of all EPCs published from 2008. The *Department of Education and Skills* use an advanced energy standard

for all new buildings and this is reflected in the 23% of school and college buildings with an A3 or better BER or EPC.

Non-Domestic Building Energy Ratings

Quarter 1 2017

% of row

Building Type (2009-2017)	Energy Rating							Total
	A	B	C	D	E	F	G	
Retail	0	14	42	17	9	6	12	17,070
Office	1	9	32	25	13	8	13	10,044
Restaurant/public house	0	7	29	36	18	6	4	4,117
Hotel	0	15	42	27	9	4	3	639
Warehouses	0	18	33	19	9	6	14	6,122
Workshops/maintenance depot	0	9	23	24	13	10	20	1,674
Industrial process building	2	36	26	16	9	3	9	997
Hospitals and primary health care	4	16	23	21	15	10	11	716
Community/day centre	3	24	32	17	9	6	9	682
Nursing residential homes and hostels	7	39	29	17	4	1	3	318
Schools and colleges	23	27	22	17	6	2	3	633
Sports facilities	2	30	29	17	8	6	8	382
Other	2	15	24	18	12	8	20	738
Total	**1**	**14**	**35**	**21**	**11**	**6**	**12**	**44,132**

Table 6: Number of non-residential buildings at NZEB standard.

The *Department of Education and Skills* is at the forefront of design with respect to sustainable energy efficiency in schools.

Colaiste Choilm is a three-storey low energy 550 student post primary school in Tullamore, Co. Offaly. The sustainable feature includes rainwater recovery system, 120 m^2 solar panels, intelligent lighting systems and biomass boilers. This project, completed in 2011, is testing sustainable design approaches and technologies. The successful elements will be incorporated into the specifications for all future post-primary schools. The main achievements of the sustainable energy project at Colaiste Choilm can be summarised as providing a quality sustainable educational facility, researching low-energy design solutions and renewables in a post-primary school and achieving an A2 energy rating.

2.I.iv. Requirements for systems and / or building components for new buildings

The overall energy, carbon and RES energy performance levels specified in the *Building Regulations* and *Technical Guidance Documents Part L* are in the nature of backstop minimum performance levels so as to ensure reasonable levels of performance for all factors affecting energy use, irrespective of the measures incorporated to achieve compliance.

Meeting the minimum individual performance levels specified will not necessarily mean that the overall level specified for primary energy consumption and related CO_2 emissions will be met. One or more of the following performance levels specified, will need to be exceeded to achieve this: use of RES, fabric insulation, airtightness, boiler efficiency, building services controls, insulation of pipes, ducts and vessels, and mechanical ventilation systems.

Maximum elemental U-value (W/m^2K)[1, 2]		
Column 1 Fabric Elements	**Column 2 Area-weighted Average Elemental U-Value (Um)**	**Column 3 Average Elemental U-value – individual element or section of element**
Roofs Pitched roof - Insulation at ceiling - Insulation on slope Flat roof	 0.16 0.16 0.20	 0.3
Walls	0.21	0.6
Ground floors[3]	0.21	0.6
Other exposed floors	0.21	0.6
External doors, windows and rooflights	1.6[4]	3.0
Notes: *1. The U-value includes the effect of unheated voids or other spaces.* *2. For alternative method of showing compliance see paragraph 1.3.2.3.* *3. For insulation of ground floors and exposed floors incorporating underfloor heating, see paragraph 1.3.2.2.* *4. Windows, doors and rooflights should have a maximum U-value of 1.6 W/m^2K when their combined area is 25% of floor area. However areas and U-values may be varied*		

Table 7: Maximum Element U-Values (W/m2K) for residential buildings.

Permitted variation in combined areas (A_{ope}) and average U-values (U_{ope}) of external doors, windows and rooflights	
Average U-value of windows, doors and rooflights (U_{ope}) (W/m^2K)	Maximum combined area of external doors, windows and rooflights (A_{ope}), expressed as % of floor area (A_f)
0.8 1.0 1.2 1.3 1.4	58.9 44.8 35.1 31.9 29.2
1.5 **1.6** 1.7 1.8 1.9	26.9 **25.0** 23.3 21.9 20.6
2.0 2.2 2.4 2.6	19.4 17.5 15.9 14.5
Note: *Intermediate values of "combined areas" or of "U-values" may be estimated by interpolation in the above Table.* *Alternatively the following expression may be used to calculate the appropriate value:* $A_{ope} / A_f = 0.3475 / (U_{ope}-0.21)$ *This expression may also be used to calculate appropriate values outside the range covered by the Table.*	

Table 8: Permitted Variation in combined areas and average U-Values of external doors, windows and rooflights in residential buildings.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

In general, *Building Regulations* apply to the construction of new buildings and to extensions and material alterations to existing buildings. In addition, certain parts of the *Regulations*, including *Part L*, apply to existing buildings where a material change of use takes place. The maximum elemental U-Value W/m^{2}K for material alterations or material change of use is shown in Table 9. Guidance is given on: insulation levels to be achieved by the plane fabric elements, thermal bridging and limitation of air permeability.

Maximum elemental U value (W/m^{2}K)[1,2] for Material Alterations or Material Change of Use		
Column 1 Fabric Elements	**Column 2 Area-weighted Average Elemental U-Value (Um)**	**Column 3 Average Elemental U-value – individual element or section of element**
Roofs Pitched roof - Insulation at ceiling - Insulation on slope Flat roof	 0.16 0.25 0.25	 0.35
Walls Cavity walls[5] Other walls	 0.55 0.35	 0.60
Ground floors[3]	- 0.45[6]	-
Other exposed floors[3]	0.25	0.60
External doors, windows and rooflights	1.60[4]	3.0
Notes: *1. The U-value includes the effect of unheated voids or other spaces.* *2. For material alterations, the U-values relate to the new works.* *3. For insulation of ground floors and exposed floors incorporating underfloor heating, see paragraph 2.1.2.2.* *4. For extensions and material change of use, windows, doors and rooflights should have a maximum U-value of 1.6 W/m^{2}K when their combined area is 25% of floor area. However areas and U-values may be varied as set out in Table 6 and paragraph 2.1.2.4.* *5. This only applies in the case of a wall suitable for the installation of cavity insulation. Where this is not the case it should be treated as for "other walls".* *6. This U value only applies where floors are being replaced.*		

Table 9: Maximum Elemental U-Value (W/m2K) for Material Alteration and Material Change of Use for residential buildings.

For buildings undergoing major renovation, the *draft 2017 Building Regulations for non-residential buildings* require that the building is upgraded to the cost-optimal level of energy performance in so far as this is technically, functionally and economically feasible. The following improvements are normally considered to be cost-optimal and will typically be economically feasible when more than 25% of the surface area of a building is being upgraded: upgrading heating, cooling, ventilation and lighting systems. As an alternative, the whole building performance achieves the performance levels specified in Table 10 where technically, functionally and economically feasible this can be considered the cost-optimal level of performance.

Whole Building Cost Optimal Level	
Building Type	**Major Renovation - Cost Optimal Performance kWh/m²/yr**
Retail Air Conditioned	338
Office Natural Ventilated offices and other Buildings	124
Office Air Conditioned	180
Hotel Air Conditioned a	342
Schools	60
Other Air Conditioned Buildings	338
Other Naturally Ventilated Buildings	124

Table 10: Whole building cost-optimal level of performance for major renovations.

The major renovation requirement will be added to the *Building Regulations* for residential buildings in 2018.

2.II.ii. Plans to improve the existing building stock

Buildings represent a significant proportion of Ireland's total energy consumption. The residential sector alone accounts for approximately 27% of all energy usage and emits some 10.5 million tonnes of CO_2 annually. Because the potential for energy savings is so high, the buildings sector has become a priority area for the Government in trying to meet its ambitious climate and energy targets for 2020 and beyond.

In 2014, The *Department of Communications, Climate Action and Environment (DCCAE)* published Ireland's first ever national renovation strategy[2] which seeks to provide a pathway towards reducing emissions from buildings in the residential and non-residential sectors. This strategy sets out the measures currently in place to reduce emissions in these sectors and the factors that will be considered in developing new measures. The strategy has been prepared to fulfil Article 4 of the EED, which requires all MSs to set out long-term strategies for mobilising investment in the renovation of buildings.

This strategy reaffirms the Government's commitment to delivering on its ambitious targets to achieve a 33% energy saving in the public sector and a 20% improvement in energy efficiency for the economy as a whole by 2020. This transition will not happen by itself. This strategy sets out a clear pathway to overcoming the barriers to renovation works and achieving the national targets by building on the success of existing policy measures, with the addition of new ambitious policy goals, designed to mobilise investment to increase the rate of renovation in the economy.

In the residential sector, the progress to date achieved by the *Better Energy programme* will be built upon with the launch of *Better Energy Finance*. This programme will be designed in a manner that acknowledges the constraints identified in this strategy and will make a compelling case to consumers on the merits of

energy efficiency. It will also ensure that there are a variety of financial options open to those consumers when they are considering undertaking renovation works. The national smart meter rollout will also help to overcome barriers by providing consumers with detailed information on their energy usage at their fingertips.

In the public sector, the energy management tools developed by *SEAI* will allow public sector organisations to take direct control over their energy bills, delivering an unprecedented level of control to each individual organisation. The promotion of exemplar projects through the *National Energy Saving Framework* will provide templates for public sector organisations considering efficiency projects, while the launch of the new *Energy Efficiency Fund* will ensure that sufficient finance is available to support new projects.

In the commercial and industrial sector, the most important barriers to overcome are the split incentives and the availability of finance. By requiring each energy supplier to work with their customers to deliver significant energy savings each year, the Government is encouraging energy suppliers to become advocates of efficiency rather than simply energy vendors.

2.II.iii. Regulation of system performance, distinct from whole building performance

A building shall be designed and constructed to limit the amount of energy required for its operation and the amount of CO_2 emissions associated with this energy use insofar as is reasonably practicable.

For new residential buildings, the requirements are:

1. providing that the energy performance is such as to limit the calculated primary energy consumption and related CO_2 emissions insofar as is reasonably practicable, where both energy consumption and CO_2 emissions are calculated using *DEAP*;
2. providing a reasonable proportion of the energy consumption by RES;
3. limiting heat loss and, where appropriate, availing of heat gain through the fabric;
4. providing and commissioning energy efficient space and water heating systems with efficient heat sources and effective controls;
5. providing that all oil and gas fired boilers shall meet a minimum seasonal efficiency of 90%;
6. providing to the owner sufficient information about the building, the fixed building services and maintenance requirements

2.II.iv. Encouragement of intelligent metering

For buildings with a heat demand of more than 100 kW a full *Building Management System (BMS)* should be installed to control the boiler(s). A *BMS* linked to the heating plant will provide sequential controls of multiple boilers, full-zoned time control and weather compensation where applicable, frost protection or night set-back optimisation and monitoring and targeting.

2.II.v. Financial instruments and incentives for existing buildings

The Better Energy Warmer Homes Scheme (BEWHS) improves the energy efficiency and comfort conditions of homes occupied by vulnerable households in receipt of the *National Fuel Allowance Scheme* through the

installation of draught proofing, attic insulation, lagging jackets, low energy light bulbs and cavity wall insulation, where appropriate.

Better Energy Homes is a Governmental programme, which gives fixed cash grants for insulation and heating system upgrades, helping to make your home more comfortable and cheaper to run. It is available to all owners of homes built before 2006.

Better Energy Communities has supported 300 community energy efficiency projects over the last five years. As a result, over 15,000 homes and hundreds of community, private and public buildings have received energy efficiency upgrades, supporting several hundred jobs each year.

The Energy Efficiency Obligation Scheme (EEOS) is implemented pursuant to the Energy Efficiency Directive 2012, Article 7. The Directive imposes a legal obligation on retail energy sales companies to achieve energy savings.

The Accelerated Capital Allowance (ACA) is a tax incentive for companies paying corporation tax which aims to encourage investment in energy efficient equipment. The *ACA* offers an attractive incentive whereby it allows companies to write off 100% of the purchase value of qualifying energy efficient equipment against their profit in the year of purchase.

2.II.vi. Information campaigns / complementary policies

The SEAI promotes grants available to homeowners. In 2017, *SEAI* ran a campaign to drive grant applications for *Better Energy Homes*. The radio, press and online campaign resulted in a 30% increase in website visits.



Figure 1 home energy grants image

SEAI's National Deep Retrofit Conference 2017 established the landscape for the decade or more of deep retrofitting ahead. The deep retrofitting of Ireland's building stock is recognised as one of our biggest energy efficiency challenges. It is also viewed by many as a major economic and employment opportunity. The conference is an annual review and information sharing platform across all stakeholder groups as to best practice and innovation, research findings and delivery of deep retrofit in Ireland across all demographics, geographic areas, technologies and building types.

2.III. Energy performance certificate requirements

SEAI as the issuing authority is responsible for the administration of the EPC scheme. Over 30% of residential and non-residential buildings have an EPC. The EPC is on the list of documents checked by the legal representatives when a building sale or rental is completed. A legal representative is not mandatory, particularly for residential buildings, when a building or building unit is offered for rent.

The total number of *BERs* for residential buildings is given in Figure 1. In a multi-unit residential building each unit has a unique EPC. In 2016, over 87,000 residential buildings or building units received an EPC.

DOMESTIC BERs BY GRADE (On Public Register and Not Expired - Current)

Energy Rating	Quantity
A1	48
A2	4,169
A3	15,501
B1	8,718
B2	20,925
B3	50,188
C1	77,337
C2	90,342
C3	91,028
D1	92,045
D2	80,556
E1	47,133
E2	37,126
F	37,456
G	50,926
Total	**703,498**

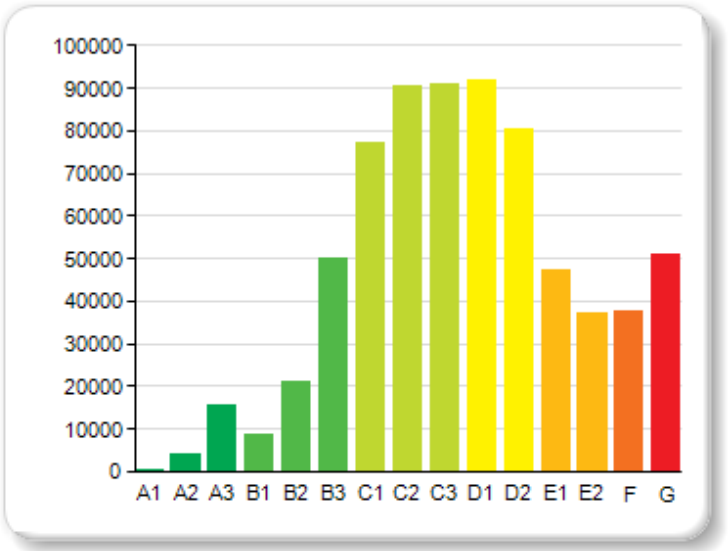


Figure 2. EPCs for residential buildings.

The *Energy Performance of Buildings Directive (EPBD) Compliance Study*[3] reported compliance rates for sales and rentals. In general, EPC production in the rental market is less well monitored and controlled than in the new construction and building sales sectors. The legal systems for checking compliance with the use and issue of EPCs in sales and new construction do not exist for a large proportion of tenancy agreements in most MSs.

SEAI carried out research in 2015 as part of the pathways report to unlocking the energy efficiency opportunity. The focus of this research with 1,500 consumers was to ascertain their propensity to borrow to fund retrofit and to establish what the important factors were in encouraging the decision to undertake financing.

The research found that of the consumers who had investigated ways to reduce energy use through energy efficiency investment but had not acted upon those yet, 74% indicated that lack of funding had a strong relevance in this. Financing is not the only barrier to encouraging home retrofit; our various pieces of research shows that other issues, such as targeted promotion, advice and support. are also essential to stimulate engagement, provide consumer knowledge for decision making and assistance to enable action. *SEAI* is updating the residential BER advisory report format and content in 2017 and 2018. as part of the deep retrofit pilot project.

2.III.i. Quality Assessment of EPCs

The selection of EPCs for audit is carried out on both a targeted and random basis with due consideration of risks associated with the EPC assessment processes. *SEAI* randomly selects a statistically significant percentage of all the EPCs issued annually and subject those certificates to verification. Routine follow up audits identify if findings from previous audits have been adequately resolved. In addition, *SEA*I may, under its *Quality Assurance System and Disciplinary Procedures*, require EPC Assessors to participate in mentoring visits arranged by its auditors to facilitate further training.

SEAI publishes a detailed *Code of Practice and Quality Assurance and Disciplinary Procedure*. The impact of errors is sized to determine the audit outcome: compliance, severity 3, severity 2 and severity 1. Findings of non-compliance may lead to the accumulation of penalty points and/or revocation of the EPC data file(s) as follows:

Severity of non-compliance	Penalty points	Revocation of EPC
Compliance	0	No
Severity 3	1	No
Severity 3 (Advisory)	0	No
Severity 2	2	Yes
Severity 2 (Advisory)	0	Yes
Severity 1	3	Yes
Severity 1 (Advisory)	0	Yes

Table 11: Classification system for audit findings of non-compliance.

Suspension or termination of registration of an EPC assessor may result where 10 penalty points or more are accumulated within the previous 2-year period.

2.III.ii. Progress and current status of EPCs on public and large buildings visited by the public

In Ireland, all large buildings (those with a total useful floor area over 500 m^2 and, since July 2015, over 250 m^2) that are frequently visited by the public should have an EPC on display. This requirement applies irrespective of whether the building is occupied by a public authority.

The *Building Control section* in each authority is responsible for monitoring and enforcing the requirement to display EPCs in public buildings and large buildings often visited by the public. The number of EPCs published for display in 2016 was 384, indicating a low compliance rate.

An *EU Energy Performance of Buildings Directive (EPBD) Compliance Study*[4] identified the following challenges with EPCs on public and large buildings visited by the public: validity of the EPC, awareness of building managers, level of interest shown by the public, compliance checks made, influence on energy management and EPC cost.

2.III.iii. Implementation of mandatory advertising requirement status

SEAI published advertisement guidelines[5] which can be summarised as follows:

- A person offering a property for sale or rent on or after 9th January 2013, or their agent, shall ensure that the energy performance indicator of the current EPC for the building is stated in any advertisements, where such advertisements are taken relating to the sale or letting of that building.
- Prospective buyers and renters will be shown the EPC rating (Alphanumeric value) along with other prescribed content (dependent on the particular medium) in a prominent location in each specific advertisement.
- Where images of the property are used, then the presentation of the alphanumeric value will be by way of *the prescribed EPC Alphanumeric Rating Motif for the particular property rating.*
- The *EPC Alphanumeric Rating Motif* artwork files will be made available in electronic format from the *SEAI* website or on request to info@ber.seai.ie.

These requirements apply to advertisements, meaning a public announcement in: newspaper, magazine, brochure, leaflet, advertising notice, vehicle, radio, television, internet (including apps and social media) and direct mail.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

In September 2012, Ireland notified the European Commission of its decision to avail of the alternative approach provided under Article 14(4) of Directive 2010/31/EU. As set out in that notification, the approach implemented in Ireland centres on the implementation of an effective information campaign aimed at encouraging regular heating system inspections/maintenance and the replacement of inefficient heating systems with high efficiency alternatives. Similar awareness measures have been ongoing in Ireland since 2006. These have been complemented by a range of additional incentives to encourage heating system upgrades. This approach continued throughout the reporting period from 30th June 2011 to 30th June 2014.

2.IV.ii. Progress and current status on heating systems

An analysis of the annual energy saving potential arising from a hypothetical regular inspection scheme complying with Article 14(1)–(3) of Directive 2010/31/EU and the alternative approach adopted in Ireland, conducted in Q3 of 2013, showed that the alternative approach in Ireland, consisting of an awareness scheme and capital grants for heating system upgrades, would yield over three times the energy and CO_2 savings that would be achieved by a hypothetical inspection scheme over the reporting period from June 2011 to June 2014. SEAI intends to run a similar suite of measures over the next 3-year period.

The updated equivalence analysis indicates that the energy savings achieved as of December 2013, which can be attributed to the implementation of alternative measures, will exceed the estimated energy savings of 93.2 GWh that could arise from a hypothetical regular inspection scheme (by a factor of 3).

The alternative measures analysed in this report are the key initiatives that will continue to deliver energy savings in the reporting period from 30th June 2014 to 30th June 2017.

2.IV.iii. Progress and current status on AC systems

Ireland confirmed to the European Commission that it is availing of the alternative equivalence measures provided for under Article 15(4) of Directive 2010/31/EU with regard to the provision of advice to users on the replacement of AC systems and/or on other modifications to AC systems which may include inspections to assess the efficiency and appropriate size of AC systems. The roll out, inter alia, of information campaigns, the provision of advice to the users of AC systems and other promotional measures will deliver significantly better results than mandatory inspections and will, accordingly, represent a better use of resources for the State.

2.IV.iv. Enforcement and impact assessment of inspections

In opting for the alternative approach set out in Article 15(4) of Directive 2010/31/EU, the proposed approach is to deliver an effective communications campaign coupled with other support actions that will encourage regular inspection of AC systems with associated maintenance, modification and replacement of inefficient installations. The focus is on establishing a well-structured set of initiatives, led by Governmental bodies, aligning with business interests of energy efficiency products and service providers, especially key influencers, in the AC systems sector. This approach is likely to achieve greater energy efficiency improvements when compared to an inspection regime.

The use of AC in residential buildings in Ireland is insignificant. The analysis, conducted during the third and fourth quarter of 2013, shows that the alternative approach in Ireland, consisting of an awareness scheme, promotional and financial support, would yield over 30% more energy and CO_2 savings that would be achieved by a hypothetical inspection scheme over the reporting period from June 2011 to June 2014. The costs of inspecting each AC system and the administration of the hypothetical regular inspection scheme have not been quantified as part of this study. These potential costs are likely to significantly reduce the potential annual energy and CO_2 savings arising from the introduction of a hypothetical regular inspection scheme.

Impact assessment, costs and benefits

Ireland has opted for alternative measures for Directive 2010/31/EU Articles 14 and 15. Consequently enforcement, penalties and quality control of inspection reports do not arise. The impact assessment of the alternative measures is quantified in the reports submitted to the European Commission.

3. A success story in EPBD implementation

The EPBD has provided the framework for understanding and improving building energy performance and raised awareness on energy consumption in buildings resulting in a more prominent role in energy policy. When the EPBD was transposed into national legislation in 2006, *SEAI* established a national database for all EPC related information. The national database of EPC is essential for collecting statistical insights in the energy performance of the existing building stock. The database is used to inform renovation strategies and to enable stakeholders in the supply chain to better understand the market for their products.

The *Central Statistics Office (CSO)* is Ireland's official statistics office. The *CSO* combines EPC data with other data sources including the national census. The *CSO* publishes comprehensive EPC data. Residential

buildings' EPC ratings for the 1st quarter of 2017 can be accessed at www.cso.ie/en/releasesandpublications/er/dber/domesticbuildingenergyratingsquarter12017/.

A total of 20,604 EPCs for residential buildings were published in the first quarter of 2017, bringing the cumulative total of EPCs to 745,347. The number of EPCs published in 2017 represents an increase of 4.9% compared with the same period in 2016.

Detached houses and semi-detached houses are the most common residential building types since 2009, each representing 26% of the total. They also had similar energy ratings with approximately 50% of each residential type receiving a rating of "C" or higher. Mid-floor apartments had the highest percentage of "A" and "B" ratings at 30%.

Dublin's postal district code area 18, with an average building age of 17 years, had the highest proportion of combined "A" and "B" rating at 38%. In contrast, Dublin 7 had the highest proportion of combined "F" and "G" rating at 27%, with an average building age of 56 years. Residential buildings with a *BER* rating in Dublin 10 had an average age of 42 years, and was the only Dublin postal district or county with no "A" or "B1" EPCs.

Overall, heating oil and natural gas were the two most prevalent main space heating systems accounting for 78% of all residential buildings (39% each), followed by electricity (15%). Of the residential buildings using natural gas, 20% were rated "A" or "B", compared with 9% for those using heating oil. Of the residential buildings built between 2010 and 2017, the majority used natural gas (58%), followed by electricity (23%) and heating oil (17%).

Table 12, which presents the energy rating by residential building type, is one of many tables published by the *CSO*.

Domestic Building Energy Ratings

Quarter 1 2017

% of row

Dwelling Type	Energy Rating					Total
	A-B	C	D	E	F-G	
Apartment	29	29	20	11	11	4,391
Ground-floor apartment	12	31	26	18	13	38,693
Mid-floor apartment	30	36	21	8	6	46,881
Top-floor apartment	14	27	27	16	16	40,055
Basement Dwelling	5	17	17	22	39	198
Maisonette	21	33	24	10	12	6,999
House	15	41	24	9	12	37,900
Detached house	12	37	25	11	15	179,948
Semi-detached house	10	41	27	12	10	178,343
End of terrace house	10	36	24	14	16	49,012
Mid-terrace house	13	37	23	13	14	97,124

Table 12. Energy ratting by residential building type.

SEAI provides grant funding for home energy upgrades and an EPC is mandatory to record the improvement. The purpose of rating is recorded as part of the EPC and one of the categories is grant aided works.

Total applications	286,039
Total homes completed	201,550
Total grants paid	€208,136,906

Table 13. The Better Energy Homes *scheme statistics from its launch in March 2009 to 30th April 2017.*

The *Better Energy Warmer Homes* is available to home owners who cannot afford to invest in energy efficiency upgrades. The *Department of Social and Family Affairs* identifies eligible low-income families. Applicants must be in receipt of one of the following: Fuel Allowance as part of the National Fuel Scheme, Job Seekers Allowance for over six months and have a child under seven years of age, Working Family Payment, Single Parent Payment, or Domiciliary Care Allowance.

The service involves the installation of standard energy efficiency measures appropriate to the eligible household subject to *SEAI* survey, budget allocation and available capacity. The service is provided at no cost to the household.

Better Energy Communities has supported 300 community energy efficiency projects over the last five years. As a result, over 15,000 residential buildings and hundreds of community, private and public buildings have received energy efficiency upgrades, supporting several hundred jobs each year.

In 2016, funding provided for energy efficiency upgrades to more than 2,600 homes and almost 300 community and commercial facilities. The total investment in energy efficiency is almost 48 million €, supporting more than 700 direct and indirect jobs right across the country.

4. Conclusions, future plans

The EPBD implementation in Ireland has provided detailed information and requirements to document the current energy efficiency of buildings. The minimum energy performance of residential buildings has undergone revisions in 2005, 2008 and 2011. RES is mandatory in new homes. The *Building Standards* will be further strengthened to align with NZEB requirements. The *Building Standards* for non-residential buildings will be improved by 40-60% in 2017, with a mandatory 20% of the energy demand being supplied through RES. The major renovation requirement will be added for all buildings.

http://seai.ie/Your_Building/BER/Advertising_of_BER/BER-Advertising-Guidelines-Issue-2-.pdf will continue to promote and support the renovation of existing buildings.

The existing housing stock in Ireland continues to pose one of the greatest energy efficiency challenges. A considerable portion of the current building stock performs poorly when compared against a building built to the current standards. The *Deep Retrofit Pilot programme* has been launched explicitly to tackle this challenge.

Deep retrofit is the significant upgrade of a building toward NZEB requirements where it is practically feasible and achievable. Rather than upgrading isolated parts of the house, the whole home should be assessed as a system, looking at how energy is used and retained. All aspects of the building fabric, airtightness, ventilation and RES should be assessed.

SEAI are commencing the first of multi-annual pilots which will investigate the challenges and opportunities that deep retrofit present. The learning from these pilots will inform *SEAI's* approach and support towards the large scale deep retrofit of buildings in Ireland. The initial focus will be on the residential market.

The government has allocated 5 million € in 2017 to support this pilot.

Funding will be provided to projects which demonstrate an integrated, comprehensive strategy for significantly improving home energy performance. Projects will generally comprise:

- whole house solution which includes a fabric first approach;
- minimum *BER* uplift of 150-200 kWh/m^2/year to minimum *BER A3;*
- deployment of RES solutions supporting transition from fossil fuels.

To maximise the learnings from the pilot, *SEAI* aims to fund a range of projects which support:

- a range of building archetypes;
- development toward large-scale deployment;
- regulatory development;
- multiple customer benefits.

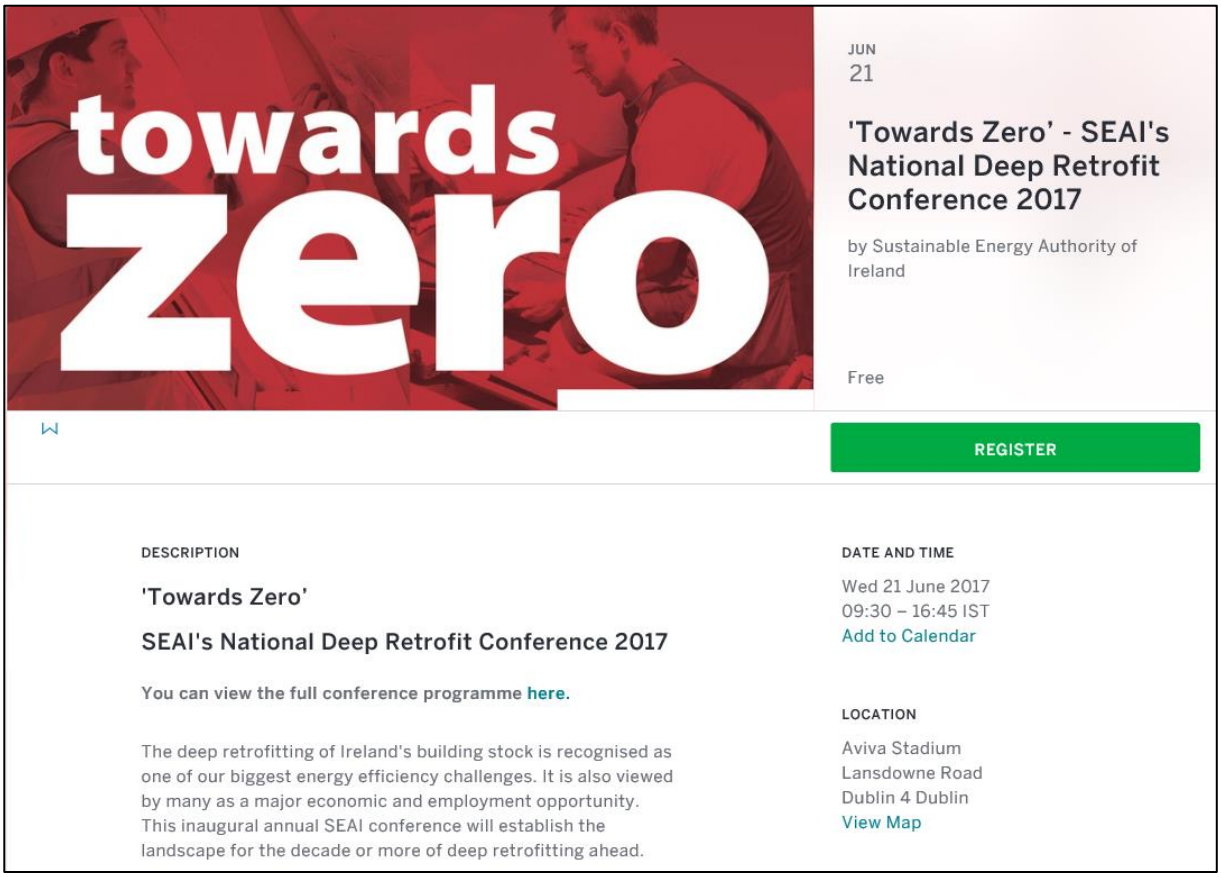


Figure 3. SEAI's National Deep Retrofit Conference.

Endnotes

1. www.seai.ie/sustainable-solutions/nearly-zero-energy-buildi-1
2. www.dccae.gov.ie/en-ie/energy/topics/Energy-Efficiency/ireland's-national-renovation-strategy/Pages/Ireland's-Renovation-Strategy.aspx
3. https://ec.europa.eu/energy/sites/ener/files/documents/MJ-04-15-968-EN-N.pdf
4. https://ec.europa.eu/energy/sites/ener/files/documents/MJ-04-15-968-EN-N.pdf
5. http://seai.ie/Your_Building/BER/Advertising_of_BER/BER-Advertising-Guidelines-Issue-2-.pdf

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Italy

Status in December 2016

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NATIONAL WEBSITES

www.sviluppoeconomico.gov.it/index.php/it/energia/efficienza-energetica, http://www.enea.it/it, www.agenziaefficienzaenergetica.it/, www.cti2000.eu, www.regioni.it/materie/ambiente-energia/energia, http://italiasicura.governo.it/site/home/scuole/scuole-sostenibili.html

EPBD LEGISLATION

Decrees 2015: www.sviluppoeconomico.gov.it/index.php/it/energia/efficienza-energetica/edifici
Presidential Decree 74/2013: www.gazzettaufficiale.it/eli/id/2013/06/27/13G00114/sg
Presidential Decree 75/2013: www.gazzettaufficiale.it/eli/id/2013/06/27/13G00115/sg

1. Introduction

Decree 192/2005[1], modified by Legislative Decree 311/2006[2], set the basis for the EPBD implementation in Italy. It was followed by a number of complementary legal acts updating the minimum requirements for buildings, building components and technical building systems, while extending the calculation to cooling and lighting systems and providing guidelines for energy performance certification (2009) and defining requirements for assessors as well as specifications for the inspection of technical building systems (2013).

Law 90/2013[3] implemented Directive 2010/31/EU, introducing significant changes to the first 2005 implementation. In June 2015, three inter-ministerial decrees (26 June 2015) have completed the EPBD transposition, which also established stricter minimum requirements for new buildings and major renovations, defined NZEB as well as rules for taking RES in buildings into account, and provided new national guidelines for EPCs.

Italian regions and autonomous provinces (a total of 21 authorities) have final jurisdiction in energy topics. The recent legislation provided, with a unanimous consensus from these authorities, an advanced harmonisation of the EPBD implementation all over the national territory and took implementation a step forward:

- The six regional/provincial authorities that had independently transposed the EPBD before October 2015 (Liguria, Emilia Romagna, Tuscany, Val d'Aosta, Piedmont, Lombardy and the provinces of Trento and Bozen) have a two-year period to fully adapt their EPC system to that required by national law; that has already occurred for most of them.

- Five more regions/autonomous provinces have established their EPC database since 2014 (a present total of 15 out of 21).

- A national information system for EPCs and for the inspection of technical heating/cooling systems is being created, although regions are still in charge of managing their own databases and for related monitoring and control.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Complementing Law 90/2013, Decree 26/06/2015 "*Minimum Requirements*"[4] strengthened the previous acts and provided an updated energy performance calculation methodology, the rules for taking into account the use of RES in buildings and the system boundary, new stricter minimum energy performance requirements for buildings, building systems and building components, as well as conversion factors. The new legislation also defined NZEB.

Current calculation methodologies are based on national standard UNI/TS 11300 (series from 1 to 6)[5], and the calculation of artificial lighting is based on standard UNI EN 15193:2008[6]. This set of standards is in line with the ones developed by CEN to support EPBD implementation.

2.I.i. Progress and current status of new buildings

The main novelties from 2015 can be summarised as follows:

1. Updated energy performance calculation methodology, according to EPBD Annex I:
   - The global annual energy use is calculated for each energy service on a monthly basis and expressed in primary energy. The renewable energy produced within the boundary of the building system (on-site) is calculated in the same way.
   - Compensation between energy needs and renewable energy produced on-site is allowed only for the same energy carrier on a monthly basis and up to cover the total energy demand for that carrier (the exported energy is not taken into account).
2. New minimum energy performance requirements for new buildings (and major renovations) are based on the application of the cost-optimal methodology results (EPBD, Article 5), with the use of a reference building. The following energy services are taken into consideration: heating, cooling, domestic hot water and ventilation for residential buildings; plus lighting and internal transports (lifts, escalators) for non-residential buildings.
3. Factors for the conversion of delivered energy into primary energy (Table 1).

Energy Carrier	$f_{P,nren}$	$f_{P,ren}$	$f_{P,tot}$
Natural Gas (1)	1.05	0	1.05
LPG	1.05	0	1.05
Diesel fuel and fuel oil	1.07	0	1.07
Coal	1.10	0	1.10
Solid bio fuels	0.20	0.80	1.00
Liquid and gaseous bio fuels	0.40	0.60	1.00
Electricity (1)	1.95	0.47	2.42
District heating (2)	1.50	0	1.50
Solid urban waste	0.2	0.2	0.2
District cooling (2)	0.5	0	0.5
Thermal energy from solar collectors	0	1.00	1.00
Electricity produced by photovoltaics, mini wind turbines and small hydro systems	0	1.00	1.00
Geo- aero-, hydrothermal energy	0	1.00	1.00

(1) To be updated every two years on the basis of data supplied by GSE, the state-owned company which promotes and supports renewable energy sources (RES) in Italy

(2) Default value in the absence of specific values declared by the supplier and certified by a third party.

Table 1. Primary energy factors

The current overall energy performance of new buildings varies with typology and climatic zone.

2.I.ii. Format of national transposition and implementation of existing regulations

Minimum requirements are defined according to the "*reference building*"[7].

Energy parameters of the reference building will entail more severe requirements (Table 2) from 2021 (2019 for public buildings, Table 3).

The new legislation in force requires the calculation of the following energy performance indicators:

- Specific energy needs for heating ($EP_{H,nd}$), cooling ($EP_{C,nd}$) and domestic hot water ($EP_{W,nd}$);
- Energy performance indexes for heating (EP_H), cooling (EP_C), domestic hot water (EP_W), ventilation (EP_V), plus lighting (EP_L) and transport (EP_T) for non-residential buildings, expressed in non-renewable and in total primary energy [kWh/m^2];
- Global energy performance index $EP_{gl} = EP_H + EP_C + EP_W + EP_V + EP_L* + EP_T*$ expressed in non-renewable and in total primary energy [kWh/m^2] (lighting and transport services for non-residential building only).

A new building (or major renovated building) satisfies the minimum requirements if the specific energy needs for heating and cooling ($EP_{H,nd}$, $EP_{C,nd}$) and the global energy performance EP_{gl} are lower than those calculated values for the reference building. New buildings further need to have a fixed minimum ratio of RES for the supply[8]. In case the required RES integration should not be feasible, the building has to adhere to a proportionally lower EP_{gl} limit value.

The designer has to justify compliance or non-compliance of the project to minimum energy performance requirements in a report (model provided in one of the 2015 decrees). This validation is compulsory to get the construction licence. Controls from local authorities to check compliance are performed on demand.

Elements /Components	Validity period	Thermal transmittance U [W/m².k] (including thermal bridges)				
		Climatic Zone				
		A and B	C	D	E	F
Envelope – walls	From 2015	0.42	0.36	0.32	0.28	0.26
	From 2019/2021	0.38	0.32	0.28	0.24	0.22
Envelope – roofs	From 2015	0.36	0.36	0.28	0.25	0.23
	From 2019/2021	0.34	0.34	0.24	0.22	0.20
Envelope – floors	From 2015	0.46	0.40	0.32	0.30	0.28
	From 2019/2021	0.42	0.36	0.28	0.26	0.24
Doors, windows and shutter boxes	From 2015	3.20	2.40	2.00	1.80	1.50
	From 2019/2021	3.00	2.20	1.80	1.40	1.10
Indoor partitions	From 2015	0.80	0.80	0.80	0.80	0.80
	From 2019/2021	0.80	0.80	0.80	0.80	0.80
		Total solar energy transmittance g_{gl+sh} [-]				
		A and B	C	D	E	F
Windows with shading devices	From 2015	0.35				
	From 2019/2021					

Table 2. Reference building - Performance of single building elements.

Generation system	Thermal energy production η_{gn}			On site electricity production η_{el}
	H	C	W	
Heat generator - liquid fuels	0.82	-	0.80	-
Heat generator - gas fuels	0.95	-	0.85	-
Heat generator - solid fuels	0.72	-	0.70	-
Heat generator - solid biofuels	0.72	-	0.65	
Heat generator - liquid biofuels	0.82		0.75	
Heat pump with electrically driven compressor	3.00	*	2.50	
Chiller with electrically driven compressor	-	2.50	-	
Absorption heat pump	1.20	*	1.10	
Indirect power absorption chiller	-	0.60 x η_{gn} (**)	-	
Direct-fired absorption chillers	-	0.60	-	
Combined heat power systems	0.55	-	0.55	0.25
Electrical heating	1.00	-	-	-
District heating	0.97	-	-	-
District cooling	-	0.97	-	-
Solar collectors	0.3	-	0.3	-
Photovoltaic systems	-	-	-	0.1
Mini wind turbines and small hydro-systems	-	-	-	(**)
	Thermal energy use (***) η_u			
	H	C	W	
Water based systems	0.81	0.81	0.70	
Air-conditioning systems	0.83	0.83	-	
Mixed distribution	0.82	0.82	-	

(*) For reversible heat pumps the value of the correspondent chiller is assumed.

(**) The efficiency of the system installed in the real building is assumed.

(***) Including emission, control and distribution.

Table 3. Reference building – technical building systems efficiency.

2.I.iii. Action plan for progression to NZEB for new buildings

According to Law 90/2013[9], a NZEB is a building characterised by a very high energy performance in which the very low energy demand is significantly covered by RES, produced *within* the building system boundaries.

In the national plan for NZEB (PANZEB, published in 2015)[10], priority is given to ambitious renovation rather than new constructions that have a very low rate in Italy. NZEB need to be implemented by 2019 for public buildings and by 2021 for all new buildings, but some regions have set earlier targets: the Lombardy region (starting by 2016) and the Emilia Romagna region (starting by January 2107 for public and by 2019 for all buildings). Among the measures addressing the transition to NZEB are included:

- Progressive strengthening of the building regulations: minimum standards in 2016 are 15% more rigorous compared to the previous ones. Moreover, the 2015 decree asks for further strengthening of energy efficiency requirements in the near future (2017-2019-2021).
- Incentives for new private buildings, provided in terms of reduced construction tax burdens, both at national and regional level.[11]
- In new public buildings, the obligation for the share of RES is 10% higher compared to the minimum share required for private ones.

Law 107/2015[12] promotes new public schools with stricter earthquake-proof reinforcement and innovative energy systems as an extra requirement, increasing the ad-hoc fund of 23.9 million € in 2016 and 126 million €/year from 2017 to 2021. With the following Decree 94/2015, the Ministry of Instruction, University and Research allocated 300 million € to the Italian regions for the construction of 30 new innovative schools.

A new CasaClima Gold single-family house in Mascalucia (Catania, warmer zone, 833 heating degree days) boasts 5 kWh/m^2 year energy needs for heating, and negative global energy performance (– 124 kWh/m^2.year) of primary energy, with an 80% share supplied by RES. A new residential and commercial neighbourhood, Centro Zero (CasaClima A) near Arezzo, Tuscany, includes highly insulated (average U=0.26 W/m^2.K) buildings with heat pumps for heating and domestic hot water, 1.5 kWp photovoltaic system per building unit, energy need for heating amounting to 17 kWh/m^2.year.

The Italian pavilion (Figure 1) at ExPo 2015 in Milan (exposition, offices, auditorium) has a high envelope performance with 0.17-0.23 W/m^2.K U-values and windows with U-values below 1.3 W/m^2.K. Its energy needs are 21 kWh/m^3 in winter and 14.4 kWh/m^3 in summer.

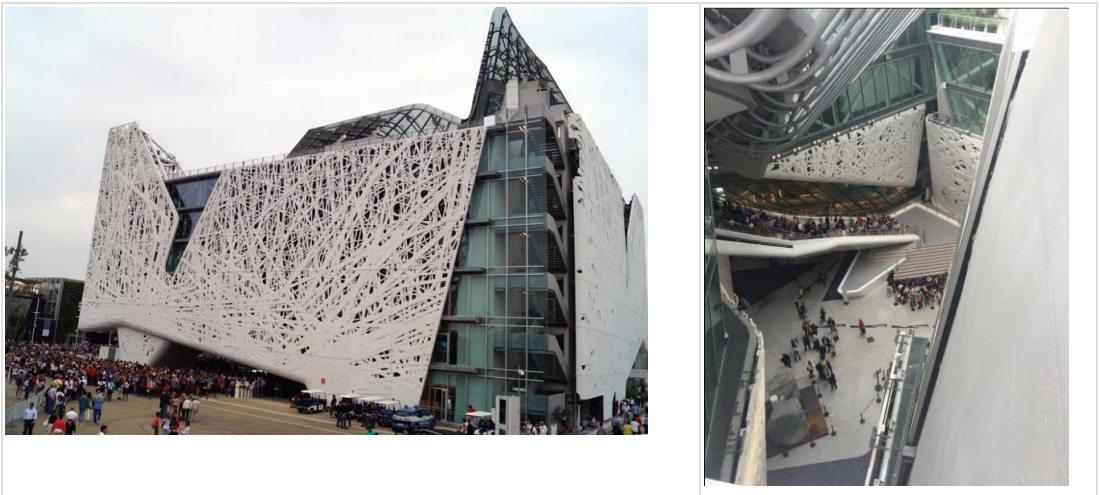


Figure 1. Italian pavilion at Expo 2015, Milan.

2.I.iv. Requirements for systems and/ or building components for new buildings

In addition to the above-mentioned requirements for the whole building performance, the following energy requirements for system and building components shall be verified[13]:

- The mean transmission heat transfer coefficient, H'_T [W/m^2.K], is lower than the limit value for that given climatic zone and surface-area-to-volume ratio (S/V) of the building (Table 4).
- The ratio of summer effective collecting areas to the net floor area, $A_{sol,est}/A_{sup\ util}$, is lower than the limit value defined for residential and non-residential buildings (Table 5).
- The mean efficiencies of the technical systems for heating (ηH), cooling (ηC) and domestic hot water (ηC) are higher than those calculated for the reference building.
- The mass of the external walls (except northeast to northwest) is larger than 230 kg/m² or, alternatively, their periodic thermal transmittance YIE (as defined in EN ISO 13786:2008) is lower than 0.12 W/m².K.
- The periodic thermal transmittance YIE of roofs and floors is lower than 0.18 W/m².K.
- The U-value of the inter-building opaque components (floors and walls) is lower than 0.80 W/m².K (Table 2).

New (or 1st-level major renovated buildings, as explained below) have to:

- Be pre-arranged for a possible connection to district heating and cooling networks which are closer than 1 km from the designed building, or if district heating and cooling networks are predicted in approved plans and closer than 1 km. Otherwise the chosen solution has to be justified.
- Be equipped with intelligent metering systems (according to EED implementation decree);
- Satisfy a minimum level of automation for building control, regulation, and management (UNI EN 15232, Table 1, Class B) in the case of non-residential buildings.

Row N.	A/V ratio of the building	Climatic zone				
		A - B	C	D	E	F
1	S/V ≥ 0.7	0.58	0.55	0.53	0.50	0.48
2	0.7 > S/V ≥ 0.4	0.63	0.60	0.58	0.55	0.53
3	0.4 > S/V	0.80	0.80	0.80	0.75	0.70
4	Second level major renovation (>25% envelope)	0.73	0.70	0.68	0.65	0.62

Table 4. H'_T maximum limit value.

Building categories	All climatic zones
Residential buildings	≤ 0.030
Non-residential buildings	≤ 0.040

Table 5. $A_{sol,est}/A_{sup,utile}$ maximum limit value.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The building sector is responsible for the biggest share of total energy demand (37.1%) in Italy. In the non-residential sector a decrease in consumption (- 6.7%) was registered in 2015 for the first time in the last 20 years. The annual rate of deep energy renovation of existing residential buildings is estimated to be nearly 0.5%.

Energy performance requirements for existing buildings are identical whether they concern residential or non-residential buildings. Minimum requirements are differentiated according to the extent of the renovation intervention:

- **Major renovations – first level** (defined as "*refurbishment of at least 50% of the envelope and renovation of the heating and/or cooling plant of the entire building*"). Standards for new buildings apply to the whole building, limited to the considered energy service(s). For building enlargements (new volume >15% of the existing volume or >500 m^3) these standards apply to the new volume.
- **Major renovations – second level** (defined as "*refurbishment of at least 25% of the external surfaces of the building with or without renovation of the heating and/or cooling plant*"). The U-value of the concerned surfaces is lower than the limit values (Table 6). The mean transmission heat transfer coefficient of refurbished building elements is lower that the limit value (Table 4). The mean efficiencies of renovated technical building systems are higher than the reference values.
- **Minor renovations** (defined as "refurbishment of less than 25% of the external surfaces of the building and/or modification of the heating and/or cooling plants). The performance of single components or of the technical building systems has to comply with mandatory limit values.

Components	Validity period	Thermal transmittance U [W/m^2.K] (including thermal bridges)				
		Climatic Zone				
		A and B	C	D	E	F
Envelope – walls	From 2015	0.45	0.40	0.36	0.30	0.28
	From 2021	0.40	0.36	0.32	0.28	0.26
Envelope – roofs	From 2015	0.34	0.34	0.28	0.26	0.24
	From 2021	0.32	0.32	0.26	0.24	0.22
Envelope – floors	From 2015	0.48	0.42	0.36	0.31	0.30
	From 2021	0.42	0.38	0.32	0.29	0.28
Doors, windows and rolling shutter boxes	From 2015	3.20	2.40	2.10	1.90	1.70
	From 2021	3.00	2.00	1.80	1.40	1.00

Table 6. U-value limits for second level major renovation and minor renovation.

2.II.ii. Plans to improve the existing building stock

Given the consistency of the existing public building stock and the low rate of new constructions, efforts are being concentrated on renovating towards NZEB levels. Major (1st level) renovated buildings with 50% envelope and technical building systems retrofit have to comply with the same NZEB requirements as new buildings.

Among the measures addressing the transition of the existing stock to NZEB can be mentioned:

- Progressive strengthening of the building regulations: minimum standards in 2016 are 15% more rigorous compared to the previous ones.
- Awareness raising and capacity building pursued by several public and private initiatives.
- Incentives to NZEB standards for new private buildings are provided in terms of reduced construction tax burdens, both at national and regional levels.
- Actions towards the implementation of NZEB public buildings: plans for the implementation of this as a standard are from 31 December 2018.

The Italian plan for NZEB analyses the extra costs, the market trends, some incentivising instruments and facilitating factors, mostly for renovating to NZEB standards. The average additional cost for the NZEB renovation of existing buildings compared to current minimum energy performance requirements (%) are illustrated in Table 7.

	Detached house	Block of flats	Office
Envelope	+4.2%	+4.6%	+5.3%
Technical system	+50.2%	+27.4%	+28.1%

Table 7. Average additional cost for the NZEB renovation of existing buildings compared to current minimum energy performance requirements (%).

The target for NZEB progress is that from 2019 all major renovated public buildings and from 2021 all remaining major renovated buildings shall be NZEB.

Table 8 shows the expected extra energy savings thanks to NZEB renovations (compared to current minimum requirements) in the residential sector for the period 2015-2020 by type of building and climatic zone. The total expected energy saving is about 3 ktoe.

Concerning the non-residential sector, Table 9 shows the expected NZEB renovated surface of public and private office and school buildings, and related energy savings. The total expected energy saving is about 5 ktoe.

The total expected energy savings due to an early application of NZEB requirements in both residential and non-residential (school and office buildings) sectors is about 8 ktoe for the period 2015-2020 (2015-2018 for public buildings).

Residential buildings		Total renovated surface	NZEB share	NZEB renovated surface	NZEB extra saving	Cumulated NZEB renovated surface 2015-2020	Expected savings 2015-2020
Type	Climatic zone	m^2	%	m^2/year	kWh/m^2/year	m^2	toe
Single-family house	A-B-C	1,469,000	1	14,690	7	88,140	183
	D	2,203,000	1	22,030	14	132,180	549
	E-F	3,672,000	1	36,720	21	220,320	1,373
Subtotal		7,344,000		73,440		440,640	2,104
Multi-family block	A-B-C	791,000	1	7,910	6	47,460	81
	D	1,186,000	1	11,860	11	71,160	243
	E-F	1,938,000	1	19,380	17	116,280	595
Subtotal		3,915,000		39,150		124,900	919
Total		11,259,000		112,590		675,540	3,024

Table 8. NZEB renovation in the residential sector (2015-2020). Source: Ministry of Economic Development.

Non-residential building		NZEB extra saving	PUBLIC			PRIVATE			TOTAL
			NZEB renovated surface	Cumulated NZEB renovated surface 2015-2018	Savings 2015-2018	NZEB renovated surface	Cumulated NZEB renovated surface 2015-2020	Savings 2015-2020	Savings 2015-2020
Type	**Climatic zone**	**kWh/m^2/year**	**m^2/year**	**m^2**	**toe**	**m^2/year**	**m^2**	**toe**	**toe**
Offices	**A-B-C**	**12**	2,153	8,612	**41**	8,232	49,394	**185**	**226**
	D	**28**	2,894	11,576	**125**	11,067	66,399	**557**	**682**
	E-F	**45**	3,283	13,132	**229**	12,551	75,306	**1,023**	**1,252**
Subtotal			8,330	33,320	**395**	31,850	191,100	**1,764**	**2,160**
Schools	**A-B-C**	**9**	23,968	95,872	**321**	2,663	15,979	**42**	**362**
	D	**19**	15,048	60,192	**451**	1,672	10,032	**59**	**510**
	E-F	**31**	37,214	148,856	**1,808**	4,135	24,809	**234**	**2,043**
Subtotal			**76,230**	**304,920**	**2,580**	**8,470**	**50,820**	**334**	**2,914**
Total			**84,560**	**338,240**	**2,975**	**40,320**	**241,920**	**2,099**	**5,074**

Source: Ministry of Economic Development

Table 9. NZEB renovation in the non-residential sector (2015-2018 public buildings, 2015-2020 private buildings).

Articles 4 and 5 of Decree 102/2014 transpose the corresponding articles of the EED.

Article 4 of the Italian Strategy for the energy renovation of the national building stock (STREPIN, published in 2015)[14] assesses an energy saving potential of almost 5.7 Mtoe/year at 2020, Figure 2.

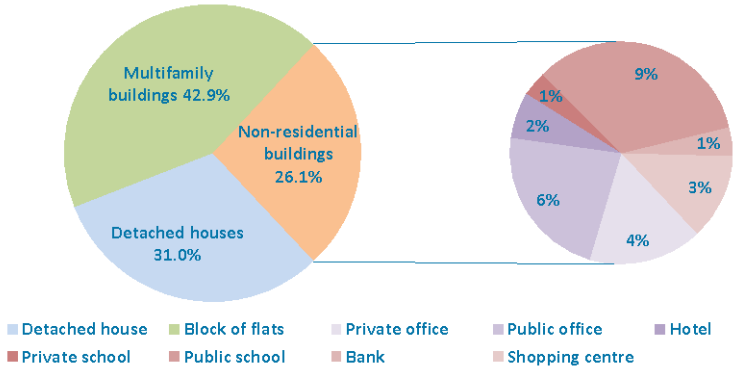


Figure 2. Italian building renovation strategy: expected energy saving at 2020 (%).

The corresponding level of investments in the residential sector is about 13.6 billion € per year for interventions aimed at the overall renovation of buildings, and 10.5 billion € per year for partial interventions (roof, façade, windows, heating system). Concerning the non-residential sector, the amount of necessary investments is about 17.5 billion € per year.

On Article 5, Italy opted for an alternative approach by implementing cost-effective measures, such as behaviour change, contracting, envelope and technical building systems renovation, energy management and inspections. Nearly 3,534 building units are owned and occupied by the central government; of these 41% belong to the Ministry of Justice. Useful floor area is about 13.3 million m^2 with an expected energy saving potential of 458,000 MWh. The Governmental PREPAC program (in force from November 2016)[15] allocated about 355 million € for the renovation of these buildings with an energy saving target of 0.04 Mtep over the 2014-2020 period. So far, central authorities have submitted 120 projects, half of which have been approved and will result in about 70 million € in investments.

2.II.iii. Regulation of system performance, distinct from whole building performance

Presidential Decree 74/2013 on heating/cooling systems lays down a set of obligations and criteria applicable to public and private buildings. They apply to most building uses and include ambient temperature limits for heating (the weighted average air temperature measured in each heated space must not exceed 18°C + 2°C tolerance in buildings for industrial or similar use, and 20°C + 2°C tolerance in all other buildings) and for cooling (the weighted average air temperature measured in each cooled space must not be below 26°C - 2°C tolerance in all buildings).

Limits are set on the operation period of heating systems during the year and each day, depending on the climate zone, with exceptions allowed for particular weather conditions, not exceeding half of the permitted daily limit.

The Ministry of Economic Development (MISE) set up a template for a heating or cooling system log-book and another for an energy efficiency report, and asked the Italian Thermotechnical Committee (CTI) to publicise examples for the most common types of systems to facilitate and standardise completion of the log-books and energy efficiency reports. In the case of major and minor renovations, performance of single components (i.e., U-values) or of the technical systems (i.e., boiler efficiency) have to comply with mandatory limit values as specified above in chapter II, iv.

2.II.iv. Encouragement of intelligent metering

Smart meters are regulated by Article 9 of Legislative Decree 102/2014 (EED transposition). In Italy the roll-out of electricity smart meters started in 2006 and was completed in 2011. ENEL, the main Italian distribution system operator, has installed 32 million smart meters in Italy.

In the last 10 years, 95% of the conventional electric meters have been replaced by digital meters that report through the power line. This conversion provided for a more detailed bill, with summaries of monthly consumption and hourly data accessible online to users with demand exceeding 50 kW. A roll-out of gas smart meters is expected to achieve 60% in 2018.

Projects for multi-services smart meters were approved in September 2014, involving nine Italian major cities and some smaller municipalities. Smart meter installation will be financed through a small annual contribution from gas bills and they will measure gas, water, and electricity consumption and, in some cases, other services such as distributed heating, public lighting and waste collection. The Italian Regulatory Authority has recently set standards for second-generation smart meters for electricity, gas and water (Deliberation 87/2016). Installation of "*second generation*" smart meters is expected to start in 2017.

2.II.v. Financial instruments and incentives for existing buildings

Tax deductions introduced by the Italian 2007 financial law are key drivers of energy efficiency improvements in the housing sector and have stimulated 32 billion € in investments so far. They consist of 55-65% reductions of personal income tax (IRPEF) and corporate income tax (IRES) granted to cover expenses incurred for the overall energy performance upgrade of the building, including major and minor renovations.

Decree 28/2012 incentivising scheme, dubbed "*Thermal Account*", is operational since 2013 and encourages energy performance improvements in public buildings and renovations to NZEB standards. Since June 2016, the revised Thermal Account 2.0 came into force, allocating 200 million € per year to public buildings: it strengthens and simplifies procedures and widens the range of eligible applicants and measures, including building automation. The incentive is granted up to 575 €/m^2 over a maximum 5-year period and covers up to 65% expenses for NZEB renovations. This incentive can be combined with other grants (i.e., regional ones) up to 100% of eligible costs. Up to September 2016, 16 million € have been granted for public buildings renovations towards NZEB levels[16].

In 2015, the Ministry of economic development allocated 50 million € for energy performance projects in municipal public buildings to those regions eligible for 2014-2020 cohesion policy funds. Four hundred sixty (460) municipalities will be granted up to 100% of renovation costs, including installation of photovoltaics connected to the grid, solar thermal, heat pumps and re-lamping.

Regions also take advantage of structural funds (POR-FESR) for public buildings renovation. This includes: 2013 – Piedmont region incentives for public school roofs, combined with asbestos clean-up; 2016 – Lombardy region deep renovation grants (FREE - EE 30.7 million € fund, 30% grants plus 40% revolving fund engaging ESCOs) and 90% grants for buildings owned by small cities (<1,000 inhabitants) supporting 55 projects with 11.1 million €.

Incentives to renovation of private buildings towards NZEB levels are provided in terms of reduced construction tax burdens.

2.II.vi. Information campaigns / complementary policies

The energy efficiency and renewable energy agencies ENEA and GSE have the mandate to manage the governmental incentives for building energy renovation and the related communication campaigns. Beyond several publications and workshops, ENEA annually releases an energy efficiency report (RAEE) that also monitors trends and best practice on policy and technology advancements in the building sector with the participation of key national stakeholders.

According to the 2015 inter-ministerial decree, ENEA developed a guideline to the new EPC. A one-stop-shop on energy efficiency of existing buildings is currently under development. Sections of the ENEA website tackle EPC, energy audits, incentives, guidelines for building renovations, technical building systems operation and inspection.



Figure 3. Institutional portal on tax deductions for building renovations.

Within the EED implementation, a three year (2016-2018) training and information program (*"Italia in Classe A"*) involves key stakeholders of the building sector.

Regions and their in-house energy agencies promote communication programs by means of websites and other actions including call-centres. Bozen CasaClima agency developed a network spread all over the Italian territory. Provinces and regions carried out information campaigns (Figure 4) on inspections of technical building systems (including costs and sanctions)[17].



Figure 4. Information campaign on inspection of technical building systems in Ascoli Piceno province.

Presidency of the Council of Ministers awareness campaigns "*Ciriesco*" and "*Italiasicura*" include guidelines and tips for building renovation, notably on schools (Figure 5).



Figure 5. Governmental campaign on sustainable schools.

Several initiatives are also organised and supported by NGOs, enterprise networks and associations, e.g.: *Legambiente, KyotoClub, Renovate-Italy, Amici della terra, Edilportale*, etc.[18]

2.III. Energy performance certificate requirements

Decree 2015 "*EPC guidelines*" introduced a new EPC system that is harmonised on national territory and a new layout which is unique for residential, commercial and public buildings.

The new EPC layout (Figure 6) is now more user-friendly and provides more useful information: it shows the performance of the envelope, both in winter and summer, and the performance of single energy services; it displays energy sources used, allows for comparison of the overall performance with similar units/buildings (new and existing) and clearly indicates if the NZEB standard has been attained. A new energy rating system has been established based on energy performance expressed in non-renewable primary energy $EP_{gl,nren}$, through comparisons with ten fixed energy classes (from G to A4).

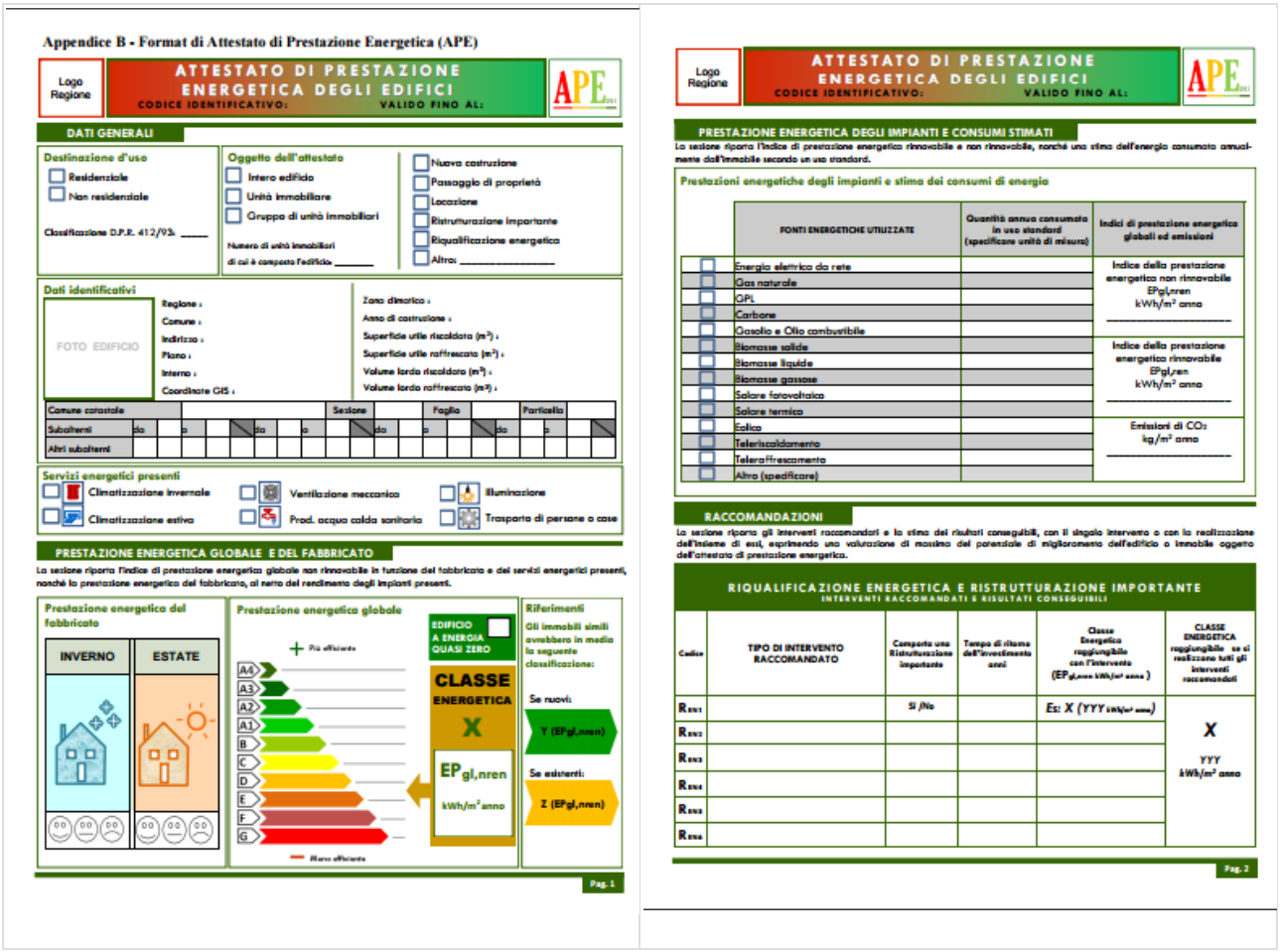


Figure 6. National EPC layout from October 2015, first and second pages.

Better quality is achieved through a mandatory visit of the unit/building before issuing the EPC, while better knowledge of the technical building system is achieved through a link to the heating and air-conditioning (HAC) inspection database. An EPC is valid only if the "*HAC log-book*" from regular inspections is attached.

Recommendations for improvements are mandatory with evidence of payback periods, and class/performance achievable through measures carried out in connection with major renovations and measures for individual building elements or technical building system(s). The expert will report on the feasibility of recommended measures and their cost effectiveness together with calculations and

verifications certifying compliance of the new/renovated building to the standards. The report is not mandatory for minor measures (e.g., replacement of boilers with power <50 kW or replacement of traditional boiler with condensation boilers).

According to Presidential Decree 75/2013[19], the EPC experts have to be qualified for building design (registered at engineers/architects/other experts' associations) or attend a training course (80 hours) undergoing final examinations. Wider use of databases has been experienced in some regions, opening the way to energy planning, insight from local authorities and studies from agencies and academies. In Lombardy, access to the EPC database is completely open (CENED website)[20], allowing interesting utilisations by the industry and investors.

Harmonisation of the EPC system is allowing for centralised support to establish and manage the EPC database in those Italian regions that previously had none. Five additional regions established or began to establish an EPC database in the period 2015-2016. Moreover, the new national information system (SIAPE[21]), will assist regional EPC data analysis and afford knowledge and decision making at the national level.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

From January 2012, it is mandatory to display the energy performance index in the commercial announcements of real estate agencies and, from October 2015, it is mandatory to display a plaque reporting the non-renewable and the renewable energy performance index in terms of primary energy, the energy class and the envelope transmission performance (Figure 7).

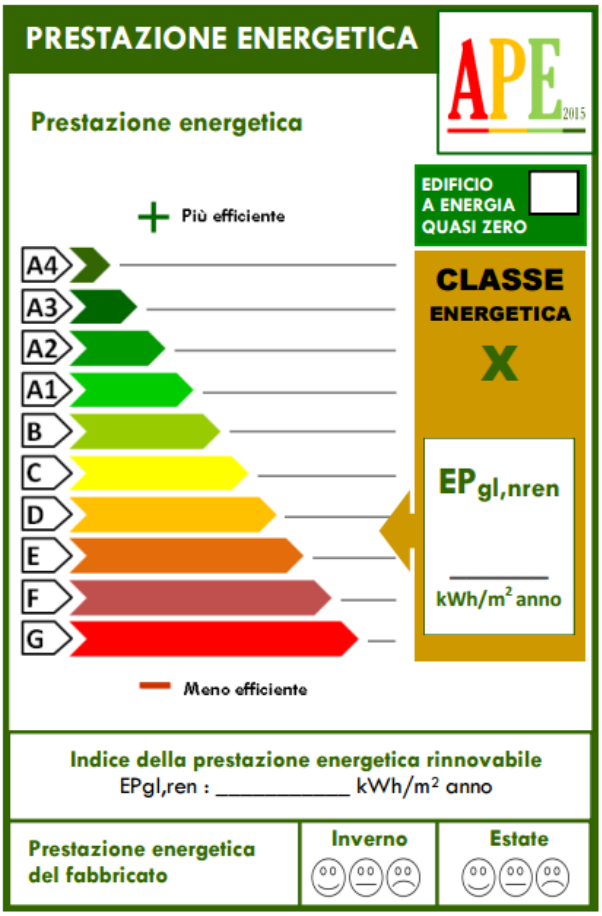


Figure 7. Plaque in commercial advertisements from October 2015.

Sanctions set at the national level are between 500 and 3,000 € for people responsible of defaulting announcements. Regions and autonomous provinces are in charge of control.

2.III.ii. Quality Assurance of EPCs

The regions are responsible for the quality assurance of the EPCs. Some regions have started to perform compliance checks on EPC reports, in numbers of a few hundred controls per year.

The national legislation requires 2% of all EPCs to be annually checked starting from best class EPC. The regions may choose to overcome and adjust this checking rate following an analysis of reports and to perform on-site checks only when strictly necessary. In the Liguria region, for example, controls are performed according to EPBD option c), point 1 of Annex II, "*full verification of the results stated in the certificate, including the recommendations made, and on-site visit of the building*".

The penalties applied by regions range from 300 € to a maximum of 10,000 €, according to the infringement. There is a gradual tolerance of errors depending on number, type and repetition rate, as the system objective is to improve the quality of EPCs, which is considered quite low at present. In case of fraud, the penalty may have penal consequences.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Monitoring the display of EPCs in buildings occupied by public authorities and frequently visited by the public, with a total useful floor area over 500 m^2 and 250 m^2 respectively, has not been implemented in Italian regions so far. This is still to be fully covered by the national legislation. The Piedmont region used to apply this requirement within the projects funded by structural funds for renovations (in almost 300 cases).

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Italy adopted regular inspections for both heating and cooling technical building systems.

2.IV.ii. Progress and current status on heating systems

The responsibility for inspections of heating systems is being transferred from provinces and main cities to regions. The template for heating systems inspections was improved in 2015 (see chapter II, iii). The large majority of inspections will be based on document control, and only 2% will consist of on-site checks. Designers of new heating systems and energy distributors are obliged to provide the documentation of both new heating systems and grid connected clients to the region; this facilitates the control of compulsory maintenance of the systems by the users. Regions are also responsible for the selection and qualification of the inspectors and for the organisation of annual campaigns for the compliance control of inspection reports.

2.IV.iii. Progress and current status on AC systems

The approach followed for inspections of heating systems has been applied to cooling systems. Regular maintenance of AC systems larger than 12 kW is compulsory and a template has been defined for the compulsory report due by the maintenance staff. Regions are responsible for the control of those reports, both through a document analysis and through on-site checks.

Inspectors in charge of this compliance control have to be qualified and certified (at regional level, but equivalences are established nationally), and are contracted by public tenders (if the inspection is performed by a private person or a company), or identified by an agreement (in case of a public organisation).

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

The enforcement of maintenance established penalties for the users in terms of payment of the control(s) and fines. Sanctions for the inspection reports consist of suspension or removal of inspectors from the register.

Quality control of inspection reports

A dozen regions have started the control of the inspection reports, e.g., 27,897 in the Marche region (25% of total inspection reports), and some 133,800 in the Lombardy region (nearly 9% of the total) in 2015.

Detailed information on the results of these controls is not available.

Impact assessment

To date, no assessment study of the impact of technical building systems inspections has been carried out.

3. A success story in EPBD implementation

The new EPC system was the outcome of a positive stakeholder consultation, involving regions, industry, and experts' associations. The shared vision on EPC in the Italian transposition of the EPBD was implemented by the 2015 decree.

Beyond various EPC features, the public consultation asked for better coordination of the action at national level and for a harmonised national EPC information system (named SIAPE) that could improve analysis and use of EPC data, as well as knowledge of the building stock.

SIAPE indicators have been agreed with regions and other key stakeholders. They encompass information from inspections and the reporting of building technical heating and cooling systems. From 2017, regional EPC data are sent to the SIAPE (developed and managed by ENEA) on an annual basis. SIAPE is a multi-tier web portal that allows regions to access and analyse their own raw data, and other users (citizens, trades, local authorities) to retrieve aggregated data. These data will be analysed and published by ENEA. The SIAPE scheme is illustrated in Figure 8.

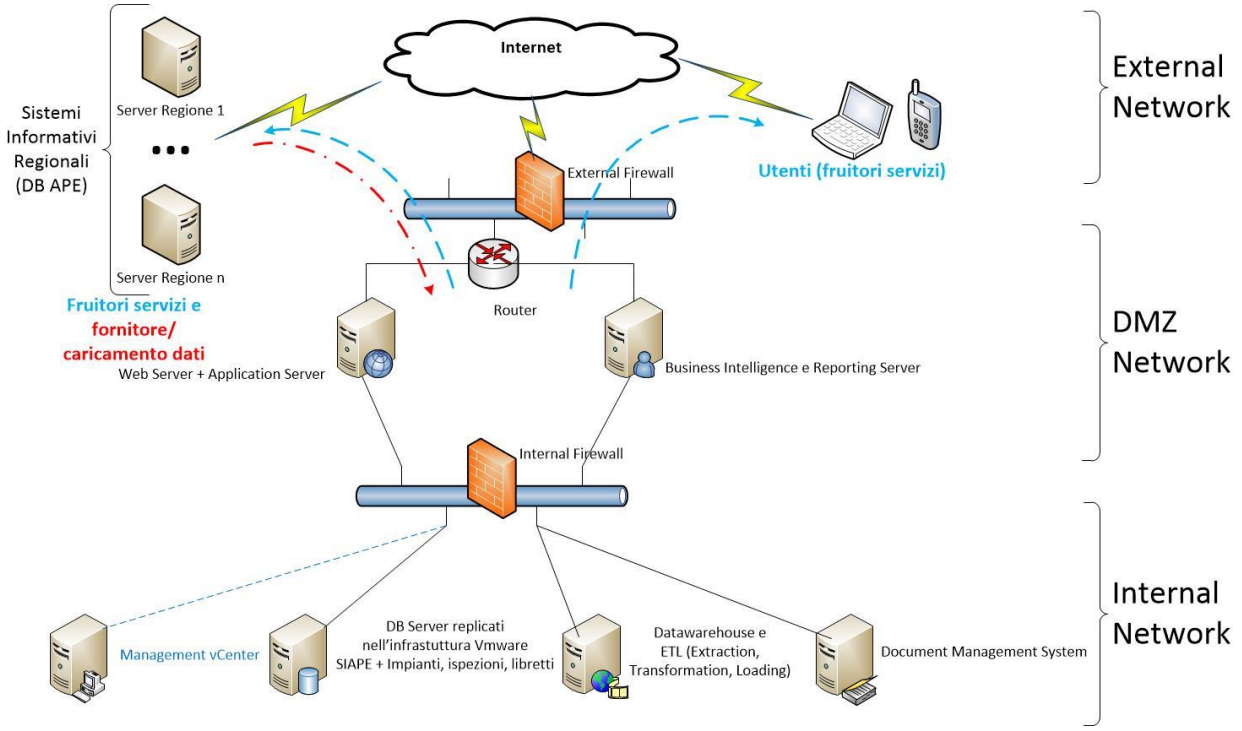


Figure 8. SIAPE Scheme – new national EPC information system (source ENEA).

Interoperability with the existing regional systems is guaranteed, taking into account specificities of regional EPC and technical building systems inspection databases. Compatibility with the building cadastre and other databases (census, national renovation incentives) is being studied. A pilot tool[22] combining EPC data with other databases has been developed as a pilot experience within the IEE Request2Action project, taking advantage of the open EPC database and management experience in the Lombardy region.

The SIAPE will provide the national statistics on the number of EPCs and related controls, average costs for issuing EPCs for different typologies, EPC distribution by energy class and NZEB, and other relevant energy performance data contained in the EPCs. The aim is to facilitate policy making on sustainable building at national and regional levels. Training for regional officers will be assured as well.

4. Conclusions, future plans

Following Law 90/2013, three ministerial decrees, signed on 26 June 2015, completed the implementation of Directive 2010/31/EU, providing:

- an updated energy performance calculation methodology, rules for taking into account the use of RES in buildings and the system boundary;
- new stricter minimum energy performance requirements for buildings and technical building systems and components since 1 October 2015;
- new conversion factors;
- a NZEB definition;
- a new national EPC scheme and guidelines.

Provisions for securing compliance to minimum requirements in new and renovated buildings were provided.

Best practice in EPBD implementation in the period 2015-2016 reside in the inspection of technical building systems, extended to cooling systems, that also resulted in improved maintenance, security and employment, and in the wider use of databases (both EPC and inspections) in some region, integrated at the national level by the establishment of a new national EPC-technical building system centralised database.

The building renovation rate is still below the potential level; a wide range of financing mechanisms are, however, in place and are being continuously strengthened.

Owing to the lack of awareness and resources for renovating to the NZEB level, a stronger effort is needed which also involves the research and academic world. In respect to central public buildings, a complex programme stimulating renovation uptake and monitoring and improving awareness is ongoing.

The display of the EPC in public buildings and the control of commercial EPC advertising from regions and local authorities are currently low priority and need better direction.

Different communication campaigns are in place and further initiatives are under preparation.

Endnotes

1. *DECRETO LEGISLATIVO 19 agosto 2005, n. 192 Attuazione della direttiva 2002/91/CE relativa al rendimento energetico nell'edilizia*
2. *DECRETO LEGISLATIVO 29 dicembre 2006, n. 311 Disposizioni correttive ed integrative al decreto legislativo 19 agosto 2005, n. 192, recante attuazione della direttiva 2002/91/CE*
3. *LEGGE 3 agosto 2013, n. 90. Conversione in legge, con modificazioni, del decreto-legge 4 giugno 2013, n. 63, recante disposizioni urgenti per il recepimento della Direttiva 2010/31/UE del Parlamento europeo e del Consiglio del 19 maggio 2010, sulla prestazione energetica nell'edilizia*
4. *Decreto interministeriale 26 giugno 2015 – "Applicazione delle metodologie di calcolo delle prestazioni energetiche e definizione delle prescrizioni e dei requisiti minimi degli edifici"*
5. Reference standards for EP calculation UNI/TS 11300
6. UNI EN 15193:2008, "Energy performance of buildings - Energy requirements for lighting"
7. The reference building is defined as a virtual building which has the same localisation and is geometrically equivalent to that considered in the project, but with thermo-physical characteristics corresponding to the minimum energy requirements in force.
8. Fixed RES use for new buildings as ratio for domestic hot water, heating and cooling services and obligation to install mandatory RES plants for electricity production are set in RESD implementation Decree 28/2011.
9. Law n. 90/2013, converting Decree 63/2013 "Transposition of Directive 2010/31/EU on Energy Performance of Buildings (Official Journal of the Italian Republic, general n.181, August 2013).
10. Draft Decree "*Piano d'azione nazionale per incrementare gli edifici a energia quasi zero (PANZEB)*", published by the Ministry of Economic Development in November 2015 and recently agreed by the Unified Conference State-Regions (22 December 2016).

11. e.g., Bozen province awards a 15-20% energy bonus consisting of the right to a surplus volume for best class buildings that overcome minimum energy requirements.
12. *LEGGE 13 luglio 2015, n. 107. Riforma del sistema nazionale di istruzione e formazione e delega per il riordino delle disposizioni legislative vigenti.*
13. According to the aforementioned decree 26/06/2015 "Minimum Requirements" (see note 4)
14. "*Strategia per la Riqualificazione Energetica del Parco Immobiliare Nazionale*" (STREPIN), published in November 2015 by the Ministry of Economic Development. http://www.sviluppoeconomico.gov.it/images/stories/documenti/STREPIN_13_11_2015.pdf
15. "*Programma di riqualificazione energetica della Pubblica Amministrazione centrale"* (PREPAC), to annually improve efficiency of 3% of the floor area of central government buildings according to EED Article 5. The Ministry of the Environment and of the Ministry of Economic Development, supported by ENEA, Italian National Agency for New Technologies, Energy and Sustainable Development and GSE, coordinate and monitor the development of the programme.
16. As an example, in a public school in Cesena (Northern Italy) access to this subsidy resulted in thermal heat consumptions being reduced by 77% (saving 58,000 €/year) and zero-electricity bill through 65 kWp photovoltaic installation.
17. According to the National Decree D.P.R. 74/2013.
18. E.g., the *Edilportale* Tour on renovation, recognised by the ministry and by public authorities-bodies, reached 20 Italian cities with 14,000 attendees in 2016.
19. *DPR 16 aprile 2013, n. 75 "Regolamento recante disciplina dei criteri di accreditamento per assicurare la qualificazione e l'indipendenza degli esperti e degli organismi a cui affidare la certificazione energetica degli edifici…"*
20. Energy Cadastre of Lombardy Region, CEER. The website (www.cened.it/opendata_cenedplus2) allows users to display and download the whole dataset of EPCs: building unit location, energy performance index, energy rating, geometry, technical building systems using fossil fuels and RES.
21. "*Sistema Informativo sugli Attestati di Prestazione Energetica*" (SIAPE), set by the Decree of 26 June 2015 "Guidelines for Energy Performance Certification" and managed by ENEA, http://www.efficienzaenergetica.enea.it/regioni/siape
22. *DIPENDE tool, "Database Integrato per la Pianificazione ENergetica dei Distretti Edilizi",* www.portale4e.it

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Latvia

Status in December 2016

AUTHORS

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NATIONAL WEBSITES
www.em.gov.lv

1. Introduction

In Latvia, the implementation of the EPBD is the overall responsibility of the Ministry of Economics. The Ministry of Economics develops and implements the national energy efficiency policy, including the transposition of the EPBD. The necessary laws and regulations for transposing the EPBD were adopted at the end of 2014 and are currently all in force. This report presents an overview of the current status of the implementation of the EPBD in Latvia. It addresses requirements for the energy performance of buildings, for technical building systems, EPCs and inspections, and includes experiences with EPBD implementation as well as future plans.

The main legislative acts concerning the energy performance of buildings consist of:

- the Law on the Energy Performance of Buildings (*LEPB*) that was adopted in the Latvian Parliament *Saeima* and came into force on 9 January 2013[1];
- Cabinet Regulation No. 383 of 9 July 2013, "*Regulations regarding Energy certification of Buildings*" (Regulation No. 383)[2];
- Cabinet Regulation No. 348 of 25 June 2013, "*Building energy performance calculation method*" (Regulation No. 348)[3];
- Cabinet Regulation No. 382 of 9 July 2013, "*Regulations Regarding Independent Experts of Energy Performance of Buildings*" (Regulation No. 382)[4];
- Cabinet Regulation No. 339 of 30 June 2015, "*Regulations of Latvian Building Norm LBN 002-15 "Thermal requirements of the buildings envelopes*" (LBN 002-15)[5].

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

The minimum energy performance requirements for new buildings are laid out in LBN 002-15 which includes requirements for building envelope U-values, and in Regulation No. 383 including minimum permissible level of energy performance of buildings.

2.I.i. Progress and current status of new buildings

Before 1980, building envelope characteristics were based on calculations for preventing moisture from forming on the inner surface of the outer walls, and for preventing freezing through the walls. For properly constructed buildings, the envelope heat transfer coefficient U-value was usually less than 1.3 W/(m^2 K). From 1980 onwards, buildings were built in accordance with a formal USSR Standard for the thermal resistance of the envelope, e.g., improving wall U-values to 1.1 W/(m^2 K). Significantly more demanding requirements were adopted by the Ministry of Architecture and Construction of the Republic of Latvia in September 1991. Since 2003, the LBN 002-15 (approved in 2001 and tightened in 2015 following cost-optimal studies) has been in force. Requirements for the minimum permissible level of energy consumption for heating (amendments in Regulation No. 383) were set in 2015.

2.I.ii. Format of national transposition and implementation of existing regulations

The energy performance calculation methodology is applicable for new and reconstructed[6] or renovated[7] buildings, as well as for existing buildings. The energy performance calculation methodology is described in Regulation No. 348. The regulations have determined that the building energy performance calculation procedure shall include thermal comfort, indoor air quality, infiltration, thermal bridges and shading devices. The building energy performance class indicator corresponds to the value which was established according to the energy consumption used to heat the building. The energy performance calculation methodology is based on the corresponding CEN Technical Report CEN/TR 15615:2009 and on Standard EN ISO 13790:2008 conditions and includes references to the 16 other CEN standards. The energy performance calculation methodology uses the primary energy factor for the non-renewable part. Primary energy factor values are shown in Table 1.

No.	Energy carrier or energy source		Primary energy factor of non-renowable part, *f*p.
1.	Fuels	Diesel fuel	1.1
2.		Natural gas	1.1
3.		LPG	1.1
4.		coal (anthracite)	1.1
5.		brown coal (lignite)	1.2
6.		biogas	0.5
7.		wood	0.2
8.	Central heating system, thermal energy produced in cogeneration*	fossil fuel	0.7
9.		renewable fuel	0.0
10.	Central heating system, thermal energy produced without cogeneration	fossil fuel	1.3
11.		renewable fuel	0.1
12.	Electricity	from electrical power networks	1.5
13.		from fossil resources	2.0
14.		from renewable energy sources, which is produced within the borders of the technical building systems	0.0
15.	Wind, solar, aerothermal, hydrothermal and sea energy, hydraulic energy		0.0

* The value corresponds to a heat supply system with 70% output from cogeneration.

Table 1. Primary energy factor values in Latvia

2.1.iii. Action plan for progression to NZEB for new buildings

The definition of NZEB was transposed into Regulation No. 383 in 2013. A cost-optimal study in 2014 showed that the defined level of NZEB (30 kWh/m^2 for heating) was difficult to achieve for almost all building types and the NZEB level was far from being cost-optimal, as the cost-optimal levels (for heating) were between 80-90 kWh/m^2. Based on this conclusion, the NZEB definition was revised in 2015. Currently, the NZEB definition (40 kWh/m^2 threshold for residential buildings and 45 kWh/m^2 threshold for non-residential buildings) is a lot closer to the cost-optimal level. The amendments to Regulation No. 383 also included building class rescaling and a plan to reach the NZEB level for new buildings by 2021.

Currently, a building shall be classified as a NZEB if it meets all the following requirements:

- The building energy performance indicator corresponds to Class A by concurrently ensuring conformity of indoor climatic conditions with the requirements of the laws and regulations in the field of construction, hygiene and labour protection.
- The total primary energy consumption for heating, domestic hot water supply, mechanical ventilation, cooling and lighting accounts for no more than 95 kWh/m^2.year.
- High-efficiency systems are used in the building, which ensure:
    - recovery of no less than 75% of the ventilation heat loss during the heating season;
    - the, at least partial, use of RES (RES>0).
- There is no low efficiency fossil fuel heating equipment installed in the building[8].

Building classes are presented in Table 2 and a plan to reach the NZEB level for new buildings is given in Table 3.

Class	comparative assessment scale (calculated energy rating for heating)	
	for residential buildings	for non-residential buildings
	kWh/m^2 per year	kWh/m^2 per year
A	Class A ≤ 40 kWh/m^2	Class A ≤ 45 kWh/m^2
B	40 kWh/m^2 < Class B ≤ 60 kWh/m^2	45 kWh/m^2 < Class B ≤ 65 kWh/m^2
C	60 kWh/m^2 < Class C ≤ 80 kWh/m^2	65 kWh/m^2 < Class C ≤ 90 kWh/m^2
D	80 kWh/m^2 < Class D ≤ 100 kWh/m^2	90 kWh/m^2 < Class D ≤ 110 kWh/m^2
E	100 kWh/m^2 < Class E ≤ 150 kWh/m^2	110 kWh/m^2 < Class E ≤ 150 kWh/m^2
F	150 kWh/m^2 < Class F	150 kWh/m^2 < Class F

Table 2. Building energy classes in Latvia

No.	Time period of approval of a construction intention (building permit documentation)	Minimum permissible level of energy performance of buildings, energy performance assessment for heating of new buildings			
		for residential buildings		for non-residential buildings	
		multi-apartment buildings	one-apartment or two-apartment buildings	buildings which are owned by the State and in the possession of the authorities and where the State authorities are located	other non-residential buildings
1	2	3	4	5	6
1.	Until 31 December 2016	≤ 70 kWh/m^2 per year	≤ 80 kWh/m^2 per year	≤ 100 kWh/m^2 per year	≤ 100 kWh/m^2 per year
2.	From 1 January 2017 to 31 December 2017	≤ 60 kWh/m^2 per year	≤ 70 kWh/m^2 per year	≤ 90 kWh/m^2 per year	≤ 90 kWh/m^2 per year
3.	From 1 January 2018 to 31 December 2018	≤ 60 kWh/m^2 per year	≤ 70 kWh/m^2 per year	≤ 65 kWh/m^2 per year	≤ 90 kWh/m^2 per year
4.	From 1 January 2019 to 31 December 2020	≤ 50 kWh/m^2 per year	≤ 60 kWh/m^2 per year	NZEB	≤ 65 kWh/m^2 per year
5.	From 1 January 2021 and hereinafter	NZEB	NZEB	NZEB	NZEB

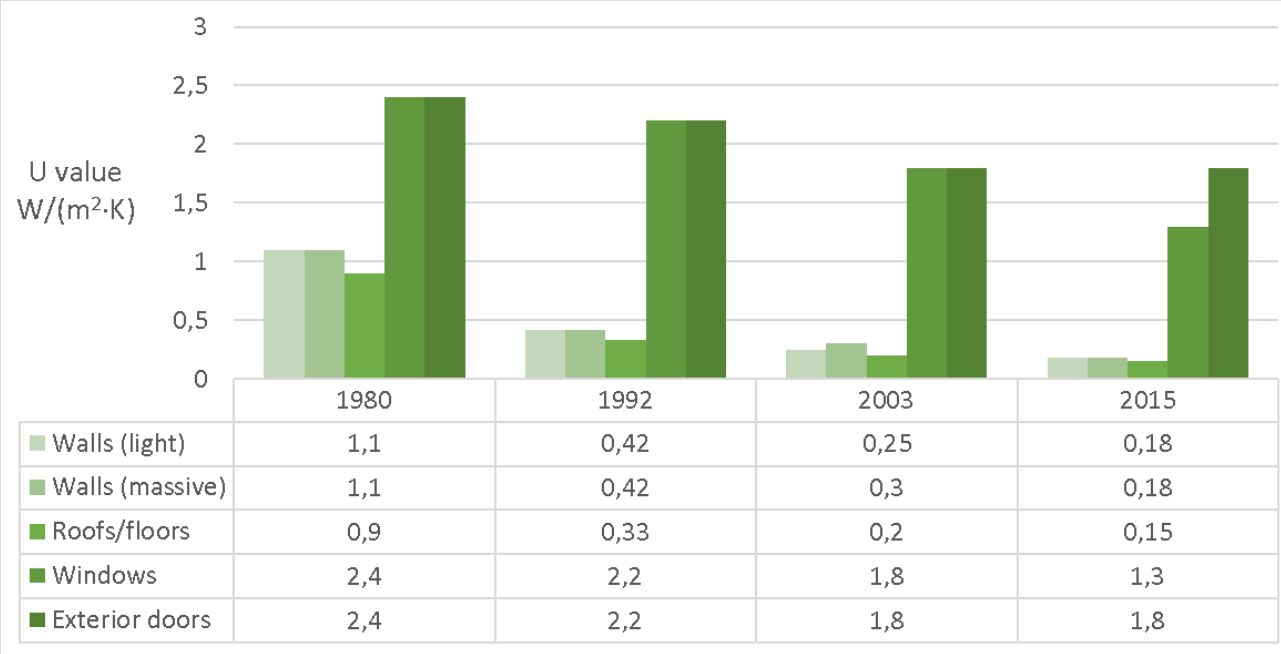
Table 3. Timeplan for reaching the NZEB level for new buildings.

2.I.iv. Requirements for systems and / or building components for new buildings

Design requirements for heating systems concern the minimum permissible level of the energy performance of buildings (Regulation No. 383) and for the envelope values (LBN – 002-15). Design requirements for hot water, cooling, ventilation and lighting systems are based on construction laws and the related building codes, with references to applicable standards. The design requirements for the primary energy level are set for NZEB only. Changes for the requirements of the building envelopes for residential buildings are shown in Table 4 and Figure 1.

Building components		1980	1992	2003	2015
Roofs and floors in contact with the outdoor air	W/ (m²·K)	0.90	0.25 - 0.40	0.2 k*	0.15 k
Floors on the ground		-	0.5	0.25 k	0.15 k
The outer wall of a mass of less than 100 kg / m²		1.1	0.33 - 0.50	0.25 k	0.18 k
The outer wall of a mass of less than 100 kg / m²				0.3 k	
Windows		2.4	1.9 - 2.4	1.8 k	1.30 k
Building exterior doors		2.4	1.9 - 2.4	1.8 k	1.80 k
Thermal bridges		-	-		
* Temperature factor **k** = 19/($T_{ind.}$ - T_{outd}), depending on climate zones **k** for residental buildings is from 0,95 (Liepāja) to 1,09 (Alūksne)					
Approximate energy consumption for heating	kWh/m² per year	150 - 200	100 - 130	70 - 90	60 - 85

Table 4. Changes for the requirements of the building envelopes for residential buildings



	1980	1992	2003	2015
Walls (light)	1,1	0,42	0,25	0,18
Walls (massive)	1,1	0,42	0,3	0,18
Roofs/floors	0,9	0,33	0,2	0,15
Windows	2,4	2,2	1,8	1,3
Exterior doors	2,4	2,2	1,8	1,8

Figure 1. Changes for the requirements of the building envelopes for residential buildings

2.II. Energy performance requirements: EXISTING BUILDINGS

The energy performance calculation methodology for existing buildings is the same as for new buildings. Also, the requirements for the individual parts of the building envelopes are the same for renovations and for new buildings. Differences are in the minimum permissible level of the energy performance of buildings, with requirements shown in Table 5. Based on EPBD requirements, Latvian regulations allow for the minimum energy performance requirements not to be applicable to buildings under reconstruction or renovation, if the application of these requirements is not technically, functionally or economically feasible. In the latter case (economic feasibility), Regulation No. 348 provides calculations according to Standard EN 15459:2008.

No.	Time period of approval of a construction intention	Minimum permissible level of energy performance of buildings, energy performance assessment for heating of existing buildings undergo renovation.			
		for residential buildings		for non-residential buildings	
		multi-apartment buildings	one-apartment or two-apartment buildings	buildings which are owned by the State and in the possession of the authorities and where the State authorities are located	other non-residential buildings
1	2	3	4	5	6
1.	From 21 November 2015 and hereinafter	≤ 90 kWh/m^2 per year	≤ 100 kWh/m^2 per year	≤ 110 kWh/m^2 per year	≤ 110 kWh/m^2 per year

Table 5. Minimum permissible level of the energy performance of buildings.

2.II.i. Progress and current status of existing buildings

The minimum energy performance requirements for existing residential buildings, i.e., the permissible level of the energy performance of a building, which, if exceeded, obliges the building owner to undertake measures for the improvement of the energy performance, is determined in Cabinet Regulation No. 907 of 28 September 2010, "*Regulations Regarding the Survey, Technical Servicing, Current Repairs and Minimal Requirements for Energy Efficiency of the Residential House*"[9]. Regulation No. 907 states that the administrator of a multi-family residential building shall plan measures for improving the energy efficiency, including the renovation of the building, if the average thermal energy consumption (heating and domestic hot water) within the last three calendar years has exceeded 200 kWh/m^2 per year, or 150 kWh/m^2 per year if the heat is only used for heating.

2.II.ii. Plans to improve the existing building stock

In 2012, the Ministry of Environmental Protection and Regional Development started a project called "*Low Energy Buildings" (LEB)* within the Latvian governmental programme of "*Climate Change Financial Instrument" (CCFI*)[10]. The *LEB* project supported the construction of new buildings and the reconstruction of existing ones to achieve target values. Within the *LEB*, 14 different pilot projects were carried out for different building types. All projects were finished but could not be cost-efficient for the owner without an external source of financing (grants). Based on these results, minimum energy performance requirements are based on cost-optimal values only, which means that the NZEB level for existing buildings is not mandatory.

In the future, Latvia must contribute to common EU targets, e.g., a long-term 2050 goal of reducing greenhouse gas emissions by 80-95% compared to 1990. According to the "*Clean Energy for all Europeans*" package of amendments to the EPBD, Latvia will indicate a target to decarbonise its national building stock. This target will be included in Latvia's next long-term renovation strategy (next strategy update will be made in 2020).

2.II.iii. Regulation of system performance, distinct from whole building performance

Design requirements for the heating system concern the minimum permissible level of the energy performance of buildings (Regulation No. 383), as well as envelope values (LBN – 002-15). Projecting requirements for domestic hot water, cooling, ventilation and lighting systems are based on construction laws and the related building codes, with references to applicable standards. The projecting requirement for the primary energy level is set for NZEB only.

2.II.iv. Encouragement of intelligent metering

In 2015, Latvia amended Cabinet Regulation No. 876 of 21 October 2008, "*Regulations Regarding the Supply and Use of Thermal Energy*". The amendments state that in multi-family apartment buildings and non-residential buildings in which residents must mutually divide the bill for the consumed thermal energy, the authorised person shall divide the amount of consumed thermal energy using measuring devices installed in each apartment. If the use of such measuring devices is not technically possible or profitable, heat-cost allocators shall be used. This requirement shall be fulfilled for buildings that received their building permit after 1 January 2016 and whose thermal energy is provided from a central source.

2.II.v. Financial instruments and incentives for existing buildings

Funding activities for buildings during the period 2014 – 2020 include:

- activities to promote the efficient use of energy resources, reducing energy consumption and transitioning to RES in the manufacturing sector[11] (grant programme for industrial and commercial sector building renovations);
- activities to promote energy efficiency in residential buildings[12] (grant programme for multi-residential sector building renovations);
- activities to promote energy efficiency in state buildings[13] (renovation programme to ensure the target fulfilment of Directive 2012/27/EU for central government buildings);
- activities to promote energy efficiency in local municipality buildings[14] (renovation programme to ensure the target fulfilment of Directive 2012/27/EU for local government buildings);
- emission allowances auctioning tool[15]
    - greenhouse gas emissions reduction – activities for low-energy buildings (programme to promote NZEB and the exemplary role of public buildings);
    - greenhouse gas emissions reduction of national significance for protected architectural monuments (specific programme for renovations of architectural monuments);
- other activities which include building renovations[16].

2.II.vi. Information campaigns / complementary policies

A campaign named "*Living warmer*"[17] for promoting the energy performance of buildings in Latvia (Figure 2) has been running since 2010. The key objective of the "*Living warmer*" campaign is to inform households about the existence and the conditions of support programmes in the EU 2007-2013 and EU 2014-2020 planning periods. More than 200 informative events have been held throughout Latvia, which included a variety of public debates, seminars, conferences and exhibitions, involving more than 8,500 participants in total.



Figure 2. "Living warmer" campaign.

Since 2011, the competition "*Energy efficient building in Latvia*"[18] has been held to promote the good practice of implementing energy efficiency in the building sector, as well as implementing energy-efficient building construction, renovation and reconstruction.

The Energy Efficiency Center[19] of the public energy generation company *JSC Latvenergo* and *Zemgales* Regional Energy Agency[20] advise the public and private sectors about ways to use electricity and heating energy efficiently.

The Energy Efficiency Information Center of Riga's municipality agency organises seminars on the quality of renovations and provides information and advice about energy efficiency, including free advice about preparing applications for renovations and energy audits.

2.III. Energy performance certificate requirements

The certification of the energy performance of a building is performed:

- for a building to be constructed, reconstructed or renovated, in order to accept it for service or to sell;
- for an existing building or building unit, in order to sell, rent or lease it, if the certification of the energy performance is requested by the purchaser, tenant or lessee;
- for an existing public building in the state or local government ownership, the heating area of which exceeds 250 m^2;
- upon request by the building owner.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Latvia is currently amending the *LEPB*, which includes improved requirements for EPC issuing and sanctions.

2.III.ii. Quality Assurance of EPCs

The *Building Information System (BIS)*, which is an electronic site that brings together all the information about the construction process and the parties involved, including a *Register of Independent Experts in the Field of Energy Performance of Building*s and a *Register of Certificates of Energy Performance of Buildings*, has been implemented since 2016. As of October 2017, 4,936 EPCs or temporary EPCs have been issued. Regulation No. 382 states that the *State Construction Control Office* analyses data registered in the *BIS* (EPCs and temporary EPCs, as well as heating and AC system inspection reports) and periodically selects documents of independent experts for random testing purposes. According to the regulation, the control office also designates an appropriate certification authority to inspect the selected documents. Also, for every project claiming European funding, energy performance compliance is required. In any other building, if a complaint is received, the certification body must check the EPC, energy audit or inspection report received by the qualified experts. In case of a violation, the certification body could apply penalty points.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The obligation to issue an EPC for public and large buildings visited by the public is only mandatory if the building owner is the central or local government. State building certifications are still in process. At this point, 30% of state-owned government buildings have an EPC. The delay in implementation is due to the fact that the activity to promote energy efficiency in state buildings[13] had only started at the end of 2016, with the EPC being one of the requested documents. Issuing an EPC is rational and cost-efficient when the building is participating in the aforementioned programme.

2.III.iv. Implementation of mandatory advertising requirement – status

The *LEPB* decrees that advertisements for the sale, rent or lease of any building or building unit should display the energy performance indicators of the building or building unit if the certification of the energy performance of the building has already been performed in accordance with the procedures specified in this law. This requirement is not fully effective, as there is no penalty system. Latvia has been developing a more ambitious penalty system since 2017.

2.IV. Inspection requirements – heating systems, air conditioning

Inspection requirements are included in the *LEPB* and in Regulation No. 383. Latvia has implemented an inspection scheme based on the requirements in EPBD Article 14 and Article 15, points 1, 2, and 3.

2.IV.i. Report on equivalence of model A and B for Heating Systems

Cabinet Regulation No. 383 determines that the inspection of boilers and heating systems is mandatory for heating systems with a boiler with an effective rated output of over 20 kW, as well as for AC systems with an effective rated output of over 12 kW. The inspection of boilers must be done in accordance with Standard LVS EN 15378:2009 L, "*Energy performance of buildings: Inspection of boilers and heating systems*"[21]. The inspection of AC systems must be done in accordance with Standard LVS EN 15240:2009 L, "*Ventilation for Buildings -Energy performance of buildings: Guidelines for the inspection of air-conditioning systems*"[22].

2.IV.ii. Progress and current status on heating systems

There are only 18 registered inspection reports in the *BIS* (data from April 2017). This indicates that the current inspection scheme is an ineffective tool which requires improvement. One possible reason for this insufficiency is a lack of control mechanisms. However, if the inspection scheme gave significant improvements, the free market would already have adopted it, regardless of whether or not control mechanisms were in place. The main obstacle could be the fact that improvements for small buildings (with a threshold of 20 kW for heating and 12 kW of AC) are usually not cost-efficient; thus, issuing an inspection deed is more of a burden than a potential gain. Another possible reason is that the EED audit scheme and the EPC inspection scheme partly overlap, thereby giving the impression that an inspection is an unnecessary financial burden. The Ministry of Economics aims to revise the current inspection scheme before the new EPBD transposition deadline.

3. A success story in EPBD implementation

With an aim to digitalise the documentation of the entire construction process, Latvia has intorduced the *BIS* which also offers public access to the *Register of Independent Experts in the Field of Energy Performance of Building*s and the *Register of Certificates of Energy Performance of Buildings.* This digitalisation process lessens the administrative and paperwork burden involved with the certification of qualified experts, as any new information is always available online for anyone to check. Implementing the *BIS* will give access to better statistical data and lead to a better understanding of how requirements work in practice.

As explained in the second section of this report, Regulation No. 907 determines the permissible level of the energy performance of a building, which must not be exceeded, lest the building owner be obliged to undertake measures for its improvement. Buildings that exceeded this level were identified in the past, with the relevant building owners receiving informative letters. This is not intended as a punishable clause and no penalties have been applied so far. It gives the administrator of a multi-apartment residential building the possibility to take mandatory actions without having to go through the usual voting procedure required of apartment owners. This is however only possible in cases where the average thermal energy consumption of the residential house within the last three calendar years has exceeded 200 kWh/m^2 per year, or 150 kWh/m^2 if the heat is only used for residential building heating. In some cases, this requirement can trigger the need for complex renovations; in other cases it will only trigger a single measure, for example, a simple change to the attic insulation. Still, this does not allow a multi-family building administrator to start a large-scale renovation that would have significant financial implications without the owners' consent. The consent through the owner voting procedure remains necessary if the improvement of the energy performance system would require a building permit from a building authority.

This mechanism is very effective for multi-family buildings where small-scale energy performance improvements are required and it is difficult to get all owners' consent. Also, it is an effective tool for encouraging the building administrator to start actively informing apartment owners about the benefits of energy performance and the need to improve it, as well as to trigger the owner voting procedure for large-scale renovation works, especially in cases where the administrator only does the bare minimum.

4. Conclusions, future plans

Latvia will develop further policies and take additional measures to improve the existing legal framework for the energy performance of buildings.

Latvian short-term plans are:

- to improve quality assurance systems with random EPC quality checks (in 2017);
- to create a more ambitious sanctioning system for issuing EPCs (during 2017-2018);
- to plan a revision of the qualified expert monitoring scheme (during 2017-2018);
- to carry out second cost-optimal calculations (during 2017-2018);
- to implement a new CEN standards package (during 2018-2019).

Latvian mid- and long-term plans are:

- to take measures to increase the number of NZEB based on NZEB requirement realisation and second cost-optimal calculation results, as well as to consider possible changes to definitions and requirements;
- to implement EU's *Clean energy for all Europeans* package (amendments to the EPBD);
- to define targets for the decarbonisation of the national building stock and integrate them in the next long-term renovation strategy;
- to plan a revision of the inspection schemes.

Endnotes

1. https://likumi.lv/doc.php?id=253635
2. http://vvc.gov.lv/image/catalog/dokumenti/Cab.%20Reg.%20No.%20383%20-%20Regulations%20Regarding%20Energy%20Certification%20of%20Buildings.docx
3. http://vvc.gov.lv/export/sites/default/docs/LRTA/MK_Noteikumi/Cab._Reg._No._348_-_Calculating_the_Energy_Performance_of_a_Building.pdf
4. http://vvc.gov.lv/export/sites/default/docs/LRTA/MK_Noteikumi/Cab._Reg._No._382_-_Independent_Experts_of_Energy_Performance_of_Buildings.doc
5. https://likumi.lv/ta/id/275015-noteikumi-par-latvijas-buvnormativu-lbn-002-15-eku-norobezojoso-konstrukciju-siltumtehnika-
6. Reconstruction or construction work as a result of changes to the dimension of a structure or a part of a structure, or as a result of the strengthening of the load-bearing elements with or without changing the type of use.
7. Renovation or construction work as a result of changes to the load-bearing elements of a structure, or if functional or technical improvements have been performed without changing the dimension of the structure or the load-bearing capacity of the elements.
8. Control-checking decisions are left to qualified experts. Usually the existing building equipment parameters are compared with new equipment parameters available in the market. If the installed equipment is significantly less efficient than what is available in the market, the requirement is not fulfilled and the building is classified as Class A level but is not considered an NZEB building.
9. http://vvc.gov.lv/image/catalog/dokumenti/Cab.%20Reg.%20No.%20907%20-%20Survey%20of%20the%20Residential%20House.docx
10. www.varam.gov.lv/lat/darbibas_veidi/KPFI/projekti/?doc=11775
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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Lithuania

Status in December 2016

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NATIONAL WEBSITES

www.am.lt, www.enmin.lt, www.spsc.lt, www.betalt.lt, www.ena.lt, www.vei.lt

1. Introduction

The Ministry of Environment and the Ministry of Energy are jointly responsible for the transposition and implementation of the EPBD in Lithuania.

Directive 2010/31/EU and the national calculation of cost-optimal levels of minimum energy performance requirements have been transposed into Lithuanian laws as planned, so that Lithuania is on track towards implementing relevant requirements. The main requirements were set up through the Law on Construction and the Law on Energy, and were further detailed in technical regulations, distributing energy efficiency requirements throughout all steps of planning, designing and constructing buildings.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

Certification, as a mandatory requirement for new buildings, came into force on 1 January 2007. New buildings, including building units, must be certified after the construction is completed. The energy performance class of new buildings and building units must not be lower than A when the permit for the construction works is undertaken after 1 November 2016. The permit for construction will therefore not be issued if the energy efficiency class of the designed building is not in line with mandatory requirements.

2.I.ii. Format of national transposition and implementation of existing regulations

The main provisions for the energy performance and the certification of the energy performance of buildings are described in the Law on Construction and the Law on Energy for the Republic of Lithuania. The calculation procedure is defined in the Building Technical Regulation STR 2.01.02:2016 "*Design and Certification of Energy Performance of Buildings*", adopted on 11 November 2016 by Order No. D1-754 of the Minister of Environment[1]. Additional rating definitions of low energy buildings, which are applicable to buildings of energy efficiency classes B, A and A+, and NZEB of class A++, are introduced in the updated regulation that came into force on 1 January 2017.

The current calculation scheme is slightly different for new buildings and existing buildings before and after major renovations.

The building energy performance class is determined in accordance with the values of the building parameters, including:

- the calculated specific heat loss of the building envelope;
- building tightness;
- mechanical ventilation with heat recovery system technical indicators;
- energy consumption for heating buildings;
- building partitions between the floors and the spans of thermal properties;
- the building energy performance indicator C1 value, describing the non-renewable primary energy efficiency of heating, ventilation, cooling and lighting;
- the building energy performance indicator C2 value, describing the primary non-renewable energy efficiency domestic hot water preparation; and
- the building energy consumption of RES.

The Building Technical Regulation STR 2.01.02:2016 includes the requirements for cost-optimal levels of minimum energy performance requirements for all categories of buildings, both new and existing.

The requirements for new single-family, multi-family, office and educational buildings on a cost-optimal level are based on the "financial" calculation with a 3% real discount rate (1,080 cases of calculations, which were calculated to set the cost-optimal levels).

According to the results of the calculation, the difference between the cost-optimal level of new buildings and normative requirements of the Regulation No. 244/2012, delegated by the European Commission, range approximately between -34% until 2016 (Class B) and -10 % after 2016 (class A).

Requirements set as U-values in W/(m^2.K) for residential buildings

Building element	Normative U-value, W/(m^2.K)			
	Class B	***Class A***	***Class A+***	**Class A++**
Roofs	0.16	0.10·κ	0.10·κ	0.080·κ
Ceiling in contact with outdoor air				
Building elements in contact with ground	0.25	0.14·κ	0.14·κ	0.10·κ
Ceilings over unheated basements and crawls				
External walls	0.20	0.12·κ	0.13·κ	0.10·κ
Windows and transparent building elements	1.6 [1)]	1.0·κ	1.0·κ	0.70·κ
Doors and gates	1.6	1.4·κ	1.0·κ	0.70·κ
1) If the total area of windows and other transparent building elements exceeds 25% of the total external wall area, the U-value of transparent elements shall not exceed 1.3 W/(m^2.K).				
2) k = 20/(θ_i – θ_e),– temperature correction factor, where θ_i = indoor air temperature in Celsius, θ_e = outdoor air temperature or design temperature of adjacent space in Celsius. Temperature of unheated spaces is determined separately. If indoor air temperature θ_i = 20^{o}C and outdoor air θ_e = 0^{o}C, then k = 1.				

Table 1. Normative requirements for the thermal protection of residential building envelopes.

The following factors shall conform to the requirements for the design of buildings and the certification of the EPBD:

	For class C buildings:	For class B low energy buildings:	For class A, A+ and A++ buildings:
1.	a) heat transfer coefficient, W/K,	a) heat transfer coefficient, W/K;	a) heat transfer coefficient, W/K;
2.	b) energy performance indicator "C_1" value	b) energy performance indicators "C_1" and "C_2" values	b) energy performance indicators "C_1" and "C_2" values
3.	___	c) calculated annual energy consumption for heating, kWh/m^2 per year;	c) calculated annual energy consumption for heating, kWh/m^2 per year;
4.	___	d) calculated airtightness of building	d) airtightness test of building
5.	___	___	f) efficiency of heat recovery equipment in ventilation system of a building;
6.	___	___	e) part of the RES (for class A++)

Table 2. Requirements for energy performance classes of buildings.

2.I.iii. Action plan for progression to NZEB for new buildings

The national NZEB plan describes the main steps towards increasing the number of NZEB in Lithuania. The new calculation methodology according to EPBD requirements was prepared and has been valid since February 2017. The calculation software tool was also corrected to reflect the changes in the calculation methods[2]. The default selection data in the software, in the form of selection tables, are expanded.

Additional rating definitions of low energy buildings, which are applicable to buildings of energy efficiency classes B, A and A+, and NZEB (class A++), are introduced in the Building Technical Regulation STR 2.01.02:2016.

The minimum energy performance class of new buildings and building units are being progressively tightened towards NZEB based on the energy efficiency classes:

- from 2016 - the energy performance class must be at least A;
- from 2018 - the energy performance class must be at least A+;
- from 2021 - the energy performance class must be at least A++.

The default heat transmission coefficient values of each element of the building envelope of a designed building are set by:

- normative values taken from the requirements of National Building Technical Regulation STR 2.05.01:2013 "*Thermal Technique of the Buildings' Envelopes*" for classes B and C;
- normative values taken from the supplementary Tables for classes A, A+ and A++;
- reference values corrected according to the changes in construction during the considered period;
- calculated values determined by the same mode, as in the previous edition.

Cost-optimal levels were calculated for new and existing single-family houses or two-apartment houses, multi-story residential buildings, and educational and administrative buildings, according to the

requirements of the Commission Delegated Regulation (EU) No 244/2012 and Guidelines 2012**/**C 115/01**.** Determining cost-optimal levels for NZEB was not the main purpose of these calculations, but their findings show that, in Lithuania, the same characteristics that are determined for NZEB could be reached by using biofuel energy for heating and hot water preparation in buildings. However, not every player in the construction market could use biofuel boilers, as the central heating system network has been installed and is still in use in many Lithuanian towns.

In order to determine the cost-optimal levels suitable for all Lithuanian construction market players, an evaluation was undertaken to understand the facilities/selections/variants that could be used in every place in Lithuania.

According to the results of the evaluation, the cost of developing NZEB is much higher than the cost-optimal levels, taking into account the costs of construction, energy and economic indicators from 2012.

The definition of NZEB is stated in Building Technical Regulation STR 2.01.02:2016 as "***buildings that use almost no energy,*** *which meet the requirements of the A++ energy efficiency class, are very high energy performance buildings in which energy consumption is almost zero or very low, and most of the energy consumption is covered by RES, including that which is produced on-site or nearby*".

Starting 1 January 2021, all new buildings with construction permits shall fulfil NZEB requirements.

All new public buildings with construction permits undertaken shall fulfil NZEB requirements starting 1 January 2019.

By the end of 2016, approximately 158,500 EPCs had been issued and registered in Lithuania. A total of 2 EPCs were issued for buildings achieving energy performance class A++, 56 EPCs for buildings of energy performance class A+ and 123 EPCs for buildings of energy performance class A.

2.I.iv. Requirements for systems and / or building components for new buildings

The requirements for the design of thermal technical features of the building structures are mandatory and established in the Building Technical Regulation STR 2.01.02:2016 for designing new buildings, as well refurbishing (modernising) or repairing existing buildings (in part).

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

When buildings or building units are offered for sale or for rent, the energy performance indicator of the EPC of the building or the building unit should be stated in the advertisements listed in commercial media. This requirement came into force on 9 January 2013.

The requirements for the energy performance class are not obligatory for existing buildings or building units during sale or rent, but the evaluation procedure and

There are minimum requirements for the design of thermal technical features of building structures. Requirements are mandatory for designing building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are replaced or retrofitted.

Legal requirements for the energy performance for existing buildings after major renovations have been established in Regulation STR 2.01.02:2016. These requirements were implemented on 1 January 2014.

Buildings which have undergone major renovations, in which the cost of the building renovation works amount to more than 25% of the building value, must conform to the following energy performance requirements:

1. The energy performance class of the building or building unit after major renovation must not be less than D if the permit for construction works was undertaken before 1 January 2014.
2. The energy performance class of the building or building unit after major renovation must not be less than C if the permit for construction works was undertaken after 1 January 2014.

The requirements for existing single-family, multi-family, office and educational buildings after major renovations at cost-optimal level are based on the "financial" calculation with a 3% real discount rate (720 cases of calculations which were calculated to set the cost-optimal levels).

According to the results of the calculation, after 1 January 2014, the difference between cost-optimal levels of existing buildings and normative requirements varies approximately between -4.8% and -13%. A one-year transitional period was foreseen to achieve allowable limits.

2.II.ii. Plans to improve the existing building stock

There is no definition of NZEB for existing buildings in Lithuania.

Deep renovations are encouraged by the EED through the requirement to establish long-term strategies for the renovation of the national building stock, covering all building types, including residential and non-residential buildings, whether in private or public ownership.

As per the implementation of Article 4 of the EED, the long-term plan for the renovation of the national building stock was adopted on 10 March 2015 as a part of the National Energy Efficiency Action Plan. The long-term plan covers all five obligations of the Directive:

- an overview of the national building stock;
- cost-effective approaches to renovations;
- policies and measures stimulating deep renovations;
- a forward-looking perspective to guide decisions for individuals and the construction industry; and
- expected energy savings and other benefits.

The targets of the long-term plan for 2020 are to renovate:

- 3,500-4,000 multi-family apartment buildings (9-11% of the multi-family apartment building stock);
- 700,000 m^2 of the building stock owned by the central government (5-6% of the central government's building stock).

Calculations show that by implementing these measures, 785-885 GWh of heating energy will be saved (in calculating from the base year of 2013) and 199-225 thousand tonnes of CO_2-equivalent will be saved.

The targets of the long-term plan for 2030 are to renovate:

- more than 4,000 multi-family apartment buildings (10-11% of the multi-family apartment building stock);
- not less than 800,000 m^2 of the building stock owned by the central government (6-7% of the central government building stock).

It is calculated that after implementing these measures, 228 thousand tonnes of CO_2 equivalent will be saved.

Regarding the implementation of Article 5 of the EED, the programme for improving the energy efficiency of public buildings was adopted on 26 November 2014 by the Government of the Republic of Lithuania. The target of the programme is to improve energy efficiency in public buildings, which are used for administrative, cultural, educational, sports, medical and other purposes.

In summary, the situation regarding existing public buildings is as follows:

- 13,123 public buildings owned by the government and municipalities[3] were registered by 1 January 2014.
- The total area of these buildings is 14.8 million m^2, which is around 35% of all buildings owned by the government and municipalities.
- Around 5,500 buildings (5.9 million m^2) are owned by the government and 7,600 (8.9 million m^2) by municipalities.
- The majority of these buildings were built during 1900-1990. These buildings do not comply with the present energy efficiency requirements, and around 2,300 GWH is used for heating these buildings.

Two major 2020 subtargets are established in the programme:

1. the renovation subtarget for public buildings owned by the government is 470,000 m^2 (responsibility of the Ministry of Energy) and
2. the renovation subtarget for public buildings owned by municipalities is 230,000 m^2 (responsibility of the Ministry of Environment).

The primary annual energy savings from these measures is calculated as 60 GWh; the equivalent of 14,000 tonnes of CO_2 will be saved by 2020. Only buildings that have an EPC energy performance class of less than C can participate in this programme.

2.II.iii. Regulation of system performance, distinct from whole building performance

The Building Technical Regulation STR 2.09.02:2005 “Heating, Cooling and Air-Conditioning” is to be taken into account when designing and building the heating, hot water, AC and ventilation systems in buildings. All minimum requirements set for heating, cooling, hot water and ventilation systems are described in this regulation in line with the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011, and are mandatory for new, replaced and upgraded technical building systems.

Requirements are laid out in the basic principle that technical building systems must be designed in accordance with the intended use of the building.

Systems must use a minimum amount of energy without compromising the indoor air quality of the building.

Building system characteristics must be calculated individually according to the energy performance requirements for the whole building or building unit.

If there are special requirements for the microclimate and the air quality in buildings, the parameters for system design are taken from the hygienic, technological and normative documents of the national legislation. When designing heating, ventilation and AC systems, the requirements for all aspects of the building should be considered in calculations, such as building location, thermal, airtightness, architectural and constructional characteristics, materials for structure and interior design, heat emissions, moisture and pollution from people, equipment, etc., climate conditions and indoor air quality, specific building purpose requirements and other factors.

2.II.iv. Financial instruments and incentives for existing buildings

The Lithuanian Housing Strategy was approved on 21 January 2004 by the Lithuanian government. One of the goals of this document is to ensure efficient use, maintenance and major renovation of the existing housing stock. The Programme for the Modernisation of Multi-family Apartment Houses, approved by Resolution No 1213 of the Government of the Republic of Lithuania on 23 September 2004, aims to provide support to home-owners of multi-family buildings when implementing energy efficiency measures; this began at the end of 2005. It is now being revised, envisaging additional financial and other measures aimed at encouraging apartment owners to renovate multi-family apartment houses, which also involves the low-income population in implementing such projects.

In 2010, a financing mechanism (JESSICA) was developed, by which state support will comprise about 30% of the rehabilitation project value from 2011 onwards: starting in 2013, the Lithuanian government decided to speed up the renovation process.

The Lithuanian government negotiated the establishment of the JESSICA Holding Fund[4] to offer an attractive financing scheme to speed up major renovations. Originally the fund size was projected at 227 million € (127 million € from ERDF[5], as well as 100 million € of the Lithuanian national budget).

In 2013, the additional incentive funded from the Special Climate Change Programme complemented the JESSICA programme in the form of an additional investment cost grants (see also best practice example).

2.II.v. Information campaigns / complementary policies

Information campaigns are generally working coherently with financial incentives when directed towards the building owner, motivating the owner to use the incentives. There have also been information campaigns towards the supplier side of the market, informing owners about new building codes, upcoming bans on fossil fuel heating and the importance of advising home-owners on energy upgrades when renovating.

The Public Company Housing Energy Efficiency Agency (BETA)[6] gives special attention to publicity while developing a multi–family apartment building renovation (modernisaton) programme, and has been supporting the subsidy programmes, including the JESSICA funding. The main goal of the publicity campaign is to encourage apartment owners to join the programme, increase public awareness of the programme, ensure that information will be effectively provided to all target groups seeking to take advantage of the programme's support, and develop positive public opinion about the programme.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

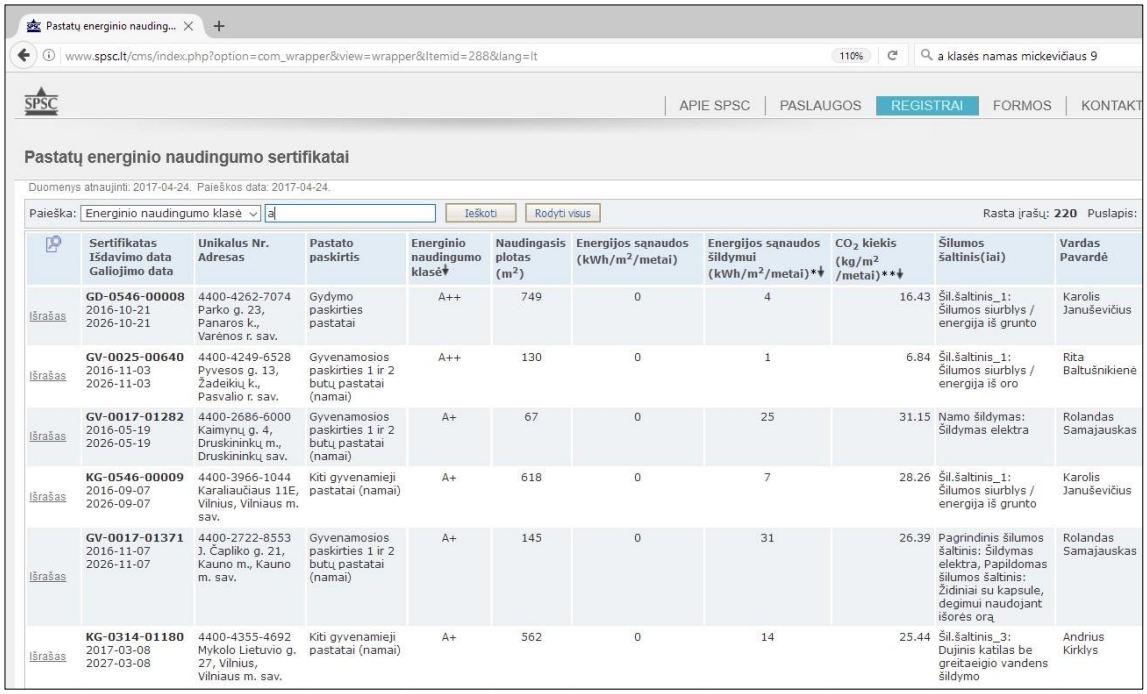
There is an obligation in Lithuania for all new buildings and building units, according to the Building Technical Regulation, to have a certificate of energy performance after construction is finished or when the buildings and building units are offered for sale or for rent. By the end of 2016, more than 158,500 EPCs had been issued since the system was implemented in January 2007.

In Lithuania, all EPCs are collected in the national central database and register. The database is always updated according to the requirements of the Building Technical Regulation. Every qualified expert has an obligation to send every EPC to the central database. Only registered and published EPCs are valid and can be presented to the customer.

Collection and registration of EPCs in the central database allows for quality control, statistical analysis and monitoring of processes.

More than 93% of registered certificates have been issued since January 2013 after new requirements for certification of energy performance of buildings came into force. Approximately 100-200 certificates are issued daily and 2,500-3,000 certificates monthly.

The database of EPCs can be used only by responsible specialists. The central register is published on www.spsc.lt and can be used by related institutions, specialists and private persons (Figure 1)**.** Since July 2014, all data are also transferred to the Real Property Register and Cadastre of Lithuania.

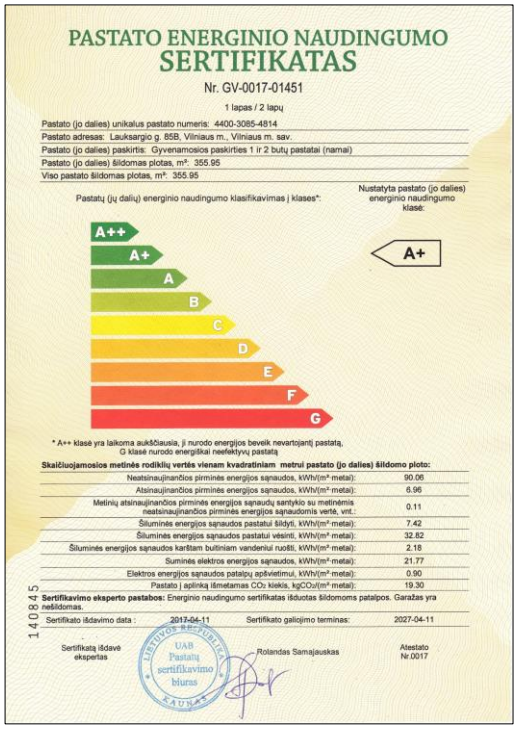


	Sertifikatas Išdavimo data Galiojimo data	Unikalus Nr. Adresas	Pastato paskirtis	Energinio naudingumo klasė	Naudingasis plotas (m^2)	Energijos sąnaudos (kWh/m^2/metai)	Energijos sąnaudos šildymui (kWh/m^2/metai)**	CO_2 kiekis (kg/m^2 /metai)***	Šilumos šaltinis(iai)	Vardas Pavardė
Išrašas	GD-0546-00008 2016-10-21 2026-10-21	4400-4262-7074 Parko g. 23, Panaros k., Varėnos r. sav.	Gydymo paskirties pastatai	A++	749	0	4	16.43	Šil.šaltinis_1: Šilumos siurblys / energija iš grunto	Karolis Januševičius
Išrašas	GV-0025-00640 2016-11-03 2026-11-03	4400-4249-6528 Pyvesos g. 13, Žadeikių k., Pasvalio r. sav.	Gyvenamosios paskirties 1 ir 2 butų pastatai (namai)	A++	130	0	1	6.84	Šil.šaltinis_1: Šilumos siurblys / energija iš oro	Rita Baltušnikienė
Išrašas	GV-0017-01282 2016-05-19 2026-05-19	4400-2686-6000 Kaimynų g. 4, Druskininkų m., Druskininkų sav.	Gyvenamosios paskirties 1 ir 2 butų pastatai (namai)	A+	67	0	25	31.15	Namo šildymas: Šildymas elektra	Rolandas Samajauskas
Išrašas	KG-0546-00009 2016-09-07 2026-09-07	4400-3966-1044 Karaliaučiaus 11E, Vilnius, Vilniaus m. sav.	Kiti gyvenamieji pastatai (namai)	A+	618	0	7	28.26	Šil.šaltinis_1: Šilumos siurblys / energija iš grunto	Karolis Januševičius
Išrašas	GV-0017-01371 2016-11-07 2026-11-07	4400-2722-8553 J. Čapliko g. 21, Kauno m., Kauno m. sav.	Gyvenamosios paskirties 1 ir 2 butų pastatai (namai)	A+	145	0	31	26.39	Pagrindinis šilumos šaltinis: Šildymas elektra, Papildomas šilumos šaltinis: Židiniai su kapsule, degimui naudojant išorės orą	Rolandas Samajauskas
Išrašas	KG-0314-01180 2017-03-08 2027-03-08	4400-4355-4692 Mykolo Lietuvio g. 27, Vilnius, Vilniaus m. sav.	Kiti gyvenamieji pastatai (namai)	A+	562	0	14	25.44	Šil.šaltinis_3: Dujinis katilas be greitaeigio vandens šildymo	Andrius Kirklys

Figure 1. Central EPCs register in Lithuania.

For new multi-family apartment buildings, an EPC is necessary for the completion of construction procedures, which means buildings can be registered as completed and in use, so there is no longer a need to certify separate apartments. This is also the case for buildings after major renovations. In the case of buying, selling or renting existing buildings, it is possible to certify a separate apartment if the whole building is not yet certified. For building units (apartments) in old existing buildings, it is possible to issue a typical EPC without detailed measurements and calculations.

The EPC of a building (building part) must include the unique number and address of the building, purpose and useful area of the building, energy performance class and estimated total energy inputs per m2 of heated area of the building (primary energy), data on the main source of heating, energy consumption for heating (primary and secondary energy), reference number of the building certificate, date of certificate issuance, expiry date of the certificate, and the name, certificate number and signature of the expert who issued the EPC (Figure 2). Every EPC also includes calculation results and recommendations for improvement.



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*:

Nustatyta pastato (jo dalies) energinio naudingumo klasė: A+

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

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

UAB Pastatų sertifikavimo biuras

1 4 0 8 4 5

Figure 2. EPC format in Lithuania.

At the moment, there are approximately 146,500 EPCs registered for residential buildings (including EPCs for apartments in multi-family houses) and 12,000 EPCs for non-residential buildings (Figure 3).

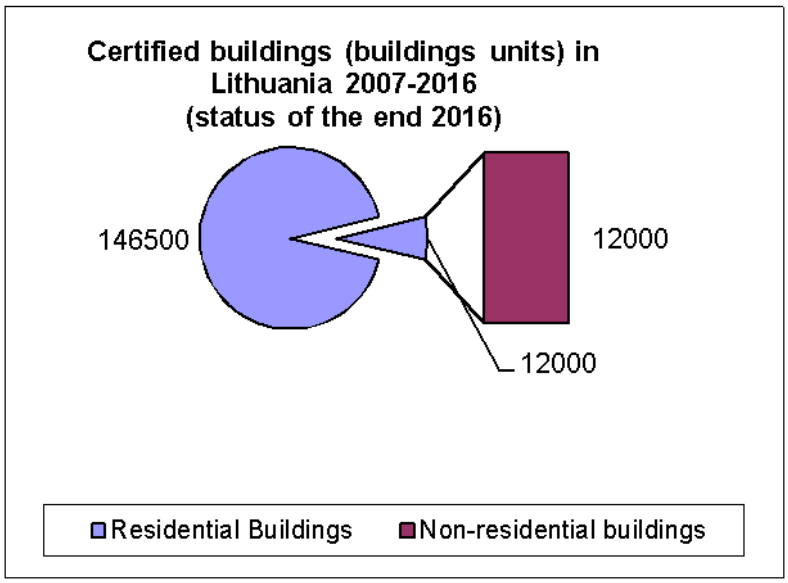


Figure 3. Certified residential and non-residential buildings in Lithuania, 2007-2016.

The certified buildings can be classified into nine classes: A++, A+, A, B, C, D, E, F and G. Class A++ indicates an NZEB, and class G indicates the least energy-efficient building (Figures 4 and 5).



Figure 4. New public building of energy performance class A++.



Figure 5. New public building of energy performance class B.

There are no fixed or pre-defined prices for the certification of energy performance of buildings in Lithuania. The EPC costs are regulated by the market and vary between 100 € and 5,000 €, depending on type, location, complexity, size, construction details and many other factors of the building. For an EPC of an apartment in a multi-family apartment building the certification costs are approximately 100 € and for a typical simplified EPC of an apartment in an old existing building the certification costs are approximately 15 €. The certification costs of a simple single-family house vary between 100 € and 350 €. The fixed registration fee of an EPC is 6 € and part of it is used to finance quality assurance.

The Experts' Training Programme, the teaching materials for examining qualified experts, and the rules and procedures for experts and their responsibilities were corrected and updated in 2012, 2014 and 2016. The new training programme as well as the teaching materials for qualified experts were prepared and adopted by the Ministry of Environment.

The main qualification requirements for building certification experts are the same for all types of buildings: an engineering degree with three years' experience in a construction branch, the completion of special 48-hour training courses and an exam, and practical experience in the certification of three buildings. The Experts Training Programme and the software tool were developed and adopted by the Minister of Environment in 2006 and updated in 2011, 2013, 2014 and 2016. The qualified expert for the certification of the energy performance of buildings shall have an additional 20 hours training and pass the exam every 5 years (Figure 6). There are no requirements that an expert must issue a minimum number of EPCs.

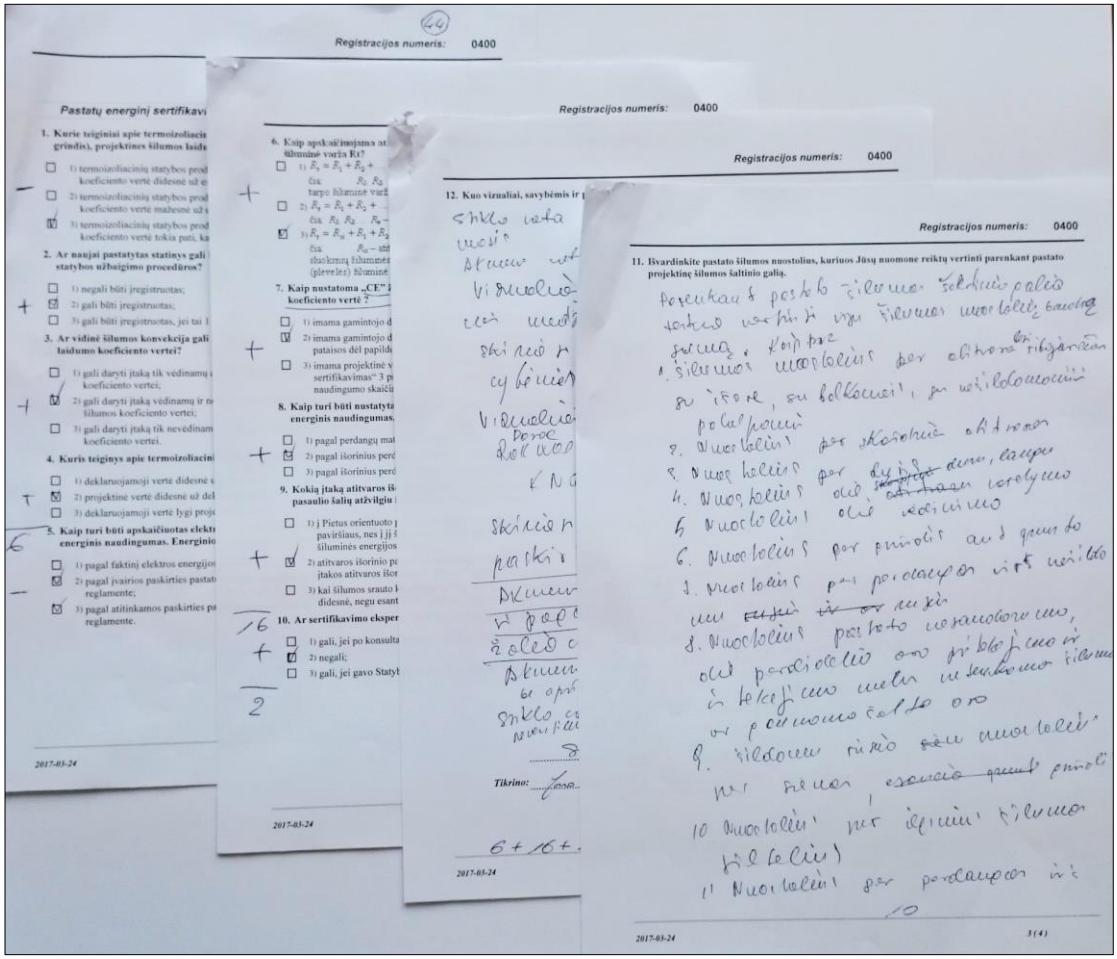


Figure 6. Experts' exams for the energy performance of buildings in Lithuania.

In Lithuania, there is an updated publicly available database, www.spsc.lt, and official register of qualified experts. At the moment, Lithuania has approximately 400 qualified experts with valid certificates for the certification of the energy performance of buildings; approximately half of these qualified experts are actively working on the market. In Lithuania, only a qualified expert can issue an EPC and is responsible for an objective certification process.

For new buildings, an EPC is necessary for the completion of construction procedures, which means a building can be registered as completed and in use. It is controlled by the State Territorial Planning and Construction Inspectorate under the Ministry of Environment. The same is applicable for buildings after major renovations. In the case of buying, selling or renting an existing building, EPCs are checked by a notary during the signing of real estate contracts. This is the main reason why the number of EPCs have significantly increased since January 2013, after new requirements for issuing of EPCs came into force (Figure 7).

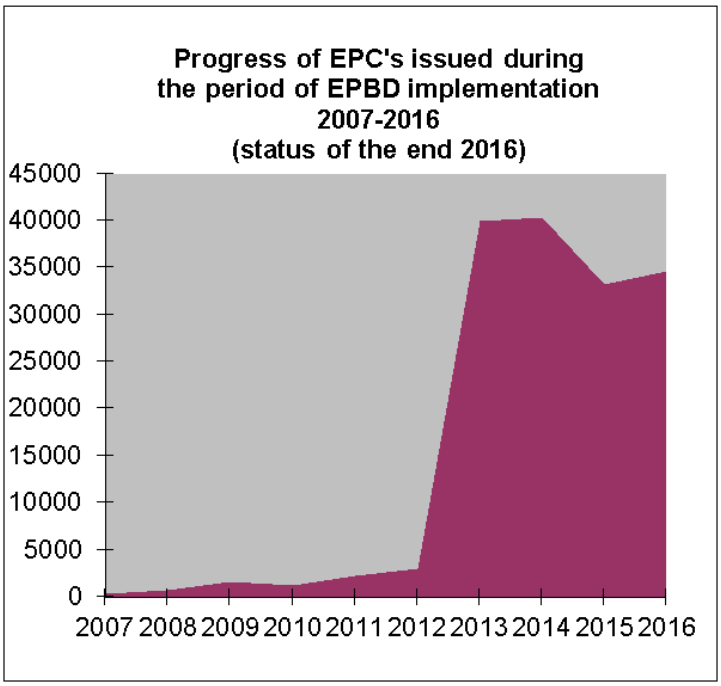


Figure 7. Progress of issued EPCs in Lithuania, 2007-2016.

Minimum requirements (the lowest acceptable energy performance class) are defined by Building Technical Regulation STR 2.01.02:2016 for buildings which have undergone major renovations (Figure 8). The construction procedures can be completed only if the EPC proves compliance with minimum requirements.



Figure 8. Renovated residential building, class A (class D before renovation).

2.III.ii. Quality assessment of EPCs

Lithuania has a single quality assessment system for different kinds of buildings. All EPCs for new as well as existing buildings are collected in the central database where they have been registered since 2007/2009. Every received EPC is automatically checked by the software for incorrect and/or incomplete data, software version, certificate validation and the completion of any additional training needed by qualified experts.

EPCs are selected for desk audits in cases where the values are out of range, or where the EPC shows a very high energy performance class. EPCs are selected for more detailed audits in cases where complaints have been received and in cases where many EPCs have been returned to the qualified experts for corrective actions; random selection according to the targeted percentage (not less than 0.5 % of all issued EPCs) is also practised.

Sanctions for incorrect EPCs may include a warning, an obligation to issue a corrected EPC for free, invalidation of the incorrect EPC, suspension of certificate, and the cancellation of the certificates of qualified experts. Any financial or other penalties for incorrect and/or insufficient certification works for qualified experts are not foreseen.

In Lithuania, during 2016, there were approximately 35,000 EPCs registered; 565 EPCs were returned to the qualified experts for corrective actions because of indicated mistakes and/ or inaccuracies, 12 EPCs were checked with a site visit and 98 EPCs were checked without a site visit.

The qualified experts were informed of their mistakes and/or warned and asked for the correct EPCs to be issued for free. An average of 30% of checked buildings are public buildings.

The aforementioned qualified expert scheme is quite simple and very effective.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

According to the requirements of the Law on Construction issued on 9 January 2013, the energy performance certification of buildings is mandatory since 9 July 2015 for buildings occupied and frequently visited by the public with a total useful floor area of over 250 m^2 that have been constructed for accommodative, administrative, trade, service-orientated, catering, transport, cultural, educational, healthcare and leisure purposes. An energy certificate not older than 10 years must be placed in the building in a prominent place clearly visible to the public (Figure 9).



Figure 9. An EPC display in a new public building.

Compliance with this requirement is checked by the municipality supervising building maintenance. There are financial penalties in Lithuania of up to 289 € for building owners/managers that do not display the EPCs.

For new public buildings, EPCs are always checked by the State Territorial Planning and Construction Inspectorate under the Ministry of Environment. The same is applicable for buildings after major renovations. In the case of buying, selling or renting existing public buildings, EPCs are carefully checked by a notary during the signing of real estate contracts.

In Lithuania, the EPC, the assessors, the costs and the quality control scheme for public buildings and large buildings visited by the public are the same as for residential buildings.

As of 2016, there are approximately 12,000 EPCs registered for non-residential buildings. Certification of the energy performance of public buildings is mandatory in Lithuania. An average of 30% of controlled buildings are public buildings.

2.III.iv. Implementation of mandatory advertising requirement - status

According to the Law on Construction in Lithuania, after 9 January 2013, when new and existing buildings or building units are sold or rented, the energy performance indicator of the building's EPC should be stated in the advertisements in commercial media. At the moment, there are no legal or financial penalties in Lithuania established and applied, and the control mechanism is not developed. The Ministry of Environment is responsible for the whole process and influences owners and real estate agencies using several publications and information campaigns.

Detailed official information, text and tools are available on the national websites. Primary information and related legal acts are already available on the national websites www.am.lt, www.spsc.lt; www.betalt.lt; www.enmin.lt.

3. A success story in EPBD implementation

A success story in Lithuania is a policy package for deep renovation based on finance and information supported by EPCs.

The Programme for the Modernisation of Multi-family apartment houses set in Lithuania's Resolution No 1213 of 23 September 2004 aims to provide support to home-owners of multi-family buildings who wish to implement energy efficiency measures. The programme began at the end of 2005. This is currently being revised as additional financial and other measures, that aim to encourage owners to renovate multi-family apartment houses and to support the involvement of low-income households with such energy saving projects, are envisaged.

The participants of the Programme were apartments owners, the Housing Energy Saving Agency, municipalities, commercial banks, housing loan insurance companies, housing administration companies, engineering consultancy companies (who prepare energy audits and investment proposals), contractors, etc.

The programme provides loans to increase the energy efficiency of buildings by replacing windows and doors, insulating ceilings, roofs and walls, installing solar panels and wind turbines, replacing energy related equipment and replacing elevators and electrical wiring in shared areas (stairwells, basements, etc.).

Additionally, the Lithuanian government negotiated the establishment of the JESSICA Holding Fund[7] to offer an attractive financing scheme to speed up major renovations. Lithuania is one of the first countries in the European Union to have used the JESSICA initiative to improve the energy efficiency of multi-family apartment buildings. Originally the fund size was projected to be 227 million € (127 million € from ERDF[8], as well as 100 million € from the Lithuanian national budget). The overall aim of the JESSICA Holding Fund is to contribute to increased energy efficiency in the housing sector by offering long-term financial support in the form of loans with preferential terms and conditions.

The JESSICA financing mechanism, developed in 2010, comprises about 30% of the state support value that pertains to rehabilitation projects from 2011 onwards and covers:

- 100% support for preparation of technical documentation and expenses for the supervision of construction works if EPC class D will be achieved;

- 15% support for implementing energy efficiency measures whereby EPC class D will be achieved;
- 100% support for low-income families.

Starting in 2013, the Lithuanian government decided to speed up the renovation process. A new model for the renovation of multi-family apartment buildings was developed whereby the loan lies with the project administrator, meaning the resident does not become burdened by debt.

In 2013, an additional incentive, funded by the Special Climate Change Programme, was set up to complement the JESSICA programme. The incentive provided an additional 10% investment cost grant that could be approved when the energy consumption of a building is reduced by at least 40%. The total subsidy for the renovation works is 40%. In the context of the scheme, the state, from its own budget, provides 100% of loan reimbursement for low-income households and 100% reimbursement for preparing and administering paperwork. JESSICA loans (with maturities of up to 20 years at a fixed annual interest rate of 3%) are offered to the owners of apartments or other premises in multi-family apartment buildings, provided they commit themselves to implementing energy efficiency measures and other measures set forth in the Investment Plan.

EPCs are carried out before the preparation of the Investment Plan (to obtain the necessary information about the condition of the building and recommendations) and after the completion of building renovation works (to check whether the measures set forth in the Investment Plan have been implemented).

The average investment for multi-family apartment building renewal is 200,000 €. This usually includes the insulation of external surfaces – roof and walls -, the replacement of windows and entrance doors, the modernisation and rebalancing of heating systems, and the installation of thermostatic valves. The value of signed construction contracts currently stands close to 150 million €, which makes up to 8.3% of the value of the country's whole construction sector last year.

The programme has already achieved significant results – between 2005 and 2016, 2,354 multi-family apartment buildings were renovated, and a further 769 buildings were renovated in 2016.

Information campaigns have been designed to work in parallel with the financial incentives as they have been directed towards the building owner, motivating the owner to use the incentives.

The Public Company Housing Energy Efficiency Agency (BETA)[9] gives special attention to the publicity of the multi–family apartment building renovation (modernisaton) programme. The main goals of the publicity campaign are to increase public awareness of the programme and thereby encourage apartment owners to join it, to ensure that the information is effectively provided to all target groups that might seek to take advantage of the support, and to develop a positive perception of the programme among the public (Table 3).

Target Groups	Main target	Direct contact:	Indirect contact:
Primary target group - final beneficiaries	Residents of apartments; chairpersons of multi-apartment associations and administrators; programme administrators appointed by the municipality	Seminars for residents; seminars for project managers and chairpersons of multi-apartment associations	Website; printed handouts (leaflets and posters); a detailed guide (handbook) which describes the entire renovation process steps (for project managers); the media; long-term projects in the popular internet portal *www.delfi.lt*; an intensive information campaign in the regional media; articles in the national and specialised media
Secondary target group	Associations related to the renovation process; local and national authorities; independent experts; opinion leaders; media; other (with an important focus on final beneficiaries during this communication process)	Seminars for project managers and chairmen of multi-apartment associations; seminars for investment planners, engineers and for contracting companies, etc.	
Other	Mayors, administrators, other stakeholders, all beneficiaries	Annual conference to summarise results which have been achieved during the year (conference organised by municipal mayors and administrators of the projects being implemented);	Renovation days in different cities of Lithuania (officially called "*Renovation days*" month, in which the Ministry of Environment and Housing Energy efficiency agency representatives meet with residents and other participants of renovation processes in different cities; free consultation line.

Table 3. Main target groups for the multi-family apartment building renovation programme's publicity campaign.

4. Conclusions, future plans

In the context of meeting its ambitious climate and energy targets for 2020, the buildings sector has become one of the priority areas for the Lithuanian government. Several legislative initiatives have been introduced for building renovations. One of them - the cost-optimal energy performance requirements - was introduced into national legislation and is used for new buildings as well as for renovation activities.

The current plans and initiatives implement the EPBD requirements to ensure that from 2019 all new buildings occupied and owned by public authorities are NZEB, and by the end of 2020 all new buildings are NZEB.

Lithuanian legislation transposing the EED complements the EPBD by encouraging ambitious renovations through the requirement to renovate annually 3% of the central governments' building stock to an energy performance level of class C. All central governmental buildings in Lithuania with a floor area of over 500 m^2 are taken into account. The adoption of the EED in 2012 was developed in order to help deliver the EU's 20% headline target on energy efficiency by 2020, as well as to pave the way for further improvements.

Endnotes

1. The calculation procedure is based on standards EN 15217:2005 and EN 15603.
2. The calculation procedure is based on standards EN 15217:2007 and EN 15603:2008.
3. According to the information of the state enterprise Centre of registry.
4. www.energy-cities.eu/IMG/pdf/infinite_solutions_lithuania.pdf
5. ERDF - European Regional Development Fund (www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.1.2.html)
6. www.betalt.lt
7. www.energy-cities.eu/IMG/pdf/infinite_solutions_lithuania.pdf
8. ERDF - European Regional Development Fund (www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.1.2.html)
9. www.betalt.lt

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Luxembourg

Status in December 2016

AUTHORS
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NATIONAL WEBSITES
www.gouvernement.lu/4067443/energie

1. Introduction

In Luxembourg, the implementation of the EPBD is the overall responsibility of the Ministry of Economy, with the General Directorate of Energy as the managing body. The EPBD was implemented by regulations based on the "*Loi modifiée du 5 août 1993 concernant l'utilisation rationnelle de l'énergie*" (Law 1993)[1]. This law is the legal basis for setting up the requirements for the energy performance of buildings. In 1995, Luxembourg implemented the first mandatory requirements for residential and non-residential buildings.

In 2008, the requirements for residential buildings were modified in order to transpose the EPBD into national law, "*Règlement grand-ducal modifié du 30 novembre 2007 concernant la performance énergétique des bâtiments d'habitation*"[2] (RGD 2007), and the EPC became mandatory for residential buildings.

The implementation of the EPBD, including the mandatory issue of EPCs for non-residential buildings, came into force in 2011, "*Règlement grand-ducal modifié du 31 août 2010 concernant la performance énergétique des bâtiments fonctionnels*"[3] (RGD 2010).

Over the years, many regulatory changes entered into force. The major changes are:

- a strengthening of the overall energy performance of buildings on a defined timeline and the definition of NZEB;
- the introduction of the "as-built" EPC;
- the obligation to indicate the energy performance of buildings in advertisements;
- the obligation to control a representative percentage of EPCs.

In 2016, some major changes (detailed in chapter 2) concerning residential buildings have been published and entered into force.

2. Current Status of Implementation of the EPBD

In Luxembourg, a distinction is made between residential and non-residential buildings, but not between public and private buildings, with regard to energy performance requirements. Nevertheless, the public sector has a leading role and has to act as an example. Minimum requirements for technical building elements and building envelope elements apply in the same way for new and existing buildings. New buildings have to comply with overall energy performance requirements (heat energy demand and primary energy needs).

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

A timetable to reinforce energy performance requirements for residential buildings and a first step to reinforce energy performance requirements for non-residential buildings have been defined in 2012 and 2014, respectively.

In 2017, the last step of the reinforcement for new residential buildings entered into force. This last step introduced the residential NZEB as a standard.

For non-residential buildings, a new step for reinforcing the energy performance entered into force in 2015 on the path towards the non-residential NZEB.

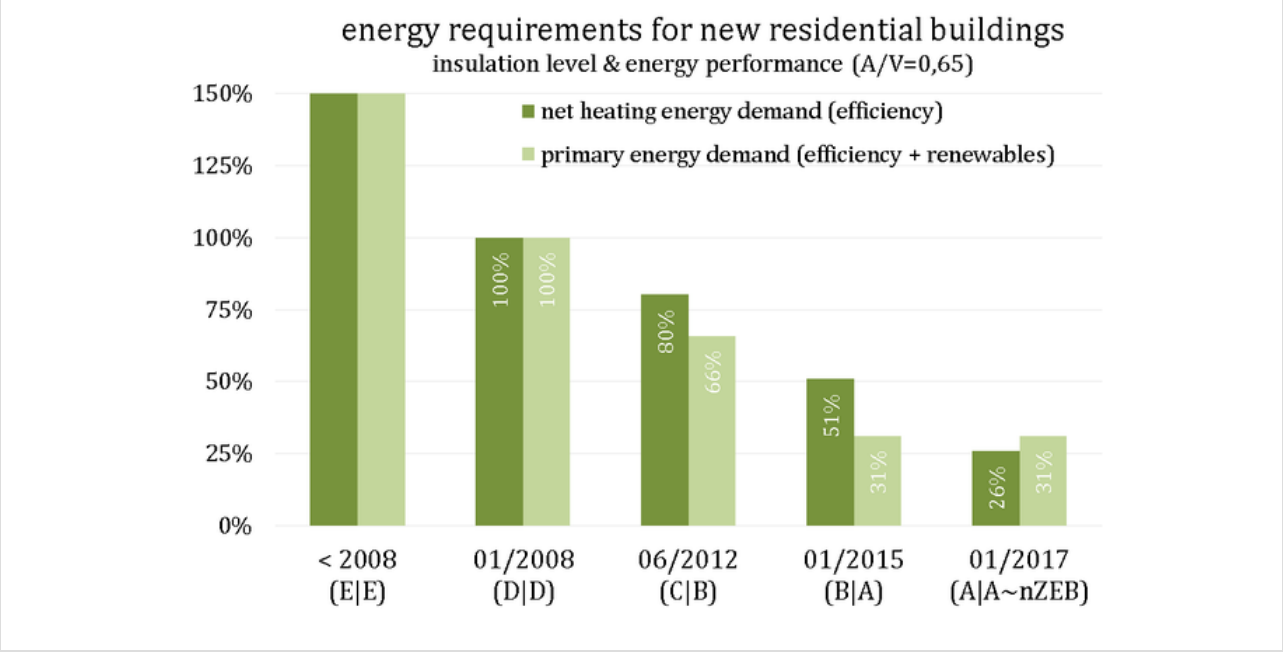


Figure 1. Reduction of energy needs over time for residential buildings. Source : Dr. Markus Lichtmess, Goblet Lavandier & Associés Ingénieurs-Conseils S.A.

In 2016, Luxembourg has implemented the following important aspects for residential buildings:

- the definition of the NZEB standard as the new standard from 1 January 2017 onwards;
- changes to the requirements and calculation methods for thermal protection in the summer, with the aim of limiting summertime overheating;
- the ability to take photovoltaic production into account at least partly;
- a change in the calculation methodology of global requirements (primary energy needs and heating energy needs) towards implementing the reference building procedure;
- the adjustment of calculated energy needs in the EPC to more adequately reflect the real energy consumption;
- the introduction of an interface in the EPC calculating tool for measured airtightness values.

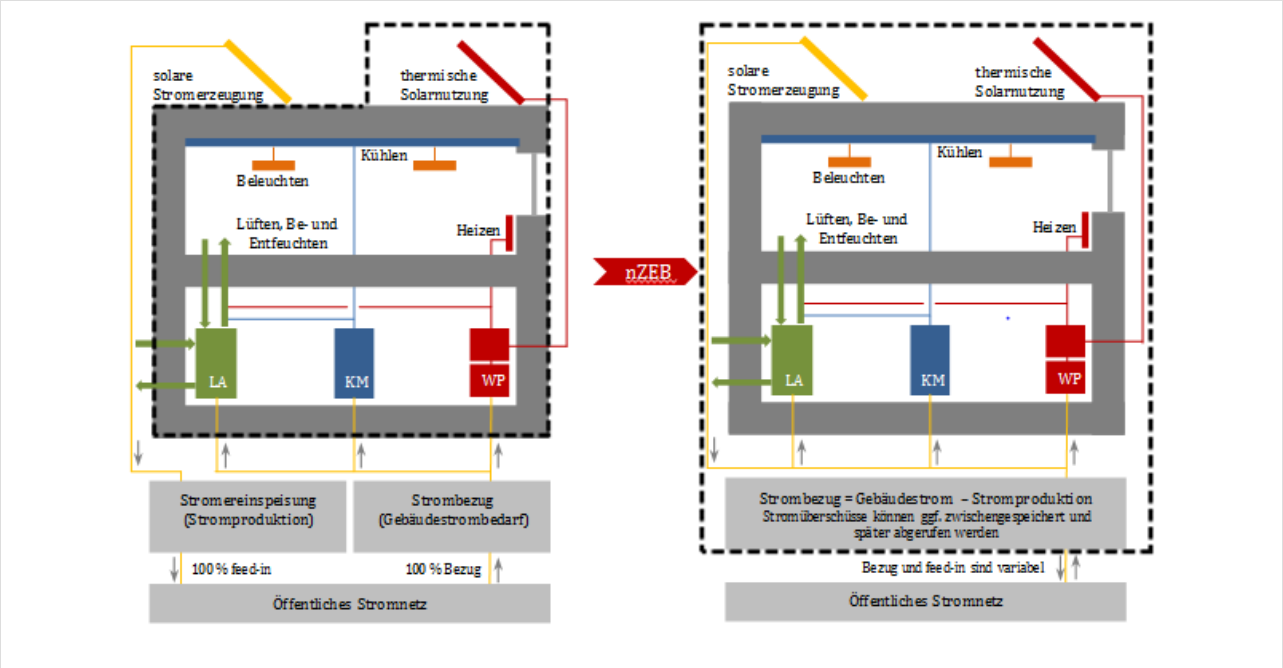


Figure 2. Integration of photovoltaic production. SOURCE: Dr. Markus Lichtmess, Goblet Lavandier & Associés Ingénieurs-Conseils S.A.

Concerning financial incentives, Luxembourg introduced a subsidy scheme for more sustainable residential buildings from 1 January 2017 onwards. This scheme is based on 46 criteria covering social, environmental and financial aspects. In each category 60% of the maximum points have to be reached in order to qualify for financial aid. The maximum aid for a sustainable house is fixed at 24,000 €.

The Luxembourgish Sustainability Certification ("***Lë****tzebuerger* ***No****haltegkeets Zertifizéierung*", LENOZ)[4], which is the new sustainable certification system for residential buildings, has also been launched (further explanations can be found in chapter III).

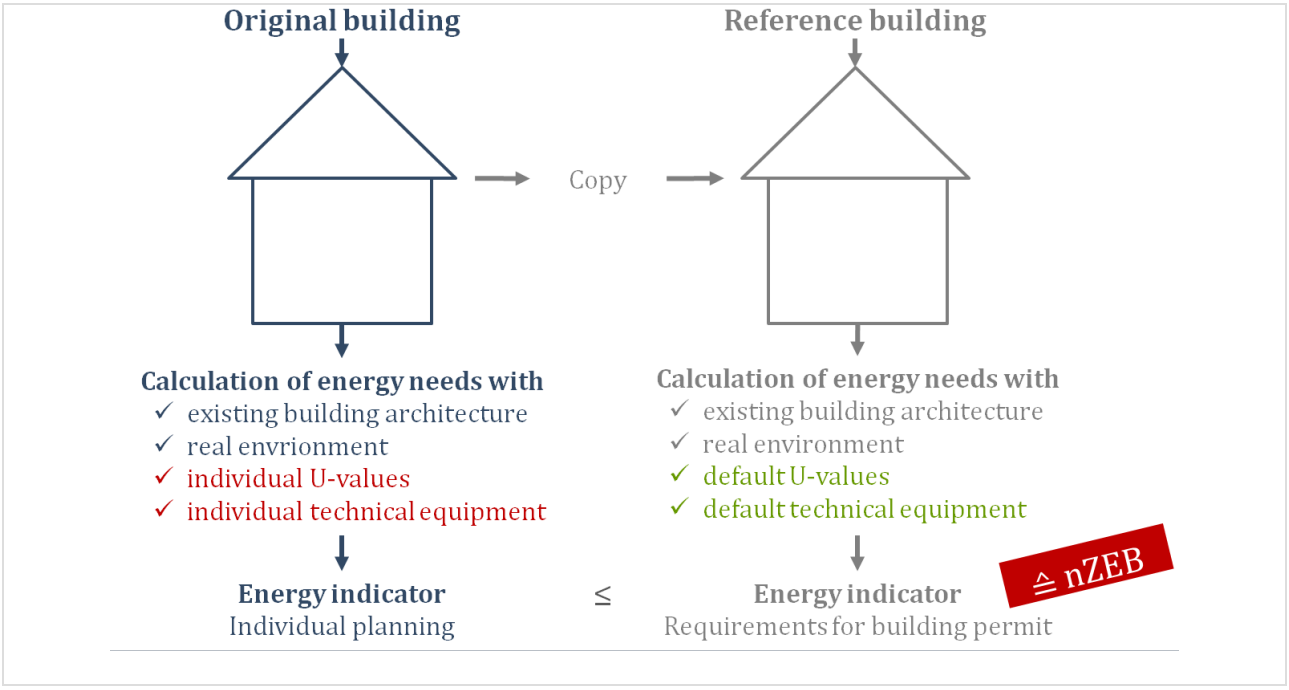


Figure 3. Methodology of the reference building. SOURCE: Dr. Markus Lichtmess, Goblet Lavandier & Associés Ingénieurs-Conseils S.A.

2.I.ii. Format of national transposition and implementation of existing regulations

For residential buildings, the energy performance calculation for new and existing buildings is based on the calculated energy needs for heating, domestic hot water, ventilation and auxiliary needs. The results are expressed in terms of primary energy needs, heating energy needs and CO_2 emissions. Since 2016, photovoltaic production can be partly taken into account (only the part which is consumed by the technical equipment of the building).

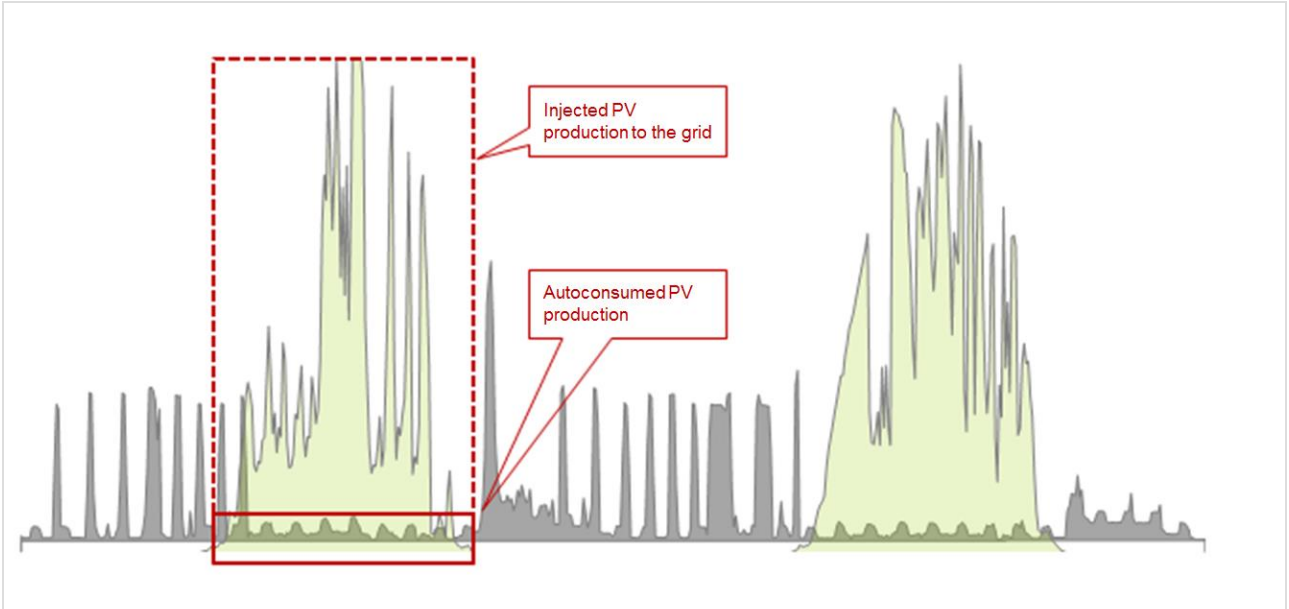


Figure 4. Integration of photovoltaic production. SOURCE: Dr. Markus Lichtmess, Goblet Lavandier & Associés Ingénieurs-Conseils S.A.

For non-residential buildings, the energy performance calculation for new buildings is also based on the calculated energy needs for heating, domestic hot water, ventilation, and auxiliary needs, but also on AC, lighting, humidification and dehumidification. For existing non-residential buildings, the real energy consumption (metered energy) is taken into account.

All new residential and non-residential buildings have to fulfil - besides minimum requirements for building envelope elements and technical equipment - global requirements expressed in heating energy needs and primary energy needs. These requirements are cost-optimal.

In order to sensitise consumers' awareness for the strengthening of the energy performance requirements for buildings and more generally energy-efficient polices, the government is operating a hotline for consumers through "*myenergy*"[5]. Further, the Ministry of Economy takes part in expert meetings and exchanges on best practices within the building sector. The Ministry regularly updates FAQ documents that are made available to the public.

Concerning quality controls, the EPC database for residential buildings is an important tool. A plausibility check of each EPC is integrated into the database as well as the software calculating the EPCs. Controls of EPCs take place regularly. A few experts who had issued EPCs containing errors have been penalised with a temporary ban, mandatory advanced training and the correction of errors in the EPCs.

2.I.iii. Action plan for progression to NZEB for new buildings

The national plan of 2013, which aims to increase the number of NZEB, mentions a number of milestones to achieve this goal: the exemplary role of the public sector, research, the update of subsidy schemes, information and communication campaigns for consumers and experts, the quality assurance of EPCs through plausibility checks and in-depth EPC control, incentive measures like energy-related advisory service, the continuous training of the workforce, including architects and engineers, and regulatory implementation of NZEB.

As aforementioned, the NZEB standard entered into force in 2017 for residential buildings. For non-residential buildings, it is scheduled for 2019 for public buildings and for 2021 at the latest for non-public buildings. Today, public authorities are requested to design very energy-efficient buildings which, if feasible, include on-site production and consumption of RES. An example is a new building in the Nature and Forestry Administration[6] that obtained an excellent score in its sustainability certification. This building is equipped with a water/water heat pump, a rainwater utilisation system, a LED-lighting system, a photovoltaic installation and an energy management system. The calculated heating energy demand of the building is 26.4 kWh/m^2.year and the primary energy demand is 70.6 kWh/m^2.year.

Concerning research, one of the priorities of the government is sustainable building. In this context, support was given to the national structure, called "*Neobuild*"[7], which is an innovation centre developing and supporting future-oriented projects in the building sector. *Neobuild* is a private sector initiative and its objective is to promote research, development and innovation in the sustainable construction industry. Besides this, a national green building council called "*Conseil national pour la construction durable*" (*CNCD*) has been reformed. The *CNCD* regroups the main actors of the national construction sector and the relevant ministries. The main goal of this structure is to prepare the sector for future opportunities and evolution in a streamlined manner.

In the field of communication and information, free basic advice with respect to the energy-efficient renovation and construction of energy-efficient buildings has been provided since 2010 by *myenergy*.

2.I.iv. Requirements for systems and / or building components for new buildings

Requirements for technical building systems are set in different regulations covering gas-, wood- and oil-fired boilers, AC systems, heat pumps, and ventilation systems.

Some decades ago, Luxembourg established a mandatory acceptance procedure for new oil- and gas-fired boilers as well as regular inspections of these boilers in existing buildings. For wood-fired boilers this system became mandatory in 2014. The acceptance procedure and the regular inspection of AC systems have been mandatory since 2009 in residential as well as non-residential buildings. The acceptance procedure checks the conformity of the security equipment, the location, the smoke exhaust and the combustion quality and efficiency. Dimensioning is not checked at this stage, but is done so during the periodic inspection. Since Luxembourg imports nearly all appliances and equipment, European standards as well as the standards of the import countries are applicable in Luxembourg.

RGD 2007 and RGD 2010 set energy performance requirements concerning building envelope elements, pipework insulation, ventilation and AC systems.

2.II. Energy performance requirements: EXISTING BUILDINGS

As aforementioned, there is no distinction with respect to the energy performance requirements for new and existing buildings.

2.II.i. Progress and current status of existing buildings

As described in the requirements for new residential buildings, the same changes apply to existing residential buildings (with the ability to partly take into account photovoltaic production: aligning real energy consumption in the EPC with the calculated theoretical energy need and introducing an interface in the EPC calculating tool for measured air-tightness values).

Subsidy schemes for the refurbishment (*PRIMe-House*) of existing buildings have been reviewed and the priority is put on deep renovations by doubling the financial bonus (20-60% bonus of the previously granted aid) if a very good energy class is reached after refurbishment[8]. In addition, the more a building element is isolated, the more specific aid is granted. More sustainable isolation materials are also promoted by a bonus system. For sustainable isolation material, a specific bonus aid (15-40 €/m^2, depending on the building element) is paid.

2.II.ii. Plans to improve the existing building stock

Luxembourg is still working on fine-tuning the national long-term strategy for boosting investment in refurbishing the national stock of residential and non-residential buildings. As part of this initiative and in conjunction with the relevant actors in the construction sector, Luxembourg's energy renovation strategy

has been developed by different theme-based workshops to analyse the barriers to refurbishment and come up with potential solutions. The various themes focused on finding ways to remove natural architectural constraints and regulatory and financial barriers, motivating building owners to refurbish and encouraging refurbishment as an opportunity for the construction sector in Luxembourg. These workshops concluded that financially supporting energy refurbishment programmes, providing information and energy advice and raising awareness play an important role in this area. As described above, Luxembourg tries to promote major renovations through aid schemes that have been updated for 2017. Deep renovations are promoted and EPCs have to be issued before and after refurbishment. In relation to the obtained energy class after refurbishment, a bonus is granted in addition to the previously received aid. The better the energy class after refurbishment, the higher the bonus.

myenergy, the national body for information and advice in the fields of energy efficiency and renewable energy, provides support to all sectors with respect to refurbishing buildings. Various market analyses made by *myenergy* have identified the existence of barriers between information and the public and the perception and motivation of building owners to finance renovations. Significant efforts have been made regarding the barriers to information (*myenergy*) by creating national information points all over the country.

In recent years, Luxembourg has introduced several measures for promoting the energy refurbishment of buildings. These range from regulatory measures to financial incentives, an increase in information and advisory measures and improvements to education and training.

RGD 2007 and RGD 2010 define minimum requirements for extensions or renovations of existing building elements. Furthermore, besides the subsidy programme *PRIMe-House*, an energy efficiency obligation (*EEO*) scheme which applies from 1 January 2015 to 31 December 2020 has been introduced. The *EEO* obliges all electricity and gas suppliers to achieve energy savings among their energy end-users. Suppliers have to deploy efforts that result in customers gaining access to information on energy efficiency, which then encourages them to implement energy efficiency measures.

2.II.iii. Regulation of system performance, distinct from whole building performance

Requirements for technical building systems and building envelope elements are set in multiple regulations[9] concerning the respective buildings or technical elements.

These regulations cover gas-, wood- and oil-fired boilers, AC systems, heat pumps, ventilation systems and components of the envelope of buildings. The Ministry of Sustainable Development and Infrastructure and the Ministry of Economy share the responsibility with respect to these areas.

Every new individual building element has to fulfil minimum requirements defined in these regulations.

Furthermore, large installations must comply with certain requirements set by the environmental and safety impact authorisation procedure[10]; such requirements depend on the scale and type of the installation. They can be grouped into general security requirements, technical requirements and energy performance requirements (according to the best available technology).

2.II.iv. Encouragement of intelligent metering

As of 1 July 2016, all new gas and electricity meters installed in Luxembourg are smart meters. From 2016 to 2020, the plan is to replace all existing electricity and gas meters with smart meters. In order to optimise operating costs, all meters will be read via a central system managed by an entity set up by the grid operators, *Luxmetering GIE*. Besides electricity and gas meters, the system will be open to other flows such as water and urban heat. Regarding deployment, more than 95% of the existing meters for electricity will have to be replaced by 31 December 2019, and more than 90% of the existing meters for gas will have to be replaced by 31 December 2020. Each customer will receive information about the meter's functionality, its use and the use of its data. Frequently asked questions and a point of contact will be made available by each grid operator via its website as well as leaflets distributed to customers.

2.II.v. Financial instruments and incentives for existing buildings

The financing mechanism in place for technologies based on RES (solar panels, heat pumps, wood-fired boilers, etc.) and the refurbishment of building envelope elements set minimum energy efficiency requirements. For building envelope elements, the aid scheme has been linked to the use of sustainable insulation materials.

In order to promote the energy renovation of existing residential buildings, the government has for several years already implemented the *PRIMe-House* subsidy programme[11] to provide financial support for renovation projects related to energy performance. As of 2017, this programme has been updated to become even more effective. In the new version of *PRIMe-House*, the procedure for aid applications has been administratively simplified by introducing a one-stop shop for citizens which examines, advises, grants projects and guides investors in all administrative procedures related to subsidies. In the new subsidy programme, the bonus for major renovations is doubled to amount to an extra 20%, 40% or 60% of the granted subsidy if the energy class after refurbishment corresponds to the C, B, or A index, respectively.

As of 2017, an additional increase of the granted aid is possible if sustainable insulation materials are used. Another new feature is *Climate Bank*, which provides a zero-interest rate or a reduced interest rate for loans granted for energy refurbishment projects. Mandatory energy advice is foreseen for this aid and the energy expert is required to control the implementation of the measure.

The zero-interest-rate loan is reserved for low-income households in order to unlock these investments (with a maximum loan of 50,000 € for over a period of 15 years). The costs for the mandatory energy advice are also paid directly by the state budget. In addition, investment aid can be granted. Every other household can apply for loans with reduced interest rates (the measure is limited to a loan of 100,000 € over a period of 15 years, with the loan rate in principle being reduced by 1.5%).

2.II.vi. Information campaigns / complementary policies

Over the last few years, Luxembourg has made numerous efforts to provide detailed information on energy savings and the use of RES to energy consumers.

These efforts are illustrated by the achievements of the public energy advisory and information provider *myenergy*, whose activities include raising awareness as well as informing and assisting households,

companies, municipalities and professionals regarding energy savings, the use of renewable and sustainable energy and the development of sustainable residential buildings.

The website www.myenergy.lu is an important tool for informing the aforementioned target groups.

The free, impartial and basic advice to private individuals is provided over phone (hotline number 8002 11 90) or in personal advisory sessions held in one of the numerous regional *myenergy* information points. These information points are part of a large network of *myenergy*'s local advice centres.

Representatives of *myenergy* also organise action weeks, including on-site consultations, information events with presentations and awareness-raising activities, attend national trade shows, create information flyers and internet platforms and ensure a regular presence in the national media. *myenergy* has also developed virtual interactive gamification tools, providing key messages in the conception of high-energy-efficient buildings.



Figure 5. Miss Energy campaign (myenergy).

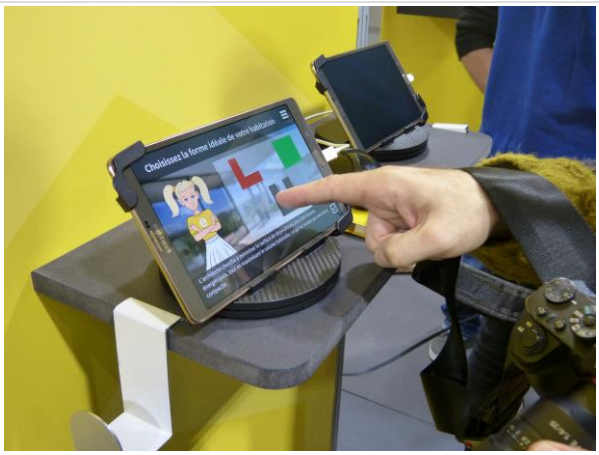


Figure 6. Serious game – my AAA.

2.III. Energy performance certificate requirements

For residential buildings, one single type of EPC exists. The EPC has not been changed as regards the recent modifications of the energy performance requirements in 2016, so that the classes remain the same. This is essential to ensuring the comparability of the issued EPCs within the buildings market.

For non-residential buildings, two types of EPCs exist. One type covers new buildings (based on calculated energy needs) and the other type covers existing buildings (based on energy consumption).

As the managing body, the General Directorate of Energy designs, develops and supports the certification system with the help of external experts, if needed. A national database has been developed which collects all EPCs (existing and new) issued by the experts for residential buildings and aims to draw statistics from the national building stock in the future. In a later phase, the database shall be extended to non-residential buildings.

The *LENOZ* certification[12], the new sustainable certification system for residential buildings, launched in 2017, is voluntary and is subsidised by financial aids of up to 1,500 €. In total, the system regroups 143 individual criteria categorised into six (6) categories and 37 sub-categories. It covers locational, societal, economic, environmental, functional and technical aspects.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

All existing residential and non-residential buildings need to be certified when sold or rented. There is no minimum requirement for existing buildings, and they are labelled from class A to I.

The EPC for existing buildings requires the indication of energy efficiency improvement measures. The owner of a building must present a valid EPC to a potential buyer or tenant. When issuing the EPC, a qualified expert visits the building and assesses the geometry and the type of construction (walls, windows, insulation, thermal bridges, ventilation and airtightness, etc.) as well as the type and quality of heating, ventilation, AC and hot water systems. The establishment of the EPC includes a calculation of the heating and primary energy needs of the building. In case of sale, the notary checks the presence of the EPC. He or she will not proceed to the sale if there is no EPC.

2.III.ii. Quality Assessment of EPCs

The Ministry of Economy organises controls of EPCs in order to verify their compliance with the legal requirements. These controls comprise two levels. The first level consists of a plausibility check of the calculated values, whereas the second level is a deeper analysis of EPCs containing non-plausible elements. The control consists of a check of all data entered into the EPC. Penalties in the form of a time-limited suspension were imposed on two experts who were also required to establish corrected EPCs (through another accredited expert) and deliver them to the client.

The EPC database as well as the national software currently checks the plausibility of the EPC automatically.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

For residential buildings and non-residential buildings occupied by public authorities and frequently visited by the public with a surface exceeding 250 m^2, the energy performance certificate must be displayed in a clearly visible place. For the same types of buildings which are not occupied by public authorities but frequently visited by the public, this obligation applies for buildings with a surface exceeding 500 m^2.

2.III.iv. Implementation of mandatory advertising requirement – status

A modification of RGD 2007 and RGD 2010 has introduced the obligation to insert the overall energy performance class (primary energy) and the heating performance class in real estate advertisements in all commercial media (paper, internet, etc.).

This obligation came into force on 1 July 2012. A large number of real estate advertisements comply with this obligation and the ministry checks compliance randomly. Penalties are foreseen in case professionals or private persons do not comply with the regulations.

2.IV. Inspection requirements – heating systems, air conditioning

The Environmental Administration manages the implementation of heating and AC system inspections on behalf of the Ministry of Sustainable Development and Infrastructure. The Ministry of Economy is responsible only for gas-fired heating systems.

2.IV.i. Report on equivalence of model A and B for Heating Systems

Luxembourg implemented inpection systems for all kind of heating systems. The report on equivalence has therefore not to be done.

2.IV.ii. Progress and current status on heating systems

The inspections of heating systems (gas-, oil- and wood-fired systems) are regulated by their respective regulations (gas, oil or wood regulations). After the reception procedure, a periodic control of the heating system (every four (4) years for gas-fired heating systems and every two (2) years for oil- and wood-fired heating systems) is mandatory. Most of the results of these reception procedures and inspections are currently stored in a central database.

The periodic controls are carried out by installers who have successfully completed special training and certification and own the necessary tools that allow them to perform the inspection in a professional and cost-effective manner.

The Ministry of Sustainable Development and Infrastructure created a specific website (www.heizungscheck.lu) and an informational advertisement (flyer) distributed to the public at fairs and via

other media. The flyer is dedicated to informing the public on all the different aspects of heating system inspections (legal requirements, environmental issues and cost-optimisation).

2.IV.iii. Progress and current status on AC systems

New AC systems are subject to a similar reception procedure as heating systems, carried out by the experts of the Chamber of Handicrafts.

In existing buildings, inspection of AC systems is performed by certified refrigeration mechanics.

Experts are certified after having completed special training courses. Certifications issued in other Member States can be recognised by the Minister of Sustainable Development and Infrastructure.

The inspection of AC systems is enforced by the Environmental Administration.

In order to support refrigeration mechanics in carrying out the evaluation of the overall efficiency and dimensioning of AC systems, the Environmental Administration has produced a guide on the energy efficiency of AC systems. Complementing this guide, a comprehensive checklist summarises the main aspects of energy efficiency and associated recommendations. This qualitative assessment tool is best suited to deal with the high complexity of AC systems, as it allows refrigeration mechanics to judge on-site which aspects of energy efficiency are best suited to the individual AC system.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

With respect to heating systems, non-compliance of the regulatory requirements can be penalised. If a craftsman fails to follow the reception procedure, or if an owner fails to do an inspection, sanctions (penalties of up to 25,000 € and 2 months' imprisonment) could be applied. The relevant ministries regularly remind owners to meet their obligations, and the Chamber of Handicrafts regularly exhorts its members to respect the legal procedures. There are no records on penalties levied.

For AC systems, sanctions (administrative penalties) for non-compliance with existing European and national legal requirements can be levied, e.g., for cancelling an authorisation, which can result in fines of up to 500,000 € and/or imprisonment of up to one (1) year, depending on the kind and severity of the infringement. Compliance is checked by the Environmental Administration. So far, no administrative sanction has been issued in the context of AC systems registration and inspection.

Quality control of inspection reports

Most reception and inspection reports are controlled and centralised in a database, which is operated by the government. Inspection reports are controlled with respect to their conformity and in case of non-conformity, sanctions (penalties) can be imposed or administrative procedures can be initiated.

3. A success story in EPBD implementation

The EPBD of 2010 introduced the concept of the NZEB. For residential buildings, Luxembourg defined this concept as being in principle an A-A-rated building (heating energy demand and primary energy needs). Luxembourg decided to advance the application of the NZEB standard in comparison to the EPBD. The NZEB standard is mandatory as of 1 January 2017. The timeline for NZEB, which was published in 2012, gave the sector enough time to create and adapt the training offer ("*Luxbuild*" project[13] under the BUILD UP Skills initiative to train blue-collar workers as well as planers). Thanks to "LuxBuild2020", Luxemburg's construction sector considers itself ready to build new residential buildings in "nearly zero-energy"-standard from 2017 onwards. The main results of the project are:

- Creation of centres of excellence for craftsmen based on a competency framework
- Innovative training concept: practical training, internal and external coaches, pedagogical tool
- Innovative learning material: toolbox for AAA-houses
- Gateway "LuxBuild2020": support services and tools

The "LuxBuild2020" initiative made it possible to improve the professional skills in the field of energy efficient constructions, and to develop and promote a broad offer of related training programmes. This training and education offer can be split into theoretical and practical on-site courses (within a "test house"). The organisation of the offer is a continuous work-in-progress which is monitored by the *"Conseil national pour la construction durable"* (CNCD) to constantly adapt and improve the available structures.

Additionally, the construction sector has created the platform "*Neobuild*[14]", with the mission to identify innovative technological and managerial concepts and to develop tools, methods and protocols for their implementation. As part of its mission, a testing laboratory was built containing over 100 different materials, products and systems. This zero-energy building, unique in Europe, offers many possibilities for life-sized monitoring and testing. The building is a complementary tool – a kind of living laboratory – to observe and analyse innovations in real-life conditions.

Working in this dynamic and future-oriented environment will improve the capacities and adaptability of the stakeholders to address the upcoming challenges.

4. Conclusions, future plans

Luxembourg has fully transposed the EPBD and is promoting increasingly more energy-efficient buildings through regulations. The aim is to further develop the energy efficiency renovation policy by granting relevant aids and low-interest loans.

Luxembourg is preparing for the future by creating financial incentives for new sustainable buildings and sustainable insulation materials for refurbishment. In September 2015, the government, the Chamber of Commerce and IMS Luxembourg jointly launched the strategic study titled, "*The Third Industrial Revolution Strategy*[15]", in close collaboration with American economist Jeremy Rifkin and his team of experts (Figure 7). This process, using an "open-societal innovation" approach, was aimed at making the existing economic model more sustainable and interconnected for future generations. It resulted in a comprehensive strategic study and a summary-synthesis with recommendations on how to deal with all these new challenges.

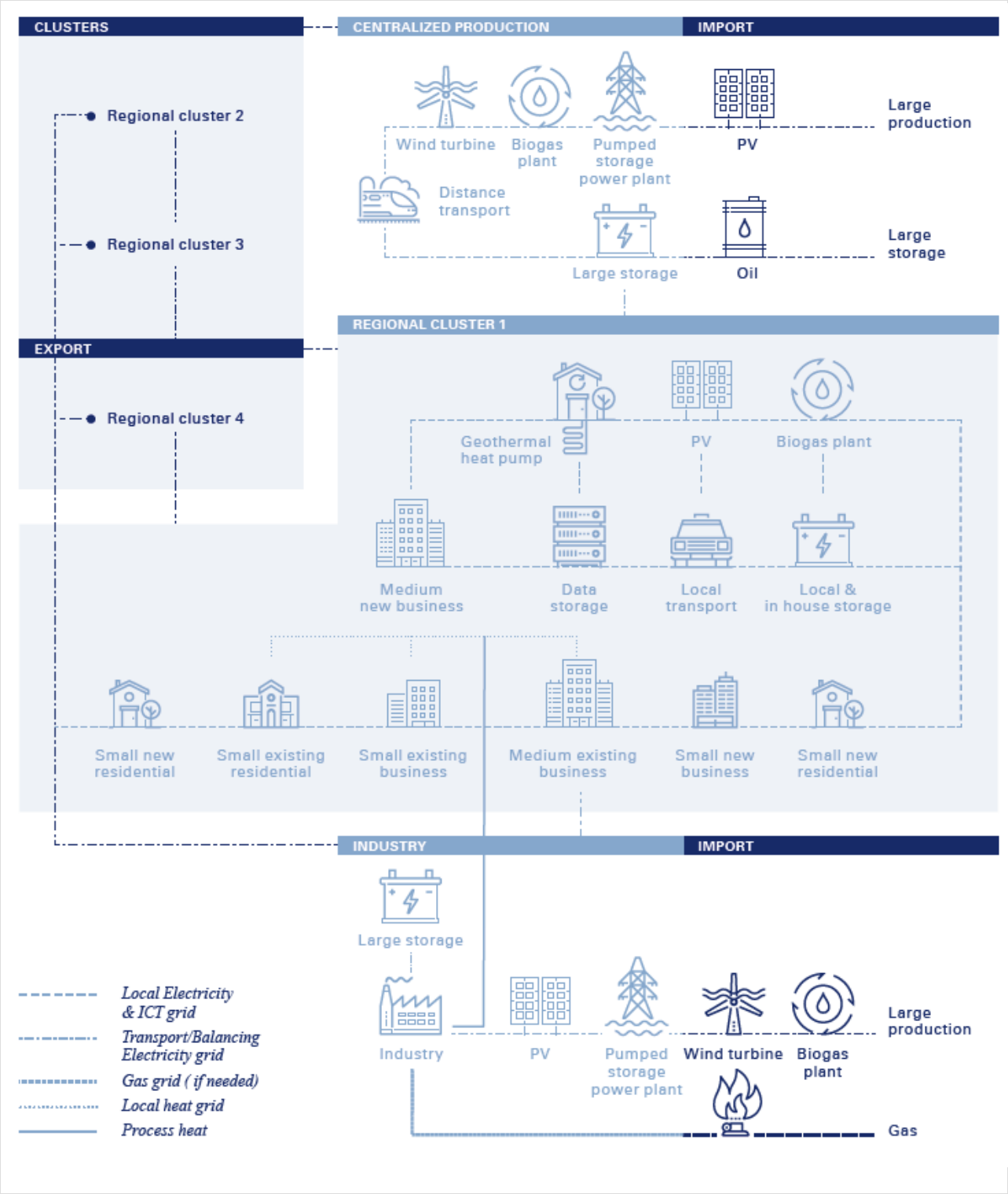


Figure 7. Schematic representation of the energy system in 2050. SOURCE: The Third Industrial revolution, study for the Grand Duchy of Luxembourg, Thematic Summary

The EU population growth will increase by 0.1% annually over the years 2013 to 2050, while Luxembourg's population could grow by 1.8% per year over that same period. The potential increase in population could provide an opportunity to build and scale up a new generation of buildings and accompanying infrastructures.

Concerning the building level, the results identified by the strategic study are detailed as follows: buildings connected to a so-called "*Energy Internet*" will play an increasingly important role in data handling, green power production and energy storage, and will act as transport and logistic hubs that will rise to the next stage – a smart-energy Luxembourg. The building-out and scaling-up of a new generation of neighbourhoods and buildings can develop aggregate efficiency, increase productivity and reduce marginal costs as well as the ecological footprint.

Within a district/eco-neighbourhood, buildings will become nodes connected to every other surrounding building to allow families, businesses, and communities to analyse big data flows along the value chains and to perfect algorithms and applications foreseen to improve the energy efficiency of the interconnected neighbourhood.

With regard to energy, RES harvesting technologies like solar, wind, geothermal, and biomass will need to be installed in and around residential, commercial, and industrial sites to generate green electricity and heat and cold for immediate use within the concerned area, or to inject the energy surplus into the electricity, heating and cooling networks. Energy storage technologies, notably including batteries, hydrogen fuel cells and thermal storage tanks, will need to be installed alongside the RES harvesting technologies to store intermittent green energy for use or sale back to the energy grids to ensure a reliable energy supply. Electric charging stations will need to be installed in or alongside buildings to power, for instance, electric, GPS-guided and self-driving vehicles, or freight vehicles belonging to the transport and logistic Internet.

Throughout 2017 and beyond, Luxembourg will continue focusing on all the strategic aspects of the medium- and long-term energy transition as well as implementing the "*Energy Internet*". The desired ambition is not simply the transition to a fully sustainable energy system, but the use of this transition to achieve energy savings while intelligently combining technical and commercial innovations.

Endnotes

1. Mémorial A – 70 du 6 septembre 1993, p. 1359 - legilux.public.lu/eli/etat/leg/loi/1993/08/05/n1/jo
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installations de combustion alimentées en combustible gazeux d'une puissance nominale utile supérieure à 3 MW et inférieure à 20 MW (Mémorial A – 195 du 17 octobre 2014 - legilux.public.lu/eli/etat/leg/rgd/2014/10/07/n1/jo); Règlement grand-ducal du 22 juin 2016 relatif a) aux contrôles d'équipements de réfrigération, de climatisation et de pompes à chaleur fonctionnant aux fluides réfrigérants du type HFC, HCFC ou CFC; b) à l'inspection des systèmes de climatisation (Mémorial A – 114 du 1er juillet 20016 - legilux.public.lu/eli/etat/leg/rgd/2016/06/22/n3/jo)

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12. www.ml.public.lu/fr/lenoz/index.html
13. http://www.luxbuild.lu/de
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15. www.tirlux.lu

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Malta

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.bro.gov.mt

1. Introduction

Malta has a long tradition regarding building regulations, with requirements ranging from prescriptive-based to performance-based. With regards to energy efficiency, the development of regulations has historically been hindered by the absence of severe weather conditions, with mean temperatures for January and February of 13-14°C, resulting in inherently low energy demands in buildings. The main challenge in climatic building design has been to employ various strategies to avoid overheating in summer; achieving high thermal mass, limiting solar gains through glazing by utilising various external shading devices, implementing stack-effect ventilation and achieving air stratification through the use of high ceilings. It was not until the implementation of Directive 2002/91/EC that the first building regulations exclusively related to energy efficiency were developed.

The EPBD was transposed through a number of acts and legal notices over the period 2006-2015. The statutory instrument transposing the EPBD has been revised by the Building Regulation Office (BRO) and is awaiting government approval. Revisions are intended to address the improved implementation of the EPBD.

Over the last three years, the minimum requirements have been revised to reflect cost-optimal levels and are now contained in two documents: Document F, part 1 and Document F, part 2[1]. These minimum requirements came into force as of January 2016 with the ratification of Legal Notice 434/2015[1].

In recent years, new developments include a definition of NZEB in Malta and a plan to achieve the targets to attain NZEB levels in the timeframe transposed by the relevant statutory instruments; furthermore, the first steps have been taken to shift the building energy demand in a positive direction. Action was also taken to address the advertisement of EPCs in all media and, to this end, guidelines were developed relating to advertising requirements.

Implementing the EPBD was further supported by training and the registration of new EPC assessors as well as inspectors of technical building systems. Guides were developed relating to inspection systems and methodologies in order to provide assistance to inspectors.

As of 2016, the responsibilities for implementing the EPBD lie with the BRO and the Building Regulation Board (BRB) of the government of Malta.

2. Current Status of Implementation of the EPBD

2.I. Energy Performance requirements: NEW BUILDINGS

Traditionally, building regulations in Malta were embedded within national legislation, with the requirements ranging from a prescriptive approach to best-practice guidance. Such legislation tended to cover various aspects of building design and performance, including energy efficiency. With the introduction of the EPBD, a progressive overhaul of the energy performance of buildings was initiated. The Building Regulation Act, Legal Notice 261 of 2008, and the first version of Technical Guidance Document F came into force, which established requirements specifically designed to improve energy performance. Following the issuance of the EPBD, a process was initiated whereby building regulations were updated to cost-optimal levels, and these came into force in January 2016 with the ratification of Legal Notice 434 of 2015[1]. Malta is now in the early stages of evaluating the regulations in force to establish whether amendments or adjustments are warranted.



Figure 1. New updated minimum requirements for buildings (left) and building services (right), which came into force in January 2016.

2.1.i. Progress and current status of new buildings

Studies to establish cost-optimal levels of energy performance in the period of 2013-2014 determined that there was a gap between the minimum requirements in force and the actual cost-optimal levels, although in some cases this difference was not particularly significant. An inter-ministerial working group was set up to address these issues, and this working group formulated proposals for new minimum requirements, including a change in approach whereby all buildings were bound by a maximum overall energy balance. The proposals were taken up and a new updated set of regulations was drawn up, coming into force as of January 2016 with the ratification of Legal Notice 434 of 2015 titled *Minimum Requirements on the Energy Performance of Buildings Regulations*[1].

Analysis of the cost-optimality reports and other available data showed that the energy performance could possibly be improved in specific building typologies if minimum energy performance requirements specifically addressed these buildings. To this end, a study was initiated to analyse the energy use within a number of reference buildings in these typologies in order to assess if the minimum requirements should be updated.

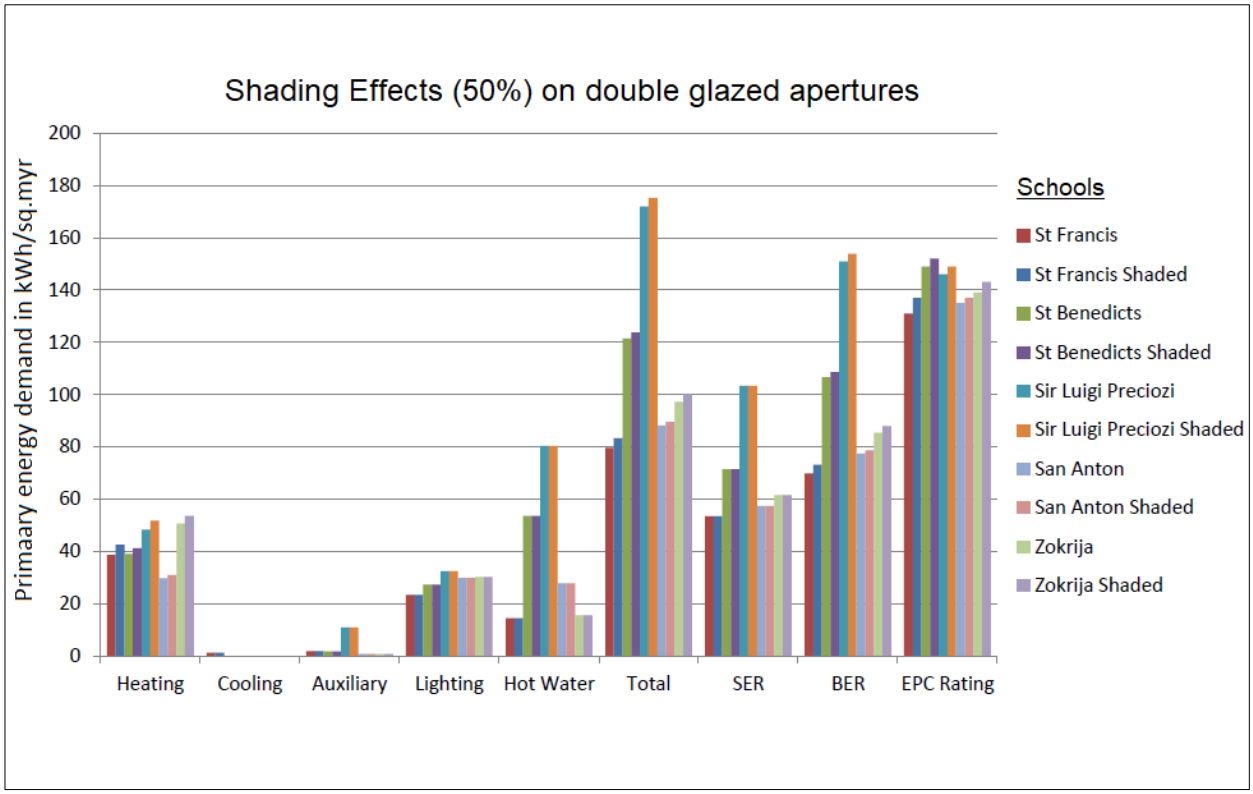


Figure 2. Extract from studies commissioned to enhance minimum requirements, showing results divided by energy use for simulations carried out for shading effects in schools.

2.1.ii. Format of national transposition and implementation of existing regulations

The minimum requirements which came into force in 2016 include a technical guidance document with two parts[1]; Part 1 relates to the building envelope and overall energy performance, while Part 2 covers building services. For the first time, requirements for the overall energy performance were introduced, taking into account the specific building types so that buildings with the potential to achieve high-energy performance (e.g., single-family detached and semi-detached houses) are required to do so. The updated documents also tighten requirements for specific elements such as glazing and roofs, while those parts designed to avoid overheating were retained. Regulations for buildings undergoing major renovations have also been

updated, while requirements were introduced for the first time for minor renovations. Buildings undergoing major renovations are now required to have a maximum overall energy demand together with the elemental requirements already in force.

The national calculation methodology for the calculation of energy performance is the same as that for issuing EPCs so that both systems may be used to enable the effective enforcement and verification of requirements. Primary energy factors are based on actual values so that building designs are able to favour systems with a higher energy performance. The contributions of RES are factored in according to the actual benefit obtained. The introduction of EPCs and the overall energy balance has enabled data to be collected for all buildings and verification may now be carried out effectively. The proposed building characteristics may now be analysed in greater detail prior to the construction phase, since there is a requirement that an EPC has to be submitted to the planning authorities at the design stage.

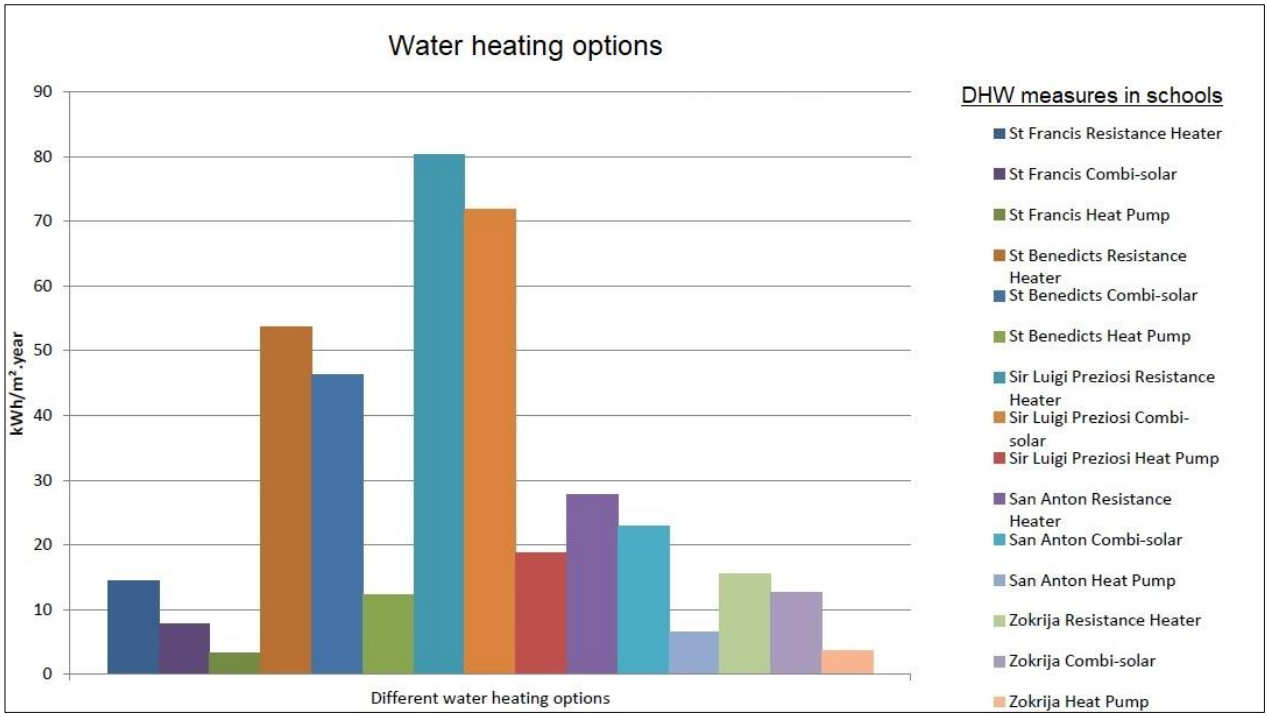


Figure 3. Extract from studies on specific aspects of minimum requirements for non-residential buildings.

2.I.iii. Action plan for progression to NZEB for new buildings

In recent years, steps towards implementing the NZEB were undertaken by an inter-ministerial working group, which follow the development of the definition for NZEB[1] (Figure 4). The working group developed an action plan for the achievement of NZEB. Barriers were identified, including those related to the skills within the construction industry at various levels in the workforce currently employed in the sector. Quantitative targets were set for the progression towards NZEB, while the qualitative progression of the newly built stock towards NZEB was monitored.

A number of studies were carried out on buildings which were known to have inherently high energy use. These were carried out by the BRO specifically in connection with the NZEB commitments. The buildings studied include hotels, restaurants and shops as well as nursing homes, sporting facilities and educational buildings. These studies will be crucial for directing investments so that the results can be achieved. The studies have shown that the investment in RES is particularly cost-effective in the local context, and this is particularly true for buildings with intensive domestic hot water use such as hotels and nursing homes.



Figure 4. The NZEB plan published in 2015 by the Building Regulation Office within the Ministry for Transport and Infrastructure. The plan includes a detailed definition for NZEB
https://epc.gov.mt/legislation?l=1

2.I.iv. Requirements for systems and / or building components for new buildings

A set of minimum energy performance requirements for buildings and building services entered into force on 1 January 2016 with the ratification of Legal Notice 434 of 2015. These requirements are officially referred to as Technical Document F, Part 1: Minimum Energy Performance Requirements for Buildings in Malta, and Technical Document F, Part 2: Minimum Energy Performance Requirements for Building Services in Malta (Figure 1 and 5).

Table 9 Maximum heat losses from DHW storage vessels

Nominal volume (litres)	Heat loss (kWh/24h)	Nominal volume (litres)	Heat loss (kWh/24h)
200	2.1	900	4.5
300	2.6	1000	4.7
400	3.1	1100	4.8
500	3.5	1200	4.9
600	3.8	1300	5.0
700	4.1	1500	5.1
800	4.3	2000	5.2

Notes

a. For guidance on maximum heat losses from DHW storage vessels with a storage volume less than 200 litres, see MSA EN 15450:2007[a].

b. The heat loss from electrically-heated cylinders (volume V litres) should not exceed $1.28 \times (0.2 + 0.051V^{2/3})$ if point-of-use or $1.28 \times (0.051V^{2/3})$ if local.

a MSA EN 15450:2007 *Heating systems in buildings. Design of heat pump heating systems.*

Figure 5. Extract from Technical Document, Part 2: Minimum Energy Performance Requirements for Building Services in Malta showing requirements for domestic hot water, which has been identified as a component with high energy demands in Malta when compared to other Member States.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The first minimum energy performance requirements, introduced in 2006 following the issuance of Directive 2002/91/EC, attempted to address the energy performance of existing buildings by ensuring that all buildings undergoing major renovations were subject to the elemental values as well as system and overheating requirements applicable for new buildings. To enable effective enforcement, major renovations were defined in Legal Notice 376 of 2012[1], to relate specifically to the building's physical characteristics. The updated minimum requirements[1], which came into force in 2016, further address minor renovations, staged renovations, and the replacement of building components. When a building component is replaced in an existing building, the requirements for the replaced component are the same as for a new building. An overall energy performance requirement was also introduced for buildings undergoing major renovations so that the maximum energy demand of the newly renovated building has been limited. A common methodology applies for the calculation of the overall energy balance required for minimum energy performance and the calculation of the energy performance indicator for EPCs. This simplifies calculation, comparison between buildings and enforcement of the requirements. When assessors issue EPCs, they are required to report the date of any renovations carried out. This simplifies the enforcement of energy performance requirements for both minor and major renovations.

2.II.ii. Plans to improve the existing building stock

Studies have shown that in existing buildings, housing in particular, significant energy performance improvements are possible through the installation of RES and the replacement of technical building systems. With this in mind, a number of financial incentives and favourable feed-in tariffs were introduced in order to specifically target existing buildings. Such incentives were aimed at enabling current building owners, and these incentive schemes generated considerable participation. As of 2015, a total of 77,000 applications for grants were made in relation to the installation of photovoltaic systems and feed-in tariffs, solar water heaters, micro-wind turbines and other measures. The housing building stock in Malta consists of a large number of single-family units with a substantial potential for the installation of solar RES. A sample of existing housing units which have undergone major renovations showed that it is not only possible to achieve the minimum requirements for overall energy performance of new housing units with the introduction of such RES technologies, but in most cases it is also possible to achieve NZEB level, which for some semi-detached and detached housing units is equivalent to 55kWh/m²(NZEB plan for Buildings in Malta, 2015; https://epc.gov.mt/legislation?l=1).

Public buildings in Malta range in size, building characteristics and age as well as energy use. As a part of central government efforts to play an exemplary role in energy efficiency and renovation, a detailed inventory of all public buildings was compiled by the Maltese Energy Agency and the BRB. As part of the renovation strategy, detailed data has been gathered as to the actual energy use. The energy use and building characteristics were assessed by these agencies to identify which buildings have the greater potential for improvement. The process for renovations on a number of these public buildings has now been initiated with the intent of reducing the energy use in these buildings, gathering information for future renovations in public and private buildings and enabling the central government to contribute to energy efficiency targets.

2.II.iii. Regulation of system performance, distinct from whole building performance

Technical Document F, Part 2: Minimum Energy Performance Requirements for Building Services in Malta sets out mandatory requirements regarding technical buildings systems as laid out in Article 8 of the EPBD, transposed by Legal Notice 47 of 2018, Energy Performance of Buildings Regulations[1]. The requirements addressed in this document apply to fixed building systems which are being designed and/or installed in both new and existing buildings. The document is available for download on the BRO website (www.bro.gov.mt). This document sets mandatory minimum energy performance requirements for cooling, heating, ventilation and lighting systems together with their relevant controls. Among various requirements, these regulations have introduced a framework for the overall performance of systems, including minimum efficiency levels for system typologies.

2.II.iv. Encouragement of intelligent metering

In the Maltese energy context, the energy generation and distribution sector is dominated by a single corporation which has invested considerably in the transition to intelligent metering in recent years. Intelligent metering has been introduced in the vast majority of buildings and intelligent meters have been in use for more than five years in most buildings.

Minimum standards for the metering of general and display lighting are referred to in Technical Document F, Part 2. The same document also specifies the minimum requirements for control and minimum efficiency for systems in various building services, including lighting, domestic hot water and space heating services.

2.II.v. Financial instruments and incentives for existing buildings

The potential for improved energy performance in existing buildings has been recognised at an early stage given the extensive building stock and the lack of energy-efficient buildings in the post-war period. The prevalence of a mild climate, which consequently results in little incentive among owners to renovate given the low financial benefits of doing so, has been a contributor to the low level of investment in this sector. Most housing units are owner-occupied, single-family homes and apartments; due to the already low amount of energy used as well as the moderate energy costs, there is not much to gain financially by achieving further energy savings. Around 4% of the total energy generation in Malta is from solar RES, the majority of which comes from the widespread installation of solar domestic hot water and photovoltaic panels on existing buildings.

2.II.vi. Information campaigns / complementary policies

While the energy performance of buildings is adhered to by means of regulation and enforcement, it has been acknowledged that the installation of RES in private residences and other buildings as well as the shift towards NZEB may be greatly aided by an increase in public demand for such buildings, even though these may not pay off in the short term. Central government authorities responsible for energy efficiency have therefore attempted to promote the benefits of energy efficiency in property values. An example where this strategy has worked is in glazing, where, due to high consumer demand, most new buildings are now being fitted with glazing systems which go beyond the newly updated minimum requirements set according to cost-optimal levels.

Information campaigns targeting energy efficiency over recent years have included:

- distributing the NZEB Plan for Malta[1] to the general public via local printed newspapers and to all building professionals to make the general public aware of the shift towards NZEB;
- distributing brochures that detail the requirements for EPC and with information regarding energy efficiency in general to all households in Malta;
- having articles published in local printed media to promote energy efficiency and outline requirements of the EPBD (Figure 6);
- having members of the BRO participate in radio and television broadcasts, including live phone-ins from the public, to promote various aspects of the EPBD such as the value of EPCs for energy efficiency;
- distributing brochures with regards to requirements for EPCs when selling a property and publishing advertisements in local printed national newspapers to encourage persons to advertise a sale of a property by providing the EPC to estate agents, in order to improve compliance with requirements to display EPCs when advertising a property;
- delivering a series of in-service courses for teachers regarding climate change and energy efficiency where teachers may then impart knowledge to students later in science lessons, creating a multiplier effect;
- delivering lectures regarding the EPBD and energy efficiency to the public in events organised by local councils;
- updating the BRO's website (www.bro.gov.mt) to provide the latest information about various aspects of the EPBD and energy efficiency.

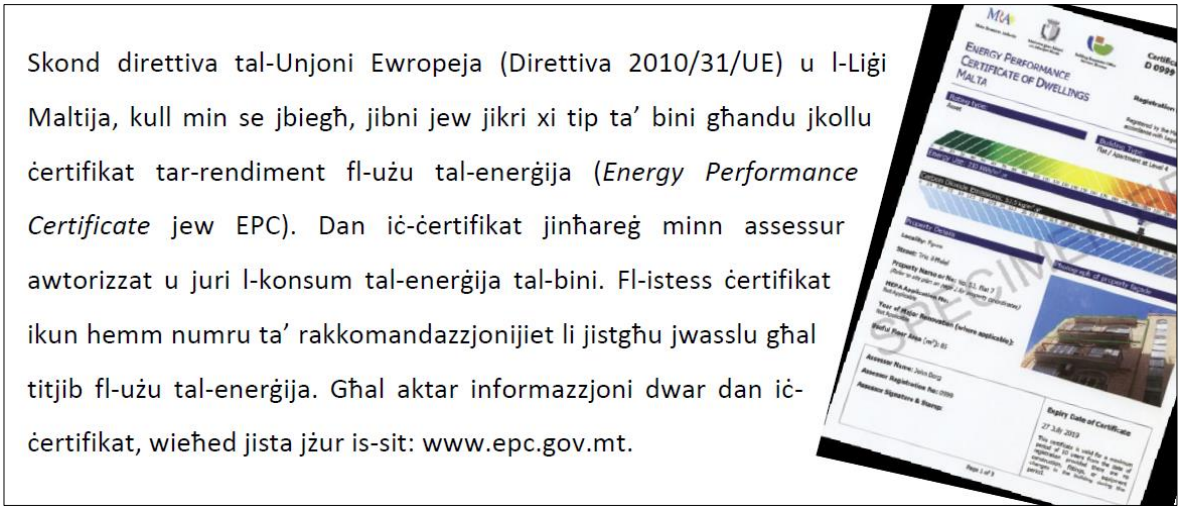


Figure 6. An article in local printed media to promote energy efficiency and outline requirements of the EPBD.



Figure 7. Billboards as part of an information campaign regarding EPCs.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

EPCS were first introduced in Malta with the ratification of Legal Notice 261 of 2008[2], and were made mandatory for housing units when built, sold or rented after 2 January 2009. For all other buildings, energy performance certification was made mandatory as of 1st of June 2009.

The EPC methodologies *Energy Performance of Residential Dwellings in Malta (EPRDM)*, and *Simplified Building Energy Model for Malta (iSBEMmt)* for residential and non-residential buildings, respectively, have become the approved national methodologies for certification purposes by means of government Notices 1025 and 1035 of 2015 issued in October of the same year.

Where a building is not yet constructed, the certificate is based on a *design rating*, while certificates for completed buildings are based on an *asset rating*. In either case, the certificate is valid for 10 years and is stored in a central national database.

In recent years, the BRO has initiated administrative processes to ensure that the requirements for EPCs are adhered to in order to increase the issuance of EPCs, with a total of 8,482 certificates issued in 2015 and 9,726 issued in 2016. Consequently, the ratio of the number of EPCs to the number of existing households increased from an estimated 2% in 2014 to 12% by the end of 2016.

The BRO has in recent years collaborated closely with the Department of Inland Revenue to be able to access private contracts related to public and private buildings so that the requirement for building owners to submit an EPC is effectively adhered to.

2.III.ii. Quality Assessment of EPCs

To ensure a high quality of EPCs and to achieve a level of independence in the auditing process, the Independent Control System has been entrusted to the Malta Competition and Consumer Affairs Authority (MCCAA). The verification system devised by the BRO and MCCAA consists of a number of checks on a statistically significant sample of certificates. During the sampling process, at least one certificate from each active registered assessor is verified. This is carried out on a yearly basis guided by Schedule II of the EPBD. Over the last three years, over 1,000 EPCs were scrutinised during this verification process.

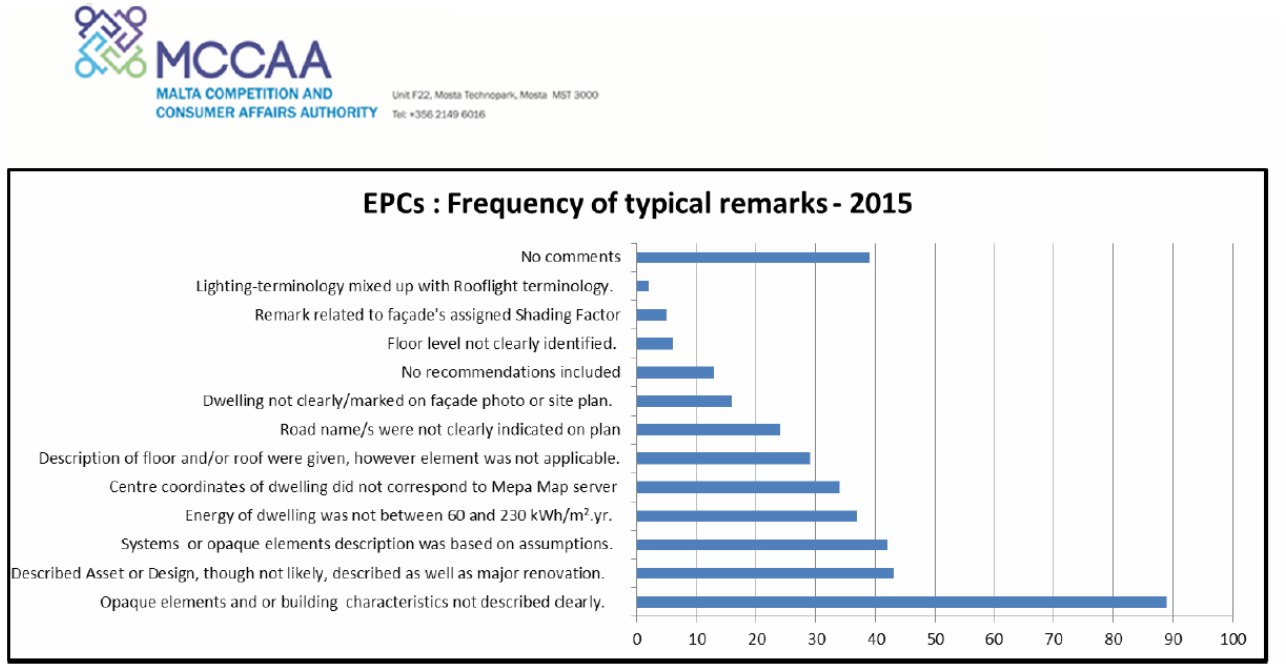


Figure 8. Results from audits carried out on a sample of EPCs by the independent authority.

Following the audit report, notifications are given to all assessors on minor errors being highlighted in the verification report so that these may be avoided in the future. Wherever quality was seen to be lacking, the assessor was asked to resubmit a new certificate addressing the issues, along with a resubmission fee.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Buildings visited by the public are considered an opportunity to disseminate information regarding EPCs and energy savings in general. In light of this, an exercise is being carried out with the specific intent to ensure that all buildings larger than 250 m^2 occupied by a public authority and frequently visited by the public are covered by an EPC clearly displayed to the public. The various government ministries have been contacted and a list of all the buildings owned and/or used by each was submitted together with information on useful floor area and whether or not these are frequently visited by the public. The buildings which satisfied the requirement for an EPC were identified and a programme for the submission of the various EPCs has been prepared by most of the building coordinators. The programmes are currently being followed up to ensure that EPCs are indeed displayed. The BRO has ensured in this way that all EPCs that have been issued are on display. The issuance of EPCs in public and private schools and central government buildings is very high. Since these EPCs are frequently viewed by the public, the BRO has undertaken a process whereby the contents and calculations of these EPCs are verified for quality purposes. This verification process is in addition to the independent control system in place and involves

on-site verification of the data. It is believed that the improvement of the EPCs on display is beneficial to the overall reputation of energy performance certification.

2.III.iv. Implementation of mandatory advertising requirement status

Legislation has recently come into force regarding the implementation of mandatory advertising requirements which had addressed previous anomalies hindering the implementation of this requirement. The new Legal Notice (47 of 2018) clearly sets out obligations of each and every party involved in the sale of a property. The party responsible for ensuring the EPCs are present in the advertisement has been defined in all cases, including in the case of websites where users are able to create advertisements themselves. A way forward has thus been set for the enforcement of this obligation.

A document titled "*Advertisement requirement guidelines*" has also been issued to serve both as a guide and a "minimum requirement" for the integration of EPCs within advertising media, including inter-alia newspapers, magazines, internet media, brochures, billboards, radio, television, direct mail, apps and estate agent listings (Figure 9).

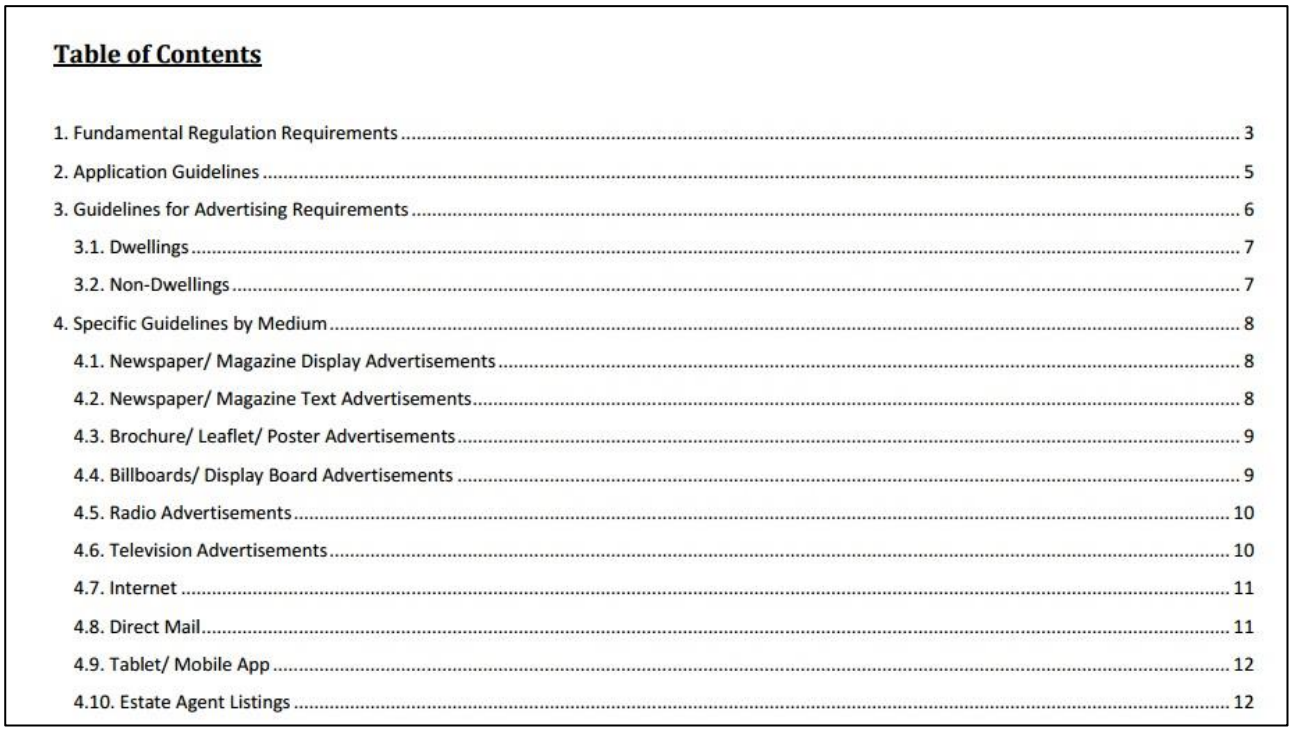


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   4.9. Tablet/ Mobile App 12
   4.10. Estate Agent Listings 12

Figure 9. Extract from advertisement requirement guidelines issued for all advertising media (https://epc.gov.mt/legislation?l=1).

2.IV. Inspection requirements - heating systems, air conditioning

Malta has adopted the inspection of heating and AC systems. The BRO has set up inspection procedures and maintains the register of inspectors and inspection reports. The register of heating and AC inspectors is available on the BRO website, including contacts for the public to be able to commission an inspector[3]. The public has been informed about the requirements and information sessions have been carried out so that professionals, building managers and other persons within the industry are informed regarding procedures to be undertaken.

2.IV.i. Progress and current status on heating systems

The BRO maintains the register for inspection reports and inspectors of heating systems. Inspections are carried out on the accessible parts of systems used for the space heating of buildings with boilers of an effective rated output of 20 kW or greater. The inspection frequencies of heating systems are shown in Figure 10.

Effective rated output of boiler	Type of boiler fuel	Inspection frequency of heating system
>100 kW	All types except gas	2 years
>100 kW	Gas	4 years
>20 kW up to 100 kW	All types	4 years

Figure 10. Inspection frequency of heating systems.

The essential aspects of an inspection include a documentation review, a visual inspection of the heating system equipment, including generation, distribution, emission and controls, and a mandatory combustion efficiency analysis. Inspectors of heating systems make an assessment of the boiler efficiency and sizing. Inspectors are also required to draw up recommendations for the cost-effective improvement of the energy performance of the inspected system(s).

In order to improve the inspection system, a new legal notice has been issued. This new legal notice defines the responsibilities of heating systems' owners and relevant inspectors in clearer terms. A "*Guide for Owners of Heating and Air-conditioning Systems" (GOHAS)* has also been prepared for publishing, along with the aforementioned Legal Notice.

This guidance document indicates which systems qualify for inspection with reference to particular system setups. It also provides additional details on the responsibilities of heating systems' owners and inspectors. The document preparation required by owners is also listed in this guide for ease of reference.

2.IV.ii. Progress and current status on AC systems

The methodology being used for AC inspections is largely based on "Technical Memorandum 44: Inspection of Air-conditioning systems, 2012", issued by the Chartered Institute of Building Services Engineers, UK (CIBSE). Inspections are carried out on AC systems which have an effective rated output of more than 12 kW. Inspection frequencies are shown in Figure 11.

Effective rated output	Inspection Frequency
12-100 kW	10 years
>100 kW	5 years

Figure 11. Inspection frequencies for AC systems according to effective rated output.

AC inspectors who have undergone a training course and assessment are registered with the BRO and their list with contact details is available on the BRO website (https://epc.gov.mt/information-assessors?l=1). The BRO has placed strict entry requirements for AC inspectors in order to ensure the necessary

competency. The AC inspectors must have a degree in mechanical and/or building services engineering, be warranted and have experience in the design and/or maintenance of AC systems. This ensures that the inspection reports are of good quality.

Owners of AC systems shall commission a registered AC inspector to carry out an inspection. The inspection requires the compilation of system documentation, the maintenance of the system, its energy efficient operation and recommendations for cost-effective improvements to the system. An assessment is also carried out on the efficiency and sizing of the AC system in comparison with the cooling requirements of the building. The AC inspection report drawn up by the inspector is then submitted for registration with the BRO. The report is handed to the client and the BRO retains a copy for the national database.

Similar to what has been described in heating system inspections, a new Legal Notice awaiting publishing is expected to contribute to improvements on the existing inspection system. This Legal Notice provides clearer definitions and responsibilities on both the inspectors and owners of AC systems.

2.IV.iii. Enforcement and impact assessment of inspections

Enforcement and penalties

The new legal notice, 47 of 2018, addresses deficiencies which are lacking in the present legal instrument. The new legal notice provides clearer obligations on the owners of AC systems, which will enable the BRO to step up the enforcement of inspections and administration of penalties.

Quality control of inspection reports

The quality of the inspection reports to date is very good, since there is a very high level of competence in the registered heating and AC systems inspectors.

The inspection reports submitted for registration were all reviewed by the BRO personnel and any deficiencies in reporting were referred back to the respective inspector to improve upon these deficiencies in order to set up a good quality standard of inspection reports.

The BRO has also a provision for the quality control of inspection reports to be carried out by the MCCAA[4], in a similar manner to that carried out on the EPCs.

Impact assessment, costs and benefits

The BRO has received feedback from the heating and AC inspectors on the current situation when carrying out inspections. The most crucial and demanding aspect of the first inspection is the gathering of documentation of the systems installed within a building. It also seems that building users are usually not aware of the systems installed in their buildings and lack information on how to best operate such systems. Therefore, the most cost-effective recommendations to achieve energy efficiency are mostly related to the proper upkeep and maintenance of systems usually requiring minimal interventions on the installed equipment.

3. A success story in EPBD implementation

Architecture and structural engineering in Malta have particularly strong ties. The engineering and architectural professions have worked together for most of their existence, and most professionals practise both. In many cases, particularly in small projects, such professionals are involved from the very early stages of the project all the way to the end, assuming responsibilities for design, planning permits, structural design and finishing. Professionals are bound by a long period of professional responsibility, which in practical terms translates into professionals being crucial in ensuring that the finished building is built according to the intended design and is structurally sound.

With the introduction of the EPBD, and with national legislation related to energy performance coming into force, architecture and engineering professionals were then tasked with new responsibilities. Establishing responsibilities applicable to minimum requirements and EPCs as well as NZEB within the current system was viewed as a golden opportunity. Architects and civil engineers would now be responsible for drawing up recommendations to improve the building's energy efficiency, since these professionals were deemed the most competent persons within the construction industry due to their experience in construction and renovations. Similarly, heating and AC inspections were entrusted to experienced building service engineers, as these are the professionals with the best available knowledge as to how to improve the efficiency of installed systems and may therefore advise building owners accordingly.

It was understood from the very beginning that training building professionals in energy efficiency aspects will have a multiplier effect in the sense that the training they undergo for energy performance certification and system inspection may then be put to good use when these same professionals are carrying out unrelated design work. Similarly, the same professionals are then able to impart the knowledge gained from EPC and inspection training onto associated professionals, trade persons within the construction industry, building users and owners.

4. Conclusions, future plans

In Malta, the EPBD is part of a wider movement towards energy efficiency in general, plug-in-loads, behavioural patterns in energy use and building energy efficiency. The actual impact of the EPBD on energy efficiency in the Maltese context has yet to be quantified, and when this is done it will be very difficult to qualify which increased efficiencies are due to the EPBD, which are attributable to other EU directives and which are attributable to other measures taken by private individuals or the Maltese authorities. For new buildings, introducing minimum EPBD requirements has effectuated improvements estimated at somewhere between 15-25%. This might be viewed as a big step forward, but when one takes into consideration that this relates only to new builds, which annually represent around 1% of the existing stock, the improvement may in fact be small overall.

An analysis by the BRO of a sample of EPCs for housing units over the period 2011-2015 shows that the energy performance of new housing units has indicated a slight improvement in energy performance over this period. Across all sectors of energy use, a reduction of carbon dioxide emissions was attained, where according to Eurostat in 2013, values were 6.8% lower than in the previous year.

Statistics show that housing units were built over various periods. The energy use for residential buildings has been shown to be low overall, and therefore the reduction in carbon dioxide emissions from this sector is expected to be low. During the past few years, it has been shown that in many cases cost-effective

energy efficiency in this sector may only be achieved when RES, particularly those related to solar energy, are integrated in the renovation or new build. These small-scale solar RES constitute the majority of the country's added share of renewable energy in the last five years.

Offices and commercial buildings are being constructed at a quick pace, due to development in the services industry. These buildings have been shown to use energy much more intensively in Malta. The requirements of the EPBD for this sector were implemented at a later stage, and as a result its effects cannot be quantified as of yet. This sector is expected to contribute to a greater effect towards energy efficiency.

Introducing the new cost-optimal minimum requirements, which include an overall energy balance limit for buildings undergoing major renovations and requirements for renovated parts, is expected to improve the overall energy demand for building stock renovations already taking place.

Endnotes

1. https://epc.gov.mt/legislation?l=1
2. http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lp&itemid=15928&l=1
3. https://epc.gov.mt/EPC/information-assessors?l=1
4. https://mccaa.org.mt

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD Implementation in The Netherlands

Status in December 2016

AUTHOR

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NATIONAL WEBSITES

www.rvo.nl, www.energielabelvoorwoningen.nl, www.zoekuwenergielabel.nl, www.energielabel.nl, www.rvo.nl/actueel/nieuws/stand-van-zaken-webapplicatie-energielabelvoorwoningennl, www.rvo.nl/initiatieven/overzicht/27008, www.energiebesparendoejenu.nl www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/energieneutraal-bouwen/publicaties, www.rijksoverheid.nl/onderwerpen/energielabel-woningen-en-gebouwen, www.verbeteruwhuis.nl

1. Introduction

The EPC system in The Netherlands has been implemented since 2008 and so far more than 3.5 million EPCs (> 50% of the total building stock) have been registered. In December 2012, the government decided to implement a new, much more consumer-friendly system for owners of residences. This new system was developed in 2013 and 2014, and has been operational since January 2015. Legislation for the new labelling system became effective on 1 January 2015[1]. Changes in the accreditation system for experts for the new EPC for residential buildings were also implemented in January 2015.

In September 2013, a national *Energy Agreement* (“*Energie Akkoord”*) was signed by more than 40 market participants and other stakeholders. The targets for energy efficiency improvements and the use of RES in buildings in this agreement are in line with the requirements of the EPBD. Under this agreement, it is foreseen that by 2020 The Netherlands will:

- improve 300,000 existing residences by two energy efficiency classes on the energy label;
- renovate the social housing building stock to the level of energy class B (on average);
- improve 80% of the private rental houses to a minimum of energy class C.

After 2020, newly-built houses have to reach the NZEB standard. The signatures of many key organisations endorsing these objectives are clear evidence that there is broad support for the market uptake of an energy-efficient and energy-neutral building environment in the future of The Netherlands.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Energy performance requirements have been in place for new buildings in The Netherlands since 1995. They are updated on a regular basis, moving towards NZEB targets by 2020 (Figure 1).

The change towards more demanding requirements took place as a result of so-called "*tightening studies*". These studies included an analysis of the market penetration of energy efficiency measures, renewable energy applications and energy-efficient heating and cooling generators. They also took into account the cost-effectiveness of these measures and their impact on indoor climate and occupant satisfaction. The *tightening studies* were carried out by consulting companies and were supervised by the *Dutch Agency for Enterprises* (*RVO*) on behalf of the *Ministry of the Interior* (*BZK*). During the studies, all stakeholders were informed about the results and could comment on them, to ensure that practical experiences with energy saving measures were taken into account[2].

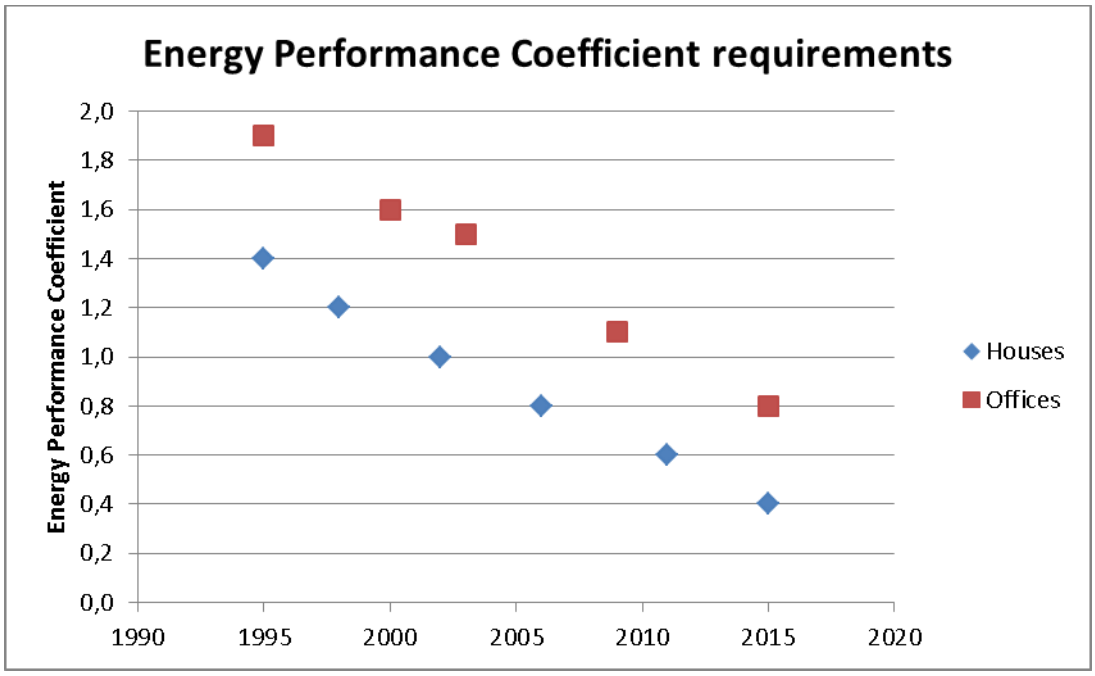


Figure 1. Change over time of the energy performance coefficient in new buildings as an indication of the improvement of the overall energetic quality of buildings (future plans are not included because the energy performance coefficient will no longer be used as an indicator for NZEB).

2.I.i. Progress and current status of new buildings

The *Energy Performance Standards* (*EPN*), established in 1995, were replaced in July 2012 by a new standard, the *Energy Performance Standard for Buildings* (*EPG*) that replaced both the existing residential and non-residential standards.

The main requirement for the energy performance of new buildings is the energy performance coefficient (in Dutch the "*energieprestatiecoefficient*'), setting *minimum energy performance* (*MEP*) for new buildings. This indicator is based on the estimated total primary energy consumption of a building based on a series

of indicators, e.g., heating, ventilation and lighting, adjusted to the useful floor area and the renewable energy produced by the building. This indicates the building energy performance in MJ/m^2.

The calculation of the energy performance coefficient is mandatory for all new buildings and for large renovations in houses and offices.

The energy performance coefficient calculation is part of the building permit application. A project developer has to demonstrate full compliance with the energy performance requirements to receive a building permit for a new building or a major renovation. Permits are checked and issued by local municipalities before construction.

Monitoring and enforcement is carried out by the regional environmental services. These are separate entities to reinforce regulation on behalf of the municipalities. These entities are part of the Dutch provinces.

Municipalities are responsible for compliance checking during construction. In case of non-compliance, they issue a "*cease-work*" order that remains valid until the requirements are met. As such, there are no financial penalties. Buildings that do not comply do not get built, and if builders deviate, construction is ceased until it is in line with the permit.

Every year, a sample is drawn by the *RVO* to check if all permits are in line with the legal requirements. If the permits are not in line with the legal requirements, the *RVO* will report this to the municipalities who will take legal action.

Energy Performance Calculation Method in The Netherlands

The energy calculation method for new and existing buildings is defined in Standard NEN 7120 that is in line with the CEN standards. This calculation of the primary energy consumption of a building is based on monthly climate data that is adjusted for physical processes with a shorter timeframe, e.g., solar gains and heat accumulation. The calculation of the thermal quality of the building envelope includes thermal bridges, ventilation and air infiltration, hot water use, efficiency of heat and cold generators, renewable energy used both in and near the building, and the contribution of passive energy, lighting and day-lighting. Shading caused by the building itself is included in these calculations. Shading by other buildings is not taken into account.

More information: http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/energieprestatie-epc/bepalingsmethode

The quotient of a building's calculated annual primary energy needs to the allowed primary energy performance provides the energy performance coefficient (Table 1).

Building Typology	Required maximum values for the energy performance coefficient (new buildings)
Day-care centres	1.1
Prisons	1.0
Healthcare buildings with bed area (hospitals)	1.8
Healthcare buildings (other than with bed area)	0.8
Office buildings	0.8
Accommodation in lodging structure (hotels)	1.0
Accommodation not in lodging structure (conference facilities)	1.4
Educational buildings	0.7
Sports buildings	0.9
Retail buildings	1.7
Residential buildings	0.4
Mobile homes	1.3

Table 1. Required maximum energy performance coefficients for new buildings since 1 January 2015 and, after cost-optimal studies, for non-residential buildings since 1 July 2015.

For residential buildings an energy performance coefficient of 0.4 means approximately 50 - 65 kWh/m^2.year.

2.I.ii. Format of national transposition and implementation of existing regulations

Since the oil crisis in the 1970s, The Netherlands applied minimum requirements for the thermal quality of the building envelope. In 2011 and 2012, a study has been carried out, to establish cost-optimal minimum requirements for existing buildings. These requirements came into effect in 2013-2014. The minimum requirements for individual building components are listed in Table 2 for major renovations (25% envelope), and in Table 3 for minor renovations.

Minimum requirements for the thermal quality of the building envelope by 1 January 2015 for new buildings and major renovation (> 25% envelope).	
Roofs	R-value ≥ 6 m^2.K/W
Floors	R-value ≥ 3.5 m^2.K/W
Façades	R-value ≥ 4.5 m^2.K/W
Transparent façade sections	U-value < 65 W/m^2.K
Individual structure	U-value < 2.2 W/m^2.K

Table 2. Minimum requirements for building components for new buildings and major renovations.

Roofs	R-value ≥ 2 m^2.K/W
Floors	R-value ≥ 2.5 m^2.K/W
Façades	R-value ≥ 1.3 m^2.K/W
Transparent façade sections	U-value < 2.2 W/m^2.K

Table 3. Minimum requirements for building components for minor renovations.

2.I.iii. Action plan for progression to NZEB for new buildings

The energy performance coefficient has been tightened on 1 January 2015, as an intermediate step to reach the NZEB level. The next step will be to specify the demands on primary energy consumption and the share of renewable energy up to the NZEB level. In March 2015, a first proposal for these requirements for new buildings was shared with stakeholders (Table 4) and sent for adoption by the parliament in July 2015.

The triple NZEB requirements are referred to in the Netherlands as the *Trias Energetica* and graphically shown as in Figure 2.

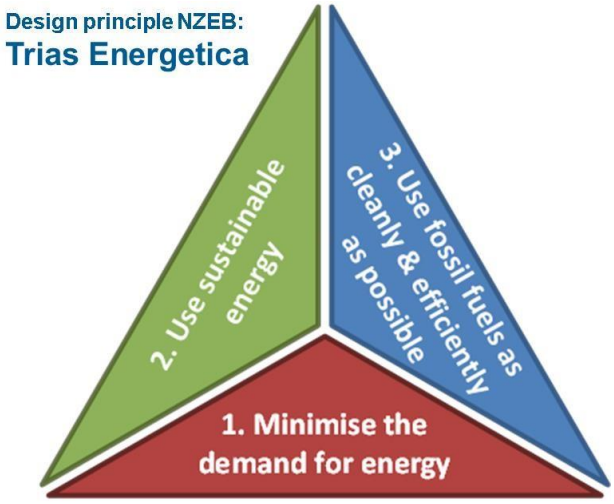


Figure 2. Trias Energetica.

Building Typology	**Energy-need [kWh/m^2.year]**	**Primary energy-use** [kWh/m^2.year]**	**Share of renewable energy** [%]**
Residential	25*	25	50
Office / healthcare with no bed area / assembly / sport / retail / prisons / lodges	50***	25	50
Healthcare with bed area	65	120	50
Schools	50	60	50
*Studio < 50 m^2 dependent on further research **Buildings > 5 floors dependent on further research ***Buildings < 50 m^2 dependent on further research			

Table 4. Proposed requirement for NZEB.

The study on the cost-optimality, in accordance with Article 5 of the EPBD, is planned for 2018. On the basis of this study, the requirements may still undergo some minor changes.

The Dutch government supports a programme from intermediary organisations, such as "*NEPROM"* (organisation of project developers) and "*Bouwend Nederland"* (organisation of builders), aimed at preparing the market players for increased demands to reach the NZEB level for new buildings.

In 2016, these intermediary organisations started a new programme under the name "*ZEN"* (i.e., "very energy-efficient new buildings") to prepare the market players for tightening of the NZEB requirements in 2020.

RVO maintains a database with NZEB examples already constructed.[3]

In 2014, the *RVO* carried out studies of the top 30 energy-efficient homes and the top 15 energy-efficient schools and offices. Some of them already met the requirements for the proposed definition of NZEB. A complete overview of the number of existing NZEB in The Netherlands is not yet available. Monitoring of this programme started in 2016. The number of NZEB will gradually increase to 100% after the implementation of the legislation regarding these buildings as per 1 January 2021.

2.I.iv. Requirements for systems and / or building components for new buildings

No requirements exist in The Netherlands for separate energy efficiency measures for technical building systems. Instead, the total building has to reach a level of efficiency, indicated by the energy performance coefficient. This way, builders and developers are given the freedom to choose the most cost-efficient solution as regards the envelope and the technical building system of that particular building. This approach gives freedom in the design and stimulates technical innovation. Products that are not yet integrated into the official calculation method are tested to establish the performance that leads to inclusion in the method. An independent commission of experts has to approve the results of the test before official publication.

This concerns the performance of systems and products in the area of heating, hot water, AC, and large ventilation systems.

On top of the energy performance coefficient for the total building, there are also mandatory minimum requirements for building elements in new buildings. Those are similar to the demands for existing buildings undergoing major renovation (Table 2).

2.II. Energy performance requirements: EXISTING BUILDINGS

Similar to new buildings, major renovations are required to have a building permit that meets minimum requirements for building components, e.g., the R-value of walls, roof and floor, and the U-value of windows and doors. A renovation is considered to be major when more than 25% of the building envelope will be renovated. The calculation of the energy performance coefficient is also mandatory for large renovations in houses and offices (see also section 2.I.i).

For minor renovations, there are only minimum requirements for the R-value of walls, roof and floor, and U-value of windows and doors. In such cases, no energy performance calculation or building permit is required. The requirements for the individual building components are listed in section 2.I.i.

2.II.i. Progress and current status of existing buildings

The Dutch strategy for the renovation of buildings is based on the *Energy Agreement* signed in 2013, endorsed by around 40 parties, public and private, with strong ambitions, goals, intentions and agreements regarding energy saving in many areas in The Netherlands. By the end of 2016, the Cabinet presented the *Energy Agenda*. Herein, the requirements for the long term are set to 2050. The *Energy Agenda* will have a major impact on the renovation strategy for buildings.

The point of departure of the *Energy Agreement* is that building owners – i.e., housing corporations, citizens, companies, institutions and governments - have self-interest in and take responsibility for energy saving, but need support. A coordinated effort by the government, municipalities, contractors, builders, installation companies, banks, building owners and landlords is necessary. A combination of information-sharing and awareness-raising, with care and funding support has been chosen as the most effective measure to increase support. In 2016, it was decided to phase out offices and rented houses with an energy label worse than label C and a contractual agreement was made with energy suppliers, installers and network administrators.

For the longer term, the *Energy Agenda* has described the strategy to achieve CO_2 neutral low temperature heating in the Netherlands by 2050. The gradual reduction of the use of natural gas in the built environment is a decision with major consequences. The elaboration of strategies will take place at regional level, as alternatives to space heating in the built environment may differ at regional and local level. Energy savings will be part of these regional strategies.

At the signing of the *Energy Agreement* in 2013, a guarantee committee has been set up to monitor compliance and understand the results of the *Energy Agreement*. The '*Borgingscommissie*' Committee ensures that the agreed measures are taken, and that this agreement does not remain an intention. In this context, the *National Energy Explorations* (*NEV*) were published in 2014, 2015 and 2016. The *National Energy Explorations*, conducted annually, analyse the Dutch energy economy and outline plausible future developments in established and planned policies. The measures of the *Energy Agreement for Sustainable Growth* are included in these analyses.

Based on the results in the *National Energy Exploration* 2015, an intensification package with measures was adopted in spring 2016, of which the label C obligation for offices is the most important for energy saving in the built environment.

The impact of this intensification package in the built environment is estimated at 10.0 PJ in 2020 (range 6.7 - 27.7 PJ) (*Energy Enhancement Package, ECN* 2016). The *National Energy Exploration* 2016 has not yet included all the measures of this intensification package because they have not yet been dealt with in a concrete way. Based on established policies and the intended (sufficiently concrete) policy, the final energy saving in the built environment is estimated at 27 PJ per year (range 13-43 PJ).

In the autumn of 2016, additional measures were agreed, among which was the obligation to phase out rental housing with a label worse than label C. This measure gives about 5 PJ additional energy savings compared to the *NEV* 2016. A task agreement ("*covenant*") was undertaken between energy suppliers, installers, network administrators and the government to trigger an energy saving market and achieve a savings goal of 10 PJ by 2020.

The *Ministry of the Interior* (*BZK)* started the three-year national activation campaign "*Save energy now*" in October 2016. This campaign aims to encourage private homeowners to save energy in their own homes by raising the urgency and removing common questions and concerns. The target group includes all homeowners with a label C or worse. In addition to commercials on radio and television, there is also a

campaign website, where homeowners can ask questions, view measures and subsidy opportunities, and refer to municipal energy information centers and suppliers of products and services.

On 1 September 2016, a subsidy scheme for energy-saving of own houses was published. A total budget of 60 million € was made available to homeowners who carry out at least two major insulation measures. For an integral, highly energy-efficient package (the insulation package belonging to a "*zero-energy-bill house*"), a further 4,000 € bonus can be made available. Subsidies are also available for energy advice and the creation of a green multi-annual maintenance programme for building owner associations (*VVE's*).

2.II.ii. Plans to improve the existing building stock

A number of measures are foreseen in the near future, to stimulate energy efficiency in the built environment. The focus is on the application of alternative high-efficiency systems during major renovations. Extra attention will be given to enlarge the economic value of the EPC during the selling and buying process of houses and buildings. Also, the market for energy efficiency will be further developed.

The development of a national renovation programme focused on large-scale neighbourhoods is currently in full swing with special attention on the development of neighbourhoods with renewable energy systems not requiring natural gas as an energy source.

The Dutch government supports two relevant initiatives, the "*Energiesprong*[4]*"* and the "*Stroomversnelling"*[5]*,* with 45 million € grant. "*Energiesprong"* (*energy jump*) is an initiative that aims to reach very energy-efficient renovations in both the private and social housing sector. From the yearly report "*Energiesprong 2014"*, nearly 130 zero-energy-bill houses have been realised in 2014. "*Stroomversnelling"* (acceleration) aims to renovate 111,000 social housing buildings and 50,000 privately-owned houses to the level of the net zero-energy bill by the year 2021.

Laws and legislation are adapted to enable owners to get a refund (*EPV* "*Energiepresetatievergoeding"*) from tenants for having reduced their energy bill through investments in energy efficiency and/or on-site energy production, thus consuming only as much energy as is generated over the course of the year. This solves the problem of the split incentive, in which the costs of energy efficiency measures are the responsibility of the building investor or owner, whereas the benefits of a lower energy bill go exclusively to the tenants.

2.II.iii. Regulation of system performance, distinct from whole building performance

(see Tables 2 and 3 in section I.ii)

2.II.iv. Encouragement of intelligent metering

Following a positively evaluated national cost-benefit analysis and a small-scale experience phase, the Dutch parliament agreed in 2014 to introduce a smart gas and electricity meter in all homes and small businesses by 2020. The distribution system operators are responsible for offering smart meters, for granting access to the metering data to the energy supplier, and for collecting and validating the metering data for other third parties upon customer request. The highest benefits associated with the smart meter rollout appear to go to the customer, as the advantages of energy savings and efficiency improvements in

the market largely benefit the customer (Figure 3 for electricity). Therefore, part of the rollout strategy is to encourage the consumer to opt for a smart meter with detailed meter readings, and to use it as efficiently as possible. Furthermore, the smart meters are considered a significant contributor to a future smart grid system.

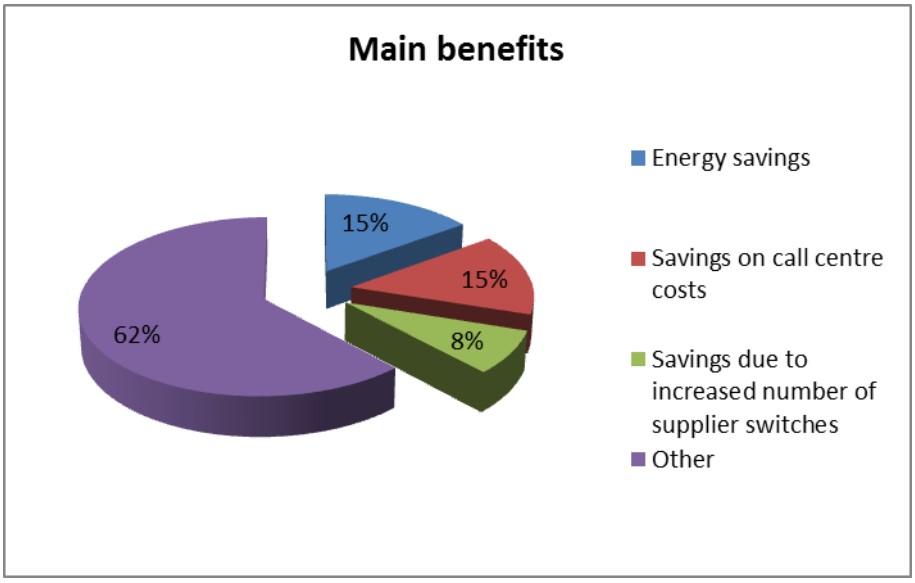


Figure 3. Share of main benefits associated with electricity smart metering rollout.

2.II.v. Financial instruments and incentives for existing buildings

Measures currently running at the end of 2016 are:

1. "*SDE+*": a subsidy scheme for investments in renewable energy systems such as geothermal systems and bio-based installations;
2. "*EIA*": a tax reduction for investments in innovative sustainable energy systems based on an EPC indicator;
3. possibilities for an extra mortgage for private investment in extreme energy efficiency measures (zero energy bills) up to a maximum of 25,000 €;
4. "*National Energy saving Fund*" (*NEF*): cheap loans for energy saving measures for private owners (300 million €);
5. "*STEP*": a subsidy scheme for social housing corporations for investment in energy efficiency (400 million €) based on EPC improvements;
6. "*Funds for the Energy Saving Rental Sector*" (*FEH*): cheap loans for extreme energy efficient renovations (75 million €);
7. "*Energie Prestatie Vergoeding*": social housing corporations that rent houses or apartments with a "zero-energy-bill house" can oblige the occupants to pay a contribution to the energy investments; this overcomes the barrier of the split incentive;
8. **"***SEEH***":** a subsidy scheme for investments in energy saving measures for private owners (65 million €).

2.II.vi. Information campaigns / complementary policies

Between January and March 2015, 4.5 million home owners that did not have an EPC received a letter with a temporary energy label for their home. The intention of this initiative was to make them aware of the energy performance of their property and the opportunities to improve it, as well as of their obligation to have a definitive EPC when selling or renting their house. The latter obligation was also communicated through social media and other national and regional public channels. Municipalities developed additional awareness campaigns and organised local information desks.

A new national campaign focusing on how to make homes more energy-efficient started in 2016. The slogan and figurative mark (Figure 4.) ensure recognisability in the different campaign expressions.

The "Saving energy now" campaign will run until 2018. The first phase will focus on improving home insulation in the private owned sector. Later, the focus of the campaign will shift to, e.g., other energy-saving measures or specific target groups.

The *Association of Dutch Municipalities* ("*Vereniging van Nederlandse Gemeenten"*[6]*)* regionally and locally supports the campaign with the so-called *Energy Centres*. The *Energy Centres* offer homeowners the possibility of personal advice on energy saving measures, and assistance in finding a suitable building company.



Figure 4. National "Saving energy now" campaign.

2.III. Energy Performance Certificate requirements

The EPC system has been in place since 2008 and more than 3.5 million EPCs (> 50% total building stock; residential, commercial and public buildings) have been registered under this legislation.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

In the period between 1 January 2015 and 30 November 2016, 991,311 labels, based on the new EPC, were issued (including sales and rented properties).

Table 6 shows the transaction rates of residential buildings (houses), with or without EPC, in 2015 and 2016. These include the new EPCs as well as the Energy Index Report (EI).

Labels residential buildings	**New EPC**	**EI (Energy Index report)**	**Total**
Total 2015	286,763	186,607	473,370
Total 2016	237,819	280,122	517,941
Total 2015&2016	**524,582**	**466,729**	**991,311**

Table 5. Labels issued over the period between 1 January 2015 and 30 November 2016

2016 Labels residential buildings	Transactions sale (with or without requirement* of EPC)	Transactions sales with requirement of EPC	Transactions sales with requirement of EPC, without EPC	%	Transactions sales with requirement of EPC, with EPC	%
January	16,945	15,584	2,656	17%	12,928	83%
February	21,022	19,475	2,680	14%	16,795	86%
March	22,422	20,443	3,319	16%	17,124	84%
April	21,705	19,690	3,025	15%	16,665	85%
May	22,068	19,849	2,546	13%	17,303	87%
June	25,565	22,005	3,050	14%	18,955	86%
July	26,342	23,904	2,971	12%	20,933	88%
August	26,295	24,338	2,625	11%	21,713	89%
September	28,457	25,942	3,091	12%	22,851	88%
October	22,843	20,696	2,523	12%	18,173	88%
November	24,615	22,255	2,839	13%	19,416	87%
December	37,846	33,306	4,539	14%	28,767	86%
Total transactions 2016	**296,125**	**267,487**	**35,864**	**13%**	**231,623**	**87%**

2015 Labels residential buildings	Transactions sale (with or without requirement of EPC)	Transactions sales with requirement of EPC	Transactions sales with requirement of EPC, without EPC	%	Transactions sales with requirement of EPC, with EPC	%
January	14,112	13,516	5,156	38%	8,360	62%
February	14,886	14,384	4,458	31%	9,926	69%
March	17,367	16,791	4,509	27%	12,282	73%
April	20,626	19,673	5,330	27%	14,343	73%
May	16,403	16,006	4,494	28%	11,512	72%
June	18,878	18,418	4,964	27%	13,454	73%
July	27,174	26,648	5,505	21%	21,143	79%
August	18,788	18,466	3,753	20%	14,713	80%
September	20,395	19,732	3,728	19%	16,004	81%
October	21,574	19,738	3,283	17%	16,455	83%
November	25,159	23,587	3,221	14%	20,366	86%
December	33,537	30,286	6,390	21%	23,896	79%
Total transactions 2015	**248,899**	**237,245**	**54,791**	**23%**	**182,454**	**77%**

* Some transactions do not have an EPC requirement, for instance monumental buildings or the transaction of a piece of land.

Tables 6a and 6b. Transaction rates of residential buildings (houses), with or without EPC, in 2015 and 2016.

According to data collected by the *Land Registry and Mapping Agency* ("*Kadaster"*)[7], at the beginning of 2016, 83% of houses with an EPC requirement had an EPC at the moment of sale. This had risen to 86% at the end of 2016. A study in 2015, carried out among housing corporations, revealed slightly higher compliance rates for rented buildings than for sold ones.

The presence of the label is checked by the "*Inspectie voor de leefomgeving en Transport"* (*IL&T*, *the National Governmental Inspection Authority*[8]) of the Ministry for Infrastructure and the Environment.

2.III.ii. Quality Assurance of EPCs

Since 1 January 2015, experts for residential buildings ("*Erkend Deskundige Energielabel Woningbouw"*) must meet the requirements of the former system or pass a new simplified exam. The exam is organised by "*SVMNIVO"*[9], the exam centre for the real estate industry. In addition, experts must follow a training course from *RVO.nl* to learn how to operate the web tool on the *RVO* website[10].

Checks and sanctioning is part of the new system that is operational since 1 January 2015 and carried out by the *IL&T*.

In 2016, 1,571 EPCs were checked by the *IL&T*. In 77 EPCs, the *IL&T* found errors in the input data. More than 95% of the EPCs were correct. Recognised experts in whose EPCs errors have been detected will be checked again in early 2017.

If this non-compliance situation is repeated, the specific experts will lose their license and will be excluded from activities related to EPCs.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The obligation to display the label has been mandatory since 2008. In 2015, 1,183 public buildings (municipality, province and government buildings) were identified, and 584 of them were checked by the *IL&T*. 245 of these buildings had not yet displayed their energy label. Another 380 public buildings were inspected in 2016.

The *IL&T* can give owners of such buildings a financial penalty in case of non-compliance. To date, several owners of public buildings have received a warning of non-compliance with the requirement for public display of the EPC. They are given a 6 months period to become compliant and will be checked again after this period.

2.III.iv. Implementation of mandatory advertising requirement – status

The presence of the label in advertising is checked by the *IL&T*.

Of all houses sold in The Netherlands, 80% are advertised on the website of the real estate chain, "*Funda"*. The remaining 20% are sold through other agencies or means, in most cases without an advertisement. On the "*Funda"* website, the preliminary EPC is presently shown in 100% of the cases, along with the characteristics of the property. Only 18% of the advertisements show the final label. The obligation to publish the final label is only mandatory if an EPC already exists. In many cases, house owners have not registered their final EPC when the advertisement is published. This explains the relatively low number of final labels.

2.IV. Inspection requirements – heating systems, air conditioning

In The Netherlands, mandatory inspections are in place for gas-fired heating systems with more than 100 kW, and for non-gas-fired heating systems with more than 20 kW heating capacity. This obligation is regulated in the *"Activiteitenbesluit Stookinstallaties"* (*Activities Decree and Activities Regulations*)[11]. For gas-fired heating systems between 20 kW and 100 kW, The Netherlands has opted for an alternative approach: since gas-fired systems between 20 and 100 kW are used for heating in more than 5 million homes (over 90% of the existing housing stock), The Netherlands has opted for a system of voluntary inspection and maintenance, combined with energy-saving advice for these systems.

2.IV.i. Report on equivalence of model A and B for Heating Systems

There is no description of main justifications available at this moment.

2.IV.ii. Progress and current status on heating systems

The proportion of systems with regular maintenance is already high, at approximately 90% in 2011, but it has decreased in recent years, partly as a result of the economic crisis. Moreover, the quality of the performed maintenance and inspections varies. For these reasons, in collaboration with the Installer branch, a new quality label was developed and put on the market in 2015 called "*OK-CV"*[12]. Regular maintenance under "*OK-CV"* is combined with an inspection and savings advice.

A communication and marketing campaign among contractors was conducted in 2014 (Figure 5).

From 2015, licenses to carry out the maintenance and inspections under the quality label are issued to contractors. The government supports the further development and communication of "*OK-CV"*.

The quality of the assessment is checked by the "*OK-CV"* organisation that has developed a database with all results of inspections. If inspectors fail to meet the "*OK-CV"* standards, they lose their license.



Figure 5. Campaign brochure OK-CV

2.IV.iii. Progress and current status on AC systems

There has been a mandatory inspections regime for AC systems in place since 1 December 2013. This comprises a mandatory inspection for systems larger than 12 kW. Private homes are excluded from this regime because there are very few such systems in houses.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

The "*Activiteitenbesluit"* includes regulations for inspection and maintenance of gas-fired heating systems above 100 kW and non-gas-fired heating systems above 20 kW (*Activities Decree*, Article 3.7, paragraph 4, 3.10p and *Activities Regulations*, Article 3.7m)[13]. The periodic inspection ensures safe operation as well as optimum combustion and energy-efficient functioning. The risks of air pollution (CO, NOx, SO_2, particulate matter and C_xH_y), explosion and energy waste are addressed. An inspection includes checking the system for the supply of fuel and combustion air, the exhaustion of combustion gases and the adjustment for combustion efficiency (*Activities Regulations*, Article 3.7, paragraph 3). The holder of the combustion plant shall keep the final report available for the authority.

The *IL&T* carries out random checks to verify that the mandatory inspection has been performed. Owners who have not had an inspection performed, currently get a 6-months period for doing so. If they fail to meet the requirement within this timeframe, they can get a fine of up to 20,250 €.

Accredited inspectors have to take a new exam every 5 years. If they fail, they will be removed from the *RVO* database. Inspection figures for 2014-2015 are not available.

Quality control of inspection reports

The "*Stichting Certificering Inspectie en Onderhoud Stookinstallaties" (SCIOS)*[14] inspectors record their findings in the inspection report. The supervisor of the competent authority (usually municipalities) checks if inspections have taken place and if reports are available. The municipalities can access the *SCIOS* database, where all inspections are recorded via a secure web application.

The *IL&T* also carries out random checks to determine if the inspection reports meet the requirements. If a report does not live up to quality standards, the owner will get a formal notification from the *IL&T* stating that they have 6 weeks to acquire a new, improved inspection report. If owners do not comply, they will be placed in default and they will be fined as if they had not had an inspection performed in the first place, at a maximum of 20,250 €.

Impact assessment. Costs and benefits

No data available at this stage.

3. A success story in EPBD implementation

The introduction of the new energy performance label in The Netherlands has changed the landscape of the Dutch built environment. While the previous label was merely technical and expensive and suffered resistance among the Dutch population, the new simplified label has empowered citizens to directly influence their energy use. The practical advice has given building owners concrete steps for improvement. The new label has become a marketing tool instead of a technical process. It is motivating for owners to improve the energy level of their houses and get a new label. A good level is perceived as an indicator for good quality and an added value. This is also recognised by banks and other financial institutions and has influenced mortgaging. Banks are investigating if they can offer lower interest rates for better energy performance labels since 2016. The label has supported builders and installers in their pursuit of energy efficiency as a new or renewed market. New market offers have sprung up from different companies that offer integral solutions for homeowners and buildings to upgrade their label. The long-term experience of Dutch professionals with integral solutions contributes to an increased demand. The voluntary agreement of the partners in the "*Energieakkoord*"[15] (*Energy Accord*) gives a central place to improvements of the label as a vehicle to reach the 2020 objectives[16]. This broad support has contributed to higher investments in energy efficiency and renewable energy.

The results of the simplified web-based approach in the first year, since its introduction in January 2015, are:

- 4.5 million houses got a letter with information about their EPC and a personal pre-setting in the EPC web tool[17];
- over 2,000 trained qualified experts, of which over 850 working with the web tool;
- costs are kept low because of competition, with an average of 25 € per EPC;
- over 800,000 individual log-ins;
- over 950,000 registered new EPCs since January 2015 and over 3.5 million EPCs in total (> 50% total building stock; residential, commercial and public buildings).

4. Conclusions, future plans

In general, The Netherlands has implemented the EPBD.

For the near future, a number of measures is foreseen to stimulate energy efficiency improvements in the built environment. The focus is on the application of alternative high efficiency systems during major renovations. Extra attention will be given to enlarge the economic value of the label during the selling and buying process of houses and buildings. Also, the market for energy efficiency will be further developed.

Financial support measures running at the end of 2016 are:

1. *SDE+"*: a subsidy scheme for investments in renewable energy systems such as geothermal systems and bio-based installations;
2. "*EIA"*: a tax reduction for investments in innovative sustainable energy systems based on an EPC indicator;
3. possibilities for an extra mortgage for private investment in extreme energy efficiency measures (zero energy bills) up to a maximum of 25,000 €;

4. "*National Energy saving Fund"* (*NEF*): cheap loans for energy saving measures for private owners (300 million €);
5. "*STEP"*: a subsidy scheme for social housing corporations for investment in energy efficiency (400 million €) based on EPC improvements;
6. "*Funds for the Energy Saving Rental Sector"* (*FEH*): cheap loans for extreme energy efficient renovations (75 million €);
7. "*Energie Prestatie Vergoeding"*: social housing corporations that rent houses or apartments with a "zero energy bill" can oblige the occupants to pay a contribution to the energy investments; this overcomes the barrier of the split incentive;
8. **"***SEEH***":** a subsidy scheme for investments in energy saving measures for private owners (65 million €).

Endnotes

1. wetten.overheid.nl/BWBR0020921/2017-01-01
2. www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels-gebouwen/energieprestatie-beng
3. www.rvo.nl/initiatieven/overzicht/27008
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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Norway

Status in December 2016

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1. Introduction

Directive 2002/91/EC has been fully implemented in Norway since 2010. Energy performance requirements for new buildings were revised in 2010 and most recently in 2015, coming to full effect as of 1 January 2017. By the end of 2016, approximately 650,000 EPCs had been issued. The majority of these concern houses and apartments, while 24,000 concern non-residential buildings.

Directive 2010/31/EU has not been included in the EEA Agreement[1] yet, and is thus not implemented in Norway. The Norwegian Government has decided to incorporate the directive into the EEA Agreement with necessary adaptations.

In 2016, the state-owned energy administration Enova took over as operator of the EPC scheme. An evaluation of the scheme is ongoing and may lead to changes in 2017. The Norwegian Water Resources and Energy Administration remains responsible for the control and use of sanctions related to EPCs.

This report presents an overview of the current status of implementation, as well as of further plans for improvement of the schemes available under the EPBD in Norway, among others minimum requirements, certification (EPCs) and inspection systems including the status of quality control mechanisms, the status of qualified experts in the market, information campaigns, and incentives and subsidies.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

In 2012, a broad agreement in the Norwegian Parliament stated that all new buildings should be at "*Passive House*" level in 2015, and NZEB by 2020.

The two Norwegian standards for passive houses and low-energy buildings are already in place. These are the NS 3700 for residential buildings, and the NS 3701 for non-residential buildings[2]. The definition of the "*Passive House level"* from the political agreement was to be implemented in the building regulations in 2015. In November 2015, the new requirements were published and have been effective since January 2017. The requirements of 2015 do not fully meet the Norwegian passive house standards, but are set at a more cost-optimal level.

The requirements for 2020 shall be set so as to comply with the EPBD, but they are yet to be defined.

2.I.ii. Format of national transposition and implementation of existing regulations

The Norwegian building regulation, mandatory since 2017, includes two options to fulfil the requirements. For non-residential buildings, only the first option is allowed.

- The first option contains specific energy limits for different building types. The requirements are set in kWh/m^2 useful energy demand per year within the building envelope, considering heat recovery from ventilation systems but not considering system losses and energy export. If this option is chosen, a set of absolute minimum requirements must also be fulfilled.

- The second option (only for residential buildings) addresses different components of the building envelope as well as requirements for technical installations and solutions. The requirements will be considered fulfilled, if it is proven that 9 specific energy measures are applied. In addition to requirements concerning insulation and envelope airtightness, there are specific requirements for the heat recovery of ventilation air in the ventilation apparatus (yearly mean heat recovery rate) and the specific fan power (SFP) factor. These are the requirements shown in Table 1.

In order to ensure flexibility in heating systems and to facilitate systems based on renewable energy, all buildings larger than 1,000 m^2 shall have flexible heating systems, normally waterborne, and must be able to utilise low-temperature heating distribution systems. Single-family houses need to have a chimney flue, unless flexible heat distribution is installed. Installation of heating systems prepared for fossil fuels is not allowed. As Norwegian electricity production is almost exclusively based on renewable energy and fossil fuels are to be phased- out from buildings, primary energy factors are not used in the regulations. To stimulate local renewable production when electricity is produced on the property (more than 20 kWh/m^2 per year), the specific energy limit can be exceeded by 10 kWh/m^2 per year.

The Norwegian energy requirements are set for 13 different building categories. Indicatively, Table 1 shows the progress over time of certain aspects necessary to fulfil the Norwegian minimum energy requirements for commercial buildings, single-family houses and apartment buildings.

Requirement	1997	2007	2010 (after Directive 2002/91/EC)	2015 Specific requirements only applicable for residential buildings
Net energy demand (kWh/m^2 per year)	-	Single-family house: 125 + 1,600/m^2 heated floor area	Single- family house: 120 + 1,600/m^2 heated floor area	Single-family house: 100 + 1,600/m^2 heated floor area
		Apartment: 120	Apartment: 115	Apartment: 95
		Commercial building: 165	Commercial building: 150	Commercial building: 115
Maximum area of glass plus doors	20% of heated floor area	20% of heated floor area	20% of heated floor area	25% of heated floor area
Max U-value: exterior wall W/(m^{2}K)	0.22	0.18	0.18	0.18
Max U-value: roof W/(m^{2}K)	0.15	0.13	0.13	0.13
Max U-value: exposed floors W/(m^{2}K)	0.15	0.15	0.15	0.1
Max U-value: glass/doors W/(m^{2}K)	1.6	1.2	1.2	0.8
Thermal bridges (max linear U-value) W/(m^{2}K)	-	Single-family house: 0.03	Single-family house: 0.03	Single-family house: 0.05
		Other buildings: 0.06	Other buildings: 0.06	Apartment buildings: 0,07
Minimum efficiency of heat recovery in ventilation air	60%	70%	Single-family house: 70%	80%
			Commercial building: 80%	
Minimum airtightness (Max air changes/hour at 50 Pa pressure difference)	Single-family house: 4.0	Single-family house: 2.5	Single-family house: 2.5	0.6
	Other buildings (with more than two floors): 1.5	Other buildings (with more than two floors): 1.5	Other buildings (with more than two floors): 1.5	
Max SFP factor kW/(m^3/s)	-	Single-family houses: 2.5	Single-family houses: 2.5	Single-family houses: 1.5
		Non-residential building: 2.0	Non-residential building: 2.0	
Max screening factor for glass/window (gt)	-	-	0.15 (all buildings)	

Table 1. Minimum energy requirements for buildings in Norway.

Table 2 shows the absolute minimum requirements that must be fulfilled if using the option of net energy demand limit.

U-value exterior wall W/(m²K)	U-value roof W/(m²K)	U-value exposed floors W/(m²K)	U-value glass/doors W/(m²K)	Airtightness (air changes/hour at 50 Pa pressure difference)
≤ 0.22	≤ 0.18	≤ 0.18	≤ 1.2	≤ 1.5

Table 2. Minimum requirements under the "specific energy limits" option.

Since 1 January 2013, all new buildings are required to be controlled by an independent expert at the end of the construction process. For larger residential buildings and for non-residential buildings, the control will be more extensive than for single-family houses. Air leakage testing is mandatory for all building types and must be documented according to the current standard.

As the requirements regulate the net energy demand, no primary energy factors are available.

The Norwegian standard for the calculation of the energy performance of buildings is NS 3031, which is derived from EN 15603. The regulation of 2015 is based on the 2014 version of NS 3031.

2.I.iii. Action plan for progression to NZEB for new buildings

The 2012 agreement on climate issues in the Norwegian Parliament stated that the building requirements in 2020 will correspond to NZEB level. This was again stated by the government in 2015, when the new requirements were presented. However, the concept of NZEB in a Norwegian context has not yet been defined. Up until now, the national support scheme for buildings has been more ambitious than the energy performance requirements, and regional programmes have worked well to increase the amount of very energy efficient buildings. The Norwegian support scheme for new buildings meeting the criteria of the "*Passive House*" standards has therefore been replaced by a new programme for even more ambitious projects. Support is given in particular to innovative solutions to improve technical systems and heating systems. A first suggestion for the NZEB requirements and a roadmap for the work towards a NZEB definition including necessary assessments were delivered by the Norwegian Building Authority to the responsible ministry in March 2017.

Actions towards the implementation of NZEB public buildings are not applicable in Norway.

Figure 1 shows one of the first residential NZEB houses in Norway, which is a good example of what can be achieved.



Heating	12.9 kWh/m² year
Hot water	29.8 kWh/m² year
Ventilation fans	4.4 kWh/m² year
Cooling	0.0 kWh/m² year
Technical equipment	17.5 kWh/m² year
Pumps	0.8 kWh/m² year
Lighting	11.4 kWh/m² year
Others	0.8 kWh/m² year
Total	76.8 kWh/m² year

Figure 1. Norway´s first NZEB, a single-family house, was completed in 2012 and has since been in operation. The table shows the specified calculated energy need.

After the first full calendar year in use, the actual energy used for the operation of the house (excluding outdoor pool and other consumption not related to the building operation) was about 6,500 kWh, and the produced electricity from the solar panels was 7,126 kWh.

2.I.iv. Requirements for systems and / or building components for new buildings

Pipes, ducts and equipment used for the building´s heating system must be insulated. The thickness of the thermal insulation must be cost-optimal and calculated according to a European standard, e.g., the EN 12828:2012+A1:2014 or the DS 452:2013.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

In general, the measures applicable to renovation of existing buildings are the same as the requirements for new buildings. The local authorities can give exemptions from the requirements under certain conditions. This applies to necessary remodelling, renovation and change of use, and in cases when, for example, the requirements will be unreasonable compared to the energy savings the measures will provide. For extensions, additions, underpinning and change of use, the requirements only apply to the new part of the building.



Heating	5.9 kWh/m^2 year
Hot water	1.4 kWh/m^2 year
Ventilation	2.3 kWh/m^2 year
Cooling	1.3 kWh/m^2 year
Lighting	7.7 kWh/m^2 year
Others	0.8 kWh/m^2 year
Total	19.4 kWh/m^2 year

Figure 2. 'Powerhouse Kjørbo' with the specified calculated energy need during operation.

The renovated office building "*Powerhouse Kjørbo*" demonstrates the possibility of transforming a typical 1980s office building into a plus-energy building, generating more energy during its lifetime since renovation than what will be consumed in that period for production of materials, construction and operation and demolition. The project was completed in 2014 and was awarded the BREEAM-NOR "*Outstanding*" classification, the highest classification in BREEAM-NOR (http://ngbc.no/breeam-nor/). The project also fulfils all requirements in the Norwegian passive house standard for non-residential buildings, NS 3701. The building produces energy using tilted solar panels on the flat roofs.

2.II.ii. Plans to improve the existing building stock

As for new buildings, the concept of NZEB in a Norwegian context has not yet been defined. The requirements in force from 2017 are considered as a step towards NZEB requirements, which are scheduled for 2020. A first suggestion and a roadmap for the work towards a NZEB definition including necessary assessments was delivered from the Norwegian Building Authority to the responsible ministry in March 2017. There are also financial and technical support schemes available through a government-financed agency as described below.

Plans for renovating the existing building stock towards NZEB are not applicable in Norway. But through Enova, grants are given to renovation projects, capacity building, etc. Many research projects are also working towards cost-efficient renovation methods. In 2017, the Parliament approved a proposal to prohibit the use of fossil oil for heating in all buildings from 2020. State owned buildings have already replaced all heating boilers that were running on fossil oil.

Directive 2012/27/EU (EED) is not implemented in Norway, and thus national renovation plans are not applicable. However, there is a political intention to incorporate the directive into the EEA Agreement with necessary adaptations.

2.II.iii. Regulation of system performance, distinct from whole building performance

For residential buildings, there is a set of requirements on component level, whereas for non-residential buildings the requirements apply to the building as a whole. As these requirements can be very difficult to fulfil for existing buildings, designers and builders might argue that they have performed a cost-optimal calculation and found that the requirements would be too costly to fulfil, and therefore build less energy efficiently. Still, constructors will have to build as energy efficiently as economically and technically feasible.

2.II.iv. Encouragement of intelligent metering

By 2019, all customers of electricity will have an advanced consumption meter. This will allow for automatic reading and will facilitate further installation of various intelligent systems for management and control.

For heating and cooling, there are requirements to measure the heat energy for space heating and domestic hot water in non-residential buildings and apartment blocks. The purpose of these measurements is to encourage energy management.

2.II.v. Financial instruments and incentives for existing buildings

For small residential buildings, incentives are established to motivate owners to upgrade their building, when renovating, so as to approach the standard for new buildings. Subsidies are offered to develop a thorough plan for the upgrade and to cover some of the investment. The support scheme is connected to the EPC, and is also coordinated with preferential loans. There are also subsidies for single technologies, like heat pumps, bio-solutions for heat, solar energy, etc.

For multi-family residential buildings and non-residential buildings, there is financial support for mapping building portfolios as a basis for larger energy upgrading projects covering all parts of a portfolio. Upgrading projects are able to access subsidies. For buildings owned by municipalities, there are in addition preferential loans available. The use of energy performance contracting for buildings owned by municipalities has in recent years increased, taking advantage of the described incentives. This has initiated large energy projects with 25 – 35%[3] reduction of energy consumption in existing buildings.

2.II.vi. Information campaigns / complementary policies

Information campaigns generally work in synergy with financial incentives when directed towards the building owners, motivating them to make use of the incentives. There have also been information campaigns targeting the supplier side of the market, informing about new building codes, an upcoming ban on fossil fuel heating and the importance of advising the home-owner on energy upgrading when renovating.

A national information centre on energy in buildings answers approximately 60,000 questions annually via telephone, webchat, social media and e-mail. The centre also contributes to certain web based discussion forums, offering expert advice to homeowners regarding renovation of private homes, certification, subsidies, technical issues, etc.

2.III. Energy Performance Certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The legislation regarding energy performance certification has been in place since 1 January 2010 under the Energy Act, but following a political discussion, the regulation was revised as of 1 July 2010.

The EPC for both residential and non-residential buildings is valid for 10 years, or until major changes are implemented in the building. EPCs are issued by Enova after on-line registration of building data. The registered data are stored in the database at Enova premises.

The owner of a building or apartment is responsible for the registration and presentation of an EPC at the point of sale or rent. The EPC shall be part of the marketing material to inform interested parties about the energy performance. The majority of the registered EPCs concern houses. Each apartment needs to have an EPC, whereas for non-residential buildings the EPC is normally issued for the building as a whole. Of a total number of 670,000 EPCs as of December 2016, 96% concern houses. Table 3 shows the building stock and the corresponding number of EPCs in 2016. The data is extracted from Statistics Norway and Enova's register of EPCs, and estimates are based on these statistics.

Experience shows that most of the EPCs for residential buildings relate to permanent houses; only a small proportion concerns holiday houses. Likewise, registration is well-advanced at the point of sale, and much less at the point of rent. The number of new EPCs in 2015 fits well to the sum of new and sold houses. Of the total number of approximately 3 million dwellings, 20% had an EPC by 2016. This number is growing year by year.

Building type	Existing stock in 2016	Newly built in 2015	Sold in 2015	Rented in 2015	Total with EPC	EPCs issued in 2015
House or apartment	2.5 mil.	31,000	86,000	n.a.	600,000 (estimation)	100,000
Holiday house	0.45 mil.	10,000 (estimation)	27,000	n.a.		
Non-residential buildings in total	2.6 mil.	80,000 (estimation)	n.a.	n.a.		
Non-residential with EPC-obligation	0.25 mil.	7,500 (estimation)	6,000 (estimation)	n.a.	20,000	2,000

Table 3. Total building stock and number of EPCs.





Figure 3. Two examples of EPCs or energy labels on the entry wall of non-residential buildings.

In the non-residential sector, approximately 8% of the buildings which have the obligation of certification, already have an EPC. Experience shows that most of the certifications concern buildings above 1,000 m^2 (obligation for EPC display; see III ii). The market for sale and rent is not as uniform as the market in the residential sector, and energy certification is in practice much less developed.

2.III.ii. Quality Assurance of EPCs

Quality assurance of EPCs takes place at three different levels:

- During registration, the energy certification system performs data validity checks and there are strong restrictions on what data are eligible. Normally, the data has to be within a certain range, thus excluding typing errors and misunderstandings. Also, there are restrictions to avoid false values. Most important is that the energy grade A cannot be achieved unless a leakage test of the building has been done according to standard procedures, and the date of the test has been registered.
  For simple registration of houses or apartments, there are even stronger restrictions as to what types of data are allowed to be registered. Only experts, who typically have the required professional knowledge and competence, are allowed to insert data.

- The most important quality assurance is the control performed by the buyer who reads the EPC and demands that data be correct. The EPC is designed to enable the reader to understand the main input data used. Sellers are in general well-aware of the obligation to give correct information to the market.

- Independent control. The first controls by NVE (2011-2012) concentrated on the existence of the EPC and, if relevant, whether the EPC was presented to potential buyers, or in the case of large non-residential buildings, to the users of the building. In the control carried out in 2016, the sample in question was also controlled for input values to the calculation of the energy label.

The first sanctions were issued in 2015 based on the lack of valid EPCs or inspection reports. Of a sample of 81 non-residential buildings, 61 building owners were addressed with warning of sanctions. In this first round, the owners were given ample time to conform to the requirements. A decision of compulsory fine was decided for 8 companies concerning 13 buildings. All the cases were finalised in December 2015 with fines for 5 companies (7 buildings).

A new round of controls with another sample is in process and planned to be finalised in early 2017. This round has also served as basis for Enova's evaluation of the present scheme to identify possible improvements to the system.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The directive's requirements for public buildings in Norway relate to all non-residential buildings. Thus, the regulation does not distinguish between public and private buildings above 1,000 m^2.

Since these buildings have an ongoing obligation to obtain and display the EPC, the task of informing the building owner on the EPC obligation has been simpler than for non-residential buildings being sold or rented. The understanding among developers of new building projects seems to be well developed – in particular among owners who want to demonstrate high quality buildings. A typical example is office buildings with headquarters for well-known companies. The knowledge and practical experience is less developed among owners of existing buildings.

A general impression is that a number of municipalities are lagging behind in certification due to budget constraints.

2.III.iv. Implementation of mandatory advertising requirement – status

Since Norway has only implemented Directive 2002/91/EC and not Directive 2010/31/EU, building owners are not required to include energy labels in all advertisements, for instance in newspapers.

The regulation does, however, require building owners to use the EPC or a summary of it, in the marketing of the building for sale or rent. The label and certificate must thus be included in the total amount of documents being presented to the potential buyer.

2.IV. Inspection requirements – heating systems, air conditioning

The Norwegian regulation requires inspections of both heating systems and AC systems.

2.IV.i. Progress and current status on heating systems

Since 2010, owners of heating systems based on fossil fuels are obliged to have the boiler inspected every four years. For systems older than 15 years, an inspection of the whole heating system is required.

There are no trustworthy statistics available on the number of systems actually in use, although an estimate by NVE is 100,000 systems. Most of these are considered to have the obligation of inspection. In Enova's registry, only around 1,000 reports can be found. This is obviously not a success for this scheme of inspections.

Parallel to establishing the inspection scheme, more attention has been given to the political wish of phasing-out fossil oil from the heating of buildings. This has led to a steep decline in the use of fossil fuels in buildings, and a number of systems are already dismantled. In the building regulation it is already decided that the installation of fossil oil based systems in new buildings is illegal as of 1 January 2017. New boilers using petroleum for base load have been banned since 2011. The use of fossil oil for heating in existing buildings is banned as of 2020.

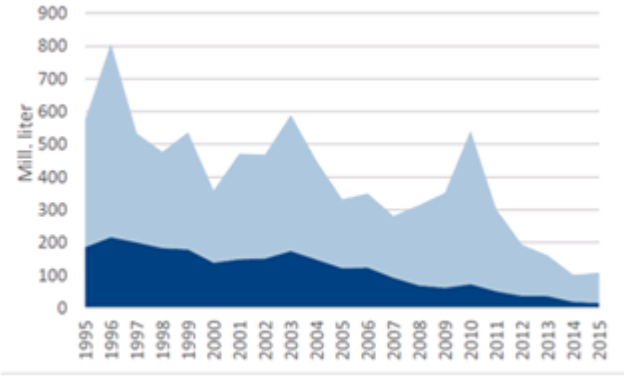


Figure 4. Decline in the use of heating oil (light blue) and kerosene (dark blue) in households and non-residential buildings, 1995 – 2015 (Norwegian Institute of Petroleum).

2.IV.ii. Progress and current status on AC systems

Since 2010 it has also been mandatory to have an inspection of AC systems. Most AC systems in Norway are for ventilation purposes only, possibly with cooling integrated in the system. The regulation thus requires that systems with a nominal effect above 12 kW, or systems that serve in total a heated area above 500 m^2, must be inspected every four years.

There are no trustworthy statistics available on the number of systems covered by this regulation, but an estimate would be 100,000 systems. As of December 2016, 4,000 systems for cooling and 18,000 ventilation systems have been inspected. Although far from all systems are inspected, this scheme has

been well-introduced in the market. For the system owner it is common practice to order an inspection as part of the regular maintenance, and in turn use the report as basis for further action. The industry organisations for maintenance and installation have undertaken an important role in providing information on the scheme, and this has proven to be vital for the results.

2.IV.iii. Enforcement and impact assessment of inspections

The same procedures for control and sanctions are in place for inspections as for energy certification. The sample of buildings, which was controlled in 2014, was controlled for the existence of both. Most compulsory fines were related to negligence of the obligation for both certification and inspection.

In Enova's current evaluation, the schemes for inspection of boilers, heating systems and AC systems are also under scrutiny.

3. A success story in EPBD implementation

Preparing the market for stricter energy performance requirements

On 1 January 2016, new and stricter energy performance requirements came into force in Norway. A one-year period of voluntary use, which has been in place before they became mandatory in January 2017, has helped all parts of the construction market to implement the new regulations. This implementation requires a change of the way buildings are constructed, though. Better planning and more cooperation between different technical professions would lead to an increase in the production of compact, airtight and well-insulated buildings, with well adapted technical installations.

The work of preparing the market for the new regulations started in 2010. Several concepts of energy efficient buildings had been tested out. Based on this, the German concept of *Passivhaus* was selected and adapted to Norwegian circumstances. A strategy was developed to share building knowledge among planners and contractors and to lift the concept into the Norwegian market for new buildings. The most important measures were:

- developing standards which describe the concept in detail for various building categories (as described under 2.I.i);
- guidelines and support to develop pre-studies establishing frontrunner-projects;
- substantial economic support to frontrunner-projects demonstrating the concept in all building categories, covering large parts of the country;
- access for planners to a highly professional team of *passive house* experts to mentor the planning of each project;
- communication about the concept and about front-runner projects;
- access to passive house training at different levels for various stakeholders.

The Norwegian programme[4], including the abovementioned elements as well as some other measures, was established in 2010. The programme ran for a period of three years. In some building categories, more than 10% of new buildings were built as *passive houses*.

Evaluations (see endnote 4) show that the programme has led to innovation and increased knowledge about building energy efficient buildings. An important key to success was the cooperation between several governmental organisations, research institutions, property developers and trade organisations in the building sector.

The evaluation documented that the most ambitious part of the market for buildings was changed, as a result of the process, but it was an open question if the rest of the market would follow. Now, almost two years later, new performance requirements were set close to the standards established in the programme. This is securing the spread of knowledge and techniques for building energy efficient buildings in a new way, which will soon be seen as the normal way.

4. Conclusions, future plans

Although Norway has only implemented Directive 2002/91/EC, Directive 2010/31/EU is also actively pursued, as there is a political decision by the government in Norway of its implementation with necessary adaptations. The result of current negotiations on the proposed revisions to the EPBD will also be considered for implementation.

The requirements for new buildings have recently been revised, and they are up for a new revision by 2020. The new requirements will be in line with a national definition of NZEB.

The energy certification and inspection schemes are currently under evaluation and possible revision to ensure the best effect in the market. By transferring the responsibility from NVE to Enova, the conditions are in place for a better coordination of these schemes with the considerable sum of programmes for information, technology dissemination and subsidies of measures for efficiency. Whereas the EPC until now has, to a large extent, been an isolated issue, there will now be options for the EPC to be integrated in the evaluation of applications and recommendations for good building owner practice.

NVE remains responsible for control and use of sanctions. This activity is scaled up to become an intrinsic part of the schemes, underlining the obligation to building owners.

Endnotes

1. The Agreement on the European Economic Area.
2. *NS 3700: 2013 Kriterier for passivhus og lavenergibygninger – Boligbygninger, NS 3701: 2012 Kriterier for passivhus og lavenergibygninger – Yrkesbygninger* (www.standards.no).
3. Experiences from approximately 50 EPC-projects in Norwegian municipalities in 2010. See also report "EPC in the Nordic countries"
4. See the evaluation report *"Evaluering av Enovas passivhusprogram"* for a presentation and evaluation of the programme (In Norwegian).



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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in **Poland**

Status in December 2016

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NATIONAL WEBSITES

www.itb.pl, www.mib.gov.pl

1. Introduction

The Act on the Energy Performance of Buildings (published on 8 September 2014) entered into force on 9 March 2015, establishing the legal basis for further legislation regarding:

- the format of inspections of heating and AC systems protocols (17 February 2015);
- the scope and methodology of the verification of EPCs and heating and AC systems inspection reports (17 February 2015);
- the methodology for the energy assessment of buildings and their parts, as well as for EPCs (27 February 2015);
- the obligatory civil liability insurance of persons issuing EPCs (21 April 2015);
- the national action plan for increasing the number of NZEB (22 June 2015).

Moreover, the act further established a "Central Register of the Energy Performance of Buildings"[1], which includes databases of:

1. persons authorised to produce EPCs;
2. persons entitled to inspect heating or AC systems;
3. EPCs;
4. protocols for heating or AC system inspections;

5. buildings with floor area exceeding 250 m^2 occupied by the judicial authorities, the prosecutor's office and public authorities that serve the public directly.

The databases mentioned under 1, 2 and 5 are made publicly available via the website[2], providing easy access to data of experts who draw up EPCs and perform inspections of heating and AC systems.

Together with building codes, the listed regulations and the five databases form the main framework for the implementation of the EPBD in Poland.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

According to the regulation concerning the technical conditions that buildings must meet, the energy performance requirements for new buildings apply both to the fabric of the building itself and to its heating, ventilation and AC and domestic hot water systems, as well as, in the case of public, collective (buildings for temporary residence, e.g., hotel, dormitory, prison, etc.), industrial, storage and livestock buildings to their built-in lighting system. The buildings need to be designed and constructed so as to meet the following minimum requirements:

1.	A maximum energy performance index value [kWh/(m^2·year)], which determines the annual non-renewable energy demand for space heating, ventilation, cooling and domestic hot water and, for collective, industrial, storage and livestock buildings, also for built-in lighting. This energy performance index is to be calculated according to the regulation that applies to the calculation methodology for the energy performance of buildings and must be lower than the value calculated for the building using the formula in §329 p.1 or 3 of the regulation. The use of maximum values for parts of the energy performance index is mentioned in §329 p.2 for the space heating, ventilation, domestic hot water and space cooling as well as built-in lighting.	
	$EP = EP_{H+W} + \Delta EP_C + \Delta EP_L$; [kWh/($m^2$·year)], [§ 329 p.1] $EP = \Sigma_i (EP_i \cdot A_{f,i}) / \Sigma_i A_{f,i}$; [kWh/($m^2$·year)], [§ 329 p.3]	
	where:	EP_{H+W} – maximum values for parts of the energy performance index for heating, ventilation and domestic hot water ΔEP_C – maximum values for parts of the energy performance index for cooling ΔEP_L – maximum values for parts of the energy performance index for built-in lighting $A_{f,i}$ – floor area heated or cooled of i-part of unified utility function of building
2.	Individual elements of the building envelope and buildings technical systems must at least meet the requirements of thermal insulation specified in Annex 2, and the window area corresponds to the requirements specified in §2.1. Annex 2.	

Buildings must be further designed and constructed in a way to avoid overheating during the summer period.

A detailed description of the regulation (as of March 2015) is given in Tables 1 – 5.

Building category	$EP_{H+W\ max}$	
	Obligatory from 1st January 2017	Obligatory from 1st January 2021* (NZEB level)
Residential building: - single-family house - multi-family house	95 85	70 65
Hotels and dormitory	85	75
Non-residential building: - health care building - other	290 60	190 45
Industrial, heated storage and livestock buildings	90	70

* In case of buildings occupied and owned by public authorities, obligatory from 1st January 2019

Table 1. Maximum permissible values of primary energy for heating, ventilation and domestic hot water (EP_{H+W}) [kWh/(m²·year)].

Building category	$\Delta EP_{C\ max}$	
	Obligatory from 1st January 2017	Obligatory from 1st January 2021* (NZEB level)
Residential building: - single-family house - multi-family house	$\Delta EP_C = 10 \cdot A_{f,C}/A_f$	$\Delta EP_C = 5 \cdot A_{f,C}/A_f$
Hotels and dormitories	$\Delta EP_C = 25 \cdot A_{f,C}/A_f$	$\Delta EP_C = 25 \cdot A_{f,C}/A_f$
Non-residential building: - health care building - other		
Industrial, heated storage and livestock buildings		
Where:	A_f – area of heated rooms in a building [m²], $A_{f,C}$ – area of cooled rooms in a building [m²]. * In case of buildings occupied and owned by public authorities, obligatory from 1st January 2019	

Table 2. Maximum permissible values of Δprimary energy for cooling] (EP_C) [kWh/(m²·year)].

Building category	$\Delta EP_{L\ max}$	
	Obligatory from 1st January 2017	Obligatory from 1st January 2021* (NZEB level)
Residential building: - single-family house - multi-family house	$\Delta EP_L = 0$	$\Delta EP_L = 0$
Hotels and dormitories	for $t_0 < 2500$ $\Delta EP_C = 50$ for $t_0 \geq 2500$ $\Delta EP_C = 100$	for $t_0 < 2500$ $\Delta EP_C = 25$ for $t_0 \geq 2500$ $\Delta EP_C = 50$
Non-residential building: - health care building - other		
Industrial, heated storage and livestock buildings		
Where: t_0 – operating time of built-in lighting installation [h/a]. * In case of buildings occupied and owned by public authorities obligatory from 1st January 2019		

Table 3. Maximum permissible values of Δprimary energy for lighting (EP_L) [kWh/(m²·year)].

Fabric element and internal temperature in the room		Maximum U-value [W/(m²·K)]	
		Obligatory from 1st January 2017	Obligatory from 1st January 2021* (NZEB level)
External walls	a) $t_i \geq 16°C$ b) $8°C \leq t_i < 16°C$ c) $t_i < 8°C$	0,23 0,45 0,90	0,20 0,45 0,90
Internal walls	a) in case of $\Delta t_i \geq 8°C$ and separating heating rooms of corridors and staircases b) in case of $\Delta t_i < 8°C$ c) separating heated and unheated rooms	1.00 no requirements 0.30	
Walls adjacent to dilatation joints width	a) to 5 cm b) more than 5 cm	1.00 0.70	
Walls of unheated underground rooms		no requirements	
Roofs, flat roofs and floors in contact with outdoor air	a) $t_i \geq 16°C$ b) $8°C \leq t_i < 16°C$ c) $t_i < 8°C$	0,18 0,30 0,70	0,15 0,30 0,70

Fabric element and internal temperature in the room		Maximum U-value [W/(m^2·K)]
Roofs on the ground	a) $t_i \geq 16°C$	0.30
	b) $8°C \leq t_i < 16°C$	1.20
	c) $t_i < 8°C$	1.50
Floors over unheated and closed spaces	a) $t_i \geq 16°C$	0.25
	b) $8°C \leq t_i < 16°C$	0.30
	c) $t_i < 8°C$	1.00
Floors over heated rooms	a) in case of $\Delta t_i \geq 8°C$	1.00
	b) in case of $\Delta t_i < 8°C$	no requirements
	c) separating heated rooms from unheated	0.25
t_i – Room temperature heated in accordance with § 134 sec. 2 of the regulation		
* In case of buildings occupied and owned by public authorities, obligatory from 1st January 2019		

Table 4. Permissible values of thermal insulation for opaque building elements.

Type of window or door	Maximum U-value [W/(m^2·K)]	
	Obligatory from 1st January 2017	Obligatory from 1st January 2021* (NZEB level)
Vertical windows, balcony doors and transparent walls: 1. $t_i \geq 16°C$ 2. $t_i < 16°C$	1.1 1.6	0.9 1.4
Roof windows: 1. $t_i \geq 16°C$ 1. $t_i < 16°C$	1.3 1.6	1.1 1.4
Windows in internal walls: 1. in case of $\Delta t_i \geq 8°C$ 2. in case of $\Delta t_i < 8°C$ 1. separating heated rooms from unheated	1.3 no requirements 1.3	1.1 no requirements 1.1
t_i – Room temperature heated in accordance with § 134 sec. 2 of the regulation		
* In case of buildings occupied and owned by public authorities, obligatory from 1st January 2019		

Table 5. Permissible values of thermal insulation for transparent building elements.

2.I.i. Progress and current status of new buildings

The energy performance requirements entered into force on 1 January 2014, and determined obligatory minimum requirements for new buildings constructed[3] from 1 January 2017, and 1 January 2019 in the case of buildings occupied and owned by public authorities, and from 1 January 2021 for all buildings (dates refer to building permit).

A detailed description of the regulation is given in the relevant country report of the CA EPBD Book 2016.

2.I.ii. Format of national transposition and implementation of existing regulations

A detailed description of the current regulation for new buildings is given in the relevant country report of the CA EPBD Book 2016.

The current methodology is described in the Regulation on the methodology for the energy assessment of buildings and their parts, as well as for EPCs. The calculation leads to the determination of the index of annual non-renewable primary energy demand (EP) in kWh/(m^2·year), which is necessary to check minimum requirements. Non-renewable primary energy factors are given in the regulation (Table 6).

#	Energy supply source for buildings	Energy carrier	Non-renewable prime energy factors
1	Local energy production in building	Heating oil	1.10
2		Natural gas	
3		Liquid gas	
4		Coal	
5		Lignite	
6		Solar energy	0.00
7		Wind energy	
8		Geothermal energy	
9		Biomass	0.20
10		Biogas	0.50
11	District heating from cogeneration	Coal or natural gas	0.80
12		Biomass or biogas	0.15
13	District heating	Coal	1.30
14		Gas or heating oil	1.20
15	Grid electricity	Electricity	3.00

Table 6. Values of correction factors (Wi) for non-renewable energy demand, for production and transfer of energy carriers.

The methodology also includes other values describing the energy performance of buildings:

- the index of annual demand for final energy (EK) in kWh/(m^2·year);
- the index of annual energy needs (EU) in kWh/(m^2·year);
- the index of CO_2 emissions;
- the share of RES in the annual demand for final energy.

The general calculations of energy demand for heating, cooling and ventilation are based on methods from CEN standards (e.g., EN ISO 13790 and other linked standards).

In June 2016, the Ministry of Infrastructure and Construction issued the "Guide to Improve the Energy Performance of Buildings"[4] *(*Figure 1*).* The guide describes the evolution of energy performance regulations in Poland. On the basis of multiple examples, it shows how to improve the energy performance of buildings. Moreover, the guidebook reveals national and regional incentives which support energy performance actions.



Figure 1. Cover of the "Guide to Improve the Energy Performance of Buildings"

2.I.iii. Action plan for progression to NZEB for new buildings

The national plan for increasing the number of buildings with low energy consumption was adopted on 22 June 2015. The plan pays particular attention to the definition of NZEB and their specific characteristics, includes important information and tips for investors, designers and contractors, and describes the main and intermediate objectives related to improving the energy efficiency of buildings, including a timetable for achieving them in accordance to Article 9 §3 of the EPBD. The characteristic actions, mainly of government measures taken to promote buildings with low energy consumption, include the design,

construction and reconstruction of buildings in a way that ensures their energy efficiency and increases the share of energy from RES in new and existing buildings. In addition, this document discusses the changes in regulations affecting the energy efficiency of buildings, making note of financial mechanisms addressed to different groups of beneficiaries, e.g., housing communities, individuals, local authorities, businesses and others.

The national plan also sets out plans for promoting the use of RES in buildings and the need to improve the technical conditions of the existing building stock. It identifies aspects of a comprehensive approach to energy efficiency, and its main objective is to achieve the provisions of Article 9 §1 of the EPBD.

Following the aims of the directive, the goals are set as follows:

- by 31 December 2018, all new buildings occupied by public authorities or owned by the government should be NZEB;
- by 31 December 2020, all new buildings should be NZEB.

2.I.iv. Requirements for systems and / or building components for new buildings

A detailed description of the current regulations for new buildings is given in in the relevant country report of the CA EPBD Book 2016.

According to the regulation on the technical conditions that new buildings must meet, the main requirements include:

- maximum values of thermal transmittance of individual elements of the building envelope: walls, roofs, floors, windows, doors and others types of partitions;
- recommended airtightness of envelope and threshold values for the air leakage of windows and balcony doors;
- the maximum area of transparent parts of the building envelope with a thermal transmittance ≥ 0.9 $W/m^2.K$;
- minimal thermal insulation of pipes and components in space heating and cooling, as well as in domestic hot water systems;
- the maximum values of specific fan power of fans used in AC and mechanical ventilation systems.

In general, heating, domestic hot water, lighting, ventilation and AC equipment used in the systems shall fulfil requirements set by separate national regulations which implement other European directives, e.g., eco-design, etc.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The previously mentioned requirements for new buildings also apply to the renovation of existing buildings. Article 1 of the regulations on technical requirements for building works specifies that minimum requirements for renovated buildings are fulfilled when walls and building technical systems correspond to

the requirements of thermal insulation specified in Annex 2 of the regulation, and the window area corresponds to the requirements specified in §2.1 of Annex 2 (Tables 1 - 5).

2.II.ii. Plans to improve the existing building stock

The national plan sets out actions for promoting the use of RES in buildings and the need to improve the technical condition of the existing building stock. It identifies aspects of a comprehensive approach to energy efficiency, and its main objective is to achieve the provisions of Article 9, §1 of the EPBD.

The national plan includes, among other topics, the definition of buildings with low energy consumption and their specific characteristics, as well as government actions to promote buildings with low energy consumption. It focuses on the design, construction and reconstruction of buildings to ensure energy efficiency and to increase the share of energy from RES in both new and existing buildings (combined with programmes for thermal modernisation and the promotion of a low-emission economy). The national plan sets a timeline for achieving these goals, which corresponds to Article 9, §3 of the EPBD.

2.II.iii. Regulation of system performance, as distinct from whole building performance

With regard to certain elements of heating, domestic hot water and cooling systems, one of the key areas covered by the regulation is the limitation of heat loss from pipes, which has to be kept below a reasonable maximum level. Specific minimum technical requirements on thermal insulation of pipes and components are given in Table 7.

#	Pipe or component	Minimum thickness of thermal insulation (material λ = 0.035 W/m·K) [mm]
1	d_i < 22 mm	20
2	22 ≤ d_i< 35 mm	30
3	35 ≤ d_i< 100 mm	equal to the diameter d_i
4	100 ≤ d_i	100
5	Pipes passing through walls or ceilings, cross of pipes	50% of the thickness given in rows 1 ÷ 4
6	Pipes in heating systems in the walls separating different uses	50% of the thickness given in rows 1 ÷ 4
7	Pipes according to row 6 embedded in the floor	6
8	Pipes of air heating (inside of the heated area of the building)	40
9	Pipes of air heating (outside of the heated area of the building)	80
10	Pipes of chilled water cooling (inside the building)	50% of the thickness given in rows 1 ÷ 4
11	Pipes of chilled water cooling (outside the building)	As given in rows 1 ÷ 4

Table 7. Requirements on thermal insulation of pipes and components in heating, hot water and cooling systems.

The ordinance also provides performance requirements for the maximum level of specific fan power of fans used in AC and mechanical ventilation systems, as shown in Table 8. The specific fan power can be increased when certain elements are used in the system (Table 9). Generally, heating, domestic hot water, lighting, ventilation and AC equipment used in the systems shall further fulfil requirements set by separate national regulations which implement other European directives, e.g., eco-design, etc. The provisions of the ordinance are applicable to related technical building systems in both the design of new buildings and the renovation of existing buildings.

#	Type and application of fan	Specific Fan Power SFP [kW/(m³/s)]
1	Supply fan:	
	a) air-conditioning system or supply and exhaust ventilation with heat recovery	1.60
	b) supply and exhaust ventilation without heat recovery and supply ventilation	1.25
2	Exhaust fan:	
	a) air-conditioning system or supply and exhaust ventilation with heat recovery	1.00
	b) supply and exhaust ventilation without heat recovery and supply ventilation	1.00
	c) exhaust system	0.80

Table 8. Performance requirements on the maximum level of specific fan power (SFP) of fans used in air-conditioning and mechanical ventilation systems.

#	Additional element of ventilation or air-conditioning system	Additional SFP [kW/(m³/s)]
1	Additional filtration level	0.3
2	Additional filtration level with filter class H10 or higher	0.6
3	Gaseous contaminants filters	0.3
4	High efficiency heat recovery device (temperature effectiveness higher than 90%)	0.3

Table 9. Elements of the systems that allow to increase the specific fan power (SPF).

2.II.iv. Encouragement of intelligent metering

As of today, the Ministry of Energy is preparing regulations for setting the legal framework and the technical installation of remote meter reading and processing of collected data. Some steps in implementing advanced metering infrastructure (AMI) have already been taken, however, they do not have a systematic nature. These are the activities of individual energy companies and relate to pilot programmes involving the installation of remote meter reading.

2.II.v. Financial instruments and incentives for existing buildings

The main measures to support investment in the energy efficiency of existing buildings include:

- The Thermo-modernisation Fund[5], funded through the state budget. The main objective of the fund is to provide financial assistance for projects to improve the condition of existing housing. Supported actions must lead to a reduction in energy consumption for heating and domestic hot water, including the reduction of losses of energy in local heating networks, or the exchange of heating sources for more efficient alternatives.

- The Green Investment Scheme[6] for the energy management in public buildings. This supports projects that improve energy efficiency and reduce CO_2 emissions through measures such as building insulation, replacement of windows and exterior doors, replacement of the heating source, replacement of heating, ventilation and AC systems, the use of energy management systems in buildings and the use of RES technologies.

- The Operational Programme Infrastructure and Environment 2014-2020 from the European Regional Development Fund and the Cohesion Funds - Promotion of energy efficiency, intelligent power management and the use of RES in public infrastructures. The funds are earmarked for the deep, complex thermo-modernisation of energy, based on a system of energy management. Elements subject to funding under the programme include an energy audit, the insulation of the building envelope, replacement of the heating source, replacement of windows and exterior doors, and the use of automatic regulation to weather conditions.

2.II.vi. Information campaigns / complementary policies

The activities taken by Poland aimed at promoting energy efficiency in buildings include:

- "The House, Which Saves for Me" campaign, conducted by the Ministry of the Environment[7].

- Certain information and educational campaigns related to RES, e.g., the “Operational Programme Knowledge Education Development (POWER)”, in the financial perspective for 2014-2020 taken by the Ministry for the Economy on basis of the law of 20 February 2015. POWER is a two-tier operational programme addressing the need for reforms in the areas of employment, social inclusion, education, health and good governance, and providing direct support in areas where support at a national level is justified by objective considerations.

- Actions by educational faculties to increase research capacity in the scope of environmental technologies.

- The "Guide to Improve the Energy Performance of Buildings"[8], developed on March 2016 by the Ministry of Infrastructure and Construction. The guide is aimed at a wide range of customers, including owners and users of buildings or their parts, investors, building managers, local government units, building contractors, architects, engineers, people authorised to draw up EPCs and inspect heating and AC systems, and energy auditors.

In addition, there are many other organisations, associations, institutions, etc., that provide services of information and consultancy to promote energy conservation issues.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Overview and administration system

The energy performance certification system is governed and administered by the Ministry of Infrastructure and Construction.

On the basis of the Act on Energy Performance of Buildings, there is a central register of the energy performance of buildings[9]. This register contains five databases, mentioned in the introduction to this document.

Every EPC in Poland has to be prepared/submitted with the use of this register. EPCs should be issued every time the building or building unit is sold or offered for rent.

Format and content of the EPC

The ordinance of 27 February 2015 specifies the basic requirements, the calculation methodology and the format of the EPCs (Figure 2), as described in the relevant country report of the CA EPBD Book 2016.

WZÓR ŚWIADECTWA CHARAKTERYSTYKI ENERGETYCZNEJ BUDYNKU

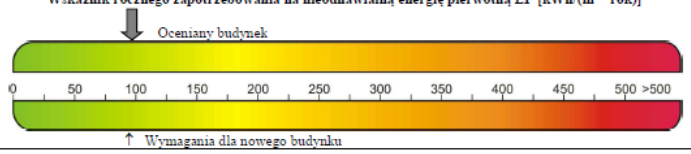
ŚWIADECTWO CHARAKTERYSTYKI ENERGETYCZNEJ BUDYNKU	
Numer świadectwa[1)]	

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 i pieczątka

Figure 2. Template of EPC.

EPC activity levels

According to the data of the General Office of Building Control, in the period between 1 January 2009 and 8 March 2015, a total of 541,193 new buildings were completed and handed over to occupants, each of which would have had an EPC. All would still be valid.

Moreover, in the same period, there were 26,114 multi-family buildings put into use. This number represents an additional several hundred thousand EPCs for the associated individual houses.

As mentioned, every EPC in Poland has to be prepared with the use of the national register. At the beginning of 2017, around 100,000 EPCs had been issued since 9 March 2015.

Typical EPC costs

The price of the EPC is fully market driven. The lowest prices offered in the publicly available transaction service are 40 €, whereas the highest price offer for buildings of a complicated structure exceeds 1,300 €. The typical price for an EPC for an apartment or a single-family building ranges between 50 € and 150 €. For a multi-occupancy apartment building, the typical price ranges between 200 € and 500 €.

Assessor corps

According to the Act on Energy Performance of Buildings, an EPC may be issued only by a qualified expert.

Since 9 March 2015, every qualified expert has to be registered in the relevant database of the central register of the energy performance of buildings. On 9 January 2017 there were 13,368 registered qualified experts.

Compliance levels by sector

The EPC and its compliance with the energy performance levels is checked on the basis of data from the central register. According to this data, new and renovated buildings comply with the minimum levels enforced by Polish law. Values of annual primary energy consumption from registered EPCs are shown in Figures 3 and 4.

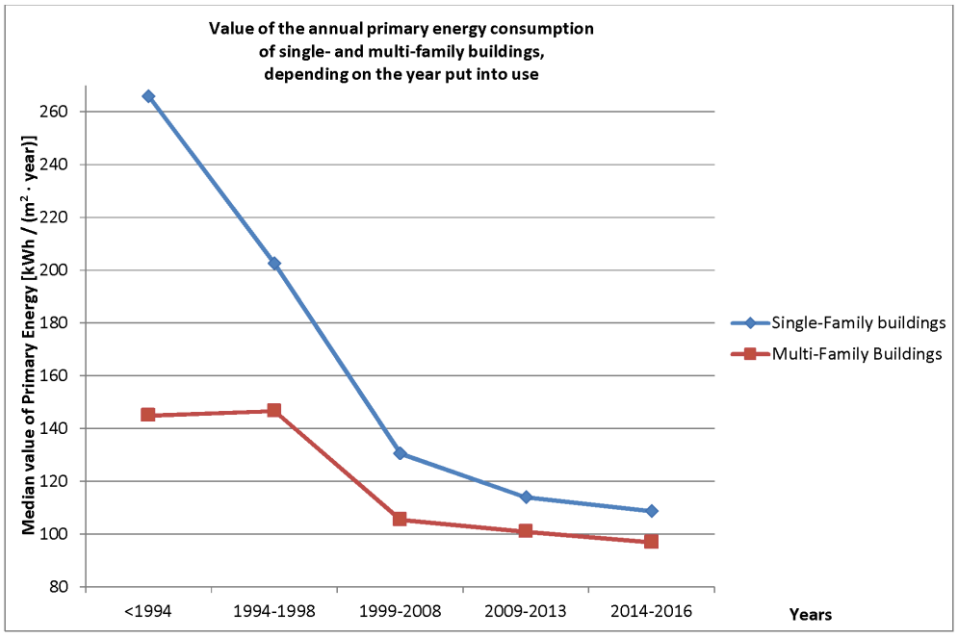


Figure 3. Value of the annual primary energy consumption of single- and multi-family buildings, depending on the year put into use.

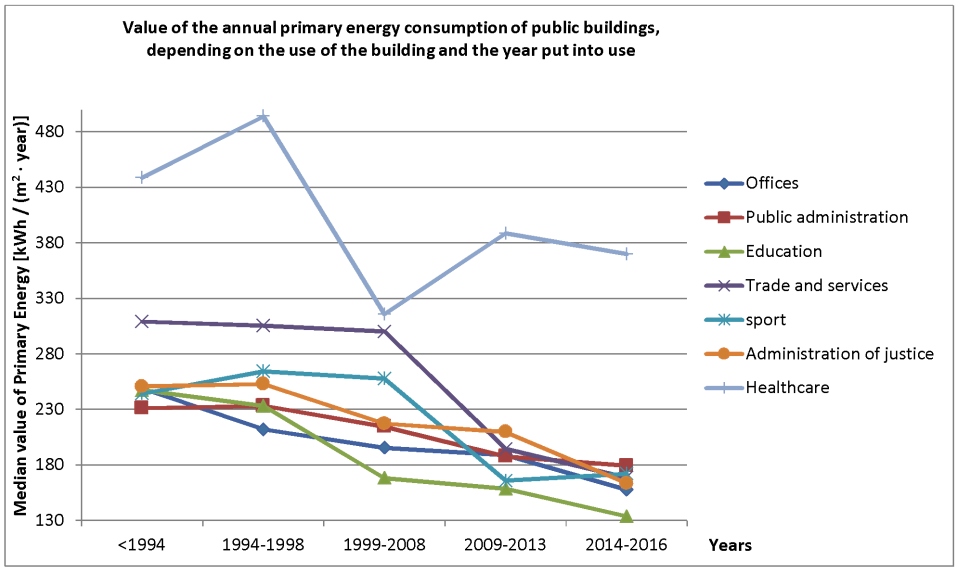


Figure 4. Value of the annual primary energy consumption of public buildings, depending on the use of the building and the year put into use.

Enforcement with building owners and real estate actor

An EPC is required in every instance where the property is subject to a change of ownership, is sold or rented.

In the case of sale or rent, according to the Act on Energy Performance of Buildings, the owner should hand over the EPC to the buyer or tenant. If the EPC is not transferred, the buyer or tenant has the right to call on the owner to fulfil their obligations and may request the EPC at the expense of the owner. The buyer or tenant may not waive these rights. The owner and the buyer are informed about their rights by a notary while signing the notary deed.

2.III.ii. Quality Assurance of EPCs

Since March 2015, there is a direct mechanism of quality assurance of EPCs in Poland, used on the basis of the central register of the energy performance of buildings. EPCs are quality controlled *ex officio* or by request. So far, less than 10 EPCs have been controlled upon a request. The number of EPCs controlled *ex officio* in the period 2015 - 2016 is 180. Following these controls, 14 qualified experts lost their authorisation. Comparatively, before 2015, three (3) qualified experts had lost their authorisation.

During control, checks are made, among other factors, on:

- calculation results;
- efficiency of technical building systems and U-values compared with requirements concerning thermal insulation of the building envelope components;
- energy demand indicators, energy consumption and categories of cost-effective recommendations, correctness of description, etc.

There are no penalties foreseen for minor faults. Fault tolerance may reach up to 10%, depending on where the error was made.

In cases of intentional adoption of incorrect technical assumptions (e.g., improving the indicators of energy demand) there is no tolerance of errors.

There are also penalties for drawing up EPCs without the necessary qualifications, or without liability insurance for damages caused in connection with the preparation of an EPC.

Moreover, according to the Act on Energy Performance of Buildings as well as the civil law, an EPC containing false data on energy use is considered a product with a physical failure. Potential conflicts between the qualified expert and the client in this matter will be settled in court.

Proposals to improve the central register of EPCs are currently being prepared. Following their introduction, it will be possible to check the correctness of EPCs more quickly and easily.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The certification process for public buildings, or for large buildings visited by the public, falls under the same regulations as for other buildings. According to the Act on Energy Performance of Buildings, the EPC shall be visible to the public in the case of buildings (> 250 m^2) used by justice authorities, the prosecutor's office, or for public buildings to which the public have access.

The template of the EPC for these buildings is the same as the one used for other buildings. EPCs for these buildings are issued by the same group of experts as EPCs for buildings that are being sold. Also, the provisions on quality assurance are the same as those described above.

The fifth database of the publicly available central register shows, on the basis of issued EPCs in Poland, information about these buildings (among other things, the parameters of the energy performance, the share of RES, the value of CO_2 emissions, etc.).

2.III.iv. Implementation of mandatory advertising requirement – status

According to the Act on Energy Performance of Buildings, the mandatory advertising requirements derived from the EPBD have been implemented into Polish law. According to these rules, the energy performance indicator from the EPC has to be included in both sale and rental advertisements (for every kind of building).

The Polish legal framework requires the publication of selected EPC information (the value of final energy is obligatory); however, the advertisements sometimes provide additional information, e.g., about numerical values of CO_2 emissions, the share of RES, or the heat transfer coefficient. This is more common for the sale of new single-family houses.

At the same time, there is still a relatively low level of interest from consumers and building owners in the EPC and energy data. The main criterion for choosing a house or apartment is not the low-energy level of the building, but location and price.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

Poland adopted the regular inspection of heating and AC systems. Regulations and requirements are specified in the Construction Act and in the Act on Energy Performance of Buildings. These laws state that building owners or managers are obliged to carry out a periodic inspection of the technical condition of a building's heating and AC system and their power adjustment concerning heating or cooling needs.

Reports issued after 9 March 2015 must be registered in the relevant database of the central register (for now 1,200 reports for heating systems and 400 reports for AC systems have been submitted) and are randomly chosen for verification.

2.IV.ii. Progress and current status on heating systems

According to the Act on the Energy Performance of Buildings now in force, periodic inspections must be performed:

- at least every 2 years for boilers of an effective rated output over 100 kW using liquids or solid fuels;
- at least every 4 years for boilers of an effective rated output over 100 kW using gas;
- at least every 5 years for boilers of an effective rated output between 20 kW and 100 kW.

Inspections of the heating system include an assessment of the efficiency of these systems and their adaptation to the demands of the building and its users.

There shall be no control of heating systems where no changes that would affect their energy efficiency were made after the previous inspection.

Inspections of heating and AC systems in buildings can be performed by a person who has:

- building qualifications in installation or;
- the qualifications required for supervision during the operation of equipment which produce, process, transform and consume heat and other power equipment.

2.IV.iii. Progress and current status on AC systems

According to the Act on the Energy Performance of Buildings, AC systems with a rated output over 12 kW should be inspected periodically and at least once every five years.

Inspections of the AC system include an assessment of the efficiency of these systems and their adaptation to the demands of the building and its users.

Requirements for inspectors of AC systems are similar to those for heating systems described under IV.ii. The person entitled to do periodical inspections must be included in the relevant database of the central register (Figure 5).

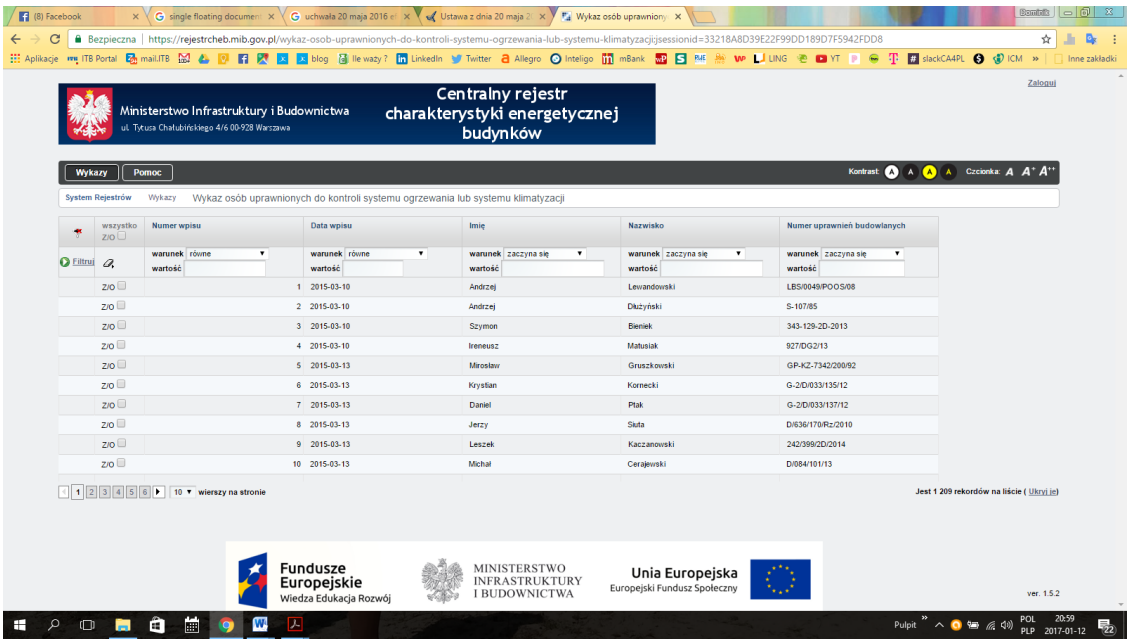


Figure 5. Central registry of the Ministry of Infrastructure and Construction.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Failure to carry out an inspection may result in a fine for the owner or manager of the building, in accordance with Article 93 point 8 of the construction act. Currently, there is no data concerning penalties issued by construction supervision authorities. Judgement on the issues shall be made on the basis of the provisions of the code of conduct in misdemeanour cases. The fine is up to 500 PLN (around 120 €) and is imposed by construction supervision authorities.

From 9 March 2015, in accordance with the Act on the Energy Performance of Buildings, failing to perform an inspection process, or carrying out the inspection without qualifications, will result in a fine for the owner, the manager of the building, or the expert. The verification of inspection outcomes is made *ex officio* or by request of the building owner/manager.

Quality control of inspection reports

An ordinance of the Minister of Infrastructure and Development, dated 17 February 2015, on the model protocols of inspection of a heating or AC system specifies that inspections:

- apply not just to the technical condition and energy efficiency of boilers, but to the whole heating system; and
- must contain more than a statement concerning proper functioning.

  There is a fixed detailed audit scope, including measurements, as well as testing and control, which ends with a protocol containing five pages.

The protocols of the inspection of a heating or AC system shall be drawn up using the communication system, which is in the central register of the energy performance of buildings.

The person conducting the inspection shall provide to the person ordering the control a printed protocol with an appropriate number given by the ICT system.

Impact assessment. Costs and benefits.

The price for inspection is not fixed. The cost depends on the area of the building, where 1 m^2 equates to around 1 PLN (about 0.22 €).

In accordance with the Construction Act, the protocol of inspections of heating and AC systems should be included in the construction site book, both for existing and new buildings. The authority in charge of the database with inspection protocols is the Ministry of Infrastructure and Construction.

The reports are registered in the relevant database of the central register and they are randomly drawn for verification.

3. A success story in EPBD implementation

The introduction of coherent energy efficiency regulations in line with the EPBD succeeded in increasing the number of energy efficient buildings in Poland and in raising public awareness.

The regulation of the Minister of Infrastructure of 12 April 2002 on the technical conditions that buildings and their locations must meet set minimum energy performance requirements for new buildings as well as for those undergoing renovations.

The Act on the Energy Performance of Buildings specified principles for the preparation and transfer of EPCs, as well as inspection principles for heating systems and AC systems in buildings. It set out documentation for their control, as well as requirements for persons qualified to issue EPCs and perform inspections of heating and AC systems in buildings.

The "Guide to Improve the Energy Performance of Buildings" released in June 2016 by the Ministry of Infrastructure and Construction, is a publicly available guidebook which offers significant support and advice in energy efficient construction to a wide range of customers, including owners, users of buildings and many others. The publication describes the evolution of energy performance regulations in Poland and, on the basis of multiple case studies, shows how to improve the energy performance of new and existing buildings. Moreover, the guidebook reveals national and regional incentives which support energy performance actions.

4. Conclusions, future plans

In accordance with Article 4 of the EPBD, the minimum energy performance requirements (included in the national legislation) are currently being reviewed to reflect the technical progress in the building sector.

Future actions are being considered, relating to the improvement of the central register for the energy performance of buildings. Plans include a further improvement of the quality of EPCs and heating and AC systems inspection protocols (including administrative simplification and quality assurance), and the addition of a supplementing section on reports and statistics which will allow collecting data pertaining to the building stock for the purpose of supporting decision-making.

Endnotes

1. *https://rejestrcheb.mib.gov.pl/wykazy*
2. *https://rejestrcheb.mib.gov.pl/wykazy*. The website is administered by the Ministry of Infrastructure and Construction (http://mib.gov.pl/).
3. With a building permit issued after these dates.
4. http://mib.gov.pl/files/0/1797054/poradnik.pdf
5. www.bgk.pl/osoby-fizyczne/fundusz-termomodernizacji-i-remontow/
6. www.nfosigw.gov.pl/oferta-finansowania/system-zielonych-inwestycji---gis/programy-priorytetowe/
7. www.oszczedzam-energie.mos.gov.pl
8. http://mib.gov.pl/files/0/1797054/poradnik.pdf
9. *https://rejestrcheb.mib.gov.pl/wykazy*

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Portugal

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.adene.pt

1. Introduction

This report presents an overview of the current status of the implementation of the EPBD in Portugal as well as plans for its evolution. It mainly focuses on energy performance requirements and EPCs, including quality control mechanisms, training of qualified experts and information campaigns.

The EPBD field implementation started in 2007, based on three decrees published in 2006. The legislation was revised in 2013 to transpose the tighter requirements of Directive 2010/31/EU. The revision process had contributions from nearly 100 different stakeholder institutions that resulted in the actual revision being aimed at, among other things, the improvement of methodologies and the certification process, based on extensive experience gained over the last four years. Those years have passed and after a period of adaptation, the changes are now being readily adopted by the market. The requirement to display an EPC in property advertisements was a major change that contributed to the increase in the number of EPCs issued monthly. The change was not only due to changes in legislation; ADENE (the Portuguese national energy agency) has developed a strategy in order to upgrade the National Building Energy Certification System (SCE), and these changes included the development of a new online platform to issue EPCs, a new EPC layout, a new website and the publication of support documentation and guidelines for experts. The main goal was to realign the SCE with the needs of the market.

2. Current Status of Implementation of the EPBD

In the most recent years, the implementation of the EPBD in Portugal was focused on updates and minor adjustments to what had already been implemented since 2006 and revised in 2013.

Some revisions of specific topics in the current regulations had to be made in order to fully comply with the EPBD, namely adjustments regarding requirements for building renovated elements. Until September 2014, only buildings that undergo major renovations had to comply with those requirements, while now every building element that is renovated has to comply with those requirements. From 1 January 2016, stricter requirements came into force. This tightening was foreseen in the 2013 regulation, aiming for NZEB levels for 2020, and focusing on U-values of building elements as well as minimum performance of technical building systems. This revision was also supported by cost-optimal studies that showed some margin of improvement in the regulations. These necessary adjustments allowed Portugal to have the EPBD transposed into national regulation.

A big step forward was given with connecting external and EPC databases[1]. This allowed for more precise and coherent information, mainly because the data is now validated by different entities and information can be used in a more purposeful way.

Another improved aspect was the importance given to the EPC as a tool for providing access to funding schemes and incentives. The EPC can be the "key" to have direct access to specific incentives for building renovations, having building taxes reduced depending on energy labels (typically A or A+), or when a building that undergoes renovations improves two (2) levels from the initial performance.

2.I. Energy performance requirements: NEW BUILDINGS

This chapter presents an outline for transposing and implementing the EPBD energy performance requirements in Portugal. It also describes the cost-optimal procedure for setting requirements, the action plan towards NZEB and plans for implementing Articles 4 and 5 from the Energy Efficiency Directive.

2.I.i. Progress and current status of new buildings

While existing buildings are believed to be relevant, the Portuguese legislation focuses heavily on new buildings, both residential and non-residential, with the primary objective of setting the pace for more efficient buildings to come, considering the substantial share of energy consumption spread across buildings throughout Europe, with Portugal being no exception.

To achieve this goal, a stepped tightening of requirements has been implemented – focusing on building envelope and technical building systems – from the establishment of the 2013 regulations. This first level of requirements was defined to be applicable until the end of 2015, after which a stricter level of requirements came to force.

In order to comply with the current regulation[2] that has been significantly strengthened since the regulations of 2013, today's buildings are designed with added concerns, among which design, a robust level of minimum requirements, and the promotion of RES.

2.I.ii. Format of national transposition and implementation of existing regulations

The current building energy performance legislation, which applies for both residential and non-residential buildings, bases the calculation methodologies on comparisons with reference buildings and includes the parameters presented in Table 1. The reference building is considered the same building as the one being evaluated, but with reference values for the building components and technical building systems, and without the contributions of RES and energy efficient solutions (heat recovery, etc.).

Building	Main legislation requirements	Requirements included in calculations
Residential and non-residential	Thermal behaviour, Energy and Indoor Air Quality	Thermal Comfort
		Minimum requirements for U-values, including thermal bridges
		Windows solar factor and shading devices
		Ventilation Indoor air quality Infiltration
		Maximum energy needs and primary energy consumption
	Systems efficiency	Minimum efficiency for HVAC systems Renewable energy systems Lighting (only for non-residential)
Non residential	Ventilation and indoor air quality	Minimum outdoor air supply Indoor air quality Infiltration
	Installation and maintenance	(Not relevant for calculations)

Table 1: Requirements included in calculations.

The energy performance requirements established for residential buildings are set in terms of the useful energy demand needs for heating and cooling. The total primary energy for heating, cooling and domestic hot water is also limited to a maximum value. There is a minimum RES contribution required for domestic hot water based on a minimum solar thermal panel area for each building occupant.

Non-residential buildings have a minimum energy performance requirement, which limits the maximum primary energy for heating, cooling, domestic hot water, and lighting.

The revised 2013 requirements (both for residential[3] and non-residential[4] buildings) were established considering the comparative methodology framework for calculating cost-optimal levels published by the European Commission. A first report[5] was presented which dealt with new residential buildings; this report concluded that the legislation requirements are close to the cost-optimal levels and it is not necessary to change them. For non-residential buildings, the study focused only on office buildings, which is the most representative building typology. The report concluded that the legislation requirements are significantly outside the cost-optimal levels and that the reference building characteristics should be updated to have legislation requirements within the range of cost-optimal levels.

Most of the requirements were tightened again in 2016 following the planned update of the national legislation[3,4].

2.I.iii. Action plan for progression to NZEB for new buildings

Since 2014, the national action plan for the progression to NZEB is supported by the revised legislation. The adopted preliminary definition of NZEB establishes a relationship with cost-optimal evaluations. NZEBs are defined as buildings that cumulatively offer:

i. very low energy demand with building components compatible with the upper levels (most efficient) of the cost-optimal evaluations;
ii. implementation of RES that covers a very significant fraction of the remaining building energy demand; and
iii. RES to be produced on site (whenever possible) and/or adjacent to the building. When local production is insufficient, the remaining production must be supplied as nearby as possible.

The full definition of NZEB, containing numeric indicators for primary energy demand and share of RES, is still in development. A working group of different entities was established, and it is expected that during 2018 additional information will be published allowing the market and all stakeholders to have clear guidance on the full NZEB definition.

Given that the NZEB definition is not yet completed, no information is available on how many NZEBs are built in Portugal, although relevant buildings have been designed considering NZEB principles. Built in 2006, Solar Building XXI, presented in Figure 1, is an example of a low-energy building using passive systems for both heating and cooling (ground cooling) to achieve NZEB. The main façade has a PV system with heat recovery which assists the heating in winter. In summer, a ground cooling system (earth tubes) is used to cool the building, together with night cooling strategies. The integration of RES in the Solar Building XXI design was one of the main objectives of the project. The last monitoring analysis, performed in 2011, has shown a total amount of electric energy consumption of 36 MWh, versus an amount of electricity produced by the three PV systems of almost 38 MWh.



Figure 1. Solar Building XXI, a low-energy building using passive systems for both heating and cooling (ground cooling) to achieve NZEB.

2.I.iv. Requirements for systems and / or building components for new buildings

Since 2014, new buildings must comply with stricter requirements[6], imposed by the roadmap defined in the national regulation[6]. This roadmap was set with the goal of having all new buildings as NZEB by 2020; thus, a tightening of the requirements was planned via a stepped enforcement (2013, 2016).

These requirements are focused on U-values for walls, roofs, pavements, and windows, as well as the solar factor (g-value) and shading when looking at building components. When it comes to technical building systems, the requirements are focused on the minimum efficiency of equipment (water heater, heat pumps, boilers, etc.) and also on the need for having RES, and specifically solar thermal collectors. Additional requirements exist for air renovation rates and minimum indoor air quality.

A brief list of the existing requirements and their evolution can be observed in Table 2 for residential buildings, envelopes, ventilation and RES, and in Table 3 for technical building systems.

<table>
<tr><th colspan="2" rowspan="2">Time interval</th><th colspan="2">1990-2006</th><th colspan="2">2006-2012</th><th colspan="2">2012-2016</th><th colspan="2">After 2016</th></tr>
<tr><td>Lisbon</td><td>Bragança</td><td>Lisbon</td><td>Bragança</td><td>Lisbon</td><td>Bragança</td><td>Lisbon</td><td>Bragança</td></tr>
<tr><td rowspan="4">U-value [W/(m2.K]</td><td>External walls</td><td>1.40</td><td>0.95</td><td>0.70</td><td>0.50</td><td>0.50</td><td>0.35</td><td>0.50</td><td>0.35</td></tr>
<tr><td>External roof / floor</td><td>1.10</td><td>0.75</td><td>0.50</td><td>0.40</td><td>0.40</td><td>0.30</td><td>0.40</td><td>0.30</td></tr>
<tr><td>External window</td><td>4.20</td><td>4.20</td><td>4.20</td><td>3.30</td><td>2.90</td><td>2.40</td><td>2.80</td><td>2.20</td></tr>
<tr><td>Flat thermal bridges</td><td colspan="2">none</td><td colspan="6">2 x U-value (closest element)</td></tr>
<tr><td rowspan="2">Maximum window solar gain factor g-value</td><td>Light inertia</td><td colspan="4">0.15</td><td>0.1</td><td>0.15</td><td>0.1</td></tr>
<tr><td>Medium and heavy inertia</td><td colspan="8">0.56</td></tr>
<tr><td colspan="2">Ventilation (air changes per hour)</td><td colspan="2">none</td><td colspan="2">≥ 0.6</td><td colspan="4">≥ 0.4</td></tr>
<tr><td colspan="2">Renewable energy systems</td><td colspan="2">none</td><td colspan="6">Minimum solar energy contribution for domestic hot water
(reference value 0,65m2 /occupant)</td></tr>
</table>

Table 2: Minimum requirements evolution for residential buildings, envelope, ventilation and renewables.

Building type	Technical system		Requirement evolution			Standard
			Before 2013	2013-2015	After 2016	
Residential and non-residential buildings	Heat pumps	cooling	none	Eurovent Label C (Example: Chiller COP ≥ 2.8; EER ≥ 2.7)	Eurovent Label B (Example: Chiller COP ≥ 3.0; EER ≥ 2.9)	EN 14511
		heating				EN 14825
		Domestic hot water		COP ≥ 2.3		EN 16147
	Boilers			Minimum nominal efficiency 86%	Minimum nominal efficiency 92%	
	DHW Gas heater	Power ≤ 10kW		Efficiency ≥ 82 %		
		Power > 10kW		Efficiency ≥ 84 %		
Residential	Domestic Electric Storage Water Heaters			Maximum stand-by heat loss		EN 60379
Non-residential	Air handling unit			Eurovent Label D Efficiency ≥ 47% Velocity ≤ 2.5 m/s Δp ≥ 125 Pa	Eurovent Label D Efficiency ≥ 57% Velocity ≤ 2.2 m/s Δp ≥ 170 Pa	EN 13053
	Pumps		Minimum EFF2 label	Minimum IE2 or IE3 class		IEC60034-30
	FANs			Minimum IE2 or IE3 class Minimum SFP 4 or 5 (W/m3/s)		IEC60034-30 EN 13779
	Lighting		None	Maximum power (W/m2)/100lux Example: Offices 2.5 (W/m2)/100lux for 500lux		EN 12464-1 EN 15193
	Lifts			Minimum C	Minimum B	VDI 4707
	Central building management system		Mandatory if HVAC thermal power > 250 kW			EN15232

Table 3: Minimum requirements for technical systems.

2.II. Energy performance requirements: EXISTING BUILDINGS

Existing buildings in Portugal account for, unsurprisingly, the largest number in the current building stock, and their energy performance is rated in the bottom half of the energy scale. Given this fact, initiatives have been taken to improve their performance. Most of the action taken in this area was related to improvements in the legislation[7], like detailing specific requirements for existing buildings or introducing requirements to building elements (only requirements pertaining to major renovations existed), raising awareness among building owners and making financial incentives available.

2.II.i. Progress and current status of existing buildings

Existing buildings are the main driver for improving energy performance of the building stock. They comprise the vast majority of buildings with the poorest performance, and for that reason they are the ones with the largest potential to improve.

For many decades, Portugal was lacking in terms of energy performance regulations. It was not until 1990 that the first energy efficiency regulation was introduced, with limited impact on building performance. At that time, preventing building pathologies such as mould growth was one of the most relevant aspects. Nevertheless, requirements relating to insulation and double-glazing were also introduced.

With the transposition of the EPBD, a clearer focus was given, not only for technical building systems and RES, but also in the reinforcement of the building envelope. When comparing the heating and cooling energy needs of existing residential buildings over the last 100 years, it is possible to discern a clearer evolution, especially in regard to heating needs (Figure 2).

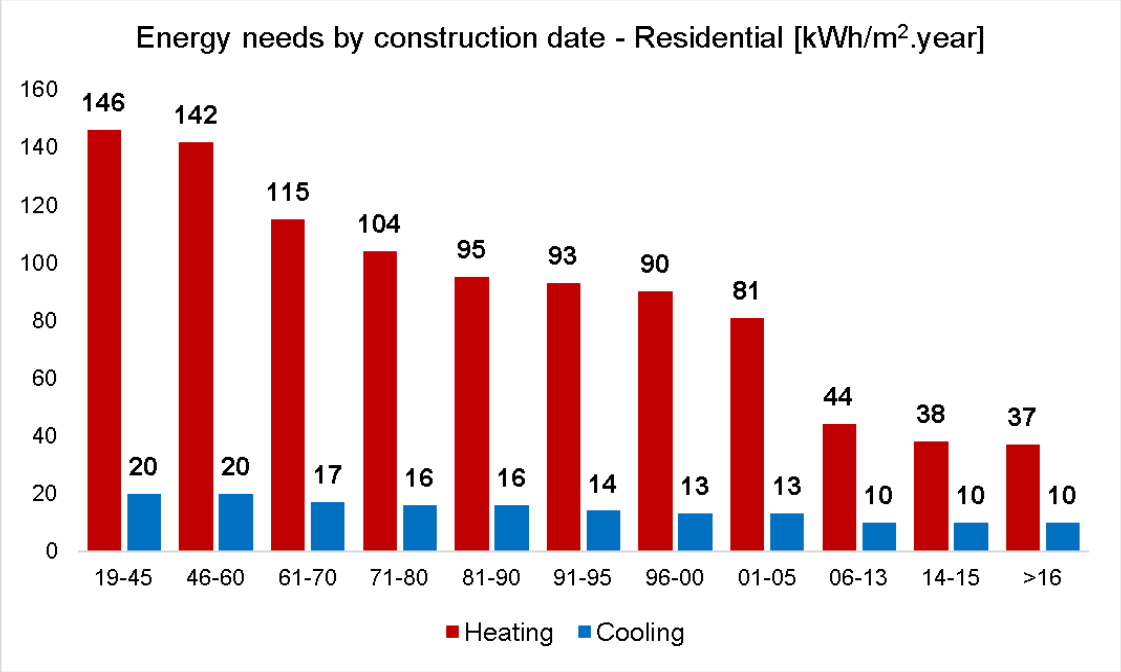


Figure 2: Energy needs by construction period - Residential [kWh/m².year]

At this moment, when a specific building component (building envelope or technical building system) is renovated, minimum requirements apply. In these cases, the energy efficiency is improved “part-by-part”, knowing that each new component of the building performs as well as it would in a new building. If a building is to undergo major renovations, then an overall assessment has to be made, and a minimum performance has to be achieved; in these cases, it might be necessary to replace or improve certain elements in order to reach that minimum threshold.

Independently of being renovated, existing non-residential buildings that have an energy consumption of over 2.5 GWh or less than energy label C are obliged to present and put in practice an Energy Rationalisation Plan (PRE). This plan refers to a set of measures to be implemented in the building, in order

to make it more efficient (label C or better). This means to reduce 2.5% of its final energy consumption for those buildings consuming more than 2.5 GWh, or 5% for those consuming more than 5 GWh. The measures and reduction in final energy consumption are to be completed during the time set for implementing the PRE, which is six (6) years. Further information about the PRE can be found in the relevant legislation[8].

2.II.ii. Plans to improve the existing building stock

Building renovation has been a government priority since the transposition of the EPBD, which came into force in 2013. In order to promote it, the new legislation gave some flexibility to the requirements that are applied to building renovations so that different cost-optimal solutions can be considered in accordance with the building characteristics. On top of that, a strategy has already been submitted which plans to boost the rate of retrofitting and stimulate the economy. This strategy is based on different topics that range from simplifying mechanisms and facilitating necessary changes in the existing building sector to possibly using national and European sources for financing.

Regarding public buildings, an Energy Efficiency Programme for Public Administration (ECO.AP[9]) was launched. This programme aims to achieve a 30% improvement in energy efficiency in public services and the various bodies of public administration by 2020. Eco.AP is an evolving programme that endeavours to establish energy efficiency measures to be implemented into services, agencies and public equipment and to change behaviours and promote the rational management of energy services, notably by hiring Energy Services Companies (ESCO).

2.II.iii. Regulation of system performance, distinct from whole building performance

An improvement seen is the stepped requirements (2013 level, 2016 level) that are applicable to building components. Technical buildings systems are, without exception, covered by these improvements, and the minimum efficiency of equipment is now higher than it was in 2013.

Existing residential buildings are only obliged to comply with these stricter requirements when they undergo renovations. The building component to be renovated must adhere to the minimum performance levels defined in the regulation.

2.II.iv. Encouragement of intelligent metering

Since 2014, it is mandatory for non-residential buildings to have energy consumption monitoring of heating ventilation and AC systems equipment with an electric power above 25 kW. The same happens for boilers with a thermal power above 100 kW.

Buildings with a thermal power above 25 kW must have an installation and maintenance technician (TIM) that guarantees proper system installation and maintenance. This technician must also supervise these specific activities and manage all relevant technical information. One of their tasks is to promote the installation of energy metering systems in the buildings.

The requirements are to encourage intelligent metering regarding the need to install building management systems in non-residential buildings with more than 250 kW of heating ventilation and AC systems power output.

2.II.v. Financial instruments and incentives for existing buildings

The Energy Efficiency Fund (FEE)[10] is a financial tool that helps implement the National Energy Efficiency Action Plan (NEEAP), and among other forms of assistance, allows for building owners to apply for funding in order to improve the energy performance and efficiency of the building (or building unit). The most recent requests for funds centred on the improvement of building components as well as the installation of solar thermal collectors.

The following building components have been targeted as eligible for funding in recent years:

- In 2015, a residential building built before 1990 for insulation, at a cost of 1M €;
- In 2015, residential buildings for solar thermal, at a cost of 500,000 €;
- In 2016, residential and commercial buildings, for domestic hot water (solar thermal water heater), windows, wall and roof insulation, and lightning, at a cost of 1.1 M €.

Another type of incentive that currently exists focuses specifically on tax reduction, namely concerning municipality taxation of real estate and building renovations. Some municipalities have tax reductions for better labelled buildings, typically A and A+, or buildings whose renovation improves the energy performance by two (2) labels.

It is expected that, under the agreement established between Portugal and the European Commission (Portugal 2020[11]), new dedicated lines of financing, like the IFRRU[12], will be available to leverage investments in the building sector and contribute to a low carbon economy. Around 700 million € are planned to be made available in November 2017, which will be leveraged by another 700 million € from the banking sector for a total of 1.4 million €.

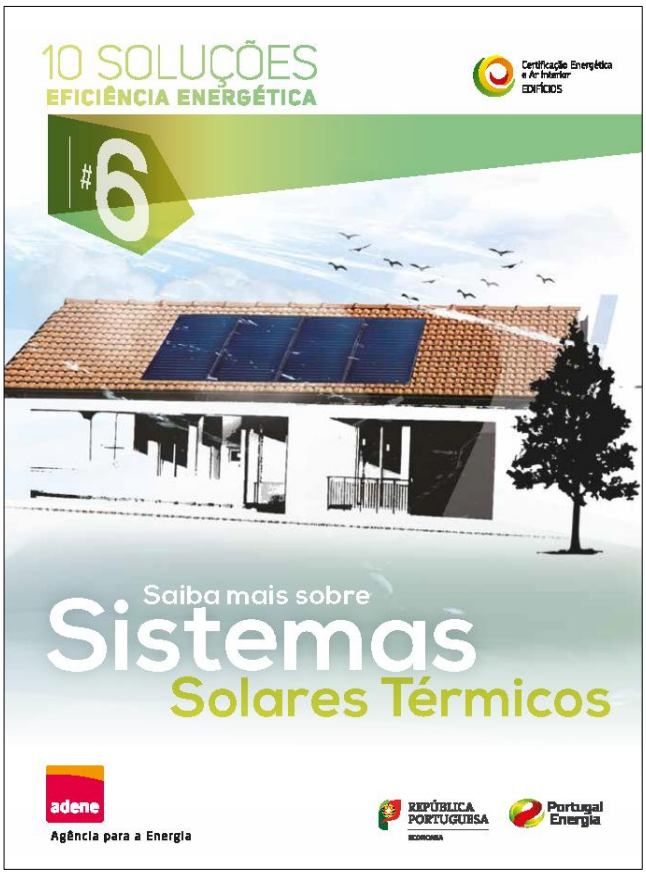
2.II.vi. Information campaigns / complementary policies

In 2016, a marketing campaign was drafted and put into practice which specifically focused on EPC recommendations. After analysing all issued EPCs, and particularly the almost 2 million proposed recommendations, the top ten measures were identified, five related to building envelope – wall insulation, roof insulation, windows, solar shading and ventilation, and five related to technical building systems – solar thermal collectors, wood stoves, boilers, heat pumps and PV, and a set of small brochures were designed (around ten pages each[13]).

These brochures had a clear message in mind – to provide a better understanding to the building owner of the building features that can be improved when considering the potential energy reduction or achieving costs savings. Each brochure follows the same structure and has a coherent design which allows homeowners to understand the impact of that specific recommendation as well as any possible constraints or difficulties in implementing it. Figures 3 and 4 present the brochure covers for roof insulation and solar thermal collectors, respectively.



Figure 3: Cover of brochure for roof insulation.



Figures 4: Cover of brochure for solar thermal collectors.

2.III. Energy performance certificate requirements

Since 2009, when the EPC became mandatory to exist in rental or sales contracts, it has become widely available to the public. It is currently not only a way to differentiate buildings before making a decision, but also as an important source of information, in great part thanks to a refreshed layout in 2013, which made the EPC a friendlier and more user-oriented document (Figure 5).

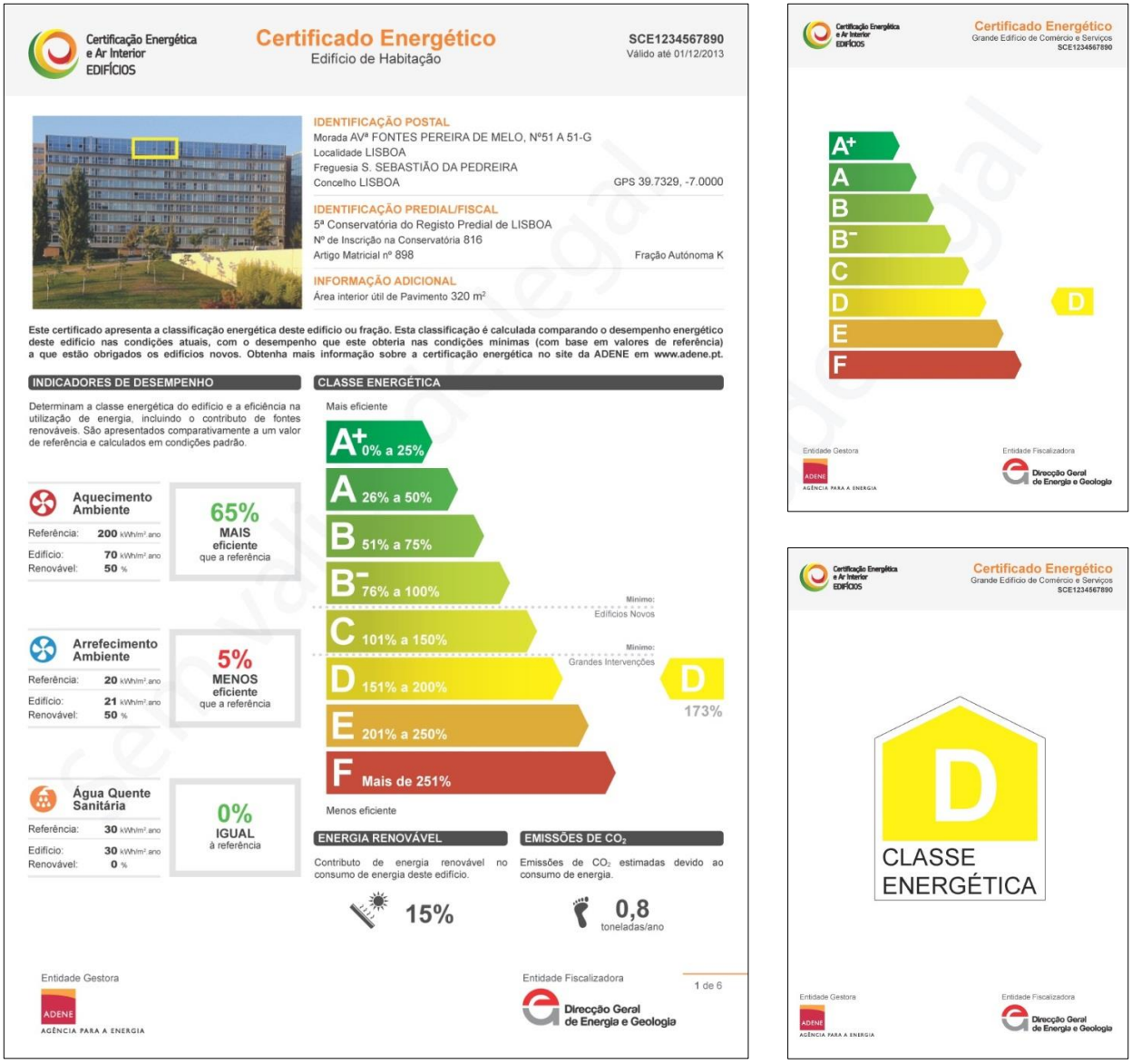


Figure 5: Energy Performance Certificate in two different sizes - First page and smaller display versions

Apart from the information, EPCs are now an important tool to enable access to funding schemes or tax benefits.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

In the last couple of years, it was possible to see a small boost in the real estate sector, and of course, the numbers of issued EPCs follow this trend. The EPC database is increasing each year, and a better definition and representation of the building stock can now be made. At the beginning of 2017, there were a total of 1.2 million EPCs; with 90% of them existing in the residential sector and 10% for non-residential buildings.

As mentioned, a very important aspect closely related with this increase is the obligatory advertisement of the EPC label before the building is rented or sold and when offered to the market; this is a responsibility for both the building owner and the real estate agent. Cases of non-compliance are now being addressed on a more regular basis, mostly because notaries, as stated in the regulation, are obliged to report whenever a transaction occurs without the existence of an EPC. In these cases, building owners or real estate agents were asked to minimise the fault by issuing the EPC and providing it, free of charge, to the new owner. As a result, the real estate market has almost fully adopted the EPC as a mandatory document and advertisements in general include the necessary information on the energy performance of the building.

Some studies are being developed, in particular by the National Institute of Statistics (INE), to ascertain if better-labelled buildings are sold faster, or if a premium exists in the sale price. These studies will be important, as they can establish additional relevance for the EPC. The positive "discrimination" for energy performance in buildings already exists, mainly when it comes to tax benefits for which reduced municipal real estate taxes are just an example. Private studies done for the city centre of Lisbon also showed a clear relationship between energy classes and the transaction price[14].

2.III.ii. Quality Assessment of EPCs

In 2015, specific regulation[15] regarding quality assessment came into force. This regulation clearly states the criteria, rules and tolerances for errors, as well as the criteria behind the need to reissue the EPC.

Two types of quality assessment can occur with the EPC: a short assessment, and a detailed assessment. A short quality assessment involves all the documents and information being uploaded by the qualified expert to the database, whilst the detailed one is a complete duplication of the necessary calculations that support the EPC, and it even includes a second site visit. The detailed assessment can be triggered at random or whenever needed to better support the assessment.

Tolerances and out-of-range values are defined in the regulation and are used to quantify the number and severity of errors or mistakes that can exist in an EPC. As a consequence of these analyses, and if the EPC is to be considered invalid based on deviations from a set of parameters, a reissue by the expert is necessary. Additional penalties might be applicable to the expert if no action is taken that would minimise the impact of the errors that he or she made.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

In 2014, the Portuguese definition of a public building includes every non-residential building as well as private buildings owned by government bodies. Non-residential buildings larger than 500 or 1,000 m² (depending on type) are required to display an EPC at the main entrance. Currently there are more than

2,500 certified public buildings and many more in the process of being certified. The low figure of issued EPCs shows that this has been the building typology with the most difficulties in terms of implementing the EPBD requirements in Portugal, but a clearer increase in the number of certified buildings can now be observed.

2.III.iv. Implementation of mandatory advertising requirement - status

Since December 2013, when the EPBD 2010 was transposed to the national regulation, any advertisement of buildings or apartments needs to present the energy label in addition to building characteristics. ADENE (the EPC management entity) also provides guidelines for advertisements that are followed by the vast majority of real estate agents, as well as specific web services for real estate agents to collect specific data from the EPC database to use for their advertising. An example of models to be used in advertisements can be observed in Figures 6 and 7.



Figure 6: Example of advertisement including the energy label.



Figure 7: Model to be used in advertisements for the energy efficiency label.

The real estate sector was informed of these two mechanisms back in 2013. After a slow start, a steady pace has been set, and it is almost impossible nowadays to see real estate advertisements without a clear reference to the energy performance of the building, in particular the energy label. It has become commonplace for real estate websites to have a specific filter for the energy label and it is often possible to sort the properties according to their energy performance.

2.IV. Inspection requirements – heating systems, air conditioning

In 2006, Portugal officially adopted option a) on Article 8 of the EPBD, establishing a regular inspection of boilers. The inspection of boilers as well as AC systems was, however, a challenging issue due to the specific climate characteristics of the country. In Portugal, boilers and AC only operate for relatively short periods during the year, the real energy consumption is very low, and this makes regular cost-effective inspections a difficult strategy. Considering these difficulties, the transposition of the EPBD for Portugal did not impose regular inspections, and provisions should be changed so that advice should be given instead of those inspections.

2.IV.i. Report on equivalence of model A and B for Heating Systems

Portugal is still working on the equivalent of Models A and B, given that it was not yet possible to evaluate the impact of the campaigns.

2.IV.ii. Progress and current status on heating systems

A first step regarding the advice given to building users was introduced in the new EPC layout in December of 2013. A specific section focuses on the importance of maintenance over heating, cooling and domestic hot water systems. It also recommends regular inspections of this equipment. Furthermore, it addresses properly selecting and sizing the correct equipment. As an additional measure, buildings with thermal power above 25 kW are required to have systems installed and maintained by a TIM to guarantee the proper installation and maintenance. This technician supervises the above activities and manages all relevant technical information. Additional tasks include the design of a maintenance plan, which is mandatory for systems above 250 kW and done according to a layout provided by law.

2.IV.iii. Progress and current status on AC systems

The information provided for heating systems should also be considered for AC systems given that there is currently no distinction to the approach.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

No specific action has occurred regarding this topic.

Quality control of inspection reports

No specific action has occurred regarding this topic.

Impact assessment. Costs and benefits

No specific action has occurred regarding this topic.

3. A success story in EPBD implementation

Portugal has managed to create a link between funding schemes/incentives and the EPC.

Funding schemes that are now in operation were designed using information that was made available by the national EPC database. This database holds information on roughly 1.2 million buildings/building units. The data contributes to a better understanding of the building stock, and it is increasing at a steady pace of approximately 160,000 EPCs per year.

In Portugal, the EPC is a tool that provides access to funding schemes and is also used as a validation mechanism (by the qualified expert) regarding the effectiveness of the implemented recommendations supported by those incentives. In order for the validation to occur, the EPC is issued at the beginning of the process in order to assess the current status (baseline) of the building. It clearly identifies which building component has to be replaced or renovated, in order to evaluate the future performance of the building and the resulting associated savings, in terms of either energy consumption or monetary value. Because of this, the EPC is a mandatory document for the application process. After the construction/renovation phase, a final EPC is issued which will be used as a validation and conformity check of the works that were carried out, and also to evaluate new energy indicators and improvements.

Since all information is stored in a central database, it makes it easier to establish connections with other databases to better operate the funding schemes. Having a single EPC ID number that not only identifies the EPC (with around 150 variables per certificate) but also the building in question, allows for several public and private bodies that are not necessarily familiar with technical data to gain easy access to the relevant information.

Current funding schemes are based on two types: "*green taxes*" and an energy efficiency fund. The former consists of a series of tax benefits or exemptions when a building's energy performance rating (as stated in its energy label) is improved by at least two (2) ratings. The latter is a fund specifically designed to aid the renovation of certain building elements. In recent years, the requests targeted specific building components, i.e., windows, wall and roof insulation, or solar thermal collectors, and were based on the EPC as a tool to better facilitate it. When EPCs are issued during a period in which funding has been made available in this way, an icon representing financing is displayed next to the specific measure in the EPC. This highlights the fact that financial support was made available, and it also includes a link to obtain further information, as shown in Figure 8.



Certificação Energética e Ar Interior EDIFÍCIOS

Certificado Energético

Edifício de Habitação

SCE1234567890

C

PROPOSTAS DE MEDIDAS DE MELHORIA

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

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

Saiba mais sobre estas medidas de melhoria nas restantes páginas deste certificado. Incentivos financeiros – Saiba mais em www.adene.pt/incentivos

Figure 8: EPC indicating available funding mechanisms.

Other types of benefits currently available are those related to municipal taxes indexed on EPC labels. For example, buildings with the highest ratings (typically A and A+) and buildings undergoing renovations that improve their EPC rating by at least two (2) ratings benefit from reduced taxes.

4. Conclusions, future plans

In 2017, the Portuguese National Building Energy Certification System (SCE) celebrated ten years of existence. The system is now well established and further steps are being considered for the upcoming years.

One of the most relevant aspects of the change in the SCE was the shift made regarding the way EPCs are registered in the national database. Instead of having EPCs registered without any external reference, they are now cross-referenced with other databases. These interconnections between databases allow for a more precise and clearer identification of each building. As an example, the EPC database is currently linked with the National Institute of Statistics (INE) as well as the electricity provider, Energias de Portugal (EDP). Additionally, tax administration and notary information is also collected, albeit manually, and plans are being drawn in order to collect this information in real time. Besides the previous information, the EPC database also stores the INSPIRE ID[16], ensuring that Portuguese EPCs will be compatible with other systems across the EU. This will allow the EPC database to serve as a central hub to connect with external entities, and as an additional advantage, improve the quality of stored information. Future connections with local and central government agencies might be implemented in the future[17].

The geographical location data is now present in the EPC database, enabling buildings to be located precisely on a map, and this is a very important step towards having a better understanding of the building stock. This knowledge is essential when policies that promote building renovations are to be implemented, giving the EPC a key role in effectively putting the strategy into practice. Figure 9 is a prime example of how easy it has become to view energy performance information for the entire certified building stock.

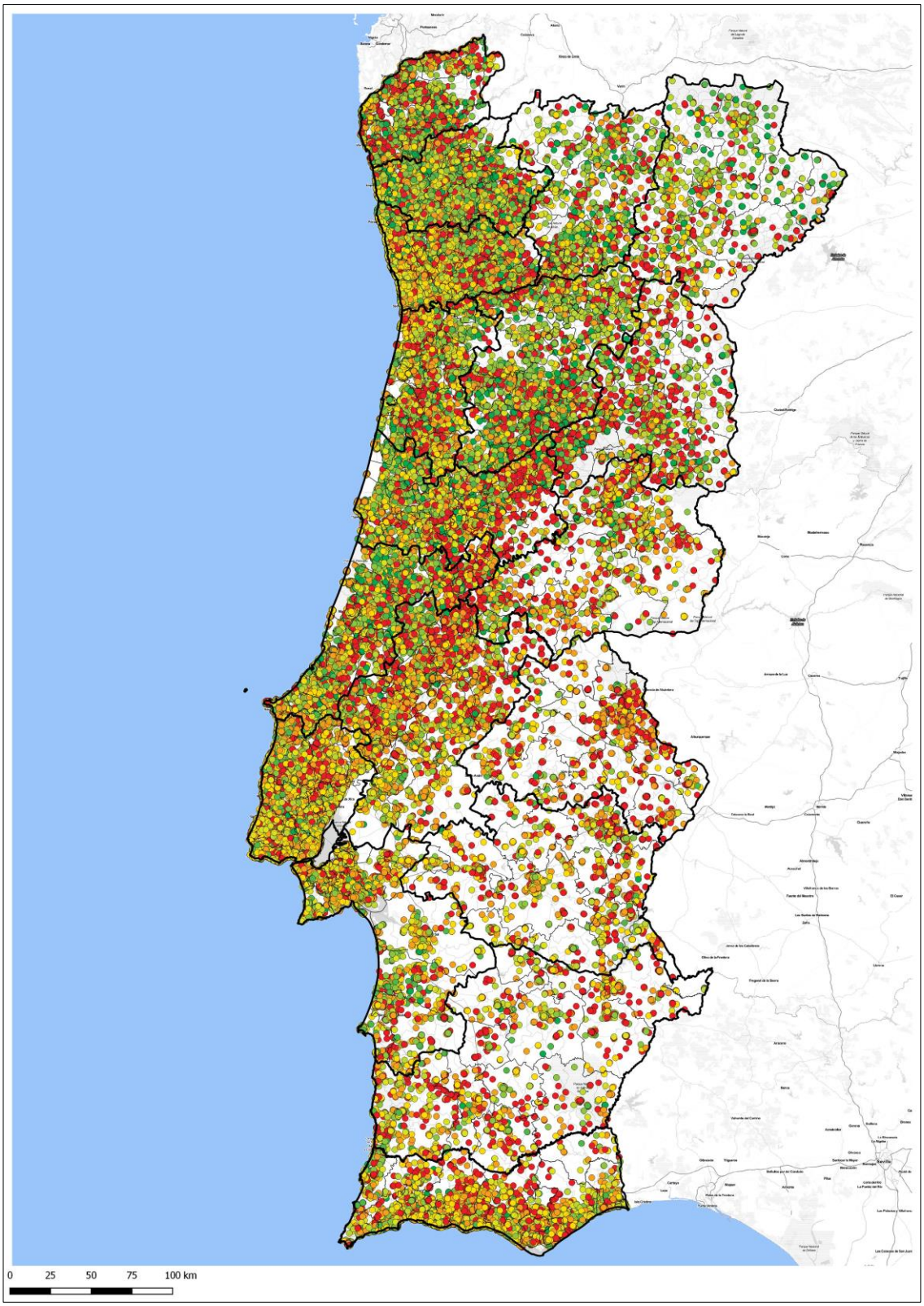


Figure 9: Energy performance information for the entire certified building stock.

As a final remark, it is important to highlight the relevance of the consumer and the role he or she plays in the building and energy sector. Based on all the information stored in the SCE database, ADENE will launch, in 2018, the *Portal casA+*. This portal is a hub for consumers to have all relevant information stored in a platform only accessible by them; it relates to their own homes and deals with energy performance. Additionally, the portal gathers together various stakeholders across the construction sector and serves as a one-stop-shop for requesting proposals to implement improvement measures. It effectively contributes to closing the gap between the supply chain and the consumer.

Besides portal casA+, ADENE is also focused on contributing to the enhancement of energy literacy throughout civil society, via an information centre called CINERGIA - Energy Information Centre, available starting at the end of 2018. This is an initiative generated by ADENE, in the context of the Portuguese Energy measure under the SIMPLEX +2017 programme, a programme that aims to give all citizens and energy producers an overview of the energy sector. Aimed at the general public (families, students, teachers, urban youth, etc.) and institutions (public and private institutions in the energy as well as other sectors, universities and research centres), CINERGIA provides a didactic narrative covering the forms, sources and production of energy, its transport, distribution, storage and marketing, and its use by various industrial sectors and by end consumers. Issues such as the history of energy in the country, its use in homes and in mobility are at the centre, as is the country's energy dependency, the state of renewable energy and the connection between energy and water efficiency. Consumers will have the opportunity to learn more about energy efficiency in their region by browsing[18] all information available on buildings with energy certificates.

Endnotes

1. The EPC database currently connects the National Institute of Statistics (INE) and the Electric Utility (EDP Distribuição) databases. The INE database provides geographical information about the residential building stock and, most importantly, references the INSPIRE ID for future European connections. Information from the EDP details the infrastructure of a building in terms of electric meters.
2. https://dre.pt/application/conteudo/74774858 (Portuguese version only)
3. https://dre.pt/application/conteudo/70789581 (Portuguese version only)
4. https://dre.pt/application/conteudo/73441202 (Portuguese version only)
5. https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings
6. https://dre.pt/application/conteudo/70789581 and https://dre.pt/application/conteudo/73441202 (Portuguese versions only)
7. https://dre.pt/application/conteudo/74774858 (Portuguese version only)
8. https://dre.pt/application/conteudo/74468516 (Portuguese version only)
9. More information available at http://ecoap.pnaee.pt/ (Portuguese version only)
10. More information available at www.pnaee.pt/fee (Portuguese version only)
11. www.portugal2020.pt/Portal2020
12. www.portaldahabitacao.pt/pt/portal/reabilitacao/ifrru/

13. Brochures available for download at www.adene.pt/10solucoes-eficiencia-energetica (Portuguese version only)
14. www.confidencialimobiliario.com/media/revista/2017/mar/files/assets/common/downloads/publication.pdf (page 10) (Portuguese version only)
15. https://dre.pt/application/file/a/70196785 (Portuguese version only)
16. http://inspire.ec.europa.eu/
17. Second half of 2017
18. http://www.cinergia.pt

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in **Romania**

Status in December 2016, revision 2018

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NATIONAL WEBSITES
www.mdrap.ro

1. Introduction

Improving the energy efficiency of the supply chain, from resources, production, transport and distribution to end-use consumers, represents one of the priorities of the energy strategy of Romania.

For the building sector, the national implementation of the EPBD is the overall responsibility of the Ministry of Regional Development and Public Administration (MDRAP).

Since 2015, in order to transpose the EPBD into national law, Law no. 372/2005 (recast 2016), which relates to the energy performance of buildings, was amended by Law no. 156/2016 which approved Government Ordinance no. 13/2016 and was republished in the Official Gazette of Romania no. 764/2016[1].

The amendments to the law concern:

- the clarification of definitions;
- the extension of law provisions to individual building elements/replacement of components;
- NZEB implementation;
- the display of EPCs in public buildings and buildings frequently visited by the public;
- implementing EPC recommendations for public buildings;

- repealing provisions for cases which lack inspection;
- the obligations and responsibilities of energy auditors;
- provisions for implementing independent control systems;
- contraventions and penalty charges;
- the validity of issued EPCs;
- elaborating a study on the technical, environmental and economic feasibility of energy use from RES. For new buildings, a complete study has to be presented to the public authority in order to obtain the urban planning certificate.

2. Current Status of Implementation of the EPBD

The transposition of the EPBD is implemented by Law no. 372/2005 (recast 2016), which relates to the energy performance of buildings and includes further amendments, and the technical regulations methodology for calculating the energy performance of buildings, Mc 001 – 2006. Further amendments to the methodology were developed based on the provisions of available European standards.

As an amendment to Law no. 372/2005, several definitions were introduced for:

- public buildings (from Law no. 159/2013);
- major renovations of existing buildings (from Law no. 156/2016);
- buildings frequently visited by the public (from Law no. 156/2016).

2.I. Energy performance requirements: NEW BUILDINGS

For the design of new buildings (residential and non-residential), technical rules are set out in the code for the thermal calculation of building elements C 107-2005, with further amendments in 2010 and 2012. In 2016, the code was amended by Ministerial Order no. 386/2016, setting the NZEB performance levels for primary energy demand and CO_2 emissions for different building categories and winter temperature zoning in Romania (5 climatic zones according to the National Standard SR 1907-1:2014) and also the minimum contribution of renewable energy.

2.I.i. Progress and current status of new buildings

Some of the minimum energy requirements set in C 107-2005, with further amendments, are under review. Ministerial Order no. 2641/04.04.2017 (published in the Official Gazette of Romania no. 252/11.04. 2017[2]) amended Mc 001 – 2006 to set explicit minimum energy requirements for new and existing buildings (residential and non-residential buildings, i.e. office, commercial and industrial buildings, as well as health care, educational, sport and tourist buildings). The minimum energy requirements will be further reviewed in the process of revising Mc 001 – 2006.

2.I.ii. Format of national transposition and implementation of existing regulations

For building design (both residential and non-residential), the technical regulation currently in force is C 107-2005, revised and completed with further amendments in 2010 and 2011. The code contains design indicators for building elements, the entire heated air volume and restrictions on thermal resistance values, but no global indicators for the energy consumption/efficiency of individual technical building systems (heating, domestic hot water, heating ventilation and AC or lighting) are presented.

For residential buildings, the code sets the annual maximum heating demand without taking the efficiency of the technical building systems into account. The code presents values for minimum thermal resistance and maximum thermal transmittance, corrected for thermal bridging, for each building element within the building envelope, as well as the global heat transfer coefficient for thermal insulation in this respect.

For non-residential buildings, the code presents values for minimum thermal resistance for each building element within the building envelope and calculation rules for the global heat transfer coefficient.

The Ministerial Order no. 2641/2017 sets maximum allowable values for the annual primary energy demand for space heating for different building categories and CO_2 emissions factors from different fossil/non-fossil fuels.

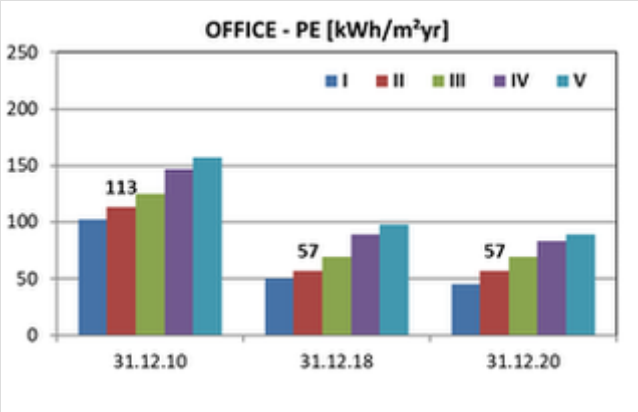
The national report for cost-optimality is under review and no further practical information is currently available.

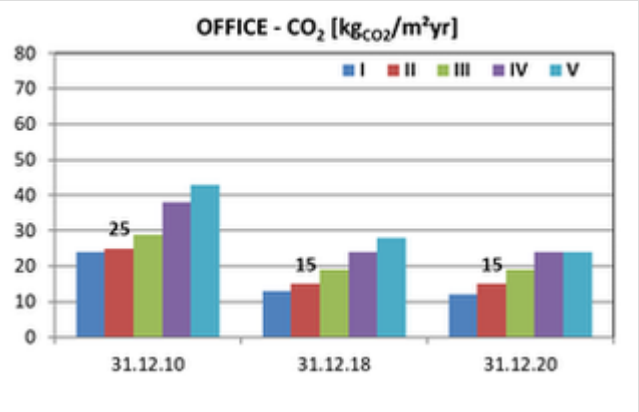
For new buildings, compliance with technical regulations shall be checked in two phases: first at the time of building permit request, when a study on technical, environmental and economic feasibility of high-efficiency alternative systems should be presented, and secondly after the completion of the building construction works.

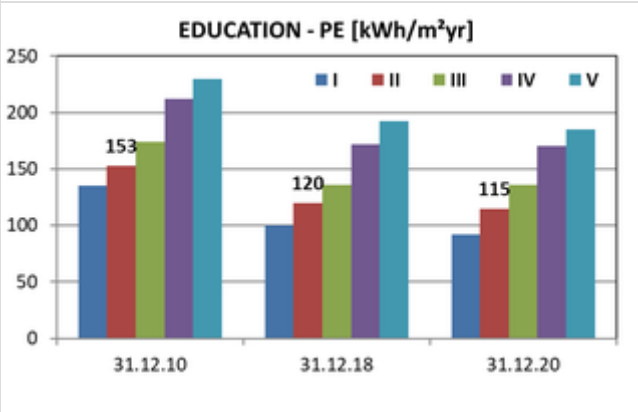
2.I.iii. Action plan for progression to NZEB for new buildings

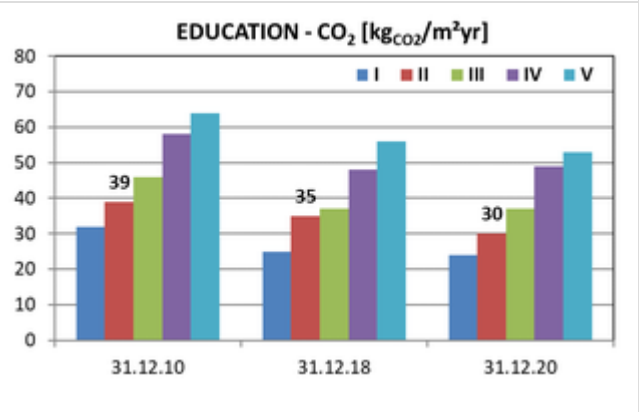
The national plan for increasing the number of NZEB was reviewed in 2014 and minimum energy requirements for single- and multi-family houses and office buildings were determined based on previous analyses of cost-optimal levels.

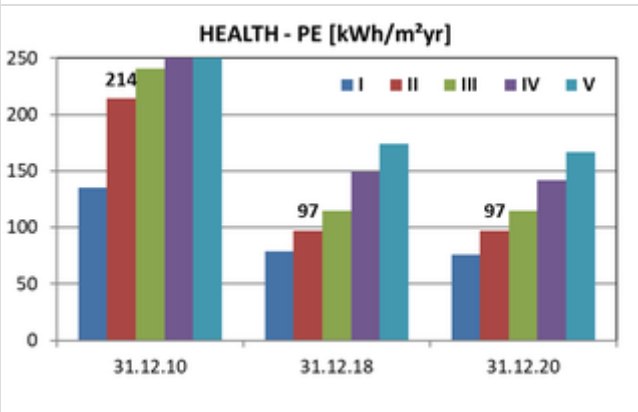
In 2016, the NZEB requirements for new single- and multi-family houses, office buildings and educational/heath care facilities (the maximum allowable values for primary energy from conventional sources of energy and CO_2 emissions) were defined (enforced) by Ministerial Order no. 386/2016 amending C 107-2005. For their implementation, intermediate values for new public buildings are set for the period until 31 December 2018 and values are set for all other new buildings until 31 December 2020. The graph below (Figure 1) illustrates the maximum values for primary energy demand (PE) and CO_2 emissions (CO_2) for key categories of non-residential and residential buildings for the period until 2018-2020 (NZEB values), differentiated by climatic zones (I to V), and values for zone II (average representative for Romania).

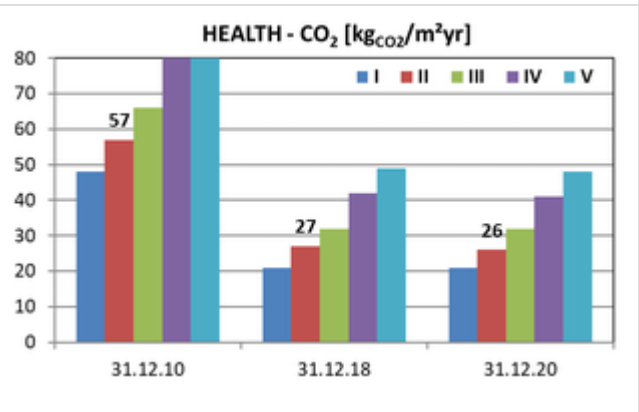

OFFICE - PE [kWh/m²yr]
I II III IV V
250 200 150 100 50 0
113
57
57
31.12.10 31.12.18 31.12.20

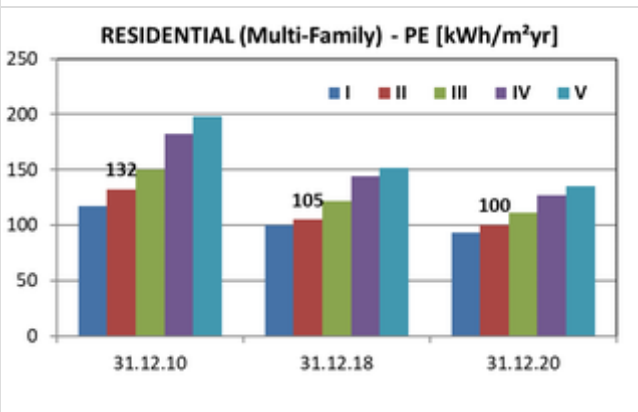

OFFICE - CO2 [kgCO2/m²yr]
I II III IV V
80 70 60 50 40 30 20 10 0
25
15
15
31.12.10 31.12.18 31.12.20

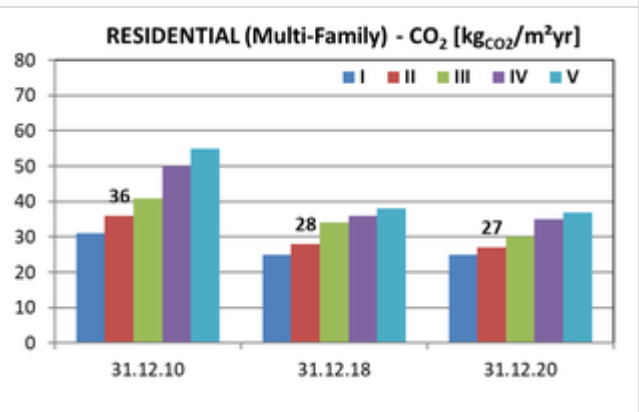

EDUCATION - PE [kWh/m²yr]
I II III IV V
250 200 150 100 50 0
153
120
115
31.12.10 31.12.18 31.12.20


EDUCATION - CO2 [kgCO2/m²yr]
I II III IV V
80 70 60 50 40 30 20 10 0
39
35
30
31.12.10 31.12.18 31.12.20


HEALTH - PE [kWh/m²yr]
I II III IV V
250 200 150 100 50 0
214
97
97
31.12.10 31.12.18 31.12.20


HEALTH - CO2 [kgCO2/m²yr]
I II III IV V
80 70 60 50 40 30 20 10 0
57
27
26
31.12.10 31.12.18 31.12.20


RESIDENTIAL (Multi-Family) - PE [kWh/m²yr]
I II III IV V
250 200 150 100 50 0
132
105
100
31.12.10 31.12.18 31.12.20


RESIDENTIAL (Multi-Family) - CO2 [kgCO2/m²yr]
I II III IV V
80 70 60 50 40 30 20 10 0
36
28
27
31.12.10 31.12.18 31.12.20

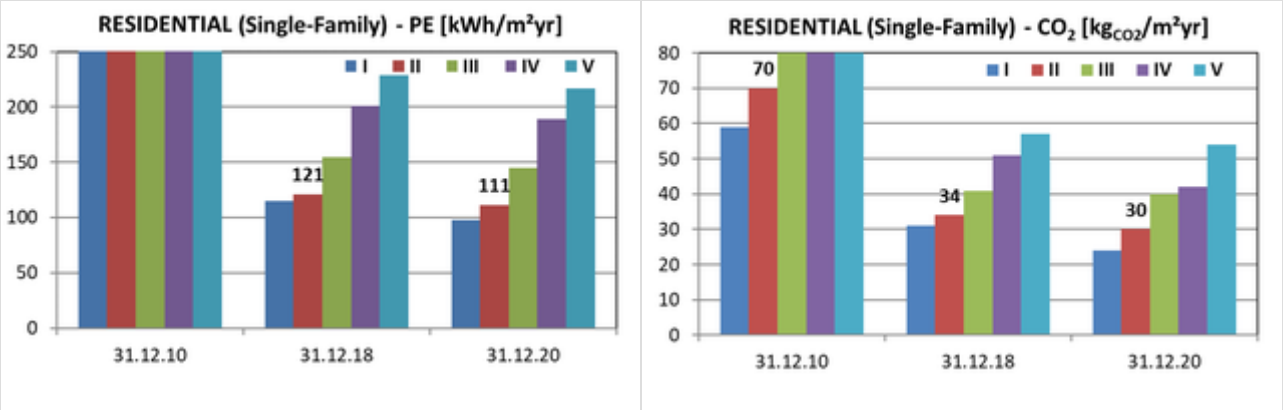


Figure 1. Maximum values for primary energy demand (PE) and CO_2 emissions (CO_2) for key building categories for the period until 2018-2020 (NZEB values), differentiated by climatic zones (I to V), and values for zone II (average representative for Romania).

Public authorities for local communities of more than 5,000 inhabitants must initiate multi-annual plans to increase the number of NZEB (including new and existing single- and multi-family houses, office buildings, educational, health care, tourist and sport buildings) in order to comply with Law no. 372/2005 (recast 2016), including further amendments. The local development plans shall contain financial policies/measures and possible financial incentives as it is a local government decision-making issue to promote NZEB and the use of RES in new buildings and existing ones undergoing major renovations.

Renewable energy sources must provide at least 10% of the total calculated primary energy needs of NZEB.

The EPC format shall be reviewed to introduce diversified energy classes for residential/non-residential NZEB.

As of November 2016, there are no newly constructed or existing NZEB documented in Romania (residential, non-residential or public buildings) and no further relevant data is available on this topic.

2.I.iv. Requirements for systems and / or building components for new buildings

The design of the technical building systems is based on the energy performance requirements set in the technical regulations: I 13 - 2015 (central heating installations), I 9 - 2015 (sanitary installations in buildings), I 5 - 2010 and GEx 011 - 2015 (ventilation & AC installations), I 7 - 2011 (lighting installations in buildings).

The calculation of heating and cooling energy needs is based on the provisions of the national standards: SR 1907-1&2:2014 (heating systems), SR 6648-1&2:2014 (ventilation & AC installations).

Energy consumption in buildings is assessed based on the methodology set in Mc 001-2006, with further amendments.

The guidance on the use of RES in new and existing buildings (technical regulation GEx 013-2015) implements the rules for use of energy from RES in buildings or in their vicinity and may be used in the design of new buildings or major renovations of existing buildings.

2.II. Energy performance requirements: EXISTING BUILDINGS

The energy performance of buildings and building units (apartments) is based on their energy consumption as calculated according to C 107-2005 and Mc 001-2006, with further amendments, including the new ministerial order published in the spring of 2017.

For buildings undergoing major renovations, the energy performance of the building or the renovated part thereof needs to be upgraded in order to meet the minimum energy performance requirements set in C 107-2005, with further amendments, so far as this is technically, functionally and economically feasible.

2.II.i. Progress and current status of existing buildings

The minimum energy requirements applied to the renovated building or building unit as a whole include:

- building elements within the building envelope;
- minimum corrected thermal resistances;
- maximum corrected thermal transmittances and maximum annual primary energy consumption for heating from conventional sources in residential buildings;
- maximum annual primary energy consumption for heating from conventional sources in non-residential buildings – office and commercial buildings, and educational, health care, tourist, and sport facilities.

See also section 2.I.i above. In the case of major renovations, the thermal renovation of the building envelope is usually taken into consideration in the first instance and the improvement or replacement of the technical building systems is considered, where necessary.

2.II.ii. Plans to improve the existing building stock

Since 2014, the current national strategy for increasing investment in the renovation of residential and commercial buildings, both public and private, has been included in the National Energy Efficiency Action Plan (NEEAP), published in 2015.

The NEEAP aims to increase the energy efficiency and the use of RES in the existing building stock and encompasses the following stages:

- Stage 1 – sets the target to implement major renovations in the next 5 years;
- Stage 2 – sets the target to implement major renovations towards NZEB in the next (more or less) 15 years;
- Stage 3 – sets the target to implement deep renovations in the next 15 years.

In the case of major renovations, the NZEB concept may be applied as long as the appropriate investments are technically and economically justified, so that the renovation work still provides greater benefits than costs over the expected lifetime of the building operation.

The NZEB requirements for existing single- and multi-family houses, office buildings, and educational and health care facilities are the same as those for new buildings that have been enforced by Ministerial Order no. 386/2016 amending C 107-2005.

As for new buildings, to comply with Law no. 372/2005 (recast 2016), with further amendments, the local public authorities for communities of more than 5,000 inhabitants must initiate multi-annual plans to increase the number of NZEB. The local development plans shall contain financial policies and other measures to promote NZEB and the use of RES in existing buildings undergoing major renovations.

In relation to major renovations, high-efficiency alternative systems may be taken into account as far as this is technically, functionally and economically feasible.

For existing NZEB buildings, RES shall provide at least 10% of the total calculated primary energy needs. This indicator is required as a minimum share of renewables for publicly funded renovation projects.

The reviewed EPC template with diversified energy classes for residential/non-residential NZEB will be used in publicly funded renovations in order to support an increased ambition of performance indicators and renovation impact monitoring.

As of November 2016, there are so far no existing buildings undergoing major renovations towards NZEB in Romania (residential, non-residential or public buildings) and no relevant data is available on this topic.

Complementary actions are taken in order to scale up investments in deep renovations of buildings in Romania, e.g., by supporting the implementation of relevant data and use of the tool developed under ENERFUND[3]. Funded by the European Commission's Horizon 2020 programme, the ENERFUND online app[4] provides key stakeholders, such as financing institutions, energy service companies and local authorities, with sound and up-to-date information regarding energy efficiency of the Romanian building stock and easy comparison with other European countries. In particular, it uses data from EPCs to map energy renovation opportunities and could also be used to monitor and showcase implemented renovation projects.

2.II.iii. Regulation of system performance, distinct from whole building performance

Law no. 372/2005 (2016 recast), with further amendments, imposes the minimum energy performance requirements for major renovations of individual building elements within the building envelope and technical building systems so that their performance meets minimum requirements set by national technical regulations (C 107-2005, Mc 001-2006, I5-2010, I7 -2011, I9-2015 and I13-2015) in so far as this is technically, functionally and economically feasible.

Also, by Law no. 196/2018 on the establishment, organisation and operation of the owners' associations, as subsequently amended and supplemented, states that the owners are obliged to take measures for consolidation or modernisation of the building, thermal rehabilitation and energy efficiency, according to the legal provisions. Regardless of the nature of the interventions, it will be considered to maintain the harmonious and unitary appearance of the entire building.

2.II.iv. Encouragement of intelligent metering

Law no. 372/2005 (recast 2016), with further amendments, allows the introduction of intelligent metering systems whenever a building undergoes major renovations, and, where appropriate, the installation of active control systems such as automation, control and monitoring systems that aim to save energy.

2.II.v. Financial instruments and incentives for existing buildings

Legal acts have been adopted with the aim of stimulating energy-efficiency-related measures financed by:

- structural funds and funds from public finance institutions for increasing energy efficiency in buildings, especially in housing;
- state budget allocations for stimulating investments in energy efficiency for achieving union objectives;
- local budgets for the elaboration of technical-economical documentation for design projects, EPCs, technical expert reports and energy audits;
- the execution of construction works for the major renovation of buildings listed in the national/local financial support multi-annual programmes with the aim of increasing energy efficiency in existing buildings.

The local authorities have an obligation to annually allocate finance from public funds for the elaboration of the documents mentioned above, and for the execution of the major renovation works for single- and multi-family buildings and buildings occupied by public authorities and for some categories of buildings frequently visited by the public.

In order to improve financing in support of implementing Directive 2010/31/EU, the use of financial incentives for major renovation works is regulated by:

- the Government Emergency Ordinance no. 18/2009, for increasing the energy efficiency in residential buildings, approved by Law no.158/2011, with further amendments: 50% is covered as a subsidy from the state budget allocations, 30% from the local public funds and 20% from the building repair fund of the single-family building/apartment building owners' association, representing owners' contribution;
- the Government Emergency Ordinance no. 69/2010 for increasing the energy efficiency in residential buildings via funding from bank loans with governmental guarantees: 10% is covered from the owners' association funds and 90% from the bank loans with governmental guarantees;
- EU regulations and procedures related to Structural and Cohesion Funds from the European Union: 60% is covered from the European funds and state budget allocations approved annually for this purpose in the MDRAP budget and 40% from the funds approved annually for this purpose in local budgets, as well as from the owners' association building repair fund and/or other legal sources;
- funding from local dedicated programmes.

2.II.vi. Information campaigns / complementary policies

Information campaigns are organised in compliance with Law no.372/2005 (recast 2016) announcing initiatives as follows:

- programmes and other activities disseminating information through the media on implementing different methods and practices to increase energy performance and for using high efficiency alternative systems;
- awareness programmes on available financial instruments, including the use of funds for promoting green technologies by developing green investment schemes[5];
- policies and programmes to increase the number of NZEB using energy from conventional sources by 2020 will be developed after the approval of the national housing strategy by government decision;
- programmes for increasing energy efficiency and for installing and operating alternative energy supply systems in buildings financed by the Environmental Fund Agency through the programmes Casa Verde[6] and Casa Verde Plus[7], and by the Regional Programme through Priority Axis 3, IP 3.1, Operation A - Residential Buildings, dedicated to encouraging sustainable energies, and through Priority Axis 3, "*Supporting the transition to an economy low carbon emissions*", Specific objective 3.2, "*Reducing carbon emissions in urban areas based on sustainable urban mobility plans*".
- Information regarding ongoing thermal renovation programmes, including funding mechanisms, is presented on the MDRAP website[8].

The Government Programme for 2017-2020 aims to inform, educate and alert consumers to conserve energy and increase efficiency.

One of the main barriers for the effective application of the NZEB concept in Romania was recognised during the BUILD UP Skills initiatives[9] pertaining to the skills gaps experienced by the building sector. To tackle this, the qualification schemes developed under BUILD UP Skills and the developments of the Train-to-NZEB project are used as effective tools to satisfy the existing demand for practical training of trainers and teachers, to provide opportunities for organising courses to certify builders of NZEB and to update existing skills. The Building Knowledge Hub (BKH) in Romania[10] (one of the 5 BKHs set up in 5 countries) will provide the capacity for conducting practical trainings for on-site professionals, high-level specialists and decision makers. For deep renovations of existing buildings, the Fit-to-NZEB project[11] aims to increase the competence and skills of the building professionals in Romania through unique educational programmes and pilot training courses, which is expected to contribute to both the quality and the scale of the deep energy building renovations.

2.III. Energy performance certificate requirements

The new ministerial order approved in April 2017 amends the current general format and content of building and building unit EPCs by introducing the primary energy conversion factors used for determining primary energy use.

Amending Law no. 372/2005 and Law no. 156/2016 enforces more effective directive transposition through:

- revised definitions and content, including recommendations of EPCs:
- new obligations for public authorities and owners of buildings frequently visited by the public;
- better procedures conducted by the State Inspectorate for Construction (ISC) for the independent control of EPCs and inspection reports.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

For all new buildings (residential and non-residential, public and private), building permits shall only be granted when the minimum energy requirements are fulfilled and the study on the technical, environmental and economic feasibility of energy use from RES is presented. The minimum energy requirements shall be checked based on detailed calculations (similar to those needed for the EPC) taking into account design data, while the EPC is required at the commissioning phase, based on as-built data.

The EPC shall present recommendations for energy use reduction in the building, as well as estimates and measures to be taken for energy savings, including detailed information on rentability and the steps to be taken to implement the recommendations, including specific information on the financial incentives or other funding means to be used.

2.III.ii. Quality Assurance of EPCs

In compliance with Law no. 372/2005 (recast 2016), with further amendments and based on its specific control procedure approved by MDRAP Order no. 3152/2013 (PCC 001-2013 indicative), the ISC has conducted random checks between January 2015 and September 2016, as follows:

- 2015: 613 new and existing buildings, 579 deficiencies, 5 sanctions imposed on energy auditors, 1,000 € penalty amount,
- 2016: 381 new and existing buildings, 274 deficiencies, 16 sanctions, 10,000 € penalty amount.

The ISC control mainly focuses on:

- the display of the EPC in buildings with total useful floor area of over 250 m^2 owned and occupied by public authorities and institutions providing public services;
- energy auditor/assessor certification requirements (specific higher education, area of expertise);
- signatures and stamps on EPCs and energy audit reports for buildings based on the legal provisions in force;
- the completeness and accuracy of information presented in EPCs and energy audit reports.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The public authorities and the owners or managers of buildings frequently visited by the public shall display the EPC for buildings where a total useful floor area of over 500 m^2 (250 m^2 starting 9 July 2015) is occupied by a public authority and frequently visited by the public.

For public buildings, the public authorities shall implement the recommendations included in the EPC within its validity period. In this respect, the public buildings shall first be structurally inspected and energy audited, and the building design, execution and handover shall be conducted based on the legislation and technical regulations in force.

The renovation works may be financed by local public funds and European structural funds or cohesion funds.

Annually, 10% of the EPCs, energy audit reports and heating and AC systems inspection reports are randomly checked by the ISC and registered in dedicated databases.

2.III.iv. Implementation of mandatory advertising requirement – status

No practical information is available on the current status of commercial media advertising around EPCs of buildings or building units for sale or rent.

2.IV. Inspection requirements – heating systems, air conditioning

In order to reduce energy consumption and limit CO_2 emissions, inspections of heating systems are carried out regularly and inspection reports are issued by certified technical experts. There are two institutions that have responsibilities, tasks and shared competencies in the field of heating systems, namely the ISC (State Inspectorate for Construction), which ensures the integrated heating and heating control system, and the State Inspection for Boiler Control, Pressure Vessels and Hoisting Installations (ISCIR), which ensures the control of the installation and operation of equipment, boilers and pressure vessels.

Inspections of AC systems are carried out regularly and inspection reports are issued by certified technical experts.

In the case of AC systems, the consumers shall be informed of possible measures to be taken on the replacement of AC systems or on other modifications to the AC system, which may include inspections to assess the efficiency and appropriate sizing of the system.

The system inspections are carried out in compliance with energy performance requirements for technical building systems set in the technical regulations in force on the date of inspection.

2.IV.i. Report on equivalence of model A and B for Heating Systems

Law no. 372/2005 (recast 2016) with further amendments lays down the necessary measures to establish the regular inspection of heating systems.

2.IV.ii. Progress and current status on heating systems

Inspection is performed based on the provisions of the technical regulations (guidelines) for energy performance inspection of boilers and heating systems in buildings

The inspection report presents recommendations for improving the energy performance of the heating system.

2.IV.iii. Progress and current status on AC systems

Inspection is performed based on the provisions of the technical regulation (guidelines) for energy performance inspection of AC systems of an effective rated output of more than 12 kW.

The inspection report presents recommendations for improving the energy performance of the AC system.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Law no. 372/2005 (recast 2016) with further amendments, states that regular inspections of heating and AC systems in buildings or building units shall be carried out periodically by certified technical experts.

There is no information available on penalties or use of these inspections.

Quality control of inspection reports

There is currently no information available on quality control of inspection reports.

Impact assessment costs and benefits

There is no information available on the impact assessment, costs and benefits.

3. A success story in EPBD implementation

In order to improve the energy performance of residential buildings and achieve the annual target on specific energy for heating consumption, a national programme was promoted in compliance with:

- Government Emergency Ordinance no. 174/2002 enforcing provisions of the Directive 76/1993/EEC;
- Government Emergency Ordinance no. 18/2009, with further amendments, repealing Government Emergency Ordinance no.174/2002 and enforcing provisions of Directive 31/2010/EU.

The programme was targeted towards building and building unit owners and/or owners' associations, and establishes different funding mechanisms, as follows: 40% public and 60% private funds (Government Emergency Ordinance no.174/2002); 80% public and 20% private funds (Government Emergency Ordinance no.18/2009, with further amendments).

According to Law no. 273/2006 regarding local public funds, with further amendments, the public funds for building thermal renovation started to be recovered from beneficiaries through further taxation by local authorities since 2014 (Government Emergency Ordinance no.63/2012 amending Government Emergency Ordinance no.18/2009).

For the efficient use of public funding in implementing various thermal renovation measures, the standard for costs of housing thermal renovation was developed and approved by Government Decision 363/2010.

The standard (currently repealed) set costs per square metre of building floor area for the thermal improvement of the building envelope.

The 2012 version of the standard was developed based on the implementation of its 2010 provisions in the ongoing programme. The new standard sets the costs for:

- individual building elements that form part of the building envelope;
- technical building systems (domestic hot water and AC, including passive cooling systems) and related equipment to allow its connection to the central heating systems, as appropriate.

In 2016, the thermal renovation works on residential buildings have been carried out for 88 housing units, accounting for 3,026 apartments.

4. Conclusions, future plans

For better implementation of Directive 31/2010/EU, the methodology for calculating energy performance of buildings (Mc 001-2006, with further amendments) shall be revised taking into account the proposed amendments to the directive and the provisions of the new/revised European Energy Standards. In addition, a new technical regulation shall be developed including guidelines of good practice for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements in new, existing, residential and non-residential buildings. Elaboration of the above technical regulations began in March 2017.

For increasing the energy efficiency in non-residential buildings, the next call for application from public authorities to participate in the 2014-2020 regional operational programme financed from structural funds began in spring 2017.

Endnotes

1. www.monitoruloficial.ro/emonitor/index.php?zi=30&luna=9&an=2016
2. www.monitoruloficial.ro/emonitor/index.php?zi=11&luna=4&an=2017
3. http://enerfund.eu
4. http://app.enerfund.eu
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9. www.buildup.eu/sites/default/files/bus_projects/build-up-skills_romania_status_quo_en_0.pdf

10. www.train-to-nzeb.com

11. www.fit-to-nzeb.com

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the Slovak Republic

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.mindop.sk, www.inforeg.sk, www.mhv.sk, www.siea.sk, www.sksi.sk

1. Introduction

The Slovak Republic began implementing Directive 2002/91/EC on 1 January 2006 by way of Act 555/2005 for the Energy Performance of Buildings. Furthermore, Decree 625/2006 of the Ministry of Construction and Regional Development of the Slovak Republic entered into force on 1 January 2007. To obtain a building permit, designers had to present evidence proving that the energy rating of the designed building met the legal minimum performance requirements. Minimum performance requirements were defined and established as mandatory since 1 January 2007. EPCs have been issued since January 2008. A new decree from the ministry came into force on 1 October 2009 introducing specific changes to the calculation process following European standards; the template of the EPC was changed. Since 1 November 2010, the responsibility for the energy performance of buildings lies with the Ministry of Transport, Construction and Regional Development (MDVRR SR). The Ministry of Economy is responsible for the regular inspection of boilers and AC systems in buildings.

Directive 2010/31/EU has been implemented by Act 300/2012 on the energy performance of buildings, which amended and supplemented Act 555/2005. The new Decree 364/2012 entered into force in January 2013. This introduced the definition of NZEB, and the global indicator for total energy use in buildings was changed to primary energy use, which also altered the EPC template. The decree sets out a gradual tightening of the minimum requirements for the years 2013, 2016 and 2021.

Since 1 January 2017, an amendment of Decree 324/2012, which provides a new method for the energy certification of building units, came into force. It also introduced a change to some primary energy factors and presented the template of the EPC.

2. Current Status of Implementation of the EPBD

The implementation of the EPBD has led to a phased tightening of the minimum requirements for the energy performance of buildings. This tightening is based on the rate of construction of high energy performance buildings. These will be followed by NZEB requirements for all new buildings starting in 2021. Renovated existing buildings must meet the requirements for new buildings when technically, functionally and economically feasible.

Requirements on the U-value of building envelope components and the energy needed for the heating of buildings are set in the national standard (STN) for thermal protection. A revision of STN 73 0540-2:2012 set the gradual tightening of requirements. The fixed requirements of ultra-low energy buildings were adjusted on 1 August 2016 for roofs and structures above the external open spaces following the results of cost-optimal studies on the levels of minimum energy performance requirements.

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

Requirements for the energy performance of new buildings have been set since 2016. According to these, new buildings, including new public buildings, should fulfil the requirements set for ultra-low energy construction and achieve the global indicator for energy class A1 (until the end of 2015, energy class B was the requirement for low-energy buildings). Heat recovery systems with a minimal efficiency of 60% for the ventilation of spaces is further required. The requirements for the global indicator for primary energy are set depending on the category of the building. New public buildings must fulfil NZEB requirements from 1 January 2019. The requirements on building components are the same for residential and non-residential buildings.

2.I.ii. Format of national transposition and implementation of existing regulations

The EPBD has been incorporated into Slovakian legal documents (act and ministerial decree). RES and heat recovery are now mandatory in new buildings. Requirements for the thermal protection of the envelope components and buildings are presented in the national standard STN 73 0540-2:2012/Z1:2016[1] (Table 1). The revised standard, which came into force on 1 August 2016, respects cost-optimality calculations. The process of the energy performance calculation is described in the Annex of the Ministerial Decree 364/2012[2] and refers to standardised calculation methods. The whole package of CEN standards was implemented and included into Slovak Technical Standards (STN). More than 50% of the CEN standards

were translated into the Slovak language and issued as STN EN standards. The monthly method is used for calculating the energy performance. The calculations are worked out separately for thermal protection and for the energy use for heating, cooling and ventilation, as well as for hot water preparation and lighting. Calculating primary energy is based on calculated delivered energy and primary energy factors. New primary energy factors are stated in the Ministerial Decree 324/2016[3], in force since 1 January 2017. Primary energy factors for electricity decreased from 2.764 to 2.2. Primary energy factors for district heating should be calculated following the Ministerial Decree 308/2016[4].

Structure / component	U-value W/(m².K)			
	Maximum value[1)] U_{max}	Standardised (required) value Low energy level of construction U_N from 1 January 2013	Recommended value Ultra low-energy level of construction standardised (required) U_{r1} from 1 January 2016	Target recommended value NZEB level of construction standardised (required) U_{r2} from 1 January 2021
External wall and pitched roof with a slope > 45°	0.46	0.32	0.22	0.15
Flat roof and pitched roof with a slope ≤ 45°	0.30	0.20	0.15	0.10
Windows, doors in external walls	1.70	1.40	1.00	0.60

Table 1. Requirements for the U-value of selected building envelope structures.

2.I.iii. Action plan for progression to NZEB for new buildings

The national action plan for NZEB reflects the requirements and the streamlining of legal documents in order to implement NZEB standards. The milestones are presented as intermediate objectives and targets focused on 2016 (ultra-low level of construction and 2021 level of NZEB construction). The definition of NZEB has been transposed into law and extended by highlighting the importance of the efficient thermal protection of buildings. A definition of NZEB is presented in the law, in force since 2013. At least 50% of the energy used in NZEB should be covered by RES. Implementing heat recovery systems/units with an efficiency higher than 60% is also required. The date set for the construction of new public NZEB is 1 January 2019. The national action plan requires that the design documentation for new public buildings should be in line with NZEB requirements when asking for a building permit by 31 December 2018. For all new buildings, the date required for design documentation to be in line with NZEB requirements is 31 December 2020.

Building components for new buildings should correspond to the requirements set by national standard STN 73 0540-2:2012 for the building envelope, with separate values for external walls, roofs, windows and dividing structures between heated and unheated spaces. Since 1 January 2016, the requirements were adjusted following the cost-optimality calculation results.

At present, there are no examples of completed NZEB in the country. Some buildings are in the design stage, reflecting the requirements for building envelope components and the global indicator for primary energy, and implementing RES, heat recovery systems and smart metering systems.

The action plan presents the gradual tightening of requirements with the global indicator for primary energy as the performance value. Energy class A1 is required since 1 January 2016, whereas NZEB should achieve energy class A0 for the global indicator as a performance value, starting 1 January 2021.

2.I.iv. Requirements for systems and / or building components for new buildings

There are no regulations defining the minimum efficiency of any technical building system as a whole. There are only specific requirements in regulations related to individual elements (e.g., boilers, pipework insulation, etc.). Technical building system requirements are mainly based on European (EN) or national (STN) standards. There are minimum requirements set for heating, cooling and ventilation, as well as for domestic hot water. In addition, building designers must assess the possibility of technical, environmental and economic utilisation of high-efficiency alternative energy systems (active solar heating systems and other heating systems and electrical systems based on RES; combined heat and power; district or block heating and cooling) before the construction begins. The energy requirements are not prioritised over health and safety or other technical requirements.

2.II. Energy perrformance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

The building code states that all construction works must fulfil essential requirements. The gradual tightening of requirements for energy performance started in 2013. From 2016, major renovations had to meet the requirements for ultra-low energy construction, namely energy class A1, if technically, functionally or economically feasible. To meet the requirements for the global indicator for primary energy, a major renovation of technical systems is also needed. Deep renovation includes changes to technical systems as well, including changes connected to the heat and hot water generation and distribution. In the event that it is not possible to change the efficiency of the device (e.g., the owner of the renovated building is not able to influence the primary energy factor), the renovated building must meet energy class A for the total energy use of the building. The energy rating is focused on technical systems for heating and domestic hot water preparation when the residential buildings are renovated, as well as for cooling, ventilation and lighting when non-residential buildings are renovated. Implemented measures should be cost-effective, where possible. The payback time of the measures proposed in the EPC should be less than 15 years.

2.II.ii. Plans to improve the existing building stock

The first draft of the Slovak “Strategy for the rehabilitation of the residential and non-residential building stock” towards improved energy efficiency, prepared under Art. 4 of the Energy Efficiency Directive (EED), was approved by Government Resolution 347/2014 (in July 2014). The renovation of buildings shall continue for a total of 29,000 apartment building units and 22,000 family houses annually, thus targeting a large proportion of the building stock constructed during the period of 1948-1992. At the end of 2016, 58.33% of apartment units in multi-family houses and 36.77% of single-family houses had been renovated. The average number of multi-family houses renovated annually during the last three years is 29,163 and 19,450 units of single-family houses have been renovated so far. The majority of renovated buildings followed the minimum energy performance requirements valid at the time of carrying out the construction

works. In the future, a deep renovation process will be necessary; unitl now, only major building renovations have been provided in all the cases. Major technical building systems renovation must now be realised as well.

According to the EED, energy audits have been carried out on buildings owned by the central government and were accompanied by progressive design documentation for building permits. Renovation works are generally financed using EU structural funds. There is no statistical data for the renovation of non-residential buildings available as of yet.

2.II.iii. Regulation of system performance, distinct from whole building performance

There are no specific technical requirements for systems installations as a whole in new and renovated buildings. New and existing buildings must only meet global minimum energy performance requirements. Regulations 422/2012[5] and 328/2005[6] define the minimum combustion efficiencies of boilers. Act 321/2014[7] on energy efficiency obliges owners of large buildings (with a total floor area larger than 1,000 m^2) to ensure that a distribution network of heat and domestic hot water is installed using suitable thermal insulation. Regulation 282/2012[8] defines those technical requirements.

Regarding other products used in technical building systems, specific requirements are to be found in implementing regulations related to the Ecodesign directive. In addition, there are specific requirements depending on the size of the building. The owner of a large building with a water-based central heating system is obliged to:

- ensure and maintain hydronic balancing of the heating system in the building;
- equip the heating system with equipment used for the automatic control of heating medium parameters for each heating appliance depending on the air temperature in heated rooms.

The owner of a building with central domestic hot water generation is obliged to:

- ensure and maintain hydronic balancing of the domestic hot water distribution system in the building.

After completing the works in a building, the owner should have performed the above-mentioned technical measures; this is one of the conditions for obtaining a building permit. In the event of non-compliance, the owner could be fined from 200 € to 8,000 € if detected by State energy inspection officials.

Table 2 is an example of requirements for individual technical elements.

	Minimum thickness of thermal insulation of heat and hot water distribution pipes made from steel pipes for thermal insulating material with a thermal conductivity of 0.035 W/(m.K) at 0 °C	
No.	Internal diameter of piping or fittings	Minimum insulation thickness
1	to 22 mm inclusive	20 mm
2	over 22 mm to 35 mm inclusive	30 mm
3	over 35 mm to 100 mm inclusive	the same as the internal diameter of the pipe
4	over 100 mm	100 mm
5	For heat distributors and heat collectors, in pipe crossings, in pipe joints and for pipes and fittings installed in wall and ceiling transitions, the minimum insulation thickness may be reduced by 50% of the insulation thickness specified in the relevant row of the table	

Table 2. Requirements for thermal insulation of pipes.

2.II.iv. Encouragement of intelligent metering

Based on the cost-benefit analysis of Distribution System Operators (DSOs), Decrees 358/2013[9] and 168/2015[10] were adopted. The decrees set a condition that at least 80% of delivery points for final customers whose annual electricity consumption is more than 4 MWh shall be equipped with an intelligent metering system (IMS) by December 2020.

The supplier of heat and domestic hot water is obliged to provide the customer with a meter that shows the actual heat consumption as well as the time of consumption. Similar obligations are valid for gas supply also.

The Regulatory Office for Network Industries (RONI) encourages DSOs to accelerate the deployment of intelligent metering before the deadlines stated in Decree 168/2015, to provide advice and information to customers, update the displayed measurement data frequently enough so they can be used to save energy, create, design and offer standardised interfaces, which would enable energy management in “real time”, and provide measurement results directly to the customer.

Intelligent metering does not in itself generate energy savings, since savings are generated by the actions of the occupants based on information from the metering system; therefore, such systems are not part of the normalised energy performance calculation. As such, installation does not influence the energy class of the building in the EPC or in the energy label.

2.II.v. Financial instruments and incentives for existing buildings

Since 1997, the main financial tools supporting the renovation of residential buildings were provided by the State fund for the development of the housing stock (SFRB). The conditions for credits are set in Act 150/2013[11] and ministerial decrees determining the type and height of provided credits and subsidies. Financial tools focus on multi-family houses. The total amount of credits for the period 2014-2016 represents 416.34 million € for the renovation of 89,258 apartments. Funding of single-family houses from SFRB was at a very low level. In order to increase the interest of owners to undertake major renovations of single-family houses (ensuring energy savings), a new programme was set up in 2016 targeting the low level of renovated existing single-family houses (33.67%)[12]. The highest possible grant is 8,000 € per single-family house.

The "*Greenlight for households*" project[13] is focused on subsidies for PV systems, solar thermal collectors, biomass boilers and heat pumps. Until now, 5,000 systems were supported with a total grant amount of 11 million €.

For the renovation of non-residential buildings, structural funds are generally used[14].

2.II.vi. Information campaigns / complementary policies

Information campaigns are organised through TV specials (broadcasted monthly), focusing on energy certification, measures recommended for major and deep building renovations, construction products, as well as information about technical building systems and components. Similarly, there are also radio broadcasts focusing on energy certification. Information about the energy performance of buildings is available at www.mindop.sk. There are already some ongoing information campaigns, e.g. "*Live with Energy*" and "*Energy for you*".

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The number of sold and rented buildings with EPCs increases from year to year, but nevertheless the overall proportion of the total building stock with EPCs is very low. The total number of issued EPCs in 2016 was 16,229 (Figure 1) and the number of sold buildings and rented buildings with EPCs was 133 and 668, respectively. The number of EPCs issued in 2015 for sold buildings and rented buildings was 277 and 205, respectively. The total number of EPCs issued in 2015 was 14,276 and in 2014 the number of issued EPCs was 13,866. The summary of issued EPCs as regards building categories and energy classes is presented in Table 3.

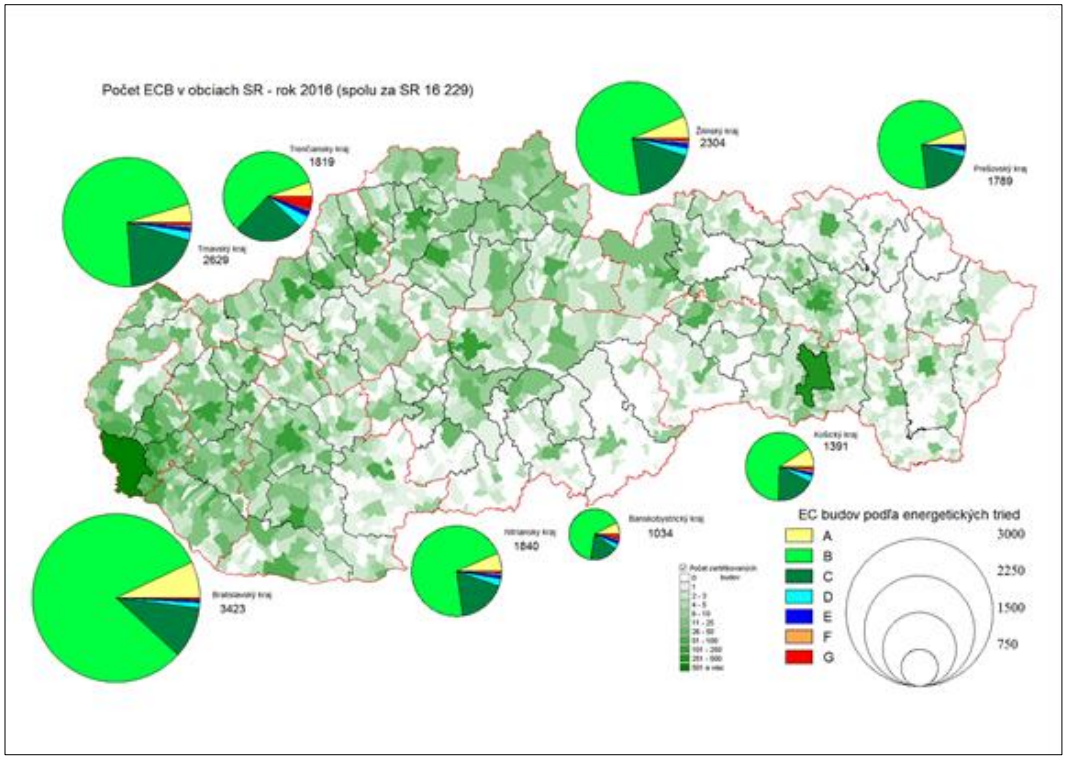


Figure 1. The number of EPCs in different regions of the Slovak Republic in 2016.

Building category	Total number	Energy class							
		A0	A1	B	C	D	E	F	G
Single-family houses	**12,996**	1,493	4,432	5,401	1,408	198	35	19	10
Multi-family houses	**1,807**	89	111	1,130	317	63	20	25	52
Office buildings	**432**	8	38	197	110	43	12	9	15
Educational buildings	**157**	1	4	59	52	14	14	5	8
Hospitals	**27**	2	3	15	4	2	-	-	1
Hotels and restaurants	**115**	9	17	57	20	7	5	-	-
Sport facilities	**35**	-	3	14	9	6	1	1	1
Wholesale and retail services buildings	**439**	2	40	190	117	55	15	5	15
Wholesale and retail services buildings	**221**	5	37	120	38	6	10	3	2
Total	**16,229**	**1,609**	**4,685**	**7,183**	**2,075**	**394**	**112**	**67**	**104**

Table 3. Summary data on performed EPCs in 2016 according to building categories and energy classes.

In accordance with Ministerial Decree 324/2016, which amends and supplements Ministerial Decree 364/2012, the responsibility for owners to obtain an EPC when renting or selling an individual apartment or parts of a building came into force on 1 January 2017 (Figure 2 and 3). A score is granted, depending on the quality of the thermal protection of structures and the performance of heating and domestic hot water systems in the individual building unit, expressing the level of construction. The final rating is expressed using pictograms (smilies). The energy certificate template consists of 4 pages and the maximum validity of issued EPCs is 10 years.



Figure 2. First page of the EPC template for individual apartments or building units.

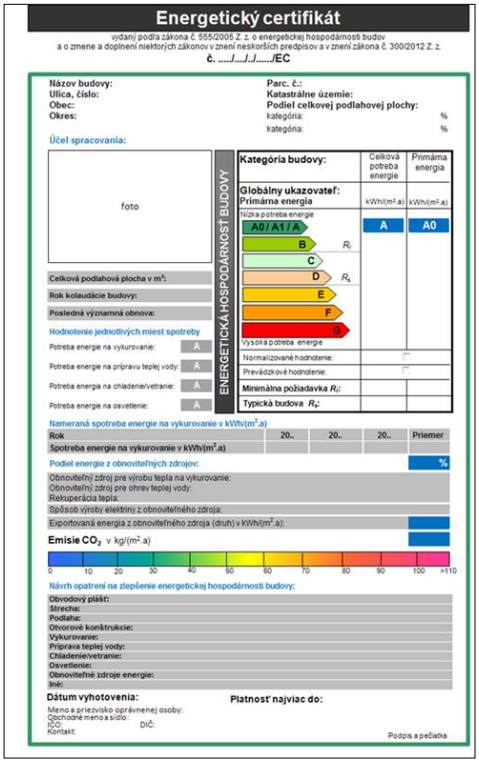


Figure 3. First page of the EPC template for residential, non-residential and public buildings.

2.III.ii. Quality Assurance of EPCs

Since 2014, the State Energy Inspection, as part of the Slovak Trade Inspection, has been responsible for the quality assurance of EPCs. A system of random control is under development.

Energy certificates for individual apartments or building parts are worked out online and every step from start until the issuing of the certificate is controlled by software.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Energy certification and display is mandatory for buildings used by public authorities with a total floor area of more than 250 m^2 (until 9 July 2015 it was for more than 500 m^2) or for buildings that are frequently visited by the public.

There is no appropriate information on the display of EPCs that is available at the moment. The Slovak Trade Inspection is in charge of checking that EPCs are publicly displayed, but as of 2016 the control had not yet been completed.

The format and content of the EPC for public and large buildings that are visited by the public are the same as for other buildings when sold or constructed. EPCs for public and large buildings visited by the public are also valid for 10 years unless the building is renovated and there is a change in the energy use.

2.III.iv. Implementation of mandatory advertising requirement – status

Act 555/2005[15] on the energy performance of buildings implements mandatory advertising requirements which have been in force since January 2013. In cases where the building is sold or rented, the building owner is required to indicate in commercial media advertisements the information about the energy class of the global indicator from the EPC. The Slovak Trade Inspection is in charge of control checks. At the end of 2016, the control had not yet been completed.

2.IV. Inspection requirements – heating systems, air conditioning

The Slovak Republic decided to use the option of regular inspections, both for heating and AC systems, in response to Articles 14/15 of the EPBD (Directive 2010/31/EU). Regular inspections were made mandatory on 1 January 2008. The Ministry of Economy is responsible for the area of regular inspection of both heating and AC systems in buildings. The legal basis for both follows from Act 314/2012. There are two linked decrees:

- Decree 422/2012, which lays down the requirements for the procedure of regular and extended inspection of heating systems and the regular inspection of AC systems;
- Decree 44/2013, which defines the details of the examination procedure that qualified experts need to follow, in order to carry out the regular inspection of heating and AC systems.

There is a common set of minimum required information in the inspection reports and a report template is provided by the SIEA. Act 314/2012 contains framework information on the content of the report which is then supplemented by Decree 422/2012. The training and examination procedures for qualified experts follow the same structure for both heating and AC system inspections. Support is provided by SIEA; additionally, the Slovak Association for Cooling and Air Conditioning Technology provides experts qualified to perform AC inspections.

2.IV.i. Report on equivalence of model A and B for Heating Systems

The Slovak Republic decided to use the option of regular inspections, both for heating and AC systems; no report is provided.

2.IV.ii. Progress and current status on heating systems

Inspections of heating systems are based on the assessment of efficiency under defined normal working conditions. Currently, inspections of heating systems must follow the reference methodologies, partially based on EN standards, (e.g., EN 15378). A detailed national methodology is defined in Decree 422/2012. The regular intervals of inspection depend on the thermal output of the heating system, the type of fuel and the type of building (residential/non-residential). Since the end of 2013, all boilers under the scope of Act 314/2014 in all buildings with a nominal thermal output of the boiler above 30 kW should be inspected; since 2014 boilers above 20 kW in non-residential buildings which are fuelled by fossil solid, liquid and gaseous fuels (with the exception of natural gas) should be inspected as well (Table 4).

Nominal output of boiler [kW]	**Fuel**	**Interval of regular inspection [year]**	
		Single-family houses and Residential houses	Office buildings, schools and educational buildings, hospitals, hotels and restaurants, sport facilities, wholesale and retail trade buildings, other types of energy-consuming buildings
In the range of 20 (incl.) to 30	Fossil solid, liquid and gaseous fuels except natural gas	10	7
	Natural gas	15 (first inspection at the latest in 31.12.2022)	12 (first inspection at the latest in 31.12.2019)
	Biomass, biogas	15	12
In the range of 30 (incl.) to 100	Fossil solid, liquid and gaseous fuels except natural gas	4	4
	Natural gas	6	6
	Biomass, biogas	6	6
Above 100 (incl.)	Fossil solid, liquid and gaseous fuels except natural gas	2	2
	Natural gas	3	3
	Biomass, biogas	2	2

Table 4. Intervals of regular inspections of boilers and heating.

There are 200 licensed bodies and 255 qualified experts registered for the regular inspection of heating systems (2016).

Inspections are ordered and paid for by the owner of the building or by the contractual administrator of the building or system. Building owners (or administrators of buildings or systems) are required to:

- arrange regular inspections of heating systems;
- keep inspection reports until a new one is received at the next periodic inspection;
- submit the last inspection report to the new owner in the case of transfer or reassignment of the ownership of the building;
- provide a copy of the latest inspection report to tenants when renting a building or heating system.

Summary data on performed inspections of heating systems including boilers in the period of 2010 – 2015 according to received inspection reports is presented in Table 5.

Data	Unit	Year					
		2010	**2011**	**2012**	**2013**	**2014**	**2015**
Number of inspected boilers	boiler unit	1,018	363	227	1,201	970	1,015
Total heat output of inspected boilers	MW	273.13	52.28	40.09	163.67	166.61	150.78
Number of LBs who sent reports	-	18	22	20	33	37	29
Share of boilers not fulfilling the required combustion efficiency out of the total number of inspected boilers	%	6.5	6.1	3.1	5.3	6.2	5.3
Share of boilers older than 15 years out of the total number of inspected boilers	%	23.1	28.7	36.2	19.8	35.6	26.9
Number of performed expanded heating systems inspections with boiler older than 15 years	Inspection	65	27	47	134	226	172

Table 5. Summary data on performed inspections of heating systems including boilers during 2010 – 2015 according to received inspection reports.

2.IV.iii. Progress and current status on AC systems

Inspections of AC systems are based on the assessment of efficiency under defined normal working conditions and must follow the reference methodologies, among others, based on EN standards, e.g., EN 15240. A detailed national methodology is defined in Decree 422/2012. The regular periods of inspection depend on the cooling output of the inspected AC system (Table 6). Inspections are ordered and paid for by the owner of the building or the contractual administrator of the building or the system. The requirements on building owners (or administrators of buildings or systems) are the same as for heating system inspections. Promotional activities are similar to the activities performed in case of inspecting heating systems.

There are 65 licenced bodies and 103 qualified experts registered for the regular inspection of AC systems (2016).

The first summary report has been prepared for inspections that were undertaken in 2011. For 2015, inspections should be implemented for all AC systems with a cooling output of over 50 kW (Table 6). The main summary data for the period 2011 – 2015 are given in Table 7.

Nominal cooling output of AC system [kW]	Interval of regular inspection [year]
In the range of 12 (incl.) to 50	8
In the range of 50 (incl.) to 250	6
In the range of 250 (incl.) to 1,000	4
Above 1,000 (incl.)	2

Table 6. Intervals of regular inspections of AC systems.

Data	Unit	Year				
		2011	2012	2013	2014	2015
Number of inspected AC systems/cooling units	system	32/32	2/10	49/49	151/151	448/448
Total cooling output of inspected system units	MW	4.32	4.50	12.00	53.0	63.23
Number of LBs who sent reports	-	2	1	11	6	6
Number of inspected AC systems/units installed in office buildings	-	13	2	27	85	81
Number of inspected AC systems/units installed in retail buildings	-	0	0	13	38	331

Table 7. Summary data on performed inspections of AC systems during 2011 – 2015 according to received inspection reports.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

For the purposes of monitoring, once a year, at the latest by 31 January, licenced bodies are required to send an electronic copy of all inspection reports produced in the previous year to the SIEA (on behalf of the Ministry). The owner or administrator of a building or a system may be fined if he/she does not arrange an inspection before the set date (Tables 4 and 6), does not keep the inspection report until receipt of the report from the next periodic inspection, does not submit a report from the last inspection to a new owner, or does not provide a certified copy of the report from the last inspection to a tenant. Owners, however, are not fined for a negative inspection result. The owner (or administrator) is not required to implement the recommendations that the qualified expert includes in the inspection report.

The Slovak Trade Inspection is responsible for compliance checking for both inspection systems. If, during the control, it is found that the inspections carried out by certain qualified experts are not undertaken in accordance with the regulations, the ministry is allowed to remove that particular qualified expert from the register. So far, only one expert has been removed from the list of qualified experts in 2013, but this was for reasons other than shortcomings identified by supervisors. If a licenced body fails to send the report from the inspection to the ministry, it can be fined up to 200 €.

Quality control of inspection reports

All inspection reports are registered in the monitoring system administered by the SIEA. The ministry (or the SIEA on behalf of the ministry) checks a statistically significant percentage of inspection reports received every year, and at least one inspection report submitted by each licensed body is inspected. Quality control is similar for both inspection systems and is focused on formal fulfilment of the legislative requirements, but the content is also checked, in particular the calculation procedure and final results written in the particular report. Key findings are subsequently followed up in the training process. In 2015, six licenced bodies produced 188 AC system inspection reports, from which 12 reports were checked for quality. Regarding the heating system inspections, 29 licenced bodies sent 522 inspection reports, and 29 of those reports were quality checked.

Impact assessment. Costs and benefits

The findings of quality checks carried out on inspection reports were incorporated in improvements to the training process and were communicated during the regular professional re-training (50 qualified experts in 2015). Key findings and recommendations based on the analysis of regular inspection reports were communicated during information activities, meetings and conferences featuring state authorities, public bodies and municipalities and were taken into account in the preparation of energy efficiency supporting measures and in the fourth National Energy Efficiency Action Plan (NEEAP)[16].

3. A success story in EPBD implementation

A particular success of the Slovak Republic in relation to creating the implementation system which focuses on the energy performance of buildings, is the strong interlinkage of different policies and steady improvements. The Slovak Republic started to implement the EPBD in 2005; since that time, the general principles and methods of energy performance certification have remained constant. The system was developed, refined and extended in accordance with changes in the EPBD and European Standards, new knowledge and the development of common conditions for the energy performance of buildings. A very important aspect for the successful implementation of the EPBD was the introduction of definitions related to the energy performance of buildings, but also the extension of terms cited in the EED.

The implementation process in relation to the EPBD was supported by CEN standards that were translated into the Slovak language. All of these standards were transposed into the Slovak technical standards system.

Defining these concepts also requires determining the conditions upon which loans to carry out major renovations are granted. Upon the request of grants or loans, the documentation should indicate that all the requirements of the EPBD can be achieved.

Research work conducted since 1992 included pilot and demonstration projects, which aimed at reducing energy use and the consumption of energy at the very least. The obtained results were used for the revision of thermal protection standards, but also for setting regulations on the energy use of technical systems, leading to a decrease in energy demand supplied by RES. In 2012, a path was set for the gradual tightening of requirements concerning the thermal protection of building envelope components and the energy performance of buildings towards the NZEB energy level of construction. This influenced the innovation and change in market conditions for construction products. All the achieved results influence the continuous improvements in the housing stock and the implementation of new conditions for overall policy integration, which has led to energy savings and improvements to the energy performance of buildings. Newly implemented procedures raise the energy awareness of building owners and mobilise them to renovate buildings.

4. Conclusions, future plans

The EPBD was implemented under Act 555/2005 and amended by Ministerial Decree 364/2012, which came into force in January 2013. Since January 2008, EPCs have been issued for new buildings and buildings undergoing major renovations when either sold or rented. The template has also changed and a new one was presented in the 2013 decree. A methodology for the energy certification of individual apartments or building units came into force in 2017 when an EPC template was also provided. It is to be noted that the compliance control system is under development and should be fully functional in 2017.

Of great importance is supporting the extensive renovations of the building stock, focusing on deep renovations so as to achieve the NZEB level. This will require additional training of experts, especially as regards quality assessment. In addition, it will be necessary to extend information campaigns targeting owners, to provide the financial tools for supporting deep renovations, and to provide a step-by-step renovation process as well.

The main challenge is to engage all involved groups (designers, developers, providers, owners and tenants) in the effort to change their attitude towards the construction of NZEB, which will require a new architectural perspective concerning the use of new materials and technical systems, including heat recovery systems and smart metering, as well as the integration of RES.

Finally, the Slovak Republic aims to implement the second generation of all CEN standards related to the EPBD into the Slovak Technical Standards (STN) system.

Endnotes

1. STN 73 0540-2:2012/Z1:2016 Tepelná ochrana budov. Tepelnotechnické vlastnosti stavebných konštrukcií a budov. Časť 2: Funkčné požiadavky
2. Vyhláška Ministerstva dopravy, výstavby a regionálneho rozvoja Slovenskej republiky č. 364/2012 Z. z. z 12. novembra 2012, ktorou sa vykonáva zákon č. 555/2005 Z. z. o energetickej hospodárnosti budov a o zmene a doplnení niektorých zákonov v znení neskorších predpisov; *www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/364/*
3. Vyhláška Ministerstva dopravy, výstavby a regionálneho rozvoja Slovesnkej republiky č. 324/2016 Z. z. z 30. novembra 2016, ktorou sa mení a dopĺňa vyhláška Ministerstva dopravy, výstavby a regionálneho rozvoja Slovenskej republiky č. 364/2012 Z. z., ktorou sa vykonáva zákon č. 555/2005 Z. z. o energetickej hospodárnosti budov a o zmene a doplnení niektorých zákonov v znení neskorších predpisov; *www.slov-lex.sk/pravne-predpisy/SK/ZZ/2016/324/20170101.html*
4. Vyhláška Ministerstva hospodárstva Slovenskej republiky č. 308/2016 Z. z. z 24. októbra 2016, ktorou sa ustanovuje postup pri výpočte faktora primárnej energie systému centralizovaného zásobovania teplom; *www.slov-lex.sk/static/pdf/2016/308/ZZ_2016_308_20170101.pdf*
5. Vyhláška Ministerstva hospodárstva Slovenskej republiky č. 422/2012 Z. z. z 13. decembra 2012, ktorou sa ustanovuje postup pri pravidelnej kontrole vykurovacieho systému, rozšírenej kontrole vykurovacieho systému a pri pravidelnej kontrole klimatizačného systému ktorou sa ustanovuje postup pri pravidelnej kontrole vykurovacieho systému, rozšírenej kontrole vykurovacieho systému a pri pravidelnej kontrole klimatizačného systému sa ustanovuje postup pri pravidelnej kontrole vykurovacieho systému, rozšírenej kontrole vykurovacieho systému a pri pravidelnej kontrole klimatizačného systému; *www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/422/20130101*

6. Vyhláška Úradu pre reguláciu sieťových odvetví č. 328/2005 Z. z. z 13. júla 2005, ktorou sa určuje spôsob overovania hospodárnosti prevádzky sústavy tepelných zariadení, ukazovatele energetickej účinnosti zariadení na výrobu tepla a distribúciu tepla, normatívne ukazovatele spotreby tepla, rozsah ekonomicky oprávnených nákladov na overenie hospodárnosti prevádzky sústavy tepelných zariadení a spôsob úhrady týchto nákladov; *www.slov-lex.sk/pravne-predpisy/SK/ZZ/2005/328/20080301*
7. Zákon č. 321/2014 Z. z. z 21. októbra 2014 o energetickej efektívnosti a o zmene a doplnení niektorých zákonov; *www.urso.gov.sk/sites/default/files/z_321_2014.pdf*
8. Vyhláška Ministerstva hospodárstva Slovenskej republiky č. 282/2012 Z. z. z 18. júla 2012, ktorou sa ustanovujú technické požiadavky na tepelnú izoláciu rozvodov tepla a teplej vody; *www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/282/vyhlasene_znenie.html*
9. Vyhláška Ministerstva hospodárstva Slovenskej republiky č. 358/2013 Z. z. z 28. októbra 2013, ktorou sa ustanovuje postup a podmienky v oblasti zavádzania a prevádzky inteligentných meracích systémov v elektroenergetike *www.slov-lex.sk/pravne-predpisy/SK/ZZ/2013/358/20131115*
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12. Zákon č. 277/2015 Z. z. Zákon, ktorým sa mení a dopĺňa zákon č. 443/2010 Z. z. o dotáciách na rozvoj bývania a o sociálnom bývaní v znení zákona č. 134/2013 Z. z. a ktorým sa mení a dopĺňa zákon č. 555/2005 Z. z. o energetickej hospodárnosti budov a o zmene a doplnení niektorých zákonov v znení neskorších predpisov; *www.zakonypreludi.sk/zz/2015-277*
13. *http://zelenadomacnostiam.sk/sk*
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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD Implementation in Slovenia

Status in December 2016

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NATIONAL WEBSITES

www.mzi.gov.si, www.energetika-portal.si, www.ekosklad.si, www.eu-skladi.si, www.energetskaizkaznica.si

1. Introduction

The transposition of the EPBD in Slovenia is the overall responsibility of the Ministry of Infrastructure and is primarily transposed by the Energy Act[1], covering the topics of NZEB, energy performance certification, inspection of heating and AC systems and energy efficiency information programmes. In addition, the Building Construction Act gives the legal basis for building codes (with minimum requirements for building energy performance, technical building systems and the calculation methodology), while the Environmental Protection Act addresses the inspection of boilers.

A proposal for the amendment of the Energy Act was put to public consultation in February 2017. The proposed changes establish the obligation for public display of the EPC for all buildings (not only public) frequently visited by the public. The proposed amendment also gives the grounds and conditions to extend the validity of licences of independent experts. The publication of the amendment is expected by the end of 2017.

In the secondary EPBD regulation only minor changes have been implemented (since December 2015), including an update to the rules on the training, accreditation and register of accredited independent experts for regular inspection of AC systems[2], completed in January 2016.

The revision of the building codes (PURES) is in progress and planned for publication in mid-2018. It will contain detailed technical requirements for NZEB based on the technical definition given in the national NZEB action plan (April 2015), and the revision of the calculation methodology according to a new set of CEN EPBD standards.

Important recent steps in EPBD implementation are the application of the central national electronic register of EPCs and associated software, the independent control system for EPCs, first steps in the cross-linking of e-registries for EPCs, inspections and public buildings, as well as wide information activities implemented by the Eco fund[3] concerning financial instruments available for the energy renovation of buildings.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

In line with the EPBD and according to the long-term planning integrated into the building codes PURES 2010, as of January 2015 more severe minimum requirements for maximum energy needs for heating have entered into force[4]. This change had already been integrated into the transitional provisions of PURES 2010 and is compliant with the cost-optimal study outcome. Minimum requirements are expressed using performance-based and energy-related requirements as well as detailed technical requirements for building components and systems.

In 2015/2016, the building codes were put under revision in order to take into account the outcome of the cost-optimal study, and mainly to include further details associated with the national definition of NZEB, and to make the necessary changes in the calculation methodology pursuant to the new CEN EPBD standards. The revision process is still ongoing and shall be finalised by mid-2018 with the publication of the updated rules.

The current development deploys detailed energy modelling for new non-residential buildings and the increased use of RES and RES systems, respectively. To support this process, the revised building codes plan to introduce obligatory (instead of optional) hourly energy calculations for complex non-residential buildings as well as to regulate the quality control of the airtightness of the envelope.

2.I.ii. Format of national transposition and implementation of existing regulations

The Slovenian building codes PURES 2010, with the more severe minimum requirements in use from January 2015, are valid for all types of new buildings, residential and non-residential, while for public buildings (public investments) 10% more severe minimum requirements are imposed. However, new public buildings are front-runners in energy efficiency due to the financial incentives available for early NZEB as well as due to the Decree on green public procurement[5] that included low primary energy among the selection criteria for bids.

Compliance with PURES 2010 must be demonstrated by fulfilling minimum requirements related to the maximum allowed specific transmission heat losses (Ht'), maximum annual heat demand for space heating (Qnh), maximum energy needs for cooling (Qnc) (for residential buildings only), and maximum primary energy for the energy systems operation (heating, ventilation and air-conditioning systems and lighting).

Maximum U-values of the envelope elements are prescribed for all buildings. The use of 25% of RES is mandatory in all new buildings from 2008; alternatively, solutions that include a comparable impact on the

primary energy are possible. The consideration of RES produced on-site is limited to the total final energy used for the building's energy systems; the consideration of exported RES is subject to the integration of the new CEN EPBD standards into the revised rules (by mid-2018).

The detailed minimum requirements and energy performance calculation methodology are given in the corresponding technical guidelines TSG-01-004[6]. A monthly energy calculation is predominantly used in practice, and energy modelling with the CEN EPBD standards validated tools is optional. Other minimum requirements cover thermal bridges, airtightness, shading, ventilation, heat recovery, cooling, lighting for residential and non-residential buildings, boilers and heat pump efficiency.

Compliance checking is done at the building permit stage, during the construction process and at building completion before the permission to use is issued. Full compliance is necessary for permission to use. Advanced control is in place for early NZEB, mostly as a precondition for financial incentives.

Maximum heating need (QNH) per useful conditioned floor area (Au)	
for residential buildings	QNH/Au ≤ 45 + 60 f0 – 4.4 TL (kWh/(m^{2}year))
for non-residential buildings	QNH/Ve ≤ 0.32 (45 + 60 f0 – 4.4 TL) (kWh/(m^{3}year))
for public buildings	QNH/Ve ≤ 0.29 (45 + 60 f0 – 4.4 TL) (kWh/(m^{3}year))
Maximum cooling need (QNC) per useful conditioned floor area (Au)	
for residential buildings	QNC/Au ≤ 50 kWh/(m^{2}year)
Maximum primary energy (Qp) per useful conditioned floor area (Au)	
for residential buildings	Qp/Au = 200 +1.1 (60 f0 – 4.4 TL) kWh/(m^{2}year)

2.I.iii. Action plan for progression to NZEB for new buildings

The Slovenian national plan for NZEB[7] (2015) imposed the technical definition of NZEB based on the cost-optimal study (2014) for reference buildings. The primary energy as a core performance indicator of NZEB is limited to 75 / 80 / 55 kWh/m^2.year for new single- and multi-family houses and for non-residential buildings, respectively, and complemented by the requirement of a 50% share of RES in the final energy use. RES may be selected in consideration of their availability and acceptable NZEB technologies. In the future, the use of RES will be increased due to the growing share of RES in district heating systems which are subject to comply with the 2020 energy efficiency targets set in the Energy Act. The nearly zero or very low amount of energy required is achieved by the limitation of energy needs for heating to a maximum value between 25 kWh/m^2.K and 15 kWh/m^2.K (EPC class A1, A2 or B1), depending on the shape factor (envelope area to buildings volume ratio) and the local climate.

A number of policies support the early construction of NZEB, including the following: the integration of NZEB criteria in revised building codes, the integration of energy efficiency in spatial planning, financial instruments for supporting private and public investments of new NZEB, demonstration projects, incentives for heating from RES (on-site, nearby and/or in district heating systems), the integration of NZEB criteria in green public procurement, energy information and advice, establishing a one-stop-shop portal, and the upskilling of blue collar workers and engineers for NZEB.

The national plan for NZEB also defined the intermediate targets for future NZEB, expressed in the floor area of new NZEB, and diversified by particular building types: single-family houses, multi-family houses, public buildings and other non-residential buildings. Comprehensive monitoring of newly constructed NZEB is not yet in place; the partial data are available only for NZEB supported by Eco Fund subsidies (Table 1).

Single-family houses are the prevailing type of early NZEB in Slovenia; after a decade of tradition in constructing passive houses, low energy single-family houses and NZEB, there are several experienced designers, contractors and installers available within the single-family houses market. Although the stakeholders of multi-family building construction turned out to be less experienced in NZEB, there are some successfully built private and public NZEB multi-family houses. In 2016, the Housing Fund of the Republic of Slovenia completed a NZEB multi-family house with 52 apartments in 4 individual staircases. This demonstration building has an average U-value of 0.26 W/m^{2}K, EPC class A2, a primary energy of 36 kWh/m^{2}year and a 72% share of RES (Figure 1).



Figure 1: NZEB multi-family house F3 Brdo, Ljubljana, built in 2016 as a demonstration project by the Housing Fund of the Republic of Slovenia (SSRS). The F3 Brdo building, with 52 apartments and a useful floor area of 5,708 m^2, holds an EPC class of A2 with a standard annual heat demand of 14 kWh/m^2.year, a total delivered energy of 49 kWh/m^2.year and a primary energy of 36 kWh/m^2.year. The share of RES in delivered energy is 72% (biomass: 48%, electricity: 28%, electricity from PV: 19% and heat from the environment for heat pumps: 5%) (www.brdo.ssrs.si) (Source: SSRS).



Figure 2. Airtightness quality control – Blower door tests for apartments and for the entire building were done in several stages during the construction of the building F3 Brdo, Ljubljana – a NZEB demonstration project of the Housing Fund of the Republic of Slovenia (2016) (Source: GI ZRMK, Photo: Andraž Rakušček).

NZEB national plan intermediate targets - new buildings (m^2)	Target 2015 A_u (m^2)	Target 2018 A_u (m^2)	Target 2020 A_u (m^2)	Target* 2014-2018 No. of NZEBs (-)	Target* 2014-2020 No. of NZEBs (-)	Achieved** 2014-2017 No. of NZEBs (-)
Single-family houses	76,850		267,500		6,300	463
Multi-family houses	9,753		73,650		167	5
Public buildings	53,320	84,126		224		30
Other non-residential buildings	50,030	115,970		189		no data

* Estimation

** The actually achieved number of new NZEB is based on the data of Eco Fund on subsidised investments and on the data from NZEB pilot projects.

Table 1. Intermediate targets for new early NZEB as given in the Slovenian national plan for NZEB (2015) versus actually constructed NZEB by September 2017.

2.I.iv. Requirements for systems and / or building components for new buildings

Current minimum requirements for systems and building components are defined in PURES 2010 regulations, with the revision of the regulation planned for publication by mid-2018.

The study on PURES revisions (2015/2016) recommended complementing the minimum efficiency requirements of technical building systems with specific values for: space heaters, combination heaters, packages of space heaters, temperature controls, solar devices and packages of combination heaters, as well as water heaters, hot water storage tanks and packages of water heaters and solar devices based on the requirements of the Eco design Directive and delegated regulations No 811/2013 and No 812/2013.

Based on the cost-optimal study, more stringent minimum requirements were proposed for building components (Table 2). However, the designers should optimise the U-values of the envelope elements in order to meet the design specific transmission heat transfer coefficient (H_T') below the minimum value, as presented in Figure 3, and to comply with energy performance-based minimum requirements. Linear thermal bridges should be kept below Ψ_e = 0.2 W/(mK).

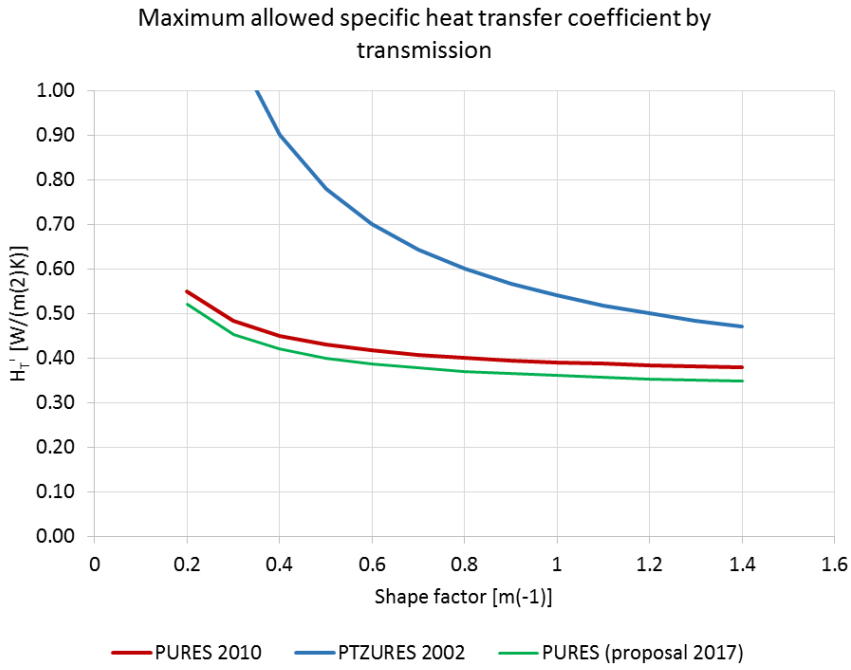


Figure 3. Maximum allowed specific heat transfer coefficient by transmission, development of regulation from 2002 to 2010 and proposal in compliance with cost-optimal study.

Minimum requirements for U-value of the envelope	Status 2017 (as in current PURES 2010)	Proposed new U-values max. (NZEB)
walls	0.28 W/m^2.K	0.20 W/m^2.K
floors between flats	0.90 W/m^2.K	0.90 W/m^2.K
flat roofs	0.20 W/m^2.K	0.18 W/m^2.K
windows	1.3 W/m^2.K	1.0 W/m^2.K

Table 2. Minimum requirements for the elements of the building envelope; current status (2017) and proposal for revised regulation expected in mid 2018.

2.II. Energy performance requirements EXISTING BUILDINGS

In Slovenia, minimum requirements for existing buildings are given in the building codes PURES 2010 and do not differ from the requirements for new buildings in case of major renovations where a building permit is needed. If the works are classified as maintenance works, then only the minimum requirements for the particular element of the technical building system component are relevant.

In case of NZEB renovations, the minimum requirements for existing buildings expressed in primary energy are less stringent compared to those for new buildings: 95 / 90 / 65 kWh/m^2.year for a NZEB renovation of a single-family house, a multi-family house and a non-residential building, respectively. These requirements are part of the national plan for NZEB and will be integrated into the revised PURES by mid 2018.

2.II.i. Progress and current status of existing buildings

Minimum requirements for existing buildings are part of the Slovenian building codes since 2002. Renovation works for which a building permit is required must be done according to the building codes and following the requirements valid for new buildings.

PURES 2010 also transposed the EPBD as regards major renovations. Thus, the minimum requirements apply to all new buildings as well as major renovations, i.e., if at least 25% of the area of the building envelope is subject to renovation. In case of maintenance works on building envelopes, if a renovation (when a building permit is needed) is less than 25% of the thermal envelope area, or if buildings have a floor area smaller than 50 m^2, only the minimum requirements for the U-values of the envelope must be considered (i.e., only an additional insulation layer will be mandatory). For major renovations of the heating system, and in case of maintenance and replacement works, minimum requirements for the systems, subsystems and elements are at the same level as those required for new buildings.

2.II.ii. Plans to improve the existing building stock

The strategy for the renovation of existing buildings to NZEB levels is defined in the Slovenian national plan for NZEB. Table 3 details the progress of this plan. About one third of the renovations included in the Long-term strategy for mobilising investment in the renovation[8] (2015) was foreseen to reach NZEB levels. Despite this, the progress in NZEB renovation is still quite slow. The NZEB renovation goes beyond deep renovations and is in many areas dependent on more sustainable energy supplies and on the deployment of smart energy networks. Deep renovation is thus the first step towards the goal and in many residential, public and non-residential buildings in Slovenia the process of step-by-step renovation has started (Figure 4, 5).

NZEB national plan intermediate targets- existing buildings (m^2)	**Target 2015** A_u **(m^2)**	**Target 2018** A_u **(m^2)**	**Target 2020** A_u **(m^2)**	**Target* 2014-2018** **No. of NZEBs (-)**	**Target* 2014-2020** **No. of NZEBs (-)**	**Progress** 2014-2017** **No. of NZEBs (-)**
Single-family houses	241,000		2,395,000		14,655	deep renovation projects initiated
Multi-family houses	88,000		596,000		333	minor progress
Public buildings		123,000		94		projects initiated
Other non-residential buildings		190,000		127		no data
Central government buildings	2,000	20,000		11		projects initiated including demonstration

* Estimation

Table 3. Intermediate targets for the NZEB renovation of existing buildings in Slovenia.

The operative measurable goals of the long-term strategy for the renovation of buildings by the year 2020 and 2030 comprise respectively:

- 3% of the annual renovation rate of buildings owned and occupied by the central government (i.e., between 15,000 m^2 and 25,000 m^2 per year, and 180,000 m^2 in total, in the 2014-2023 period);
- deep renovations of 1.8 million m^2 of public buildings within the 2014-2023 period;
- improved ratio (1:3) between invested public resources and initiated investments in energy renovations in the public sector;
- the implementation of five demonstration projects of energy renovations of different building types.

According to the long-term strategy, the renovation rate of residential buildings is planned to be 1.7% in the 2016-2030 period, 1.8% in the period of 2021-2030, 2.3% in the 2031-2040 period and 1.9% in the 2041-2050 period. Figures 4 and 5 present the renovation rate in single- and multi-family houses based on national subsidies allocated by Eco Fund; the buildings with envelope insulation installed present a solid base for future deep and SNES renovations. In multi-family building envelopes, insulation is a predominately implemented measure (apart from windows replacement that are done per individual apartment). The next steps towards deep or NZEB renovations are then frequently hindered due to economic barriers. In non-residential and public buildings in which the energy renovation was initiated, many projects are in the pipeline, and to facilitate the investment process, the update of the long-term strategy was amended with new financial instruments and offered in October 2017 for interministerial consultation.

The proposed update of the long-term strategy identified three critical fields in the energy renovation of existing buildings: quality management, the development of financial instruments and the problem of a moderately developed energy contracting market. The update suggested the following policies:

- developing quality assurance protocols for construction and building energy renovations with a building life-cycle perspective (building elements, systems, processes, and skilled workforce);
- updating PURES building codes with stricter minimum requirements;
- developing compensation rules for the allocation of subsidies for the energy renovations of private buildings (by now only public buildings benefitted from such special rules for heritage);
- developing holistic financial instruments which include technical support that would complement existing subsidies and other financial sources (e.g., European Fund for Strategic Investment- EFSI) and create a holistic support framework, including long-term loans and warranty schemes for risk-sharing, refinancing of investments (factoring, repurchase of green bonds), and capital injections for new Energy Service Companies (ESCOs);
- revising the Eco Fund program of subsidies for households, as a decrease in using the funds was recently noticed; implementing additional information, awareness, energy advisory and fuel poverty actions; upgrading programmes to finance partial renovations in public buildings (for buildings where deep renovations are not justified) and preparing a programme for financing deep renovations of public building projects with low returns;
- monitoring RES measures in building energy renovation projects with an “RES on-site” indicator.

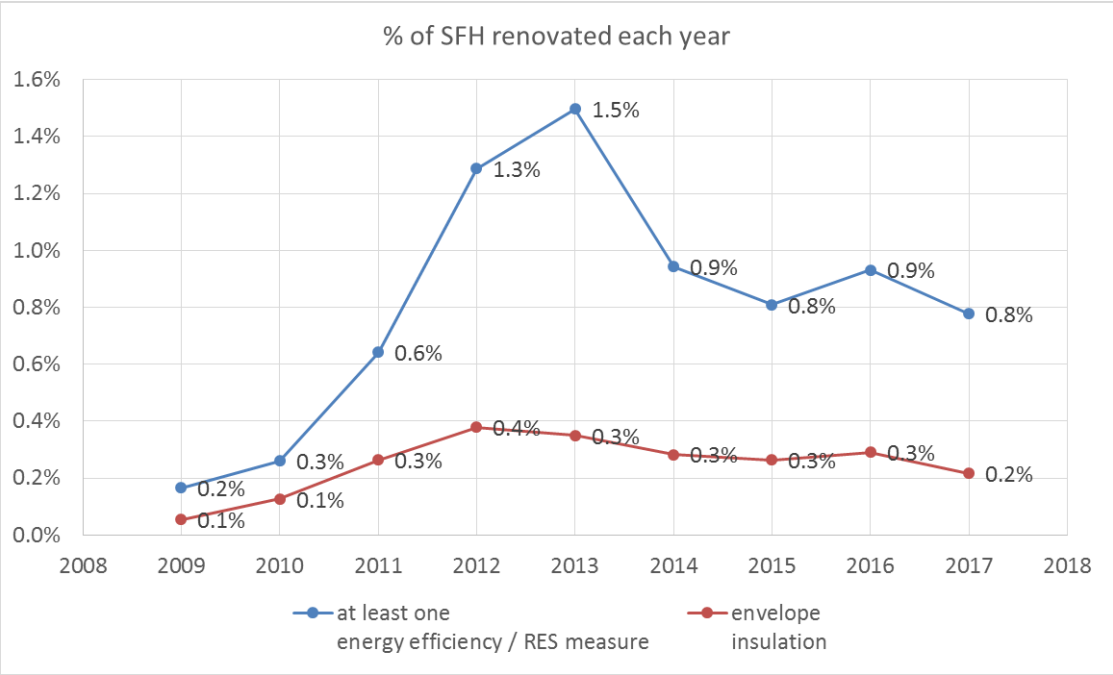


Figure 4. Annual share of single-family building renovations (based on Eco Fund subsidies).

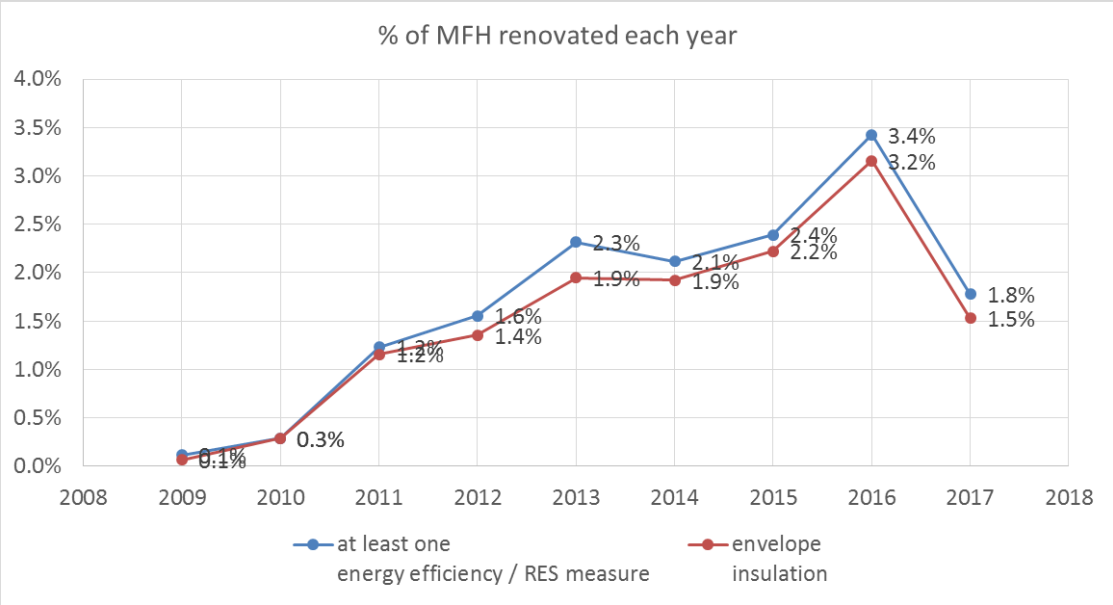


Figure 5. Annual share of multi-family building renovations (based on Eco Fund subsidies).

2.II.iii. Regulation of system performance, distinct from whole building performance

The introduction of system performance minimum requirements is being considered in the revision of the building codes PURES, planned for mid 2018. The amendment is related to the introduction of the new set of CEN EPBD standards.

Currently (in PURES 2010), system energy efficiency is achieved by selecting products that fulfil the energy efficiency requirements, with corresponding design and construction rules for sub-systems. The regulation has imposed system performance requirements via many rules on product and sub-system energy efficiency. The rules address heating, ventilation, cooling, AC and lighting sub-system and the energy efficiency of products.

2.II.iv. Encouragement of intelligent metering

The plan in Slovenia is to replace up to 80% of the existing electricity meters with smart meters by the year 2023. Cohesion funding is available specifically for this process. Companies owning electricity networks are eligible for a 33% co-financing of the investment with a total available budget of 13.9 million € in the 2017-2022 period.

By the end of 2016, over 50% of meters had been replaced with intelligent metering; it is also estimated that between 65% and 70% of households already had intelligent meters installed. The Decree on measures and procedures for the introduction and interoperability of advanced electric power metering systems[9] (2015) supported the introduction of intelligent meters.

2.II.v. Financial instruments and incentives for existing buildings

Financial resources for the renovation of public buildings, mitigating fuel poverty in households and developing demonstration projects are planned in the Operational Programme for the implementation of the European cohesion policy in the 2014-2020 period[10]. A strong focus is placed on mobilising private resources. A budget line in the operational programme is available to support the development of energy performance contracting, partly (115 million €) with grants and partly (50 million €) with financial instruments. In several Slovenian municipalities, ELENA technical assistance was supported by the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD), respectively. A number of municipal public buildings and buildings of the central government are subject to call for promotors or ESCOs. However, the ESCOs market in Slovenia is moderately developed (experiences are limited) and new domestic and foreign private investors are in demand. Low energy prices and much lower profitability of deep renovations compared to certain individual measures are a challenge for new financial instruments in revision of the long-term strategy.

The Eco Fund will further provide grants and soft loans for the renovation of existing residential buildings and to intensify awareness, information and energy advisory activities; new financial products are currently available as soft loans from commercial banks for renovating residential buildings. The energy renovation of existing buildings will rely to a great extent on the funds from the EIB, the funds of the Republic of Slovenia, private funds, and on the EFSI.

The website of the Ministry of Infrastructure[11] contains a list of the financing options currently available for building energy renovations in all sectors.

2.II.vi. Information campaigns / complementary policies

Based on the Energy Act, the state-owned company BORZEN promotes energy efficiency in all sectors via the web portal "*Trajnostna energija*"[12], with events, publications and television broadcasts on energy efficiency and RES.

Eco Fund manages ENSVET[13] energy advisory projects for buildings and households and partly for municipalities. The ENSVET network operates in municipal offices and on major events and fairs; it is free of charge for the end-user. The Eco Fund web portal gives an abundance of information on financing and technical details on the measures.

The participation of Slovenian partners in consortia of EU funded projects raises the general knowledge of important topics for EPBD implementation and often stimulates beneficiaries to become front-runners in building renovations and other projects. The building industry and the private sector contribute to the information by establishing energy technology exhibitions and training centres.

2.III. Energy performance certificate requirements

The provisions for the EPC are given in the Energy Act for new and existing buildings as well as for public buildings. The last change in the Slovenian EPC system was imposed in 2014.

EPCs are completed by licenced independent experts and issued by authorised organisations. The EPC rating can be either calculated or metered. For new buildings and for all residential buildings (i.e., new and existing), only a calculated EPC rating is possible. An EPC may be issued for a building as a whole, for an individual part of the building or for an apartment. For non-residential buildings, either a metered or a calculated EPC rating can be given. A metered EPC rating is the first choice and is also simpler and cheaper, but in case of a lack of data, an independent expert may decide that for technical reasons a calculated EPC rating is needed.

An EPC is obligatory for new buildings where it is part of the documentation of the completed construction works. All existing buildings must have an EPC when sold or rented and by law, the building owner must show the EPC to the buyer/tenant before the contract is concluded. Display of the energy performance indicator is obligatory in advertisements; in all public buildings with more than 250 m^2 of floor area, the EPC must be displayed in a clearly visible place. The amended Energy Act (publication expected by the end of 2017) will define that the display of an EPC is also obligatory in buildings frequently visited by the public (i.e., commercial buildings like hotels, banks, shops, etc.).

The database of issued EPCs is maintained by the Ministry of Infrastructure. All EPCs are stored in an electronic registry and linked to the national real estate database. From the beginning of 2015, all issued EPCs are also publicly accessible via the national real estate registry at the Geodetic Administration of the Republic of Slovenia. In 2017 the beta version of the visualisation of building energy efficiency was being prepared based on linking the EPC database with GIS data.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

On average, approximately 10,000 EPCs are issued per year in Slovenia. In total, the status of all EPCs registered in the state register by the end of 2016 was around 39,000 (39,211 by 20 January 2017; 45,317 by 10 October 2017).

Compared to the previous national report, the recent changes showed a tangible increase of EPCs in the residential sector in contrast to non-residential buildings, mainly due to more EPCs being issued for multi-family buildings.

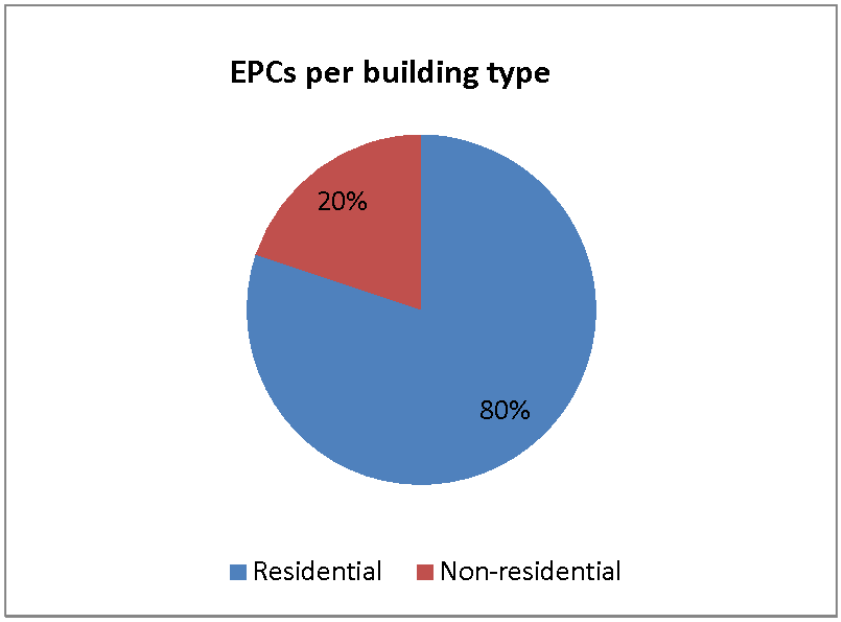


Figure 6. The structure of issued EPCs per building type in the 2013-2016 period.

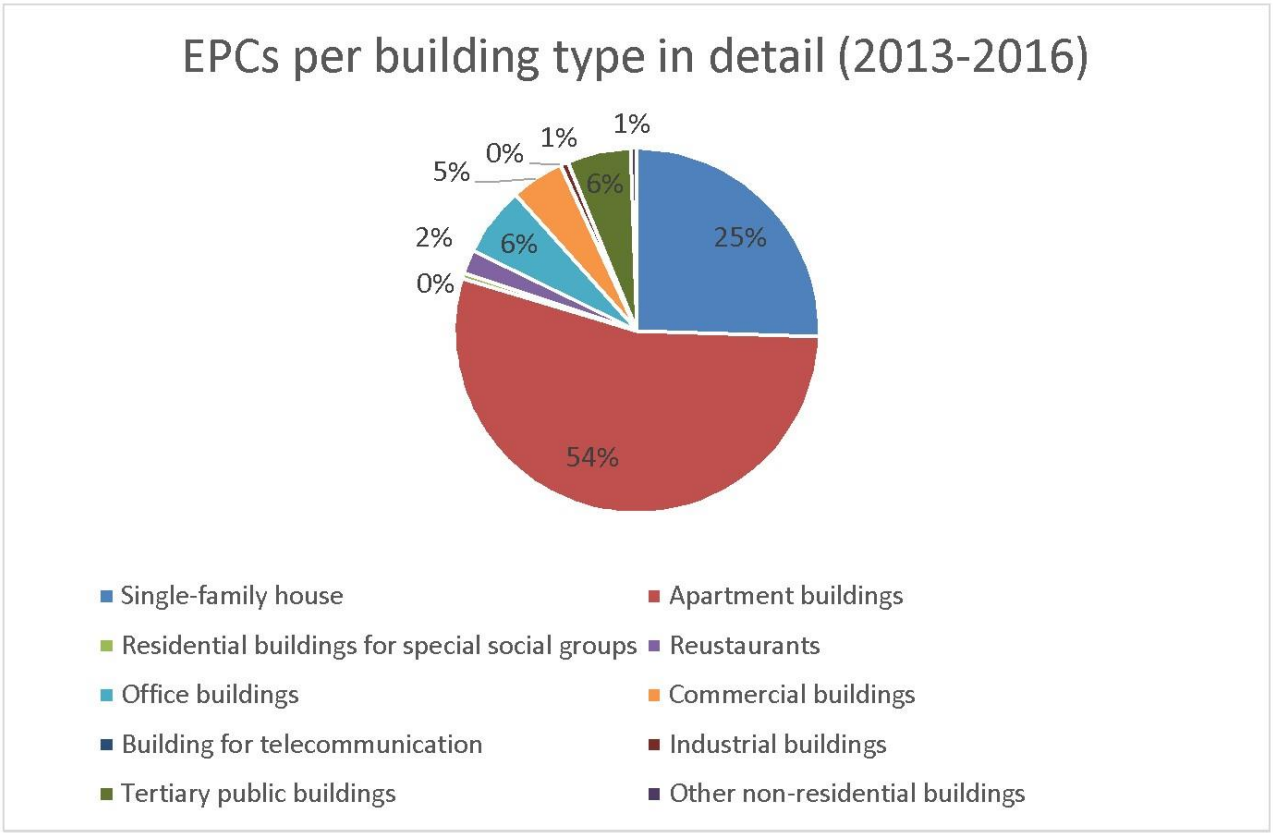


Figure 7. Share of EPCs per building type in detail, for the 2013-2016 period.

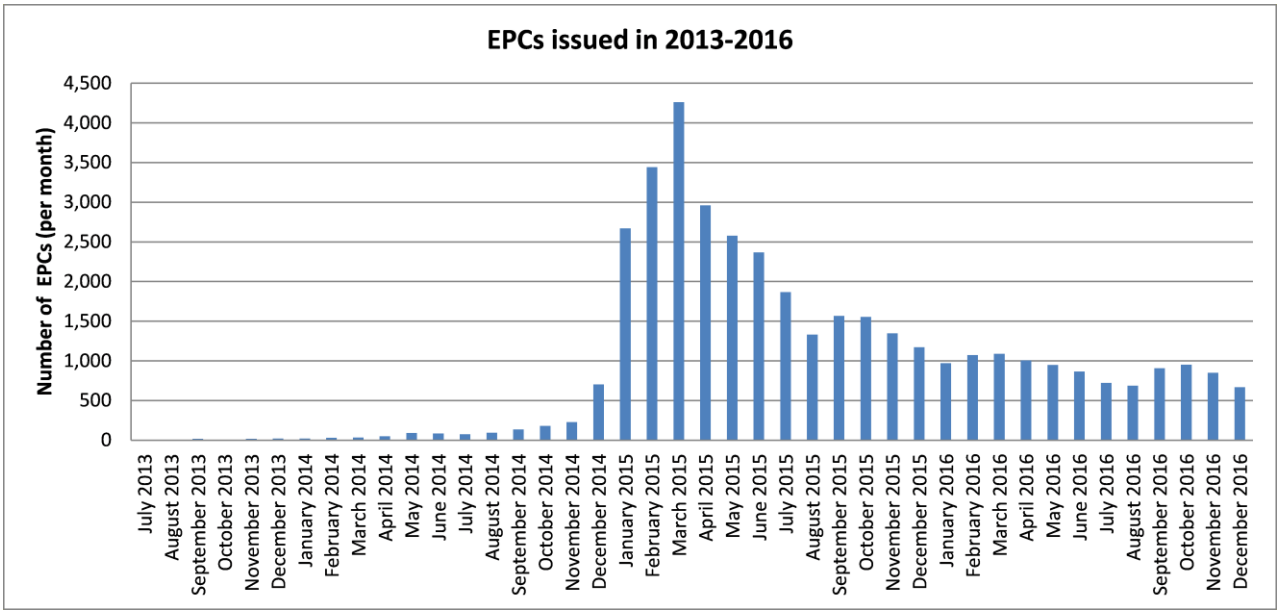


Figure 8. Number of EPCs issued per month by the end of 2016.

2.III.ii. Quality Assurance of EPCs

The control of technical quality is a responsibility of the Ministry of Infrastructure. First-level control is automatically performed by the EPC electronic registry, during the last step of the EPC entry. Validity and plausibility of data in an EPC are examined by validating the data against the EPC and other public real estate registers. If an EPC does not meet the check, it cannot be issued. Second-level control is performed by the Inspectorate of the Republic of Slovenia for the Ministry of the Environment and Spatial Planning. If a quality problem of an EPC is claimed, the inspectorate checks the status and the issued EPC and then declares its decision regarding the quality with a decision and a penalty, if relevant. The penalty depends on the mistake, i.e., if necessary, one must correct the EPC as well as issue and store a new one in the register. Currently, statistical data on issued corrected EPCs are not yet available.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The public building stock represents 11% (around 600,000) of the entire number of buildings. Public and large buildings visited by the public represent 28% of all EPCs issued for non-residential buildings in Slovenia in the 2013-2016 period.

Most public and large buildings visited by the public have an EPC, primarily due to the obligation defined in the Energy Act, and secondly due to energy renovation planning processes. An energy audit is a precondition for financing the investment, and for each building for which an energy audit is performed there is also an issued EPC. The progress is good due to a number of financing possibilities. In addition, the 3% annual energy renovation rate of buildings owned and used by the central government contributed to a significant increase of the number of EPCs within 2 years, as all the buildings on this list obtained an EPC.

2.III.iv. Implementation of mandatory advertising requirement - status

In Slovenia, advertising with the inclusion of the EPC energy performance indicator is obligatory when selling and/or renting the building or the building unit. The control is the responsibility of the market inspectorate. Various intensive additional activities are ongoing in this field.

The Ministry of Infrastructure is testing the application for the electronic comparison of the database of the real estate transaction, the rental database and an EPC database.

The Energy Act EZ-1 defined the penalties for non-compliance with EPC rules. On 24 February 2014, penalties of between 1,000 € and 10,000 € were introduced for public building owners/users if an EPC is not displayed. A fine is also set for the person responsible for the task (from 100 € to 500 €). The penalties (250 €) for building owners advertising the selling/renting of the building without displaying the energy indicators from an EPC were put in place as of 1 January 2015, while as of 24 February 2015 the penalty for selling/renting a building without an EPC is 300 €.

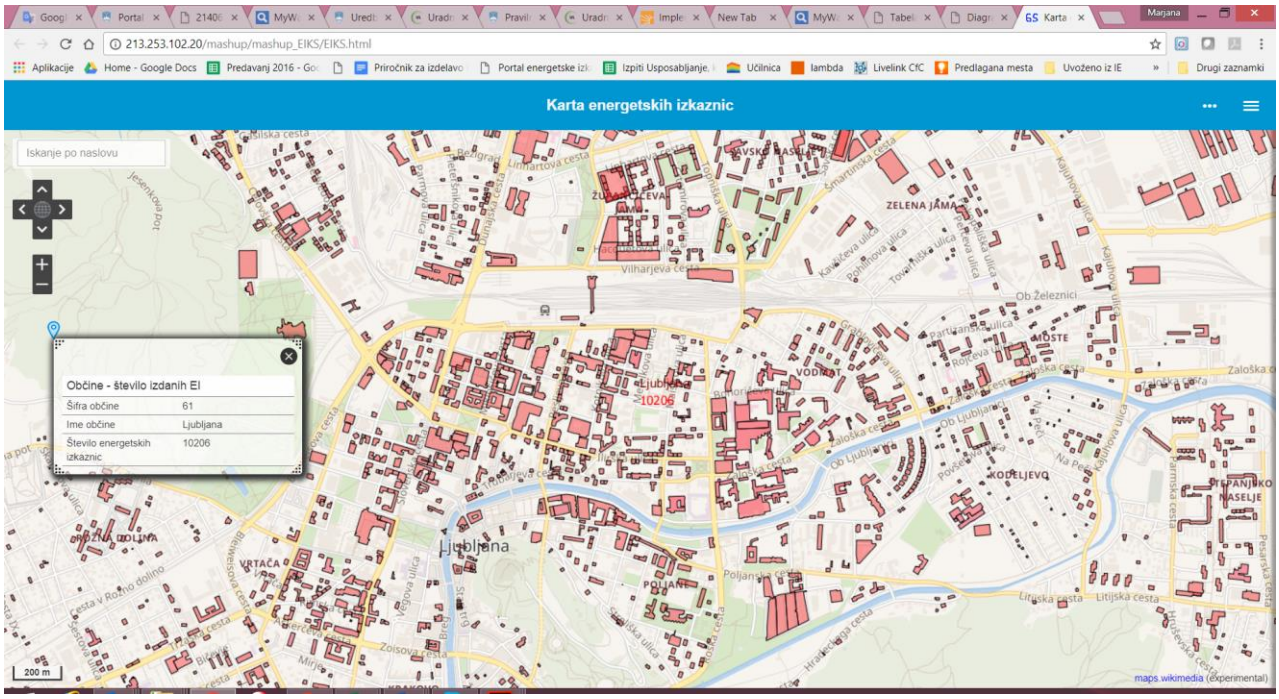


Figure 9. Cross-linking of public databases. The map shows the EPCs issued per municipality and visualises the EPC e-register on a GIS map.

2.IV. Inspection requirements - heating systems, air conditioning

Slovenia has a combined system which includes inspections and alternative measures in the inspection of heating systems. A mandatory inspection of the installations of heat generators with a power above 600 kW is required and undertaken by qualified independent experts (in 2015 the new regulation on this topic has successfully passed public consultation; however, the adoption is still pending due to expected new thresholds in the new EPBD).

For nominal heat output of the generators between 20 kW and 600 kW, the use of alternative measures is in place under the existing scheme of chimney sweep inspections.

Inspections are required for AC systems with more than 12 kW nominal power. The methodology is defined in the regulation for regular inspections of AC systems (adopted in 2008).

2.IV.i. Report on equivalence of model A and B for Heating Systems

The described system is fully in operation. There is a system of licenced independent experts for the inspection of AC systems in place; the regulation of training and accreditation of experts was revised in 2016.

2.IV.ii. Progress and current status on heating systems

A number of activities from alternative measures are entirely implemented. This part is connected primarily to smaller heating devices inspected by chimney sweepers.

2.IV.iii. Progress and current status on AC systems

The inspections of AC systems are fully in use. Inspections are performed by licenced independent experts, who undergo training and exams and have been issued a licence which is valid for a period of 5 years. All AC inspection reports are registered by the Ministry of Infrastructure. An e-register for reports on the inspection of AC systems is in preparation.

The inspection of AC systems is promoted through different channels; in the future, information activities will be intensified.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Penalties are set by Article 493 of the Energy Act. A penalty of 300 € is foreseen when the owner of a building or building unit fails to ensure regular inspection of the AC systems of buildings or parts of buildings in which AC systems of a nominal output capacity exceeding 12kW are installed.

Quality control of inspection reports

The quality control is done in line with Article 347 and Article 461 of the Energy Act.

The first formal quality controls of AC inspection reports were done in 2016.

Impact assessment. Costs and benefits

Impact assessment is not yet available at this stage.

3. A success story in EPBD implementation

Based on the Long-term strategy for energy renovations of existing buildings (2015), Slovenia developed holistic policies for specific building types. This success story is about a set of policies for multi-family buildings. There are around 25,000 old multi-family buildings in Slovenia, built mostly between 1960 and 1980 and privatised in the 1990s. The Residential Act imposed building management as an obligatory service in each multi-family building. A new profile of companies for building (facility) management was developed which manages the proper operation, maintenance, repair and renovation of existing multi-family buildings on behalf of the building owners. The owners are obliged to contribute at least a minimum amount (0.2 to 0.3 EUR/m^2) or more to a "reserve fund" of the buildings, and the budget can only be used for regular maintenance, urgent repair and for renovations, including investments in energy renovations, and to repay the loan for the works. A precondition is an accepted maintenance plan, where a 50% consensus is required to accept such a plan and to use the reserve fund, respectively. On the other hand, for energy renovations, a 50% consensus (elapsed economic lifetime of the element) to a 75% consensus (investment before the end of economic life) is needed.

The most important barriers hindering deep energy renovations of multi-family buildings are: the lack of consensus (50%, 75%) for renovation investment (100% if a building permit is needed); the lack of money and/or fuel poverty; the 100% consensus needed to take a loan; the credit worthiness of all building owners – necessary for the approval of the loan; previously completed single measures that prolong the payback of later planned energy efficiency measures; insufficient information on technical solutions and financing options; insufficient design and planning of the works before commencement; the unreliable control of works; a low level of trust in contractors, who are unfortunately not always adequately skilled; and a lack of monitoring and optimisation after the completion of works.

To break through these barriers and allow for deep energy renovations of multi-family buildings to take place, the following package of policies was put into action in 2016:

information activities for flat owners (web portals, radio and television broadcasts, information events at fairs and in shops);

- free advice for households at ENSVET energy advisory offices;
- guidelines for renovating heritage buildings;
- training of over 200 building managers (in 2 full-day training sessions) for facilitating deep renovations of multi-family buildings;
- progressive subsidies made available by Eco fund for common investments:
  A. thermal insulation of the envelope;
  B. thermal insulation of roof;
  C. optimisation of the heating system;
  D. deep renovation of a multi-family building.

A 20% subsidy is allocated in case of a single measure, 30% for 2 measures -- one of them being optimising the heating system, and 40% for deep renovations, i.e., thermal insulation of outer wall, roof or ceiling and optimising a heating system. The precondition (and eligibility for a 50% subsidy) is providing detailed design documentation for the envelope insulation as well as the regular quality control of the renovation works by a designer and a chartered engineer. The following is also considered/provided:

- a limited time frame of 24 months to complete the investment, as the aim is to achieve deep renovations rather than step by step;

- exceptional financial support made available to low-income homeowners (upon approval of the office for social work), i.e., a 100% subsidy for their share of the common energy efficiency investment in a multi-family house;
- loans for common renovation works in multi-family buildings made available at Eco Fund and at commercial banks via SID bank14, from EIB funds or from own bank fund;
- new financial instruments offered by commercial banks – "factoring", in which the bank buys the claim from the contractor that completed the renovation and accepts monthly payments into the reserve fund for the repayment of debt.

4. Conclusions, future plans

The implementation of the EPBD has been a complex process for Slovenia. Certain parts of the requirements, e.g., energy performance certification and EPBD-based building codes, were successfully implemented and are already well accepted by professionals and the general public; regarding other elements, there is still progress to be made.

Further plans concern optimising certain parts in the regulation, including:

- upgrading the energy performance calculation methodology in accordance with the new CEN EPBD standards;
- developing a new national calculation tool that adheres to new CEN EPBD standards;
- introducing energy indicators for NZEB;
- transposing NZEB minimum requirements into the building code;
- enabling consideration of NZEB in interaction with the NZEB district energy supply;
- elaborating on EPCs for complex non-residential buildings as well as for the inspection of heating and AC systems;
- finding a balance between more effective implementation procedures and a reasonable application of penalties in cases of non-compliance;
- creating a high level of acceptance of EPBD obligations.

Endnotes

1. Energy Act (Uradni list RS, št. 17/14 in 81/15); www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO6665
2. Rules on the training, accreditation and register of accredited independent experts for regular inspection of AC systems (Uradni list RS, št. 18/16); www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV12525
3. The Slovenian Environment Public Fund, a subsidy system that requires blower door tests www.ekosklad.si/information-in-english
4. Rules on the efficient use of energy in buildings with technical guidelines (Uradni list RS, št. 52/10); www.pisrs.si/Pis.web/pregledPredpisa?id=PRAV10043
5. The decree on green public procurement (Uradni list RS, št. 102/11, 18/12, 24/12, 64/12, 2/13, 89/14 in 91/15 – ZJN-3); www.pisrs.si/Pis.web/pregledPredpisa?id=URED5194
6. www.arhiv.mop.gov.si/fileadmin/mop.gov.si/pageuploads/zakonodaja/prostor/graditev/TSG-01-004_2010.pdf
7. www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/akcijski-nacrt-za-skoraj-nic-energijske-stavbe/
8. www.energetika-portal.si/dokumenti/strateski-razvojni-dokumenti/dolgorocna-strategija-za-spodbujanje-nalozb-energetske-prenove-stavb/
9. The decree on measures and procedures for the introduction and interoperability of advanced electric power metering systems (Uradni list RS, št. 79/15); www.pisrs.si/Pis.web/pregledPredpisa?id=URED6907
10. Operational Programme for the implementation of the European cohesion policy for the 2014-2020 period; www.eu-skladi.si/sl/dokumenti/kljucni-dokumenti/op_ang_final_web.pdf
11. www.energetika-portal.si/javne-objave/
12. www.borzen.si/sl/Domov/menu1/Trajnostna-energija/Portal-Trajnostna-energija
13. www.ekosklad.si/fizicne-osebe/en-svet
14. www.sid.si

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Spain

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.mincotur.gob.es/energia/desarrollo/EficienciaEnergetica/CertificacionEnergetica/Paginas/certificacion.aspx

1. Introduction

The transposition of the Directive of Energy Performance of Buildings began in Spain through legislative documents, published between 2006 and 2007, which pertain to the construction of new buildings, the design, execution and maintenance of thermal installations, and energy performance certification.

This first normative version has been revised and adapted over several years up to 2013, and updates of each of these documents have been republished again, in particular:

- RD 235/2013 on the Energy Certification of Buildings;
- RD 238/2013 on Thermal Installations of Buildings;
- The Technical Building Code, Order 1635/2013 of the Ministry of Development.

Since 2014, the main modifications are related to the basic methodology of calculating the energy performance of buildings. Royal Decree 235/2013 established both obligations and the appropriate mechanisms for the proper monitoring of the certification system in Spain, experts authorised to issue energy performance certificates (EPCs), the EPC registration system, control and inspection of certificates, as well as the obligations that involve the use of EPCs.

This document included references to the established methodology in Spain, published as Recognised Documents in the Official Website of Certification. The methodology was adapted to European Standards in 2014, thereby also addressing the problems which were detected through past experience.

Finally, in 2016, part of these documents was further adapted to improve processes, make the methodology more transparent, and eliminate barriers to new technological systems. One of the main changes that occurred was the inclusion of a second indicator for energy performance, complementing the CO_2 emissions indicator with one for non-renewable primary energy consumption.

2. Current Status of Implementation of the EPBD

The Spanish administration considers the transposition of the EPBD completed through the definition of appropriate mechanisms to achieve the set targets.

All aspects necessary for the correct transposition have been analysed and implemented through different actions, among which are normative, formative, and informative measures as well as public support plans and policies.

However, work continues to improve each of these processes in order to resolve the barriers and challenges that have arisen in recent years.

2.I. Energy performance requirements: NEW BUILDINGS

Energy performance requirements for new buildings in Spain are regulated through the Technical Building Code (CTE, Figure 1). This document is the guide and normative reference document for the construction and renovation of buildings in Spain.



Figure 1. Efficiency section in Technical Building Code document.

The document regulates both public and private buildings without distinction, including differentiated requirements for residential and non-residential buildings, and adapting the requirements in a differentiated way, based on knowledge of the national building stock.

In particular, since 2007, this CTE document includes five (5) specific sections related to energy performance requirements and renewable energy that must be considered during the construction of new buildings, as described in the 2002 directive.

The update was carried out in 2013, since it is mandatory to perform an update every 5 years, tightening these energy performance requirements.

2.I.i. Progress and current status of new buildings

With the publication of the CTE update in Spain in 2013, through the Order of the Ministry of Development 1635, three main changes were made to the previous Technical Code:

- Stricter energy performance requirements were established, increasing the requirements for both public and private buildings.
- The indicator system was modified and adapted to incorporate a new indicator for non-renewable primary energy consumption, which was recommended by European standards for energy performance published in 2008 and 2009.
- The requirements for the contribution of renewable energy sources to buildings were increased. The document increased the requirements for the contribution of renewable energy from solar thermal, and attempted to eliminate the technological barriers that had been detected up to now, which could hinder the implementation of the different renewable generation systems in new construction projects.

2.I.ii. Format of national transposition and implementation of existing regulations

Minimum requirements for the energy performance of buildings are established in Spain in the following document (CTE):

www.codigotecnico.org/index.php/menu-que-cte.html

This document contains the mandatory requirements to be followed, but it needs complementary guidelines which would allow for a better application of the regulatory requirements and a better understanding of the requirements by professionals.

These documents and guidelines can be found on the official website of the CTE in Spain, and in particular:

www.codigotecnico.org/index.php/menu-ahorro-energia.html

General methodology

The basic methodology adopted by the Spanish administration is common for both the energy performance certification of buildings and the establishment of minimum requirements for the construction of new and the renovation of existing buildings. In particular, it follows the specifications set out in the EPBD.

Following five years of operation, the methodology established in the regulatory reviews of 2013 tries to include some of the basic aspects set out in the European Standards for calculating energy performance, published in 2008.

Among others, the calculation methodology was corrected and partially adapted to consider European standards, as well as the use of indicators for different building typologies.

In general, Spain's calculation methodology is included in five (5) official computer software programmes, which are mandatory for energy certification, and are a very useful tool for compliance with the CTE.

The steps to be followed by this calculation methodology, and therefore by the computer software, are: firstly, to calculate the energy demand, both thermal and for domestic hot water and lighting; then, to calculate the energy consumption of the systems necessary to cover the demand. These calculations are made by integrating the building's needs on an hourly basis, and by a transitory time-scale regime.

With the above, the final energy consumption is calculated and extrapolated to non-renewable primary energy consumption and CO_2 emissions; these two indicators are finally evaluated and established by regulations.

Since the energy simulation software in Spain calculates the final energy consumption, it is necessary to have adequate conversion factors to obtain the non-renewable primary energy consumption and CO_2 emissions.

The primary energy factors and the methodology for obtaining them are published in the official document:

www.mincotur.gob.es/energia/desarrollo/EficienciaEnergetica/RITE/Reconocidos/Reconocidos/Otros%20documentos/Factores_emision_CO2.pdf

The electricity conversion factor is based on real data on fossil fuel energy consumption and energy generated from alternative sources. For the power plants of electricity production in Spain, it includes the energy losses during transportation and distribution. The statistical data of consumption used to generate this document includes the last seven (7) seasons. This document is also updated every five (5) years.

Cost Optimal

The limits established in the 2013 CTE for the consumption of non-renewable primary energy and for energy demand, were based on the Spanish cost-optimal calculations as foreseen in the EPBD. This document included cost-optimal calculations for all the building types included in the current regulations, for both residential and non-residential buildings, and for all climatic zones of Spain.

All new buildings in Spain, as well as buildings being rehabilitated, meet the CTE's established requirements, as this is mandatory for obtaining a building permit. It is thus not possible to build a building without complying with those regulations.

2.I.iii. Action plan for progression to NZEB for new buildings

The roadmap established in Spain for the construction and promotion of NZEB implies the compliance with the current CTE. These requirements have been demonstrated through the corresponding analysis of cost-optimal calculations, which indicates the most suitable and more restrictive possibilities according to what is considered state-of-the-art as well as the cost of implementing different construction solutions.

The roadmap establishes and provides for a revision of the limit values contained in the CTE in 2018, prior to the first phase of the NZEB entering into force according to the EPBD. Regarding the scope of planning

and promoting the construction of NZEB, the Spanish administration has published two additional documents including regulatory developments: the Housing Plan of the Ministry of Development, and the Renovation Strategy of the Spanish Building Stock, following the requirement established in the Energy Efficiency Directive.

Both documents are published in the following links:

www.fomento.gob.es/portal-del-suelo-y-politicas-urbanas/sistema-de-informacion-urbana/enlaces-relacionados/plan-estatal-de-vivienda-y-rehabilitacion/presentacion

www.fomento.gob.es/el-ministerio/planes-estrategicos/estrategia-a-largo-plazo-para-la-rehabilitacion-energetica-en-el-sector-de-la-edificacion-en-espana

The Housing Plan analyses the Spanish building stock and establishes guidelines to promote the evolution towards a more efficient sector. It contributes to reactivating the real estate sector, which is fundamental for the promotion of the rehabilitation of buildings, and to regenerating urban or rural areas.

In parallel, the Renovation Strategy analyses the existing building stock, as well as the needs of the stock in the field of renovation, including renovation scenarios in order to meet the established requirements for both national and international commitments.

2.I.iv. Requirements for systems and / or building components for new buildings

The energy performance requirements for heating, cooling and domestic hot water generation systems are regulated in Spain through the Regulation of Thermal Installations of Buildings (RITE), and those for lighting in non-residential buildings through the CTE.

www.boe.es/boe/dias/2007/08/29/pdfs/A35931-35984.pdf

The RITE is a technical document of a regulatory nature; therefore, it is mandatory to obtain installation permits for the use of thermal energy systems. It regulates, among others, the following aspects:

- requirements for the correct dimensioning and assembly of thermal systems;
- minimum performance of heat generating systems, cooling and domestic hot water;
- the mechanism and periodicity of safety and energy performance inspections.

This document was updated and published in 2013 through Royal Decree 238/2013, and a new update is planned in five (5) years' time.

2.II. Energy performance requirements: EXISTING BUILDINGS

Energy performance requirements for the renovation of existing buildings are also regulated in the CTE. According to the CTE, deep renovations in Spain must comply with the energy performance requirements established for the construction of new buildings. For partial renovations, the requirements vary according to the parts of the building that are being renovated.

2.II.i. Progress and current status of existing buildings

The 2013 revision of the CTE was in line with the requirements established in the previous document of 2007, though effectively tightening them up, mainly because the requirements for deep renovations were set to be the same as for new buildings. This section will analyse the requirements for the partial renovation of buildings.

In general, it can be considered that the maximum and minimum limit values of the 2013 CTE for partial renovations of buildings are similar to the limit values that newly constructed buildings had in the CTE of 2007. These values have been obtained based on the cost-optimal calculations made by the Spanish administration.

This change implies a tightening of requirements, which is also reflected into the actual construction trends identified in recent years. The building sector has been able to incorporate new components into buildings, taking advantage of the progress that had to be made for the construction of new buildings, and applying it now to the renovation of existing buildings.

2.II.ii. Plans to improve the existing building stock

Since there is a large stock of buildings with low energy performance, the main objective in Spain, in terms of the energy performance of buildings in recent years, has been to establish a renovation standard with high performance criteria.

This effort is translated into action plans, based on public support, and a Renovation Strategy, which have led to the energy renovation of buildings to meet the CTE requirements. This criterium also defines the current NZEB levels in Spain, which means efforts are centred around the transposition of the building stock towards NZEB levels.

Current Renovation Support Plans which relate to building renovations are the following:

- the National Government Building and Renovation Support Plan of the Ministry of Public Works;
- the IDAE PAREER support line.

National Government Building and Renovation Support Plan

The National Government Building and Renovation support plan is developed through collaboration agreements with the Autonomous Communities, which include, among others, actions for the renovation of buildings and neighbourhoods. In particular, they aim to reduce the energy demand of buildings, with a focus on the building envelope, wall insulation, roofs and floors, and window replacement.

www.fomento.gob.es/arquitectura-vivienda-y-suelo/programas-de-ayudas-a-la-vivienda/programa-de-fomento-de-eficiencia-energetica-y-sostenibilidad-en-viviendas

The targets are single-family housing and buildings. A 20% - 35% reduction in the global annual energy demand for heating and cooling is required and public support ranges between 40% and 75% of the final investment.

Regarding PAREER grants

PAREER grants exist exclusively to improve the energy performance of buildings and the incorporation of renewable energy. The programme includes aid for the improvement of the thermal envelope of the building, the replacement of cooling, heating and domestic hot water generation systems with high efficiency ones, as well as the installation of renewable energy systems using geothermal or biomass fuel.

The plans to improve and increase the national renovation of existing buildings according to the EED (Energy Efficiency Directive), are developed in the Renovation Strategy, prepared and submitted by the Ministry of Public Works and Development, which envisages the lines of public support previously described. This document includes different alternatives and possible scenarios for the evolution of the building stock based on the actions carried out.

2.II.iii. Regulation of system performance, distinct from whole building performance

The analysis of the performance of thermal generation systems in Spain is carried out through the Regulation of Thermal Installations of buildings. One of the main aspects that has been improved in recent years, and that is helping to renovate the thermal generation systems, is the PAREER[1] support line.

This programme has a specific section that encourages the replacement of thermal generation systems with more efficient ones, with aid of up to 30% for large-scale replacements. This aid has proved to be effective due to the high volume of applications received in recent years.

The evaluation mechanism to check the effectiveness of this aid programme is based on the energy rating; to qualify for aid, it is necessary to improve the energy performance rating of the building by at least one energy class. Therefore, it has a dual benefit: it encourages energy performance certification beyond sale and rental purposes, while at the same time encouraging the revitalisation of the sector, with the replacement of high-performance systems in thermal generation.

2.II.iv. Encouragement of intelligent metering

The aid programmes support energy improvement measures only if the energy performance rating of the building shows an improvement of at least one energy class. The actual improvement of the energy performance must be shown, analysed and tested by the official certification programme. Therefore, in order to achieve the necessary improvement to qualify for aid support and opt for the grants, one of the aspects to consider is the inclusion of intelligent metering systems. Intelligent metering is thus indirectly encouraged through the above-mentioned aid programmes.

2.II.v. Financial instruments and incentives for existing buildings

In order to encourage and promote the implementation of renovation actions that favour energy savings, the improvement of energy performance, the use of renewable energy and the reduction of carbon dioxide emissions in existing buildings, the Spanish administration, through the Institute for Energy Diversification and Savings (IDAE), launched a specific programme of support and financing endowed with economic funds. This programme also served to achieve the objectives established in Directive 2012/27/EU on energy

efficiency, and created opportunities for growth and employment in different economic sectors, especially in the construction sector, to favour urban regeneration.

2.II.vi. Information campaigns / complementary policies

To achieve the planned energy savings and energy performance of buildings in Spain, annual communication campaigns have been highlighting the most critical aspects and their related potential.

Following this line, the Institute for Diversification and Energy Savings (IDAE) holds yearly communication campaigns which are published and broadcast via television media, press and radio (Figure 2).

The link to one of the communication campaign programmes is indicated here:
www.idae.es/ahorra-energia/campanas-y-acciones-de-acompanamiento



Figure 2. IDAE advertising campaigns.

2.III. Energy performance certificate requirements

The status regarding building energy performance certification in Spain is currently being analysed. Once the relevant legal documents are published, and the corresponding systems for registration, control and inspection of EPCs throughout the Autonomous Communities are fully in place, first results on building energy performance certificates will become available.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The Spanish regulation establishes obligations to certify residential and commercial buildings in an indistinct manner, provided that a purchase or rental transaction of the building is made. In the case of public buildings, the obligation since 2015 includes all those with a size above 250 m^2.

The information of the energy performance certificates (EPCs) is collected and registered in each of the seventeen (17) Autonomous Communities and in the two (2) Autonomous Cities of Spain; thus, nineteen (19) official EPC registries have been established.

The regional registries originally obtained information directly from the EPC issued in paper format and collected information on building owners, certifiers, and the physical location and identification of the building, as well as information on the overall qualification obtained. The information collected nowadays from the EPCs has changed substantially since 2016, when the certification software was updated to generate a digital file with building information that included partial indicators on consumption, emissions, and construction characteristics of the buildings, as well as the power generation systems and improvement measures.

All this information is included in the EPC databases, but there is not yet an integrated database that aggregates the information from the nineteen registers into one single database. Therefore, each regional registry compiles its specific report on the state of the certificates, and the reports are published every six (6) months on the official certification website.

www.mincotur.gob.es/energia/desarrollo/EficienciaEnergetica/CertificacionEnergetica/Documentos/Paginas/documentosInformativos.aspx

There are currently three million issued EPCs, covering both new and existing buildings (Figure 3).

	A	B	C	D	E	F	G	
Spain	12,112	34,271	130,582	394,906	1,522,385	358,195	575,568	3,028,019
	0.4%	1.1%	4.3%	13.0%	50.3%	11.8%	19.0%	

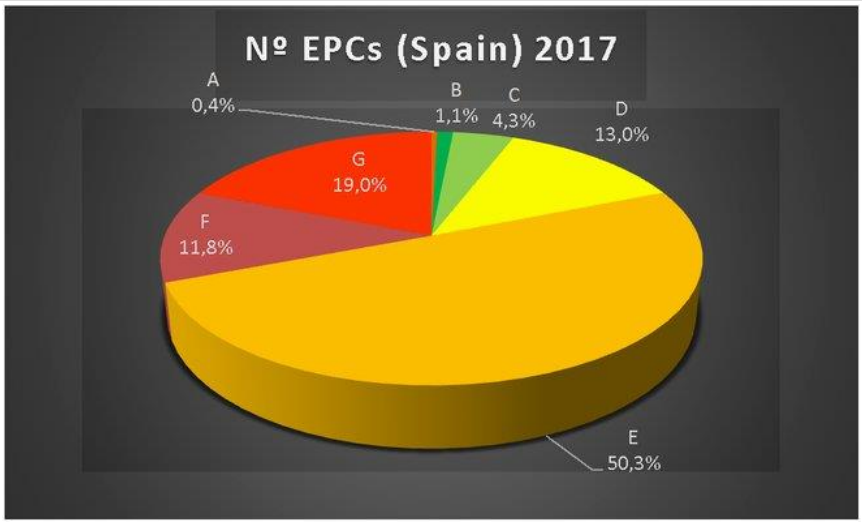


Figure 3. Number of registered certificates (Dec 2017) (source: CCAA registration).

2.III.ii. Quality Assurance of EPCs

In addition to incorporating EPC information into their databases and issuing the registered energy performance label, the aforementioned Autonomous Communities registries are also responsible for control and inspection works.

Control and inspection of EPCs has been established in a differentiated manner in each region, while maintaining basic requirements, such as establishing a statistical control based on the obtained qualifications, as well as establishing mechanisms to prioritise some controls and carrying out inspections in several stages with several degrees of depth.

The current situation is that 100% of the certificates are automatically controlled, thanks to computer mechanisms that evaluate all the certificate data, and generate automatic notices about certificates that do not correspond with reasonable average parameters.

Additionally, a document control is carried out on nearly 50% of the certificates using complementary information.

There are also specific inspection mechanisms that reach 0.5% of the certificates in terms of information review and improvement measures, and a deep inspection system, with a visit to the building, which occurs 0.05% of the time.

The number of inspections and controls as of 2017 are given in Table 1.

Document Control	Visits to the property	Verification of Competent Technicians	Inspection and Control of Advertising	Completed Inspections	Sanctions
1,392,880	**15,140**	**27,029**	**9,084**	**1,211**	**545**

Table 1. Number of inspections and controls as of 2017 in Spain.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The obligation to obtain an EPC for public buildings when its total useful area exceeds 500 m^2 dates from June 2013. As of 9 July 2015, the obligation for public buildings stands when the total useful area is greater than 250 m^2, and from 31 December 2015 when the total useful area exceeds 250 m^2 and is under lease.

The obligation also stands for privately-owned buildings that are frequented visited by the public, when they are sold or rented.

The registration, control and inspection system for this type of building is the same as for the rest of the buildings, and there are no specific additional measures for compliance.

2.III.iv. Implementation of mandatory advertising requirement – status

The obligation to show the energy performance label follows the same calendar and the same pattern as that for obtaining it, according to article 13 of RD 2015/2013.

In Spain, it is mandatory that sale or rent advertisements of buildings include the energy performance label. This requirement is contained in Law 8/2013 on sanctions in the field of energy performance, as one of the cases that may imply economic sanctions. No additional actions have been undertaken in order to explicitly assess compliance with this requirement.

2.IV. Inspection requirements – heating systems, air conditioning

Following the requirements established in the EPBD, Spain has developed an inspection system for thermal installations which is published in the Regulation on Thermal Installations of Buildings.

2.IV.i. Report on equivalence of model A and B for Heating Systems

The inspection system in Spain has been implemented since 1998 through Royal Decree 1751, although the 1980 regulation already referred to the inspection of energy consumption in AC installations, prior to the publication of the first Directive of Energy Efficiency in Buildings (EPBD). Since Spain had already established a system of specialised technicians and inspectors, the most appropriate option for Articles 14 and 15 of the said Directive was to maintain and improve the existing inspection systems.

After the publication of the Directive, the national regulations have been adapted and the inspection of AC systems currently pertains to the following aspects:

- initial inspections;
- periodic energy performance inspections;
- complete periodic inspections.

The mechanism is customised within the Autonomous Communities (Figure 4).

The company or entity that carries out the inspection must issue a certificate of inspection that becomes part of the documentation of the installation; this certificate must follow a specific model established by the different Autonomous Communities.

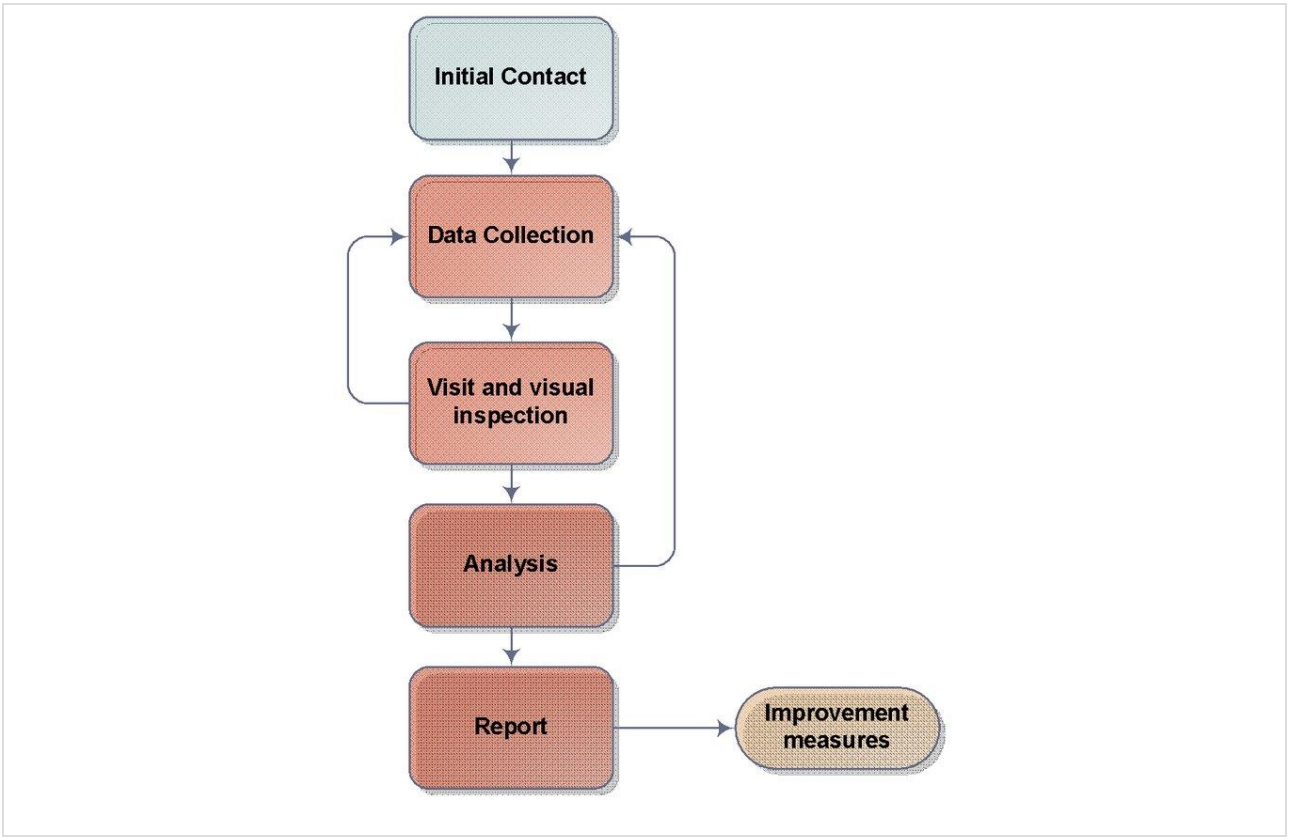


Figure 4. Established scheme for inspection.

2.IV.ii. Progress and current status on heating systems

Due to the territorialisation and competences regarding inspections in the Autonomous Communities in Spain, the current situation of heating inspection systems in buildings is different for each of the seventeen Communities and two Autonomous Cities.

The main actions carried out to improve the energy performance of the systems are based on training courses, as well as on specific aids for the replacement of low performing systems with others of high efficiency, namely the previously described PAREER[2].

2.IV.iii. Progress and current status on AC systems

The Regulation of Thermal Installations holds the owners of the installations responsible for the mandatory inspection of their thermal installation (Article 25).

At present, AC systems with a rated power equal to or greater than 12 kW must be inspected. The objective of these inspections is to verify the level of energy performance of fixed thermal installations aimed at the health and well-being of citizens.

The agents and inspection entities in Spain, which also cover heating systems, are the Autonomous Communities, which establish the procedures for the accreditation of entities and agents for their realisation. This accreditation obtained in an Autonomous Community allows in any case the performance of technical inspections in any part of the national territory (Article 29).

Accredited agents usually are:

- authorised control organisations;
- competent technicians accredited by an accredited entity for the certification of persons;
- maintenance companies.

In the case of Madrid, the link is as follows:
www.madrid.org/cs/Satellite?c=CM_Tramite_FA&cid=1354361028204&definicion=ComunicacionesDeclaraciones&language=es&pagename=ComunidadMadrid%2FEstructura&pid=1109265444835&segmento=1&tipoServicio=CM_Tramite_FA#.V-DfaYhF9Uk.facebook

Following the established procedure, the owner of the system selects the agent or inspection entity of his choice from a public list of qualified or accredited experts, companies or entities, which is updated by the Autonomous Community.

The Autonomous Communities themselves have control systems over the inspections, as well as the agents, companies or entities that carry them out.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

There is no specific registry that holds the aggregate information of the nineteen (19) national inspection bodies.

Quality control of inspection reports

A number of explanatory and consultation guides have been developed to support specialised technicians in providing higher quality AC systems. The guides are published on the official website of the Regulation of Thermal Installations of buildings:
www.mincotur.gob.es/energia/desarrollo/EficienciaEnergetica/RITE/Reconocidos/Paginas/IndexDocumentosReconocidos.aspx

The guides are summarised in Table 2.

Guides	Links
Maintenance of thermal installations	*Mantenimiento de instalaciones térmicas*
Procedures for determining the energy efficiency of water chillers and autonomous air treatment equipment	*Procedimientos para la determinación del rendimiento energético de plantas enfriadoras de agua y equipos autónomos de tratamiento de aire*
Design and calculation of the thermal insulation of pipes, appliances and equipment	*Diseño y cálculo del aislamiento térmico de conducciones, aparatos y equipos*
Cooling towers	*Torres de refrigeración*
Periodic energy efficiency inspection procedure for boilers	*Procedimiento de inspección periódica de eficiencia energética para calderas*
Consumption accounting	*Contabilización de consumos*
Central sanitary hot water	*Agua caliente sanitaria central*
Thermal biomass installations in buildings	*Instalaciones de biomasa térmica en los edificios*
Practical guide on centralised heating and domestic hot water installations in residential buildings	*Guía práctica sobre instalaciones centralizadas de calefacción y agua caliente sanitaria (ACS) en edificios de viviendas*
Design of efficient heating plants	*Diseño de centrales de calor eficientes*
External climatic conditions of the project	*Condiciones climáticas exteriores de proyecto*
ASIT guide for solar thermal energy	*Guía ASIT de la energía solar térmica*
Savings and recovery of energy in AC installations	*Ahorro y recuperación de energía en instalaciones de climatización*
Design of closed-circuit geothermal exchange systems	*Diseño de sistemas de intercambio geotérmico de circuito cerrado*
AC installations with autonomous equipment	*Instalaciones de climatización con equipos autónomos*
Water conditioning installations	*Instalaciones de climatización por agua*
Selection of fluid transport equipment. Pumps and fans	*Selección de equipos de transporte de fluidos. Bombas y ventiladores*

Table 2. Published guides on control, design and inspection.

Impact assessment / Costs and benefits

There is no economic analysis and impact on that matter.

3. A success story in EPBD implementation

One of the best-case success stories considered in Spain, due to its impact on compliance with the EPBD, is the PAREER-CRECE[3] support programme (Figure 5).



Figure 5. PAREER-CRECE support programme.

This programme has been created to encourage and promote the implementation of reform actions that favour energy savings, the improvement of energy efficiency, the use of renewable energy and the reduction of carbon dioxide emissions in existing buildings.

It has been designed to create opportunities for growth and employment in different economic sectors, especially in the construction sector, to favour urban regeneration.

The management of this programme lies with the Institute for the Diversification and Savings of Energy (IDAE), which has managed the programme with funds worth 200 million €.

The programme is designed to encourage the renovation of buildings, including the following actions:

- improvement of the energy performance of the thermal envelope;
- improvement of the energy performance of thermal and lighting installations;
- replacement of conventional energy in thermal installations by biomass;
- replacement of conventional energy in thermal installations by geothermal energy.

The criterium established to evaluate and limit the technical quality of the renovations is the energy performance rating. The actions supported must improve the total energy performance rating of the building by at least one (1) energy class measured in the scale of carbon dioxide emissions (kg CO_2/m^2.year).

Each project can opt for two types of support:

- financing
- repayable loans

The characteristics of the aids are included in Table 3.

TYPOLOGY		MAXIMUM SUBSIDY	MAXIMUM LOAN
ENERGY EFFICIENCY	TYPOLOGY 1. Improving the energy performance of the thermal envelope	30%	60%
	TYPOLOGY 2. Improvement of the energy performance of thermal and lighting installations	20%	70%
RENEWABLES	TYPOLOGY 3. Substitution of conventional energy in thermal installations by biomass	25%	65%
	TYPOLOGY 4. Replacement of conventional energy in thermal installations by geothermal energy	30%	60%

Table 3. Typologies and support of the PAREER-CRECE programme.

The results of the programme have involved requests for help that have exceeded 235 million € through more than 1,500 projects that are currently being executed.

To date, 377 cases have been evaluated, which involve improving the energy efficiency of:

- 14,768 homes;
- 1,787 rooms in 12 hotels.

It is estimated that a final energy saving of 7,487 toe / year will be achieved through said projects.

A success story is the renovation of the "Oscar" Building in San Sebastián de los Reyes (Madrid) (Figures 6 and 7).

The action consisted of the renovation of the thermal envelope in a building of 80 existing housing units.





Figure 6. Renovation works "Oscar" building in San Sebastián de los Reyes (Madrid).

The building was constructed in 1991 under a 1979 regulation for thermal insulation; with assistance from the programme for the energy renovation of existing buildings, PAREER-CRECE of the IDEA, 80 millimetres of expanded polystyrene insulation was installed. All windows were renovated and now achieve transmittance values of U = 1.8 W / m^2 K. The shell has also been insulated, and the lighting systems of common areas and garages have been replaced by LED lighting.

The result has been a two (2)-energy class improvement in the EPC rating, from an E to a C, with an estimated final energy saving of 44% and a reduction in primary energy demand of 53%.

This project has had a total cost of 1.06 million € and has received a subsidy of 240,000 €.



Figure 7. "Oscar" building in San Sebastián de los Reyes (Madrid) after rehabilitation.

4. Conclusions, future plans

The transposition of the EPBD in Spain is generally considered to be completed. For many of the specific actions that this Directive specifies, efforts have been made to publish the legal provisions that regulate it, in any case adapting them to the characteristics of the buildings in Spain, as well as to climatic and construction characteristics, and to the characteristics of professional sectors in charge of carrying out the necessary work to achieve the objectives.

In this sense, many of the difficulties encountered while implementing a roadmap which allows the achievement of the objectives while assessing both economic and social impacts, have been resolved in recent years.

After several years of operation of the first legislative publications which regulate the construction of new buildings, including renovation, inspection systems and the energy performance certification of buildings, the first positive results are beginning to show. Revisions have been made every five years, solving many of the problems with localised barriers and giving rise to a new normative package published in 2013. Forthcoming challenges are expected to be addressed in 2018 and 2019.

Future plans include the continuation of actions that are reporting energy savings in the building sector, while also reviewing the minimum performance values according to the latest cost-optimal calculations. Plans will also involve solving barriers related to energy performance certificates, improving their quality and expanding their use, as well as increasing the awareness and knowledge around building energy performance, with defined objectives for 2020 based on NZEB.

Endnotes

1. Programa De Ayudas Para La Rehabilitación Energética De Edificios Existentes (PAREER)
2. Programa De Ayudas Para La Rehabilitación Energética De Edificios Existentes (PAREER)
3. Programa De Ayudas Para La Rehabilitación Energética De Edificios Existentes 2 (PROGRAMA PAREER-CRECE)

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Sweden

Status in December 2016

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NATIONAL WEBSITES

www.boverket.se, www.energimyndigheten.se

1. Introduction

Sweden had most elements of the EPBD in place in 2014. Since then, Sweden has been working hard on defining the Nearly Zero Energy regulations, i.e., establishing the NZEB levels and a numerical indicator for energy performance. The *Planning and Building Ordinance* (2011:338) was altered in December 2016 and put into force on 1 April 2017; additional regulations are expected to come into force during 2017. The supervision of the EPC system has developed further, resulting in better compliance. A new and updated building regulation for determining energy performance of buildings is also in place since December 2016 (BFS 2016:13 and "*Boverket[1]s föreskrifter och allmänna råd om fastställande av byggnadens energianvädning vid normalt brukandeunder ett normalår,* BFS 2016:12 - BEN[2]).

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status of new buildings

The energy performance requirements were tightened in 2015 (BFS 2015:3) and concerned the following:

Climate Correction

Sweden was divided in four climatic zones, as shown in Figure 1.

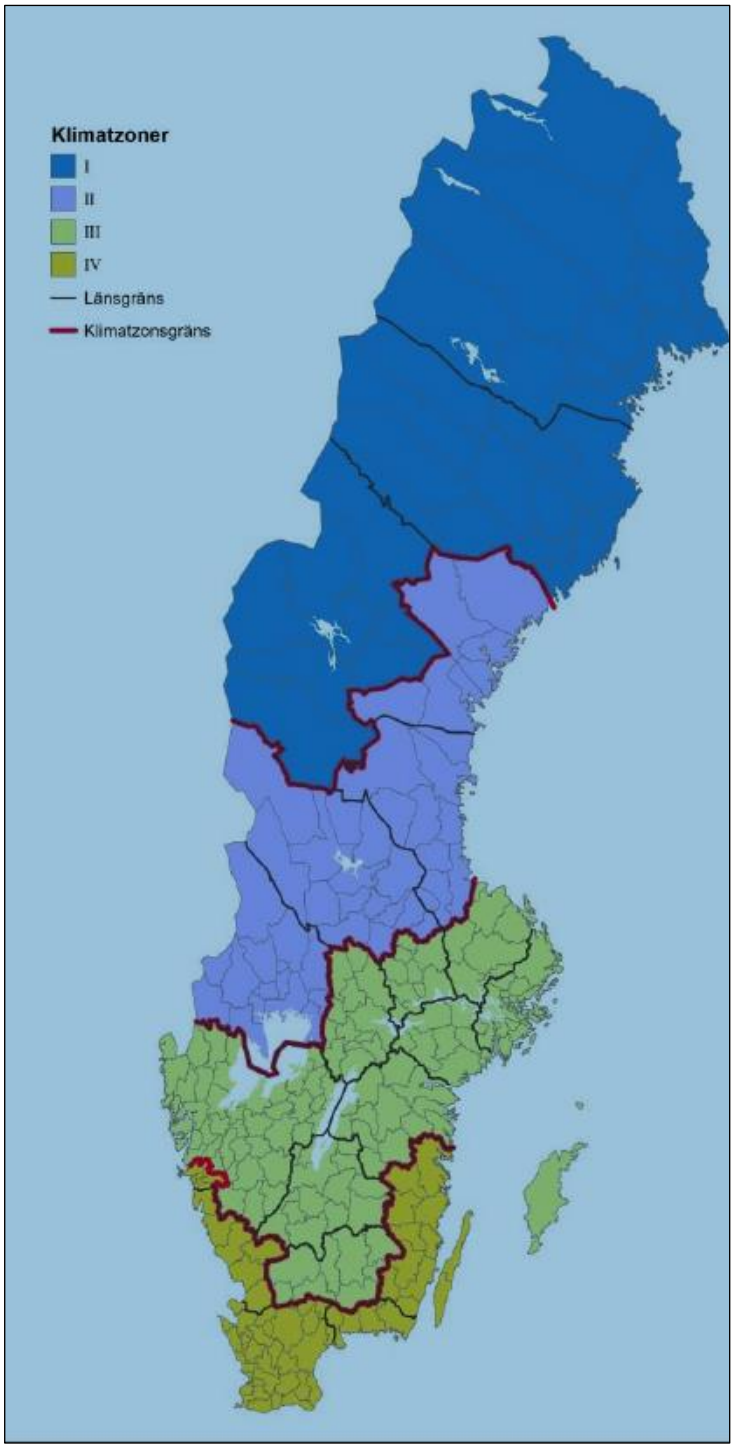


Figure 1. Swedish climatic zones I-IV from north to south (länsgränser = county limits).

The new climatic zone IV includes municipalities in southern and western Sweden. The new zone tightened requirements by about 10% compared to the new levels that were adjusted for climatic zone III.

Non-residential buildings

Requirements were tightened by:

- 15 kWh/m^2 per year for spaces with heating other than electric in climatic zones I and IV;
- 10 kWh/m^2 per year for spaces with heating other than electric in climatic zones II and III;
- 10 kWh/m^2 per year for electrically heated premises in climatic zones I and II;
- 5 kWh/m^2 per year for electrically heated premises in climatic zone III.

The requirements for premises smaller than 50 m^2 remain unchanged.

Residential buildings

Residential buildings are divided into two new categories: single-family homes and apartment buildings.

Requirements for apartment buildings were tightened by:

- 15 kWh/m^2 per year for apartment buildings with heating means other than electric heating in climatic zones I and IV;
- 10 kWh/m^2 per year for apartment buildings with heating means other than electric heating in climatic zones II and III;
- 10 kWh/m^2 per year for electrically heated apartment buildings in climatic zones I and II;
- 5 kWh/m^2 per year for electrically heated apartment buildings in climatic zone III.

The requirements for single-family homes remain unchanged in all zones, except in the new climatic zone IV where requirements are tightened by about 10%.

A new method for adjusting to normal use was developed and came into force in December 2016.

2.I.ii. Format of national transposition and implementation of existing regulations

The Swedish energy performance regulations are based on measured delivered energy, including energy performance requirements for heating, cooling, hot water and other general uses of the building (pumps, fans and lighting for all buildings), known in Sweden as "*estate energy*", divided by the area intended to be heated to more than 10 °C (A_{temp}).

According to the building regulations (BFS 2011:6), new buildings must be designed in such a way that energy use is limited by low heat losses, low cooling demands, efficient use of heating and cooling, and efficient use of electricity.

Buildings must be designed so as to comply with:

- the building's specific energy performance requirements; e.g., for climatic zone III, where the majority of the Swedish population lives, the requirements are listed in Table 1 for residential buildings, and in Table 2 for non-residential buildings;
- the installed maximum electric power rating for heating devices, as in Table 1, applicable to electric resistance, electric boilers or heat pumps;
- the average thermal transmittance (U_m) of the building envelope (A_{om}) displayed in Table 3.

Energy use requirements for new[5] residential buildings [kWh/m²] A_{temp}	**2006**	**2009**	**2012**	**2015**					**2017**
				Single-family houses		**Multi-family houses:**			
				1-2 apartments	PE-ratio[4]	>2 apartments	more than 50% of the heated floor area, $A_{temp,}$ consists of dwellings < 35 m²	PE-ratio[4]	
Electrically heated[1,2]	75[3]	55	55	55	90/55=1.64	50	55	80/50=1.60	NZEB planned for all buildings for July 2017
Not electrically heated	110	110	90	90		80	90	90/55=1.64	
1. Electrically heated defined as more than 10 W/m² installed power.									
2. Electrical heating devices shouldcomply with a maximum power limit. P_{max}= 4.5 + 0.025*(A_{temp}-130)[kW]									
3. Only for electrical panels in single-family houses.									
4. Primary Energy (PE)-ratio is the ratio between the value for non-electrically heated and electrically heated buildings.									
5. When altered, aim at the above with regard to the size of the alteration and the possibility of the building. Recommended but not required target. Target is defined by the possibilities of the building, for example, no change to the cultural values should be made. Owners cannot alter the look of the window and because of this it might not be possible to reach the exact requirement.									

Table 1. Building code since 2006 - residential buildings, electrically / not electrically heated climatic zone III.

Energy use requirements for new[6] non-residential (including public) buildings [kWh/m^2] A_{temp}	2006	2009	2012	2015	PE-ratio	2017
Electrically heated[1,2]	100[3]	55[5]	55[5]	50[5]	70/50= 1.40	NZEB planned for all buildings July 2017
Not electrically heated		100[4]	80[4]	70[4]		
1. Electrically heated defined as more than 10 W/m^2 installed power						
2. Electrical heating devices should comply with a maximum power limit						
Addendum if the $q_{hygiene}$ is between 0.35 and 1.0 l/s, m^2						
3. Addendum if $q_{hygiene}$ is between 0.35 and 1.0 l/s, m^2. +110*(q-0.35) [kWh/m^2]						
4. Addendum if $q_{hygiene}$ is between 0.35 and 1.0 l/s, m^2. +70*(q-0.35) [kWh/m^2]						
5. Addendum if $q_{hygiene}$ is between 0.35 and 1.0 l/s, m^2. +45*(q-0.35) [kWh/m^2]						
6. Existing buildings: When altered, aim at the above with regard to the size of the alteration and the possibility of the building.						
$q_{hygiene}$ is the extra air flow needed to fulfil the special hygiene demand in certain non- residential buildings.						

Table 2. Building code since 2006 - non-residential buildings with and without electrical heating, climate zone III.

		2006	2008	2011	2015
Residential buildings	Not electrically heated	0.5	0.5	0.4	0.4
	Electrically heated		0.4		
Non-residential buildings	Not electrically heated	0.7	0.7	0.6	0.6
	Electrically heated		0.6		
For buildings < 50m^2					0.33
Airtightness for buildings < 50 m^2					0.6 l/s.m^2

Table 3. Evolution of maximum average building U-value [W/m2,K].

Technical guidance documents[3] are developed and will be available online in 2017.

A new regulation on how to determine the building's energy performance connected to normal use was developed during 2016 and came into force in December 2016. The primary energy factor is defined as a factor that takes into account the difference of primary energy in electrically heated buildings and buildings heated with other energy sources.

Boverket is continuously monitoring the results of the cost-optimal calculation requirements. It also examines the possible effect of a further tightening of requirements on the cost-optimal calculations for the three building categories, i.e., single-family houses, multi-family houses and non-residential buildings, according to the latest revision of the regulations. In case of favourable economic conditions, the regulations are tightened.

The latest revision of the building requirements (following cost-optimal calculations) occurred in 2015.

Responsible parties for building compliance comprise the developer and its representative, the certified person responsible for inspections and verification, and the local municipal building council. In case the mandatory requirements are not met, the municipality can prohibit the use of the building or fine the developer until compliance is reached.

2.I.iii. Action plan for progression to NZEB for new buildings

Key elements and milestones, including national application of the definition of NZEB for new buildings

Alterations in the *Planning and Building Ordinance (2011:338)* and the *Building Regulation (BFS2011:6)* specify the definition and levels of the NZEB requirement. The alteration included, e.g., the definition of energy performance. The Swedish Energy Agency[4] has launched a training initiative called "*Energilyftet*"[5] .

Actions towards the implementation of NZEB public buildings. Plans for the implementation of this as standard from 31st of December 2018

The NZEB definition has been fully implemented in 2017. The levels were set in 2015.

2.I.iv. Requirements for systems and / or building components for new buildings

Sweden uses functional, instead of detailed requirements. This means that the developers are free to choose which areas they will focus their efforts on. As a result, there are no qualitative figures on specific parts of systems (e.g., boiler efficiency). As long as the total measured energy consumption value measured is lower than the requirements, the building is regarded as compliant.

Small stand-alone buildings < 50 m^2 are exempted from energy performance requirements. The exemption will no longer be regulated in the building ordinance but will instead be part of the building regulation. Thus, in small buildings apply requirements for U-values and airtightness.

2.II. Energy performance requirements: EXISTING BUILDINGS

In existing buildings, the requirements only come into force when the building is altered, no matter how small the alteration. When a building is renovated or refurbished, it is the altered part of the building that should comply with the regulations for new buildings. Requirements are set in relation to the extent of the alteration, e.g., a window should meet the requirements for a new window, if possible according to "*the technical possibilities for changes in the building*", for example due to cultural values.

2.II.i. Progress, current status and plans to improve the existing building stock

Each time the regulation for new buildings is tightened, a tightening of the regulation for existing buildings follows, as they are closely connected. Energy performance requirements apply when an existing building is altered (major renovation or an alteration of a small part of the building). The levels of the requirements are the same as for new buildings but are adapted to the extent of the alteration and the technical and cultural possibilities of the buildings. For existing buildings, U-values requirements apply when alterations in the building envelope are made. For alterations in the technical building systems certain requirements apply, e.g., specific fan power for inhaust/exhaust systems with heat retention should currently not be higher than 2 kWh/m^3.s.

2.II.ii. Plans for implementation of renovation in national plans according to EED articles 4 and 5

In the analysis of the first national plan for renovation, Sweden identified the lack of knowledge in the area of energy efficiency renovations as an important obstacle. The government has therefore proposed that a national information centre for sustainable buildings should be established in 2017. In the analysis of the second renovation strategy, Sweden identifies further areas that need to be developed in order to achieve a higher rate of energy efficient renovations. These areas comprise further development of the EPCs, developing guidance documents for all actors taking part in the renovation process, with specific emphasis on the relation between landlord and tenants, and a broadened scope for the existing governmental insurance for banks.

2.II.iii. Regulation of system performance, distinct from whole building performance

Sweden has got requirements on U-values and specific fan power for the altered part of a building.

See the Swedish building regulation Section 9:9[6].

2.II.iv. Encouragement of intelligent metering

The Swedish Energy Agency provides information on smart meters. For example, a test of eight (8) different smart meters has been made[7].

2.II.v. Financial instruments and incentives for existing buildings

Sweden provides different types of incentives, e.g., administrative, economic, informational, research and market introduction of efficient technologies. Examples are subsidies for multi-family houses in areas with challenging socio-economic circumstances and poor energy performance[8]. The subsidies amount to about 100 million €. For single-family houses there is a tax deduction system[9] in place to stimulate renovation. Schools can also apply for subsidies to improve poor indoor conditions and thereby also improve the energy performance[10]. These school subsidies amount to about 50 million € between 2017 and 2019.

2.II.vi. Information campaigns / complementary policies

The government has budgeted a "*national information centre for sustainable buildings*" and the framework of this is under development. *Boverket* has been instructed to perform a procurement to establish and run the national information centre. Focus will be on improving the energy efficiency while performing renovation works, and on energy-efficient construction with the use of sustainable materials with low environmental impact from a life-cycle perspective.

To fulfill these purposes, the information centre shall collect and review data, ensure quality and disseminate information to target groups within the building industry. The information shall be distributed free of charge. The first procurement will be done for a period of two years and this procurement is currently in process.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Since 2009, all new buildings, as well as all existing buildings sold or rented, shall have an EPC. The *National Board of Housing, Building and Planning* administer and supervise the EPCs scheme and the national register of EPCs. This is regulated in Law 2006:985, Ordinance 2006:1592 and *Regulation by the National Board of Housing, Building and Planning* BFS 2007:4 on EPCs for buildings. The latest changes concerned amendments in the definition of energy performance and normal use in the regulation regarding EPCs. As of May 2017, over 660,000 buildings have been certified and registered in the national register of EPCs.

The *National Board of Housing, Building and Planning* enforce conditional fines in case a building owner has not obtained and registered an EPC. The first fine is at the level of the cost of an EPC, followed by further fines if the EPC is still not obtained. More information is available in the relevant country report of the "Book: 2016 – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports"[11].

2.III.ii. Quality Assessment of EPCs

Quality assurance is made through automatic controls in the electronic certification system for all EPCs. These controls include, e.g., the level of energy performance, the heated area, the real-estate information and the climate-data. Controls are complemented with analyses of the EPCs database. If a certified energy expert does not meet the requirements concerning competence, access to the register and the EPCs issuing permit can be withdrawn.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Public buildings have been included in the certification system since 2008. The regulation follows the area limits provided in the EPBD Directive 2010/31/EU.

2.III.iv. Implementation of mandatory advertising requirement – status

Requirements for advertising have been implemented since 2012 and *Boverket* regularly carries out advertisement controls. The most recent control is mainly focusing on the information given by real-estate agents during sales. If the requirements are not met, the supervisory authority can make an order for correction, which can be combined with a conditional fine.

2.IV. Inspection requirements – heating systems, air conditioning

For heating and AC systems, Sweden has chosen alternative measures (advice) in response to Articles 14 and 15 of the EPBD.

2.IV.i. Report on equivalence of model A and B for Heating Systems

Article 14 of the EPBD targets locally fired boilers. These types of boilers represent a small proportion of heating systems for buildings in Sweden. For instance, 95% of the energy used for heating of premises and apartment buildings is covered by district heating and electricity. Efforts directed only at heating and AC systems are proven to be expensive compared to earnings. Therefore, Sweden has chosen to use and to develop already existing information channels, e.g., use energy and climate advisors and other professionals so as to disseminate information in order to fulfil the obligations. Specific measures to develop and customise information activities for each target group have been implemented.

By educating and supporting established professionals and developing existing activities, knowledge about energy efficiency measures can be spread to yet more actors. Through these actions, the Swedish strategy gives more property owners the opportunity to receive advice, which would not be the case, if only inspections took place.

2.IV.ii. Progress and current status on heating systems

Sweden has chosen three different alternative measures:

Personal advice focusing on energy efficiency

Municipal energy advisors provide free of charge advice to individuals, companies and organisations on how to reduce the total energy use. To ensure that proper focus is given on advice to building owners with large heating and/or AC systems, a special task has been assigned to the advisors by the National Energy Agency. The agency ensures the quality of advice given, by educating the energy advisors and by collecting reports of their work. The agency produces brochures and leaflets as well as information material for the internet. Support is also given by identifying those building owners who are affected by the directive so that they can be easily contacted by the advisors.

As a result of the cooperation between different authorities, an attachment with information about energy saving measures is distributed together with the EPCs.

Personal advice carried out by professionals not focusing on energy efficiency

Accredited EPC assessors, chimneysweepers and service personnel for heating systems meet regularly with building owners and are encouraged to give information about energy efficient measures. Customised information material has been developed by the National Energy Agency in order to support these meetings. See the relevant country report in the “Book: 2016 – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports”.

Other dissemination of information

Information material tailored for owners of large heating systems has been produced and is offered free of charge (Figure 2).



Figure 2. Information material for owners of large heating systems.

Impact and equivalence assessment

Due to the lack of data at a system level, Sweden has chosen to use the top-down method to describe the impact from the measures mentioned above on heating systems according to the EU framework.

The impact of advice has been estimated based on reports submitted by the energy advisors. Several studies have been carried out in Sweden during the last years on the effect of the advice given by energy advisors, and also a system has been developed for collecting data from visits. These efforts will lead to better estimates of future energy savings. Table 4 shows the assessment of energy saved in heating systems. The assessment comprises advice given by energy advisors and during on-site inspections by energy experts issuing EPCs, via a mandatory survey, but data from chimneysweepers was not available at the time of the assessment.

	Calculation of outcome of final energy savings (MWh)		
Source of advice	**2014**	**2015**	**2016**
On-site inspections by municipal energy advisors	0	780	810
On-site inspections by other skilled professionals	2470	2590	2290
Written information (websites, brochures, leaflets etc.)	0	970	660
Total	2470	4340	3760

Table 4. The assessment of energy saved in heating systems.

Preliminary results indicate that the number of companies that have been assessed is fewer than estimated. At the same time, the number of large individual heating systems fired with fossil fuels has decreased by 14% from 2011 to 2015. National statistics show that the use of energy for heating of apartment buildings and facilities has decreased between 2003 and 2015, from 398 TWh in 2003 to 370 TWh in 2015, although the building stock has increased (Figure 3).

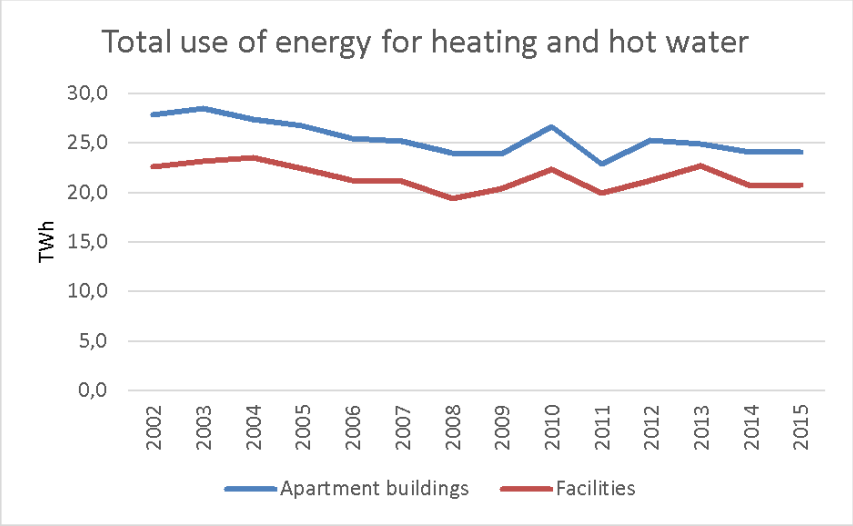


Figure 3. National statistics show that the use of energy for heating of apartment buildings and facilities is decreasing.

2.IV.iii. Progress and current status on AC systems

The methods to improve energy performance of AC systems overlap with those for the heating systems, and the activities are similar.

Personal advice focusing on energy efficiency

Municipal energy advisors are also offering advice to building owners with large AC systems, and the support from the National Energy Agency also includes AC systems.

Personal advice carried out by professionals not focusing on energy efficiency

Within the procedures of compulsory control of ventilations systems, the assessors are obliged to give suitable advice on how to reduce the use of energy.

Service engineers working with cooling systems are also encouraged to provide information about energy efficient measures.

Other dissemination of information

Information material tailored for owners of large AC systems has been produced and is offered free of charge.

Impact and equivalence assessment

Cooling systems are almost always powered by electricity and it is hard to separate the energy used for cooling from electricity used for other purposes. Due to this lack of data, Sweden has chosen to use the bottom-up method to describe the impact of advice on cooling systems according to the EU framework. Assessments on the number of AC systems and the potential for energy savings have been made based on information from the EPC protocols. Table 5 shows the assessment of energy saved in AC systems. The assessment only comprises advice given by energy advisors and on-site inspections by experts performing EPC and ventilation control, but data from service engineers was not available at the time of the assessment.

	Calculation of outcome of final energy savings (MWh)		
Source of advice	**2014**	**2015**	**2016**
On-site inspections by municipal energy advisors	0	210	230
On-site inspections by other skilled professionals	2260	2370	2380
Written information (websites, brochures, leaflets etc.)	30	160	90
Total	2290	2740	2700

Table 5. The assessment of energy saved in AC systems.

The Swedish climate is generally favourable for avoiding or reducing the need for cooling. In order to make AC systems more efficient, it is essential to control heating and cooling together to ensure that the building is neither over-heated nor over-cooled. The main benefit of the chosen alternative measures is that the energy advisor gives advice on both aspects.

3. A success story in EPBD implementation

The database for EPCs

Sweden has used a national database for EPCs since its implementation in 2006/2007. The database holds, up to this date, approximately 660,000 EPCs.

The database contains a unique set of information concerning the energy consumption in the Swedish building stock. The EPCs are mainly based on measured energy consumption, and the quality is ensured by the fact that the EPCs are issued by certified assessors. The EPC is, in most cases, preceded by an on-site inspection of the building. This makes the database and the information therein valuable for statistics and research, as well as for monitoring and evaluation of the energy use in the building stock.

In addition to these areas of use, the database is also the foundation in making information on energy performance of buildings available to the general public and to potential building buyers or tenants. Furthermore, the database is also used for supervision activities, and for the development of regulations.

Actual energy consumption

The use of actual energy consumption as the basis of buildings' energy performance assessment has been important for achieving better energy efficiency for buildings.

Among others, this approach contributed to the construction and real estate industry focussing on construction quality, efficient building management and efficient operation of technical building systems, and provided incentives to increased measurement of the energy consumption, thus raising awareness and knowledge, which, in turn, contributed to the application of further measures to reduce the actual energy use. For the above reasons, the use of actual energy consumption for the building energy performance assessment has the strong support of the construction and real estate industry. Further regulation has been developed on how to determine the energy performance based on actual energy consumption connected to normal use of the building.

4. Conclusions, future plans

As the EPC energy classes are dynamic and evolving over time, Sweden is working on further developing the NZEB-levels in the energy classes of the EPCs. Energy classes are, in the near future, going to be adapted to primary energy factors. Regulations for NZEB will come into effect in July 2017, and further sharpening of the requirements will take place in 2021.

Sweden is also investigating the possibilities of implementing a life-cycle assessment of the building requirements.

Endnotes

1. Boverket is the Swedish National Board of Housing, Building and Planning
2. Boverket´s regulation and general advice about determination of the normal energy use of a building during a normal year
3. www.boverket.se/sv/PBL-kunskapsbanken/regler-om-byggande/boverkets-byggregler/energihushallning
4. Energimyndigheten
5. http://energilyftet.learnways.com
6. www.boverket.se/sv/lag--ratt/forfattningssamling/gallande/bbr---bfs-20116/
7. www.energimyndigheten.se
8. www.boverket.se/sv/bidrag--garantier/hyreshus/stod-for-renovering-och-energieffektivisering-i-vissa-bostadsomraden
9. www.skatteverket.se/privat/fastigheterochbostad/rotochrutarbete/villkorforattfarotavdrag.4.5947400c11f47f7f9dd80004014.html
10. www.boverket.se/contentassets/1fc456aa2c514a4fb7c3dd84a78a0299/2017-06-01-trend--energideklarationer.pdf
11. www.epbd-ca.eu/ca-outcomes/2011-2015

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the United Kingdom - England

Status in December 2016

AUTHORS

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NATIONAL WEBSITES
www.gov.uk/government/organisations/departmentforcommunitiesandlocalgovernment

1. Introduction

This report provides information about the implementation of the EPBD in England. It supersedes the previous reports published in 2010, 2012 and 2016. The implementation of the EPBD in the other three UK jurisdictions (Wales, Scotland and Northern Ireland) is addressed in separate reports.

In the UK, some powers of the UK Parliament have been transferred to the Scottish Parliament, the National Assembly for Wales, the Northern Ireland Assembly and to their executive bodies the Scottish Government, the Welsh Government, the Northern Ireland Executive. References to "Government" in this England report should be read as the "UK Government". References to the Scottish Government, the Welsh Government, and the Northern Ireland Executive have been included in their respective country report as appropriate[1].

The implementation of the EPBD in England is the responsibility of the Department for Communities and Local Government (DCLG). This report introduces the most recent requirements. It also addresses performance standards, certification and inspection systems, including quality control mechanisms, the training of Energy Assessors, information campaigns, incentives and subsidies. For more details please visit the referenced websites or contact the responsible institutions.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status

Figures 1 and 2 show the simplified historical Building Regulations improvements in England for new residential and new non-residential buildings. Since 2010, energy standards for new buildings have been strengthened by over 30%. Energy requirements are set as net CO_2 emissions targets (kg CO_2/m^2.year) and primary energy is also reported. Each new building must have emissions below those of a reference building, which has the same geometry as the actual building, but with standard levels of insulation, systems efficiency, etc. Each type of energy (e.g., gas, electricity) has a different carbon intensity, expressed as kg CO_2/kWh, which reflects the amount of CO_2 emitted to deliver 1 kWh of energy to the building.

The graphs in Figures 1 and 2 are based on the 2006 Building Regulations (the reference) and historical improvements for 2010 and 2013. Following the 2015 elections, the UK Government announced[2] that it would not be following the previous Government's zero carbon policies. The UK Government will keep energy standards under review. An assessment of cost effectiveness/ cost optimality has commenced and will inform whether any strengthening of standards is required.

The 2013 Building Regulations set energy performance requirements for new and existing buildings (residential and non-residential) and came into effect in April 2014. The 2013 regulations were strengthened to deliver improved CO_2 savings over the previous 2010 Building Regulations of:

- 6% across new residential buildings;
- 9% across new non-residential buildings.

Minor changes to the requirements for existing buildings were also introduced in 2013. There are no specific requirements for public buildings.

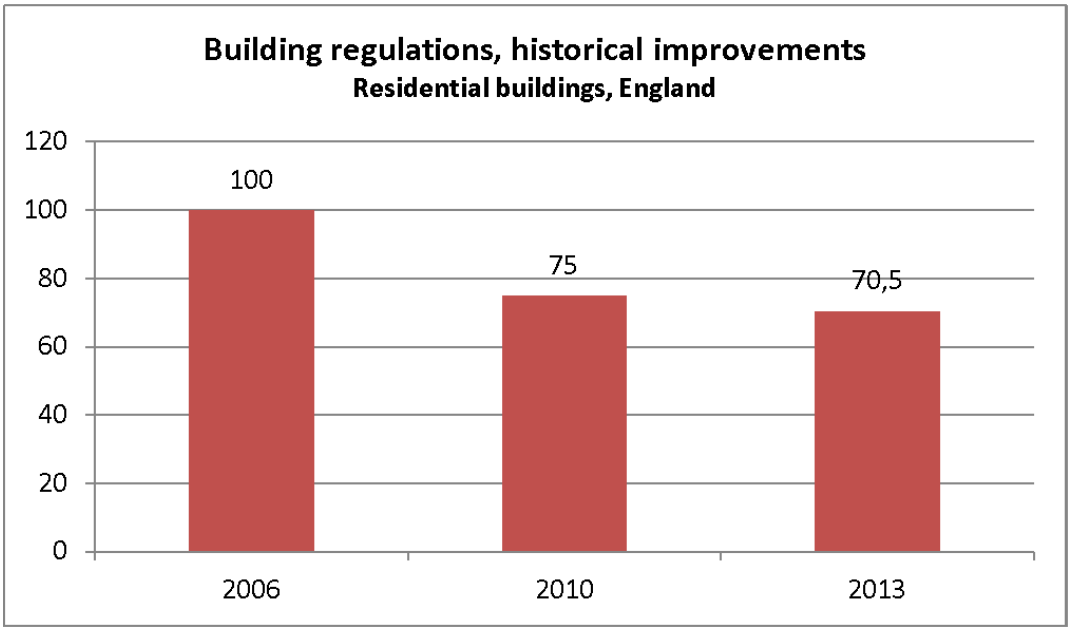


Figure 1: New residential Building Regulations (England), historical improvements.

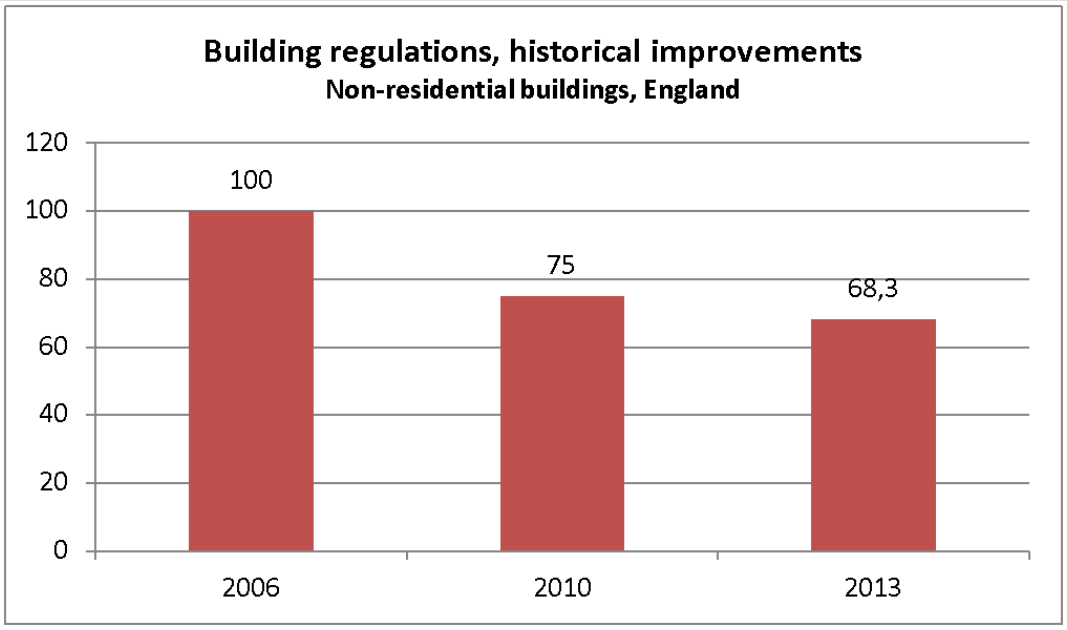


Figure 2: New non-residential Building Regulations (England), historical improvements.

2.I.ii. Format of national transposition and implementation of existing regulations

Part L of the Building Regulations addresses energy efficiency and transposes some of the EPBD requirements. To support the implementation of the Building Regulations, "Approved Documents" (ADs)[3] have been published. These ADs are adopted for most projects to demonstrate compliance with Building Regulations. The ADs are:

- AD L1A and AD L1B for new and existing residential buildings; and
- AD L2A and AD L2B for new and existing non-residential buildings[4].

The ADs include references to guides such as Eurocodes (EN) and set out five criteria for new buildings, as detailed in Table 1:

Criteria	Definitions
1	For all buildings: achieve a Target CO_2 Emission Rate. In addition, for residential buildings: achieve a Target Fabric Energy Efficiency, which reflects space heating and cooling demand in kWh/m^2 year.
2	Meet design flexibility limits, including minimum fabric standards and building services efficiencies.
3	Limit heat gains in summer including the effect of shading devices.
4	Ensure the building performance is consistent with design calculations. Focus on air permeability, commissioning of services and thermal bridges.
5	Provide information for energy-efficient building operation.

Table 1: New buildings requirements, England

Note that internal air quality is addressed under Part F of the Building Regulations: "Ventilation".

Compliance, particularly with the first three criteria, is assessed using the National Calculation Methodology (NCM)[5]. For new residential units, the NCM is the Standard Assessment Procedure (SAP)[6]. An updated version (SAP 2012) was released in 2013 and encoded in privately-owned software tools. For new non-residential buildings, the NCM Modelling Guide was updated in 2013 and is encoded in both a Government-approved software tool (SBEM)[vi] and privately-owned software tools. Both NCMs use an Asset Rating approach, i.e., predicted energy consumption based on standardised thermal condition. These software tools are also used to produce EPCs on construction, sale and rent.

To support construction quality, the UK Government produced Approved Construction Details (ACDs)[7]. Alternatively, construction details calculated by qualified professionals may also be used. ACDs focus on improving thermal bridging and airtightness. Airtightness testing is required for most new residential and non-residential buildings with some exemptions.

Building Regulations outputs are submitted to Building Control Bodies (BCBs)[8] for checking. Statistics on compliance, enforcement and penalties are not kept in England. "Competent Persons", who are registered with a Government-approved Competent Person Scheme[9], are allowed to self-certify that their work complies with Building Regulations as an alternative to a BCBs submission.

Cost-optimal assessment of energy performance requirements

A UK-wide cost-optimal report was published in May 2013. The report compares Building Regulations[10] (current at the time) in each UK jurisdiction to the calculated cost-optimal levels.

Residential buildings

For new residential buildings, two reference building types were considered representative of developments in the UK: semi-detached (single-family house) and mid-floor apartment. For existing buildings, the same two reference building types were adopted and modelled with the two most common wall construction types: uninsulated cavity wall and uninsulated solid wall. For new buildings, potential measures were grouped into packages representing three different components of a building design: fabric, heating and renewable energy (photovoltaics). A hundred and twenty (120) alternatives were considered for each reference building. For existing buildings, each measure was assessed individually. Primary energy was calculated for each package/measure using the NCM. Costs were calculated for each model to identify cost-optimal levels which were then compared to standards (current at the time) in each jurisdiction (Tables 2 and 3).

> ***New residential buildings*** – The results show that standards were on average 16 to 23% more energy efficient than the cost-optimal level.

Table 2: New residential buildings. Comparison of cost-optimal levels to current requirements for England and Northern Ireland.

Reference building	Cost-optimal level (kWh/m².year)	Current requirements (kWh/m².year)	Gap (%)
Semi-detached	141	117	+16% better than cost-optimal
Mid-floor apartment	116	99	

Table 2: New residential buildings. Comparison of cost-optimal levels to current requirements for England and Northern Ireland.

> ***Existing residential buildings*** – In all cases, the standards meet or improve upon cost-optimal levels.

Reference building (averages)	Cost-optimal level	Current requirements	Gap
Cavity walls	U=0.55 W/m².K	U=0.55 W/m².K	cost-optimal
Solid walls	U=0.4 W/m².K	U=0.30 W/m².K	+25% better than cost-optimal
Windows	U=1.6 W/m².K	U=1.6 W/m².K	cost-optimal
Roof	U=0.20 W/m².K	U=0.18 W/m².K	cost-optimal
Heating	88% (gas boiler)	88% (gas boiler)	cost-optimal

Table 3: Existing residential buildings. Comparison of cost-optimal levels to current requirements for England, Wales and Northern Ireland

Non-residential buildings

For new non-residential buildings, seven reference buildings (representative of the building stock) were selected: office (natural ventilation and air-conditioning), education, hotel/restaurant, retail, distribution warehouse, and hospital/healthcare. A construction type (cavity wall or steel frames) was selected for each reference building. For existing buildings, two reference buildings were considered for each of the seven building types: a low and a high energy efficiency building based on benchmark data. A similar approach was adopted for measures and packages as for residential buildings. For new buildings, packages represent four different components of a building: fabric, services, heating and renewable energy (photovoltaics), therefore selecting one package from each component forms a complete building design. A total of 225 packages were considered for each reference building. For existing buildings, common renovation and replacement measures with significant impact on energy use were selected. As for residential buildings, primary energy was calculated using the NCM. Costs were calculated for each model to identify cost-optimal levels which were then compared to standards (current at the time) in each jurisdiction (Tables 4 and 5).

> ***New non-residential buildings*** – In four building sectors, the reference standards were more energy efficient than the cost-optimal levels: air-conditioned office, naturally ventilated office, secondary school, and hospital. Reference standards in three sectors were below cost-optimal levels (air-conditioned hotel, distribution warehouse, air-conditioned retail warehouse). On average across all sectors, standards were 4 to 7% lower than cost-optimal levels. These standards have since been strengthened.

Reference building	Cost-optimal Level (kWh/m^2.year)	Current requirements (kWh/m^2.year)	Gap (%)
Office (air-conditioned)	163	155	-4% worse than cost-optimal
Office (naturally ventilated)	89	87	
Secondary school	143	132	
Hospital	279	246	
Hotel (air-conditioned)	419	487	
Distribution warehouse	131	136	
Retail warehouse (air-conditioned)	193	232	
Average	202	211	

Table 4: New non-residential buildings. Comparison of cost-optimal levels to current requirements for England, Wales and Northern Ireland.

> ***Existing non-residential buildings*** – On average across all building sectors, the standards were below cost-optimal levels for walls, floors, windows, lighting, chillers, and air handling units. These standards have since been strengthened. The roof and heating standards met or improved upon cost-optimal levels.

Reference building (averages)	Cost-optimal level	Current requirement	Gap
Cavity walls	U=0.30 W/m².K	U=0.55 W/m².K	-83% worse than cost-optimal
Other walls	U=0.20 W/m².K	U=0.30 W/m².K	-50% worse than cost-optimal
Roof	U=0.24 W/m².K	U=0.18 W/m².K	+25% better than cost-optimal
Heating	84% (gas boiler)	84%	cost-optimal
Floor	U=0.22 W/m².K	U=0.25 W/m².K	-14% worse than cost-optimal
Windows	U=1.64 W/m².K	U=1.8 W/m².K	-10% worse than cost-optimal
Lighting	U=1.64 W/m².K	55 lm/W	-10% worse than cost-optimal
Chiller	3.9	3.5	-10% worse than cost-optimal

Table 5: Existing non-residential buildings. Comparison of cost-optimal levels to current requirements for England, Wales and Northern Ireland.

2.I.iii. Action plan for progression to NZEB

The 2012 UK national plan "Increasing the number of Nearly Zero-Energy Buildings"[11] covers all four UK jurisdictions. The plan was submitted to the European Commission and confirms the UK's legally binding commitment (under the Climate Change Act 2008) to reduce greenhouse gas emissions by at least 34% by 2020 and 80% by 2050. To meet these targets, the emissions footprint of buildings will need to be almost zero, which will mainly be achieved through:

- reducing the energy demand in buildings;
- decarbonising the heating and cooling supply.

The UK has made successive improvements in new-build energy standards through changes to the Building Regulations in each jurisdiction (Figures 1 and 2).

England had a target for all new homes to be zero-carbon from 2016, and an ambition for all new non-residential buildings to be zero-carbon from 2019 (2018 for new public sector buildings). In 2015, the UK-Government announced that it would not be following the previous Government's zero carbon policies. The Government will keep energy standards under review. A cost-effectiveness/cost-optimality assessment has commenced and will inform whether any strengthening of energy standards is required. The cost-optimal assessment calculated in accordance with Article 5 of the EPBD will also help define NZEB requirements for new buildings from 2021.

NZEB statistics are not maintained in England. Figure 3 shows historical EPC records for classes A and A+. The graph shows a steady increase for non-residential buildings, and a sharp drop in 2016 for residential buildings. Note that new building construction rates also affect these data.

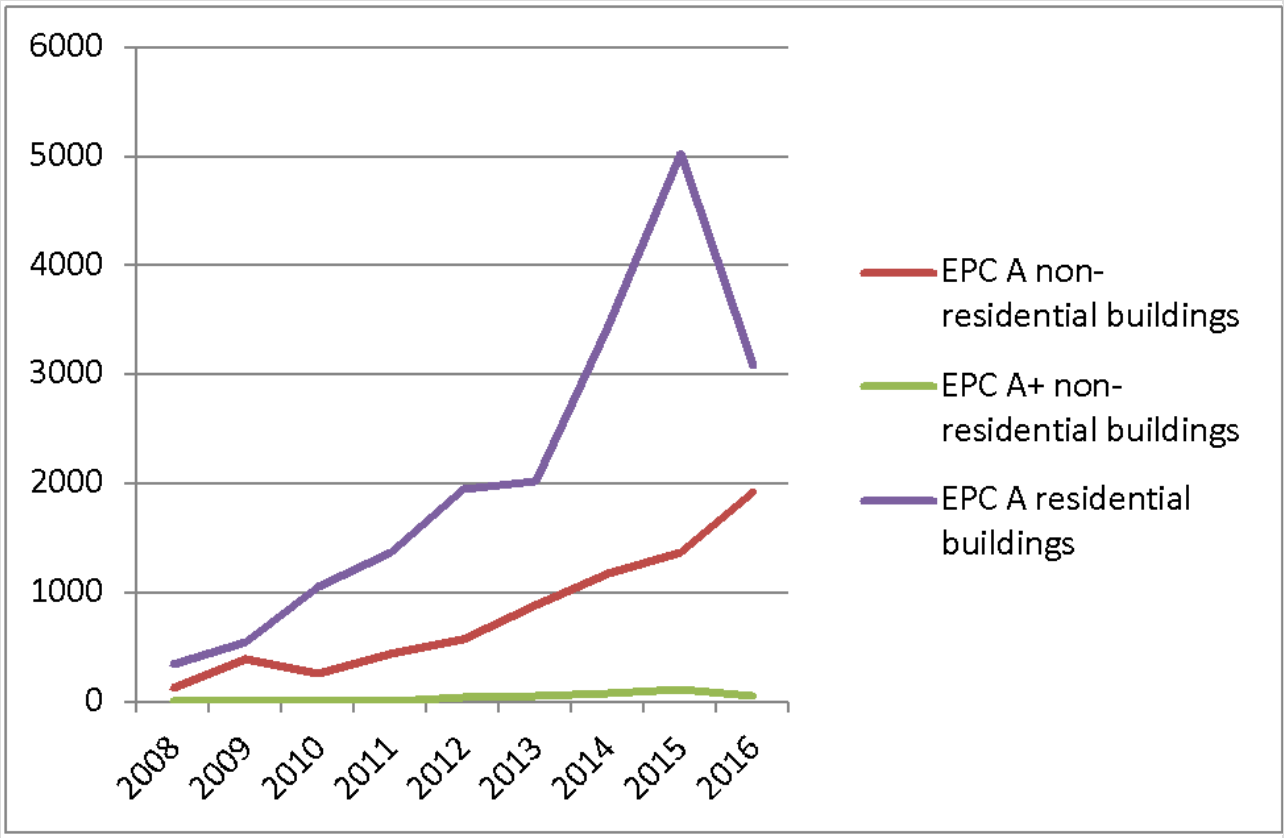


Figure 3: Historical EPCs classes A and A+, England.

2.I.iv. Requirements for systems and / or building components

Coverage of heating, domestic hot water, air-conditioning and large ventilation systems

The ADs reference the Domestic and Non-domestic Building Services Compliance Guides[iv] which set out minimum energy efficiency standards for fixed building services systems, including:

- space heating;
- domestic hot water;
- mechanical ventilation;
- comfort cooling;
- internal and external lighting;
- low carbon generation of heat by heat-pumps, solar thermal panels, and combined heat & power .

Table 6 shows a summary of minimum standards for residential buildings as an example.

Building Services Type	Recommended minimum energy efficiency standard
Gas-fired wet central heating: condensing boiler	Seasonal Efficiency of Domestic Boilers in the UK (SEDBUK 2009): 88%
Solid fuel heating: independent boiler – wood/ pellets/ chips	75% nominal load 70% part load
Oil-fired wet central heating: condensing regular boiler	Seasonal efficiency (SEDBUK 2009): 88%
Heat pump – electrically driven (not air to air): space heating	For new buildings: coefficient of performance 2.5 at rating conditions in EN 14511
Heat pump – electrically driven (not air to air): domestic hot water	For new buildings: coefficient of performance 2.0 at rating conditions in EN 14511
Mechanical ventilation: continuous supply and extract with heat recovery	Specific fan power (W/(l.s)): 1.5
Heat recovery: balanced mechanical ventilation systems	Dry heat recovery efficiency: 70%
Fixed lighting: internal light fittings	Lighting efficacy: 45 lamp lumens per circuit-watt
Comfort cooling: water-cooled air-conditioners working in cooling mode	Energy efficiency ratio: 2.5

Table 6: Selected examples of minimum standards. Domestic Building Services Compliance Guide, HM Government, 2013 edition – for use in England.

The ADs (for new buildings) include detailed specifications for the "reference building" from which the Target CO_2 Emission Rate is derived. The "reference building" provides typical specifications for the actual building design. Standards higher than the minimum (Table 6) may be required to satisfy Building Regulations for new buildings.

2.I.v. Regulation of system performance, distinct from product or whole building performance

The commissioning of fixed technical building systems is required by Building Regualtions to ensure the actual building performance is as consistent as possible with design intentions. The ADs reference the Domestic and Non-domestic Building Services Compliance Guides, and industry guidance. Typically, the guides recommend following manufacturer's instructions, and include information such as the qualifications/accreditation required for commissioning experts.

The non-residential ADs also reference Soft Landings[12], a voluntary approach to address the performance gap between design intentions and operational outcomes. The Government Soft Landings policy[13] was to be mandated in 2016, and it is the responsibility of each Central Government Department to implement it.

2.I.vi. Encouragement of intelligent metering

Metering requirements are included in the ADs for new and existing non-residential buildings. The aim is to enable occupiers to meter at least 90% of the estimated annual energy consumption and to assign energy to the various end uses. The ADs reference industry best practice for meters installation. Automatic meter reading and data collection must be provided in new non-residential buildings greater than 1,000 m^2.

There are no metering provisions for new and existing residential units. Instead, the Government aims for all homes to be offered smart meters by the end of 2020. Energy suppliers are responsible for replacing over 53 million gas and electricity meters in the UK [14] [15].

2.I.vii. Encouragement of active energy saving control (automation, control and monitoring)

Effective control of technical building systems are included in the Domestic and Non-Domestic Building Services Compliance Guides, the ADs, and the Building Regulations. The NCM also provides additional benefits for more effective controls.

The new ADs for non-residential buildings include benefits for installing automatic monitoring of the building's energy performance and power factor correction equipment. E.g., the calculated Building Emission Rate (BER) may be reduced where management features are provided, which helps the new building to meet the maximum Target Emission Rate (TER). For "automatic monitoring and targeting with alarms for out of range values" the BER may be reduced by 5%.

2.II. Energy performance requirements: EXISTING BUILDINGS

The UK National Energy Efficiency Action Plan[16] gives an overview of the UK building stock. Figures 14 and 15 illustrate data from the EPC register, therefore they are not fully representative of the building stock.

The UK has 27 million homes, of which 22.1 million are located in England. Figure 4 shows the distribution of about 14.5 million residential EPCs in England. Buildings with no EPCs are not represented.

There are >1.8 million non-residential premises in the UK. Figure 5 shows the distribution of >0.5 million non-residential EPCs in the UK. Buildings with no EPCs are not represented.

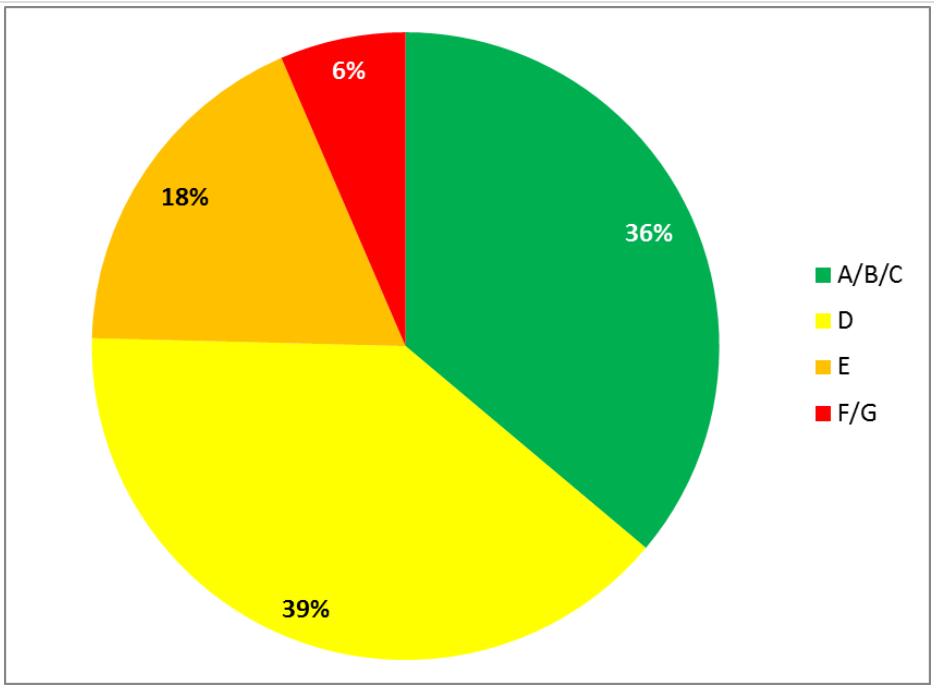


Figure 4: EPC ratings, residential building stock, 2016

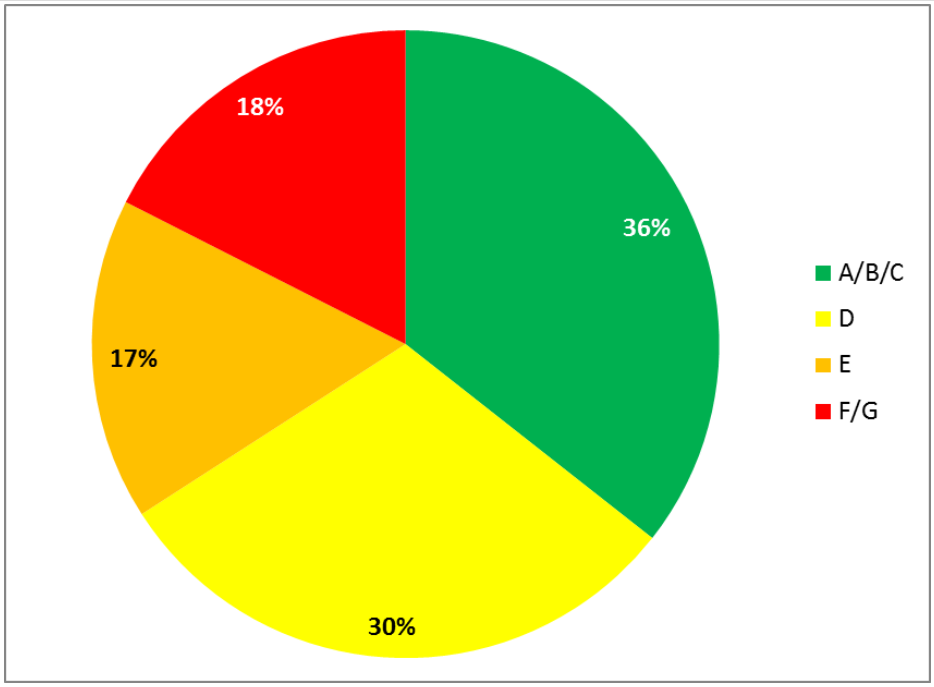


Figure 5: EPC ratings, non-residential building stock, 2016.

2.II.i. Progress and current status of existing buildings

Building regulations are supported by AD L1B and AD L2B for existing residential and existing non-residential buildings respectively[17], which set out an elemental approach for existing buildings, and Domestic and Non-domestic Building Services Compliance Guides which include minimum energy efficiency standards for new and replacement of existing building systems.

Under certain circumstances (typically where the liveable building area is extended or where the capacity of building services is increased), additional energy efficiency measures (named "consequential improvements") must be undertaken. These requirements only apply to large, existing residential and non-residential buildings (greater than 1,000 m^2) and can include improvements to the performance of the building fabric and/ or services where technically, functionally or economically feasible.

2.II.ii. Plans to improve the existing building stock

The Department for Business, Energy & Indutrial Strategy (BEIS) is responsible for the transposition of the EED, which is mostly implemented on a UK-wide basis with some jurisdiction-specific exceptions.

The UK National Energy Efficiency Action Plan[xvi] includes a Building Renovation Strategy in compliance with EED Article 4. The strategy references existing measures, e.g., the Energy Company Obligation (helping households insulate homes), the Green Investment Bank (connecting private finance with demand for energy efficiency measures), Salix (improving energy efficiency in public sector organisations) and RE:FIT (financing modernisation of public sector buildings), smart meters for households and small businesses, and the residential Renewable Heat Incentive (transforming the way homes are heated).

The UK is implementing the alternative approach under Article 5(6) and notified the Commission of the alternative measures adopted to achieve an equivalent improvement in the energy performance of Government buildings. The National Energy Efficiency Action Plan confirms the main policies and measures used to meet the target: the Greening Government Commitments (GGC) for Central Government in England, and separate initiatives in Scotland, Wales and Northern Ireland. The measures include behavioural change, facilities management, estate management, and energy efficient technology. The GGC are expected to deliver 516.6 GWh savings by 2020, exceeding the 163.6 GWh target for equivalence.

2.II.iii. Regulation of system performance, distinct from whole building performance

As per new buildings. See details above.

2.II.iv. Encouragement of intelligent metering

As per new buildings. See details above.

2.II.v. Financial instruments and incentives for existing buildings

See National Energy Efficiency Action Plan details above.

2.II.vi. Information campaigns / complementary policies

A communication campaign, across multiple media including television, to promote the installation of smart meters in residential buildings is ongoing, (Figure 6). More information at www.smartenergygb.org



Figure 6: Smart Meter promotion campaign, Smart Energy GB.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Overview and administration system

The systems in place are identical across all building sectors. The UK Government has licensed Accreditation Schemes which are permitted to accredit qualified/trained Energy Assessors for producing regulatory outputs in compliance with the Energy Performance of Buildings Regulations. Licenses are under regular review and may be revoked. In December 2016, seven Accreditation Schemes were licensed.

Accredited Energy Assessors must use Government-approved software tools to produce regulatory outputs such as EPCs, recommendations reports, AC inspection reports, etc. Regulatory outputs are recorded on a register (which covers England and Wales) and are publicly available.

Format and content of the EPC

Residential

The EPC provides a calculated energy rating (asset rating) of the current and potential energy efficiency of the building on an A to G scale (Figure 7). The current rating is based on the characteristics of the building, a standardised occupancy profile, and the energy consumption cost. The potential rating shows the effect of undertaking the EPC's recommendations. The average EPC for a residential unit in England & Wales is D, rating 60. Typically, the lowest rating for a new building would be C.

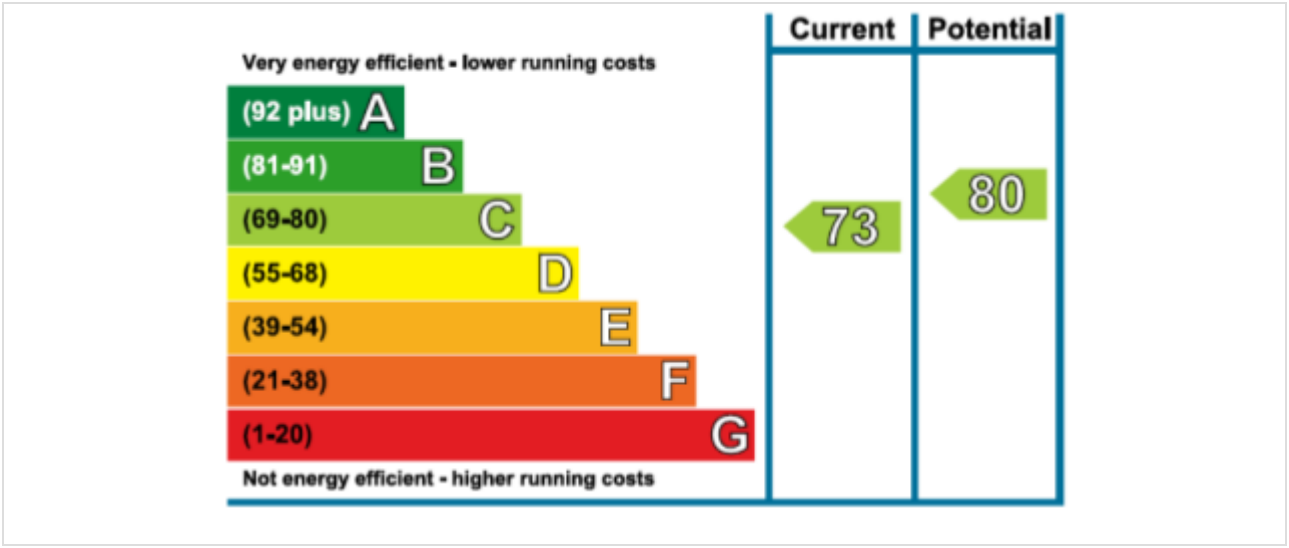
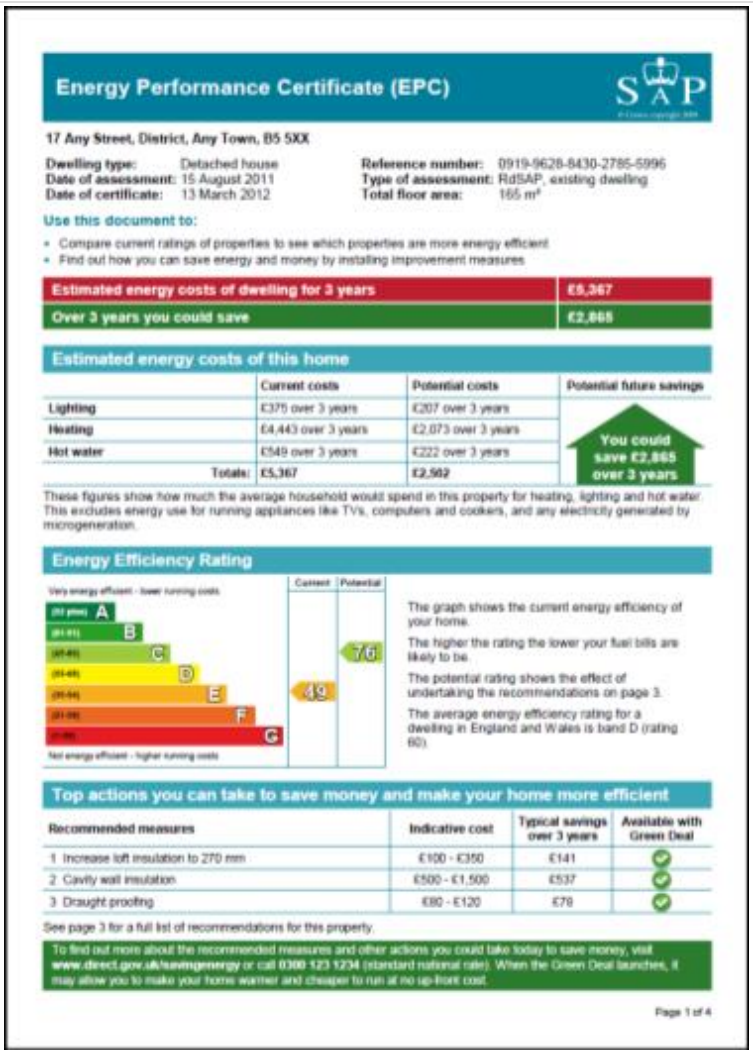


Figure 7: Residential EPC classes, asset ratings, and examples of current and potential ratings.

In 2012, the format of the EPC was revised based on consumer research. The revised residential EPC is shorter, uses plain English and has an improved design. It focuses on potential costs and savings. The first page of a residential EPC is shown in Figure 8.



Energy Performance Certificate (EPC)

17 Any Street, District, Any Town, B5 5XX

Dwelling type: Detached house
Date of assessment: 15 August 2011
Date of certificate: 13 March 2012
Reference number: 0919-9628-8430-2785-5996
Type of assessment: RdSAP, existing dwelling
Total floor area: 165 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years	£5,367
Over 3 years you could save	£2,865

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£375 over 3 years	£207 over 3 years	You could save £2,865 over 3 years
Heating	£4,443 over 3 years	£2,073 over 3 years	
Hot water	£549 over 3 years	£222 over 3 years	
Totals:	£5,367	£2,502	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating

Current | Potential

Very energy efficient - lower running costs
(92 plus) A
(81-91) B
(69-80) C
(55-68) D
(39-54) E
(21-38) F
(1-20) G
Not energy efficient - higher running costs

49 | 76

The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Increase loft insulation to 270 mm	£100 - £350	£141	✓
2 Cavity wall insulation	£500 - £1,500	£537	✓
3 Draught proofing	£80 - £120	£78	✓

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit www.direct.gov.uk/savingenergy or call 0300 123 1234 (standard national rate). When the Green Deal launches, it may allow you to make your home warmer and cheaper to run at no up-front cost.

Page 1 of 4

Figure 8: First page of a residential EPC.

The EPC includes: an environmental impact rating in terms of CO_2 emissions and a list of cost-effective recommendations. It indicates the potential energy efficiency and environmental impact ratings if all cost-effective measures were installed. For new buildings, the current and potential ratings may be identical.

Non-residential

Energy performance is shown as a CO_2-based asset rating against an A to G scale (Figure 9). The EPC includes two benchmarks: the energy rating if the property were new, and the energy rating if it were typical of the existing stock (Figure 10). Standard cost-effective recommendations are generated by the EPC software. Appropriate recommendations are selected by the assessor for inclusion in the Recommendations Report. Bespoke recommendations may also be provided, based on the assessor's knowledge.

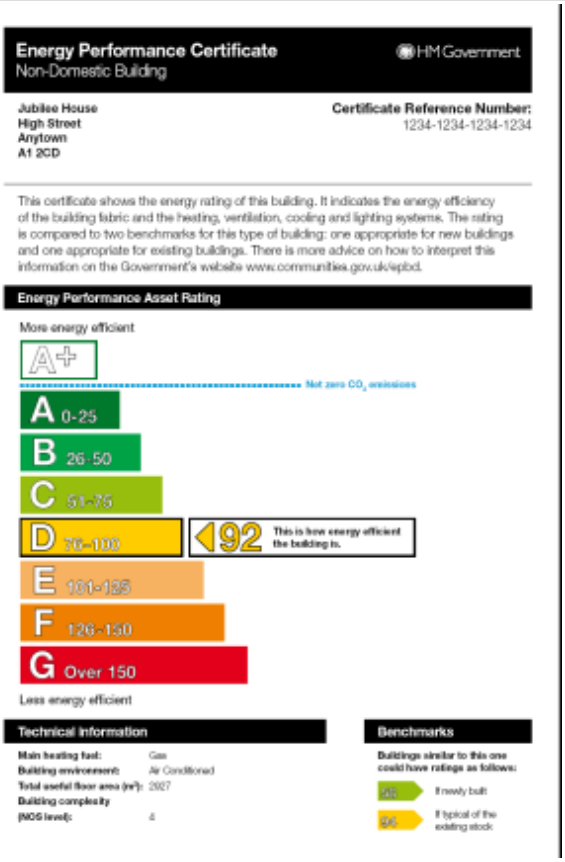


Figure 9: First page of a non-residential EPC.

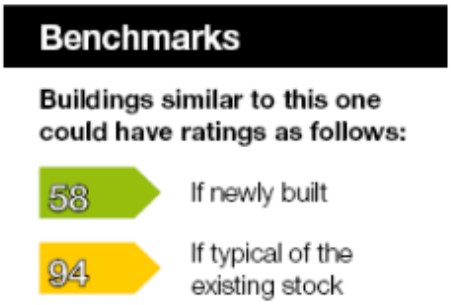


Figure 10: Non-residential EPC benchmarks.

EPC activity levels

Calculated EPCs are produced for buildings on construction, sale and rent, and are valid for 10 years. All EPCs become valid after they are recorded on the register[18]. The register contains ~14.5 million EPCs (including cancelled, "not for issue" and multiple EPCs on a single property) and is growing by ~1 million/year, which represents a valuable source of information as they cover an increasingly larger proportion of the ~27 million UK homes.

Most EPCs on the register are publicly accessible through an address search, unless the building owner opted out. All EPCs on the register are accessible through a unique reference number search. EPCs statistics are also available on the register. Government provides statistics on EPC activity in England & Wales[19]. Data from 2008 to December 2016 is included in Tables 7 and 8, Figures 11 and 12.

	Domestic EPC lodgements by band								
	Total EPCs	A	B	C	D	E	F	G	not recorded
Total	14,453,300	18,870	1,341,598	3,858,620	5,679,040	2,618,980	725,099	210,705	388
Percentage	100%	0.1%	9.3%	26.7%	39.3%	18.1%	5.0%	1.5%	0.0%

Table 7: Residential EPCs, 2008 to December 2016, England.

"not recorded" = faulty EPC (cancelled, withdrawn, etc.).

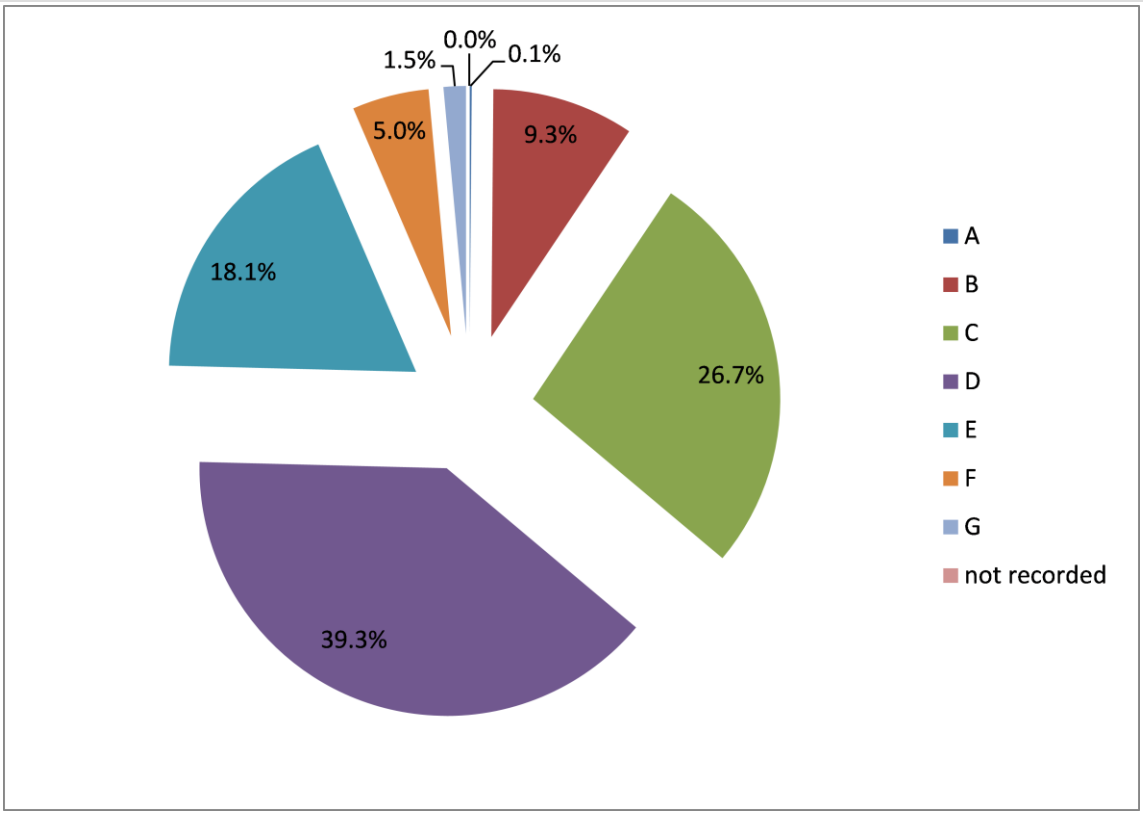


Figure 11: Residential EPCs, 2008 to December 2016, England. Percentages by EPC band.

	Non-domestic EPC lodgements by band									
	Total EPCs	A+	A	B	C	D	E	F	G	not recorded
Total	643,475	365	7,167	50,013	171,427	194,882	106,671	51,093	61,627	230
Percentage	100%	0.1%	1.1%	7.8%	26.6%	30.3%	16.6%	7.9%	9.6%	0.0%

Table 8: Non-residential EPCs, 2008 to December 2016, England.

"not recorded" = faulty EPC (cancelled, withdrawn, etc.).

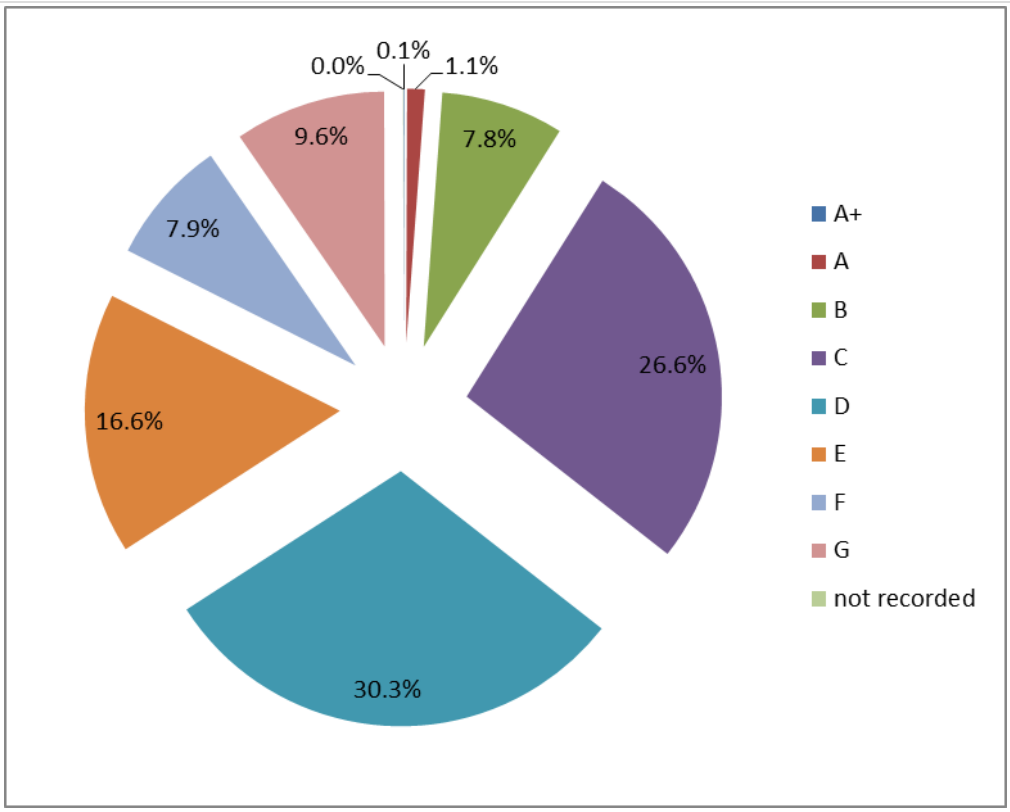


Figure 12: Non-residential EPCs, 2008 to December 2016, England. Percentages by EPC band.

Selected organisations have access to limited bulk data to protect consumers and there is a charge for this service. Benefits of allowing access to this data include supporting other Government energy efficiency programmes and facilitating research and analysis to inform policies.

Typical EPC costs

EPC costs vary significantly. Indicative lowest costs based on internet search:

- for residential EPCs: £35 to £ 60 (~41 € to 70 €);
- for non-residential EPCs: £129 to £150 (~150 € to 174 €).

These costs include the registration fee payable each time an EPC is recorded on the register which range from £1.30 (~2 €) to £9.73 (~11 €).

Assessor corps

National Occupational Standards (NOS) specify the qualifications and skills, which Energy Assessors should meet to be accredited to produce regulatory outputs. Different accreditations are available (Table 9) depending on the building type, the complexity of the building software to be used, and the type of regulatory outputs to be produced. Accreditation Schemes ensure accredited assessors satisfy the NOS requirements through training and examination, or by demonstrating suitable experience.

Assessor types	Assessor numbers
Residential EPCs (existing buildings) RdSAP	58,982
Residential EPCs (new buildings) SAP	4,427
Non-residential EPCs (level 3)	9,205
Non-residential EPCs (level 4)	5,987
Non-residential EPCs (level 5)	745
Display Energy Certificate (DEC)	3,331
AC inspection (level 3, simple)	1,941
AC inspection (level 4, complex)	1,620
Total Assessors	*86,238*

Notes
RdSAP: Reduced Standard Assessment Procedure
SAP: Standard Assessment Procedure
EPC: Energy Performance Certificate
DEC: Display Energy Certificate
AC: Air-Conditioning
EPC level 3: simple non-residential buildings
EPC level 4: medium complexity non-residential buildings
EPC level 5: complex non-residential buildings
AC level 3: simple packaged AC
AC level 4: complex central AC

Table 9: Energy assessor types and numbers notified to the England & Wales register.

The NOS apply across England & Wales, therefore accredited Energy Assessors can operate in both jurisdictions. Minimum Continuous Professional Development (CPD) requirements apply, e.g., non-residential level 5 assessors must complete 7.5 hours/year. Penalties for not meeting the CPD requirement include temporary expulsion from the Accreditation Scheme, which prevents the assessor from producing EPCs.

2.III.ii. Quality Assessment of EPCs

Quality assurance of EPCs

The UK Government introduced Scheme Operating Requirements (SORs) in 2010 with an update in 2012 to ensure all Accreditation Schemes achieve common minimum quality standards.

SORs mandate Accreditation Schemes to undertake Quality Assurance of outputs produced by their accredited Energy Assessors. The Government carries out audits of the quality systems implemented by Accreditation Schemes and compliance with the SORs. These provisions ensure that a statistically significant percentage of certificates is checked.

In the most severe instances the Government may suspend or revoke an Accreditation Scheme's license. To date, Government has made limited use of these powers. The number of EPCs controlled is recorded by Government but is not published. Similarly, Accreditation Schemes may revoke an Energy Assessor's license to operate.

Compliance levels by sector

The Government does not monitor compliance. Compliance is verified by Local Authorities which are not required to publish compliance assessment outcomes. There is no central national body recording compliance.

Enforcement with building owners and real estate actors

Local Authorities Trading Standard Officers (TSOs) have the powers to require the "relevant person" (e.g., the seller, the prospective landlord or the constructor) to produce copies of the EPC for inspection. In 2012, these powers were extended to include persons acting on behalf of the "relevant person", e.g., the Estate or Letting Agents.

Penalties for non-compliance vary depending on building types:

- for residential properties, the penalty is £200 (~232 €);
- for non-residential properties, the penalty is 12.5% of the rateable value of the building, subject to a minimum of £500 (~580 €) and a maximum of £5,000 (~5,800 €).

The Government does not collect data about the number of penalties issued by Local Authorities for non-compliance.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Overview

The approach depends on the type of occupier and the building's floor area (Table 10). Diplay Energy Certificates (DECs) are issued and displayed in buildings > 250 m² that are occupied by a public authority and frequently visited by the public. EPCs are displayed in commercial premises > 500 m² that are frequently visited by the public, and where an EPC has previously been issued.

Occupier	Floor area	Requirements	Validity
Public authority*	>250 m^2	Produce and display a DEC	10 years
		Produce a Recommendation Report	10 years
	>1,000 m^2	Produce and display a DEC	1 years
		Produce a Recommendation Report	7 years
Commercial premises*	>500 m^2	If an EPC has been produced (for construction, sale or rent), the EPC must be displayed**	10 years
(*) The building must be frequently visited by the public.			
(**) EPCs must be accompanied by a Recommendation Report.			

Table 10: Energy performance display requirements

EPCs are based on calculated energy consumption. DECs are based on measured energy, normalised to allow cross sector comparison. Annual DECs are only required for public authority buildings with a floor area > 1,000 m^2 (Table 10).

Format and content of DECs

DECs show the performance of a building based on actual energy consumption for the previous year in the form of an Operational Rating (OR), Figure 13. If available, the building's performance over the previous three years is shown to illustrate the performance trend. The OR is a numerical indicator of a building's CO_2 emissions on an A to G scale.

Display Energy Certificate

HM Government

How efficiently is this building being used?

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Anytown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

More energy efficient

A 0-25
B 26-50
C 51-75
D 76-100

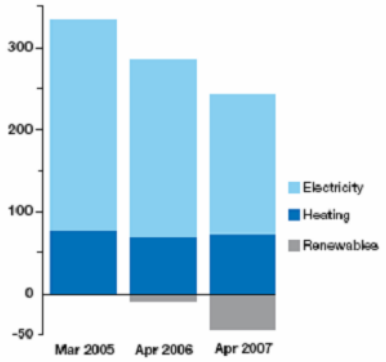
100 would be typical

E 101-125 ◀108
F 126-150
G Over 150

Less energy efficient

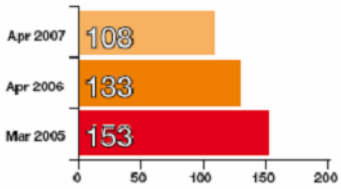
Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2.



Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods



Technical information

This tells you technical information about how energy is used in this building. Consumption data based on actual readings.

Main heating fuel:	Gas
Building Environment:	Air Conditioned
Total useful floor area (m^2):	2927
Asset Rating:	92

	Heating	Electrical
Annual Energy Use (kWh/m^2/year)	126	129
Typical Energy Use (kWh/m^2/year)	120	95
Energy from renewables	0%	20%

Administrative information

This a Display Energy Certificate as defined in SI2007:991 as amended.

Assessment Software:	OR v1
Property Reference:	891123776612
Assessor Name:	John Smith
Assessor Number:	ABC12345
Accreditation Scheme:	ABC Accreditation Ltd
Employer/Trading Name:	EnergyWatch Ltd
Employer/Trading Address:	Alpha House, New Way, Birmingham, B2 1AA
Issue Date:	12 May 2007
Nominated Date:	01 Apr 2007
Valid Until:	31 Mar 2008
Related Party Disclosure:	EnergyWatch are contracted as energy managers

Recommendations for improving the energy efficiency of the building are contained in Report Reference Number 1234-1234-1234-1234

Figure 13: Display Energy Certificate (DEC).

The building's performance is compared to a benchmark specific to its category. Benchmarks are reviewed periodically to ensure they are adequate. Buildings with zero CO_2 emissions or net energy generators achieve an OR of zero. Buildings, which perform at the benchmark level, achieve an OR of 100 at the D to E boundary. Buildings, which emit twice as much CO_2 as the benchmark, achieve an OR of 200. The approved benchmarks are set out in Energy Benchmarks (TM46)[20]. DECs are accompanied by a Recommendation Report, which includes cost-effective recommendations and has a maximum validity of seven or 10 years (Table 10). DEC record data from 2008 to December 2016 is included in Table 11 and Figure 14.

DEC lodgements by band									
	Total	A	B	C	D	E	F	G	not recorded
Total	269,281	1,939	14,476	55,357	92,942	59,016	22,960	22,585	6
Percentage	100%	0.7%	5.4%	20.6%	34.5%	21.9%	8.5%	8.4%	0.0%

"not recorded" = faulty EPC (cancelled, withdrawn, etc.).

Table 11: Display Energy Certificates (DECs), 2008 to December 2016, England.

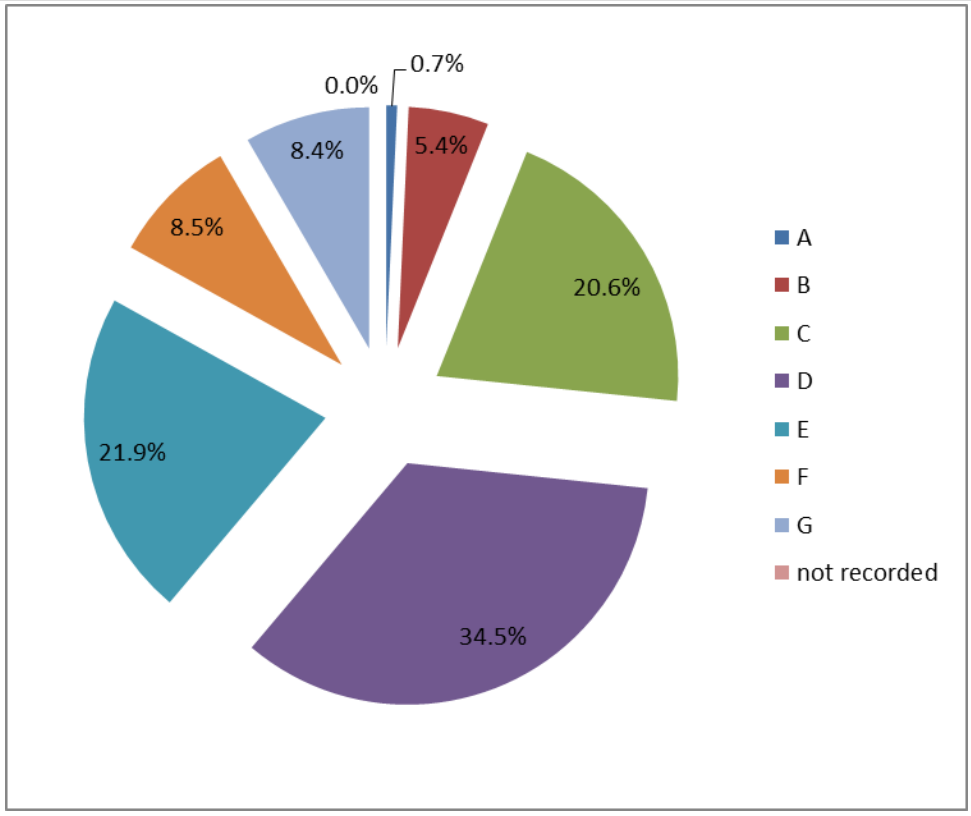


Figure 14: Display Energy Certificates (DECs), 2008 to December 2016, England. Percentages by band.

DEC costs vary greatly. Indicative lowest market costs (based on internet search) range from £80 to £175 (~93 € to 203 €). These costs include the registration fee (£9.73 = ~11 €) payable each time a DEC is recorded on the non-residential register.

2.III.iv. Implementation of mandatory advertising requirement – status

Sellers and landlords are responsible for commissioning an EPC before the property is marketed. Estate or Letting Agents (acting on behalf of sellers or landlords) must be satisfied that an EPC is available or has been commissioned before the property is marketed.

Since 2013, for buildings on sale or rent that have a valid EPC, the Asset Rating of the building expressed in the EPC must be stated in any advertisement of the sale or rental in commercial media.

The enforcement and penalty regimes are as described for EPCs above.

2.IV Inspection requirements – heating systems, air conditioning

The UK adopted alternative measures for heating systems and inspections for AC systems. The UK-wide Energy Savings Opportunity Scheme (ESOS)[21] transposes the requirements of EED Article 8 ESOS allows compliance with EED Article 8 through the use of DECs. The inspection of AC systems and the alternative measures adopted for heating systems are not recognised by ESOS but they would likely be considered when undertaking ESOS.

2.IV.i. Report on equivalence of model A and B for Heating Systems

The UK decided to provide advice on boilers/heating systems, rather than implement an inspection regime. This is in continuation of the extensive programme of information, grant schemes and regulation which the UK has implemented historically. Equivalence reports were issued to the Commission in 2007, 2010 and 2013. The fourth report is being prepared and the information below is based on the 2013 report.

The 2013 report found that the UK's alternative measures would produce a primary energy saving of 4.27 TWh during the period 2013 to 2015. In comparison, a boiler inspection regime would produce a saving of 1.14 TWh, thus justifying the UK's preferred approach.

2.IV.ii. Progress and current status on heating systems

Activities to improve energy performance of heating systems

The alternative measures identified in the 2013 report are:

(1) The carbon emissions reduction target (early replacement of band G boilers).

(2) The community energy savings programme (energy suppliers/generators to deliver energy saving to residential consumers in low-income areas).

(3) Fuel poverty programmes in the UK (to improve identification and targeting of existing help to fuel poor customers).

(4) The energy company obligation – affordable warmth obligation (to obligate larger energy suppliers to deliver energy efficiency measures to residential premises).

(5) Green deal non-residential heating measures (to finance energy efficiency measures).

(6) Advice programmes and guidance encouraging boiler inspections leading to adjustments, installation of improved controls and early boiler replacements.

Building regulations requirements for heating systems – particularly the need to install condensing boilers – have not been included as an alternative measure, although the specific performance requirements are integral to all of the above alternative measures.

Impact and equivalence assessment

The impact of the alternative measures is detailed in Table 12.

Alternative measure	Primary energy saving (2013-2015) (TWh)
The carbon emissions reduction target	2.41
The community energy saving programme	0.40
UK fuel poverty programmes	0.68
Energy company obligation – affordable warmth obligation	0.65
Green deal – non-residential heating measures	0.13
Advice programmes	0.003
Total	**4.27**

Table 12: Primary energy savings attributable to alternative measures, UK 2013 Equivalence Report.

The UK boiler stock model was updated to estimate the savings (Table 13) that would result from a hypothetical boiler inspection regime that extended the existing boiler inspection regime and met the requirements.

Sector	Measure	Primary energy saving (2013-2015) (TWh)
Residential	Boiler adjustment	0.11
	Implementation of controls guidance	0.21
	Early boiler replacement	0.25
	Subtotal	0.57
Non-residential	Boiler adjustment	0.53
	Early boiler replacement	0.05
	Subtotal	0.57
Grand total		**1.14**

Table 13: Primary energy savings attributable to boiler inspection regime, UK 2013 Equivalence Report.

2.IV.iii. Progress and current status on AC systems

Overview, technical method and administration system

AC inspections were phased in between 2009 (systems > 250 kW) and 2011 (systems > 12 kW). Installations must be inspected by an accredited Energy Assessor at least every five years.

From 2012, all new AC inspection reports must be registered on the EPC register for England & Wales which allows Qquality Assurance. The report is publicly accessible from the Register using the building address or the report reference number.

Arrangements for assurance, registration and promotion of competent persons

Inspection of Air-conditioning Systems (TM 44)[22] sets out good practice for AC inspections. The Chartered Institution of Building Service Engineers (CIBSE) is one of the main professional institutions for building services engineers.

NOS and SOR have been established for AC inspections. NOS provide two levels of accreditation for assessors: “Level 3” for simple packaged cooling systems, and “Level 4” for complex, centralised systems. SOR define minimum requirements for Accreditation Schemes and address the quality assurance of AC reports.

Promotional activities

Publicity campaigns were run in 2008 and 2009 to introduce a range of initiatives, including AC inspections. The Government has not run promotional activities focused solely on AC inspections.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Local Authorities Trading Standard Officers (TSOs) are responsible for ensuring that owners of AC systems (> 12 kW) possess a valid inspection report. The penalty for non-compliance is £300 (~348 €).

TSOs are required to record their enforcement action and publish a report annually.

Quality control of inspection reports

Over 62,000 AC reports are recorded on the England & Wales register. About 34,000 reports were registered between 2014 and 2016. It is difficult to estimate how many reports were produced before mandatory registration came into effect.

Impact assessment.

The impact assessment[23] estimated a cost for AC inspection in England & Wales of ~£149 million (~173 M€) and benefits (improved performance, reduced operating costs, added stimulus for improvements) of ~£213 million (~247 M€). The net benefit is ~£64 million (~74 M€), with CO_2 savings in the year 2020 at ~0.08 million tonnes.

3. A success story in EPBD implementation

Although not required by the EPBD, an EPC register was established in 2008, when EPBD requirements were first implemented. Regulatory outputs must be entered on the register before they are given to the person who requested them. All documents on the register are retained for 20 years minimum.

The register allows historic documents to be retrieved, Quality Assurance, and dissemination of certificates and reports. The register also supports enforcement activities, reduces fraud, and allows statistical analysis to inform policies and improve knowledge of the building stock.

In 2013, an analysis of DECs in England & Wales suggested that Operational Ratings (Figure 15) and energy consumption fell for public sector buildings with DECs. Comparing private sector offices to public sector offices with DECs provided tentative evidence to suggest that DECs had a slight impact on the energy performance (Figure 16).

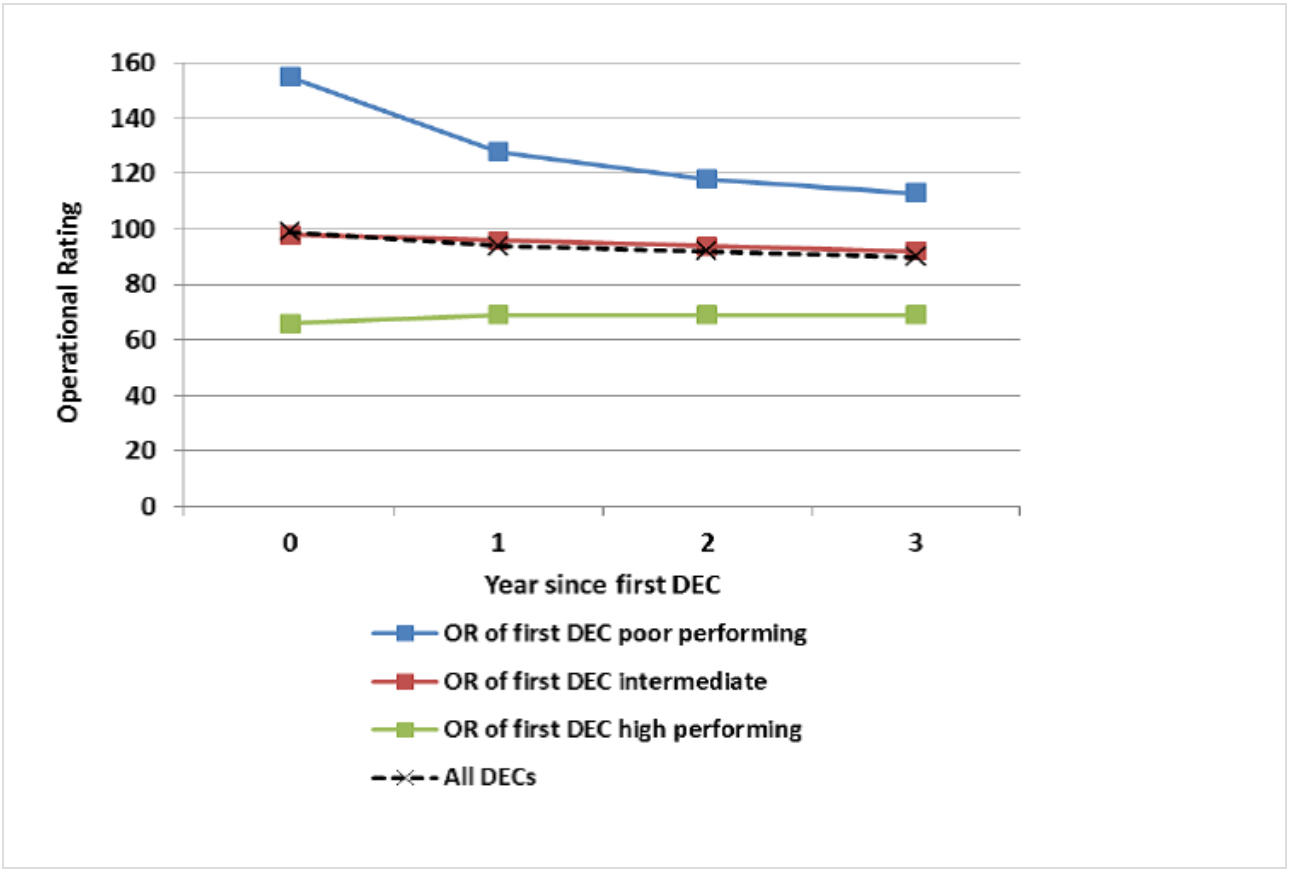


Figure 15: Trend in median OR, based on performance of first DEC[24].

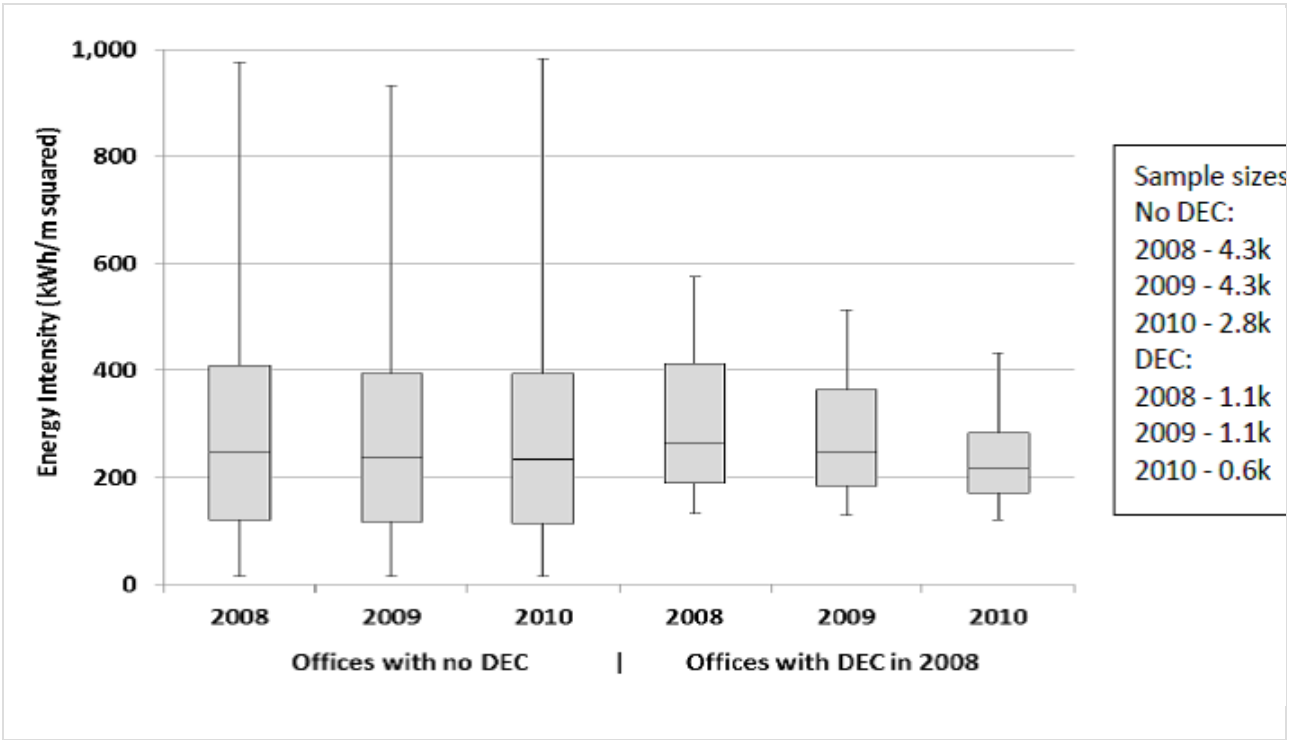


Figure 16: Comparing private sector offices with no DEC to public sector offices with a DEC (offices with DEC in 2008)[xxiv].

4. Conclusions, future plans

The UK is divided into four jurisdictions. In some instances, the mix of approaches transposing the requirements of the EPBD differs between jurisdictions. In other cases, similar approaches were adopted by two or more jurisdictions.

Overall, the 2013 Building Regulations in England were expected to improve the performance of new residential units by 6% and non-residential buildings by 9% over the previous (2010) standards. Government will keep energy standards under review, including assessing cost effectiveness/ cost-optimality to determine whether any strengthening of standards is required.

The transposition of the EPBD and its benefits are being reviewed by each jurisdiction as part of their programmes to achieve national energy efficiency objectives and carbon emissions reduction.

In some instances, these reviews validated the current implementation approach. In other cases, the reviews resulted in changes, such as the 2012 updates of the residential EPC adopted in England, Wales and Scotland. Changes have and will continue to be made to the implementation instruments where deemed appropriate.

Endnotes

1. For more information visit www.gov.uk/guidance/devolution-of-powers-to-scotland-wales-and-northern-ireland
2. Fixing the foundations: Creating a more prosperous nation, HM Treasury, July 2015
3. The Approved Documents (ADs) are available at: www.gov.uk/government/collections/approved-documents
4. www.gov.uk/government/collections/approved-documents
5. www.uk-ncm.org.uk
6. www.uk-ncm.org.uk/, www.bre.co.uk/sap2012/page.jsp?id=2759
7. webarchive.nationalarchives.gov.uk/20150728221852, www.planningportal.gov.uk/buildingregulations/approveddocuments/partl/bcassociateddocuments9/acd
8. Building control bodies are, e.g., the building control department of the local authority, or an approved inspector.
9. www.competentperson.co.uk
10. In England, Building Regulations 2010 were used as the 2013 update was not finalised at the time of the cost-optimal study.
11. http://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/nearly-zero-energy-buildings
12. More information at www.bsria.co.uk/services/design/softlandings

13. Government Soft Landings, Cabinet Office, April 2013 available at: www.bimtaskgroup.org/wp-content/uploads/2013/05/Government-Soft-Landings-Section-1-Introduction.pdf

14. Central Government Departments refer to the Departments of the UK Government. For more information visit: www.gov.uk/government/organisations

15. Evidence Check: Smart metering of electricity and gas Contents, Appendix 1: The Government's smart metering evidence check statement, UK Parliament 2016 www.publications.parliament.uk/pa/cm201617/cmselect/cmsctech/161/16111.htm

16. UK National Energy Efficiency Action Plan, Department of Energy & Climate Change, April 2014

17. Approved Documents: AD L1B and AD L2B for existing residential and existing non-residential buildings respectively.

18. Residential register (England and Wales) www.epcregister.com; non-residential register (England and Wales for certificates and AC inspection reports) www.ndepcregister.com

19. www.gov.uk/government/collections/energyperformanceofbuildingscertificates

20. Energy Benchmarks, TM 46: 2008, Chartered Institution of Building Services Engineers (CIBSE)

21. www.gov.uk/guidance/energy-savings-opportunity-scheme-esos

22. Inspection of air conditioning systems. A guide to EPBD compliance. Technical Memorandum (TM) 44: 2012. Chartered Institution of Building Service Engineers (CIBSE)

23. Regulatory Impact Assessment Energy Performance of Buildings Directive Articles 7-10. Department for Communities and Local Government. March 2007

24. Extracted from "Special Feature, What is the impact of DECs?" DECC, June 2013

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The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the views of the European Commission. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the United Kingdom - Wales

Status in December 2016

AUTHORS

Lionel Delorme, *AECOM*
Francois Samuel, *Welsh Government*

NATIONAL WEBSITES
www.wales.gov.uk/topics/planning/buildingregs/?lang=en

1. Introduction

This report provides information about the implementation of the EPBD in Wales. It updates the previous reports published in 2010, 2012 and 2016. The implementation of the EPBD in the other three UK jurisdictions (England, Scotland and Northern Ireland) is addressed in separate reports.

From 31 December 2011, Wales became responsible for its own Building Regulations. Prior to this date, EPBD requirements were implemented across England and Wales with no distinction. Today, the implementation of the EPBD in Wales is shared between the Welsh Government (WG) responsible for Building Regulations, and the UK Department for Communities and Local Government (DCLG) responsible for the Energy Performance of Buildings Regulations in England and Wales.

This report introduces the Wales-specific requirements. Requirements that are common to England and Wales are detailed in the England report and have not been repeated in this one.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status

Figures 1 and 2 show simplified historical Building Regulations improvements in Wales for new buildings. The graphs are based on the 2006 Regulations (the reference year), historical improvements for 2010 and 2014, and Government announcements for 2017 and 2020. Note that the 2006 and 2010 Regulations

applied across England and Wales, whereas the 2014 Regulations apply to Wales only, following the devolution of powers to the Welsh Government in 2011.

The 2014 amendments to the Building Regulations set energy performance requirements for new and existing buildings. The Regulations were strengthened to deliver improved CO_2 savings over the previous Regulations i.e., 8% across new residential buildings and 20% across new non-residential buildings. Changes to existing building requirements were also introduced in 2014.

Further changes to the Building Regulations will be required to achieve the Government's NZEB commitment for all new buildings by 2018/2020. A review of Building Regulations' energy performance requirements ("Part L") is scheduled for 2017 for all building types.

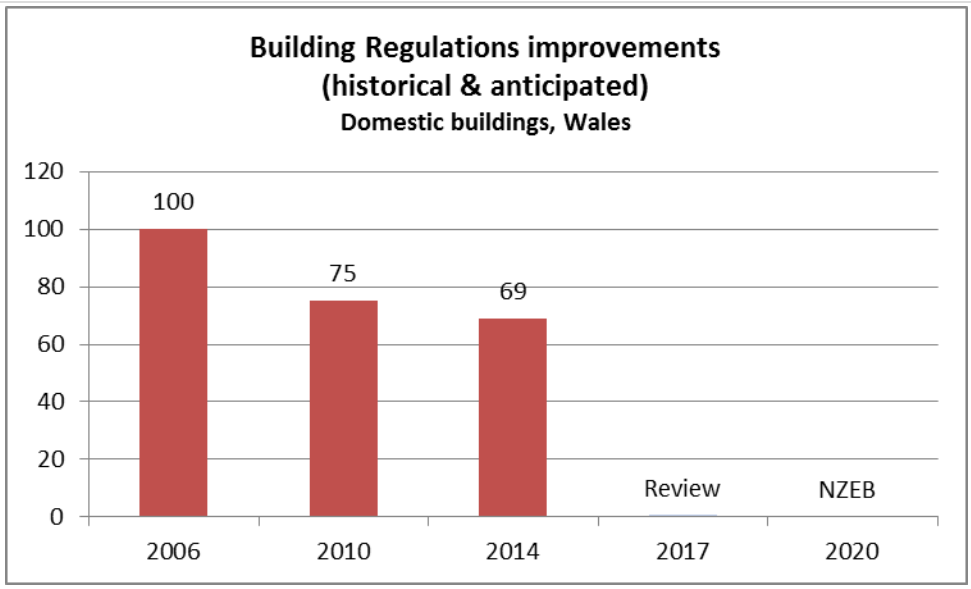


Figure 1. New residential Building Regulations improvements, Wales.

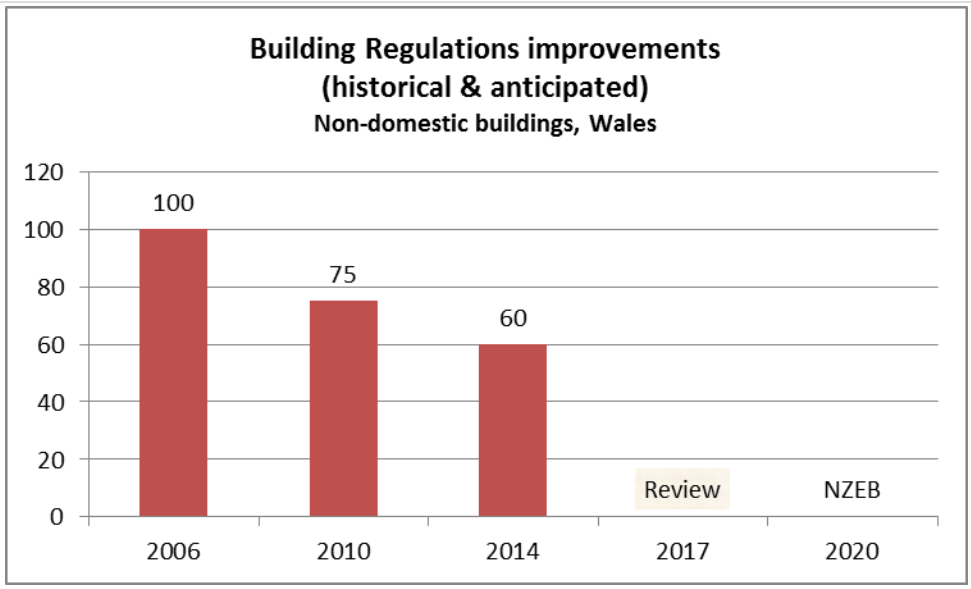


Figure 2. New non-residential Building Regulations improvements, Wales.

2.I.ii. Format of national transposition and implementation of existing regulations

Wales adopted a similar approach to England, i.e., four "Approved Documents" (ADs) which provide a route to comply with Building Regulations. Five criteria are set for new residential and non-residential buildings (Table 1).

Criteria	Definitions
1	Ensure that the calculated Building CO_2 Emission Rate is no greater than the target. For non-residential buildings only, ensure that the Building Primary Energy Consumption is not greater than the target.
2	Meet limits on design flexibility, including minimum fabric standards and building services efficiencies.
3	Ensure appropriate passive control measures to limit summer heat gains, including the effect of shading devices and comfort assessment.
4	Ensure the "*as built*" building performance (including fabric and fixed building services) is consistent with design calculations.
5	Provide information for energy efficient building operation.

Table 1. Requirements for new buildings, Wales.

As with England, these requirements are included in the National Calculation Methodology (NCM) and compliance is demonstrated by using Government-approved software. The Welsh Approved Documents allow the use of Accredited Construction Details (ACDs) to demonstrate compliance. Wales adopted the English ACDs[1]. Figure 3 gives an example. Compliance checks are similar to England, using Building Control Bodies (BCBs) and "*Competent Persons*". See England report for details.

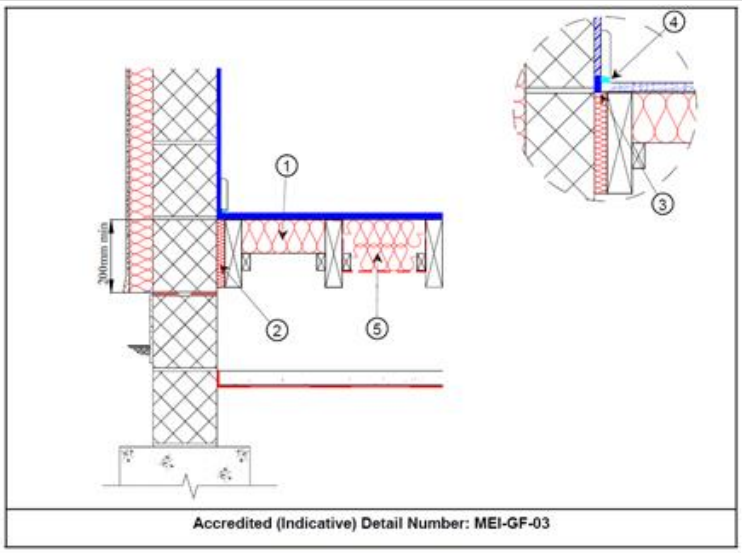


Figure 3. ACD for Timber Suspended Ground Floor. Extracted from ACDs for Masonry External Wall insulation.

Cost-optimal procedure for setting energy performance requirements

A UK-wide cost-optimal report, which addresses Wales, was published in May 2013. See England report for details. The report is expected to be updated in 2017 in line with EPBD requirements.

2.I.iii. Action plan for progression to NZEB

The current Building Regulations incorporate NZEB. Regulation 25B[2] states: "*Where a building is erected, it must be a nearly zero-energy building.*" and implementation dates align with the EPBD.

A review of Building Regulations Part L is scheduled to commence in 2017. The review is intended to deliver, as a minimum, cost-optimal NZEB standards to be applied to new public buildings from 2018 and all new buildings from 2020.

National application of the NZEB definition

NZEB statistics are not maintained in Wales. Figure 4 shows historical records of EPCs for energy classes A and A+. The graph shows an upward trend for both residential and non-residential sectors. Note that new building construction rates will also affect these data.

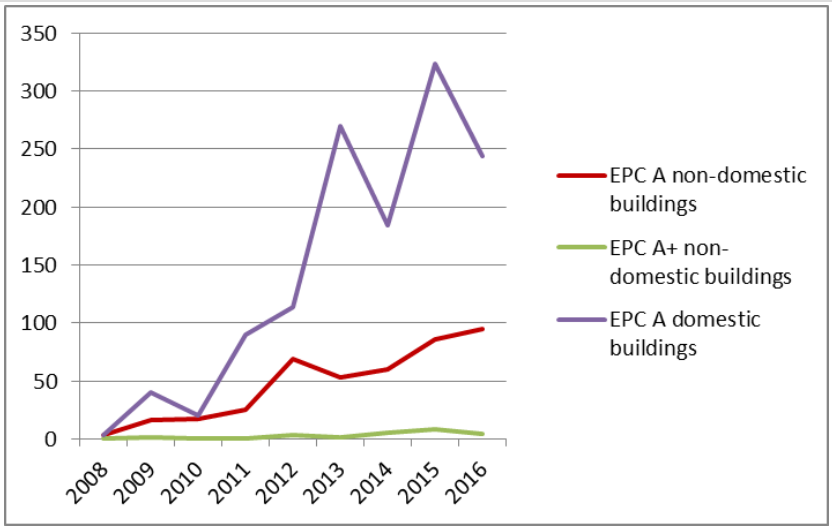


Figure 4. Historical EPC A/A+ records for residential and non-residential buildings in Wales.

2.I.iv. Requirements for systems and / or building components

Wales adopted the same approach as England, where the "Domestic and Non-domestic Building Services Compliance Guides" recommend minimum energy efficiency standards. See England report for details.

The commissioning of technical building systems is addressed in the Approved Documents and the Building Services Compliance Guides. They require commissioning to be done in accordance with relevant industry guidance, e.g., the Chartered Institution of Building Service Engineers (CIBSE)[3] Commissioning Code M: Commissioning management.

2.II. Energy performance requirements: EXISTING BUILDINGS

The UK National Energy Efficiency Action Plan (NEEAP)[4] gives a statistical overview of the UK building stock. See England report for details.

Wales has about 1.3 million homes. Figures 5 and 6 show the distribution of >800,000 residential EPCs and >32,000 non-domestic EPCs in Wales. Buildings with no EPCs are not represented.

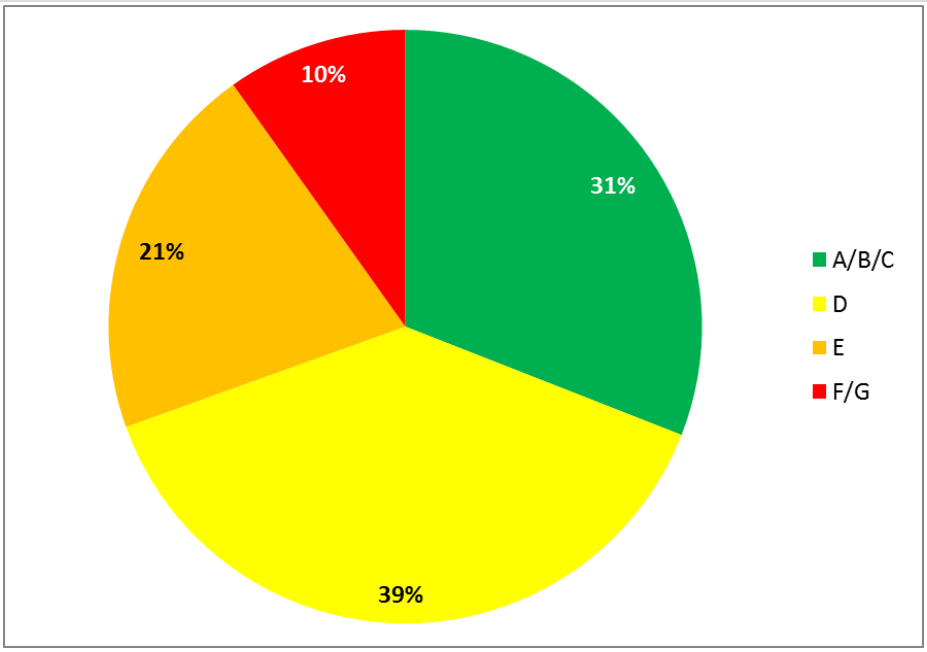


Figure 5. Distribution of residential EPCs in Wales, 2008 to December 2016.

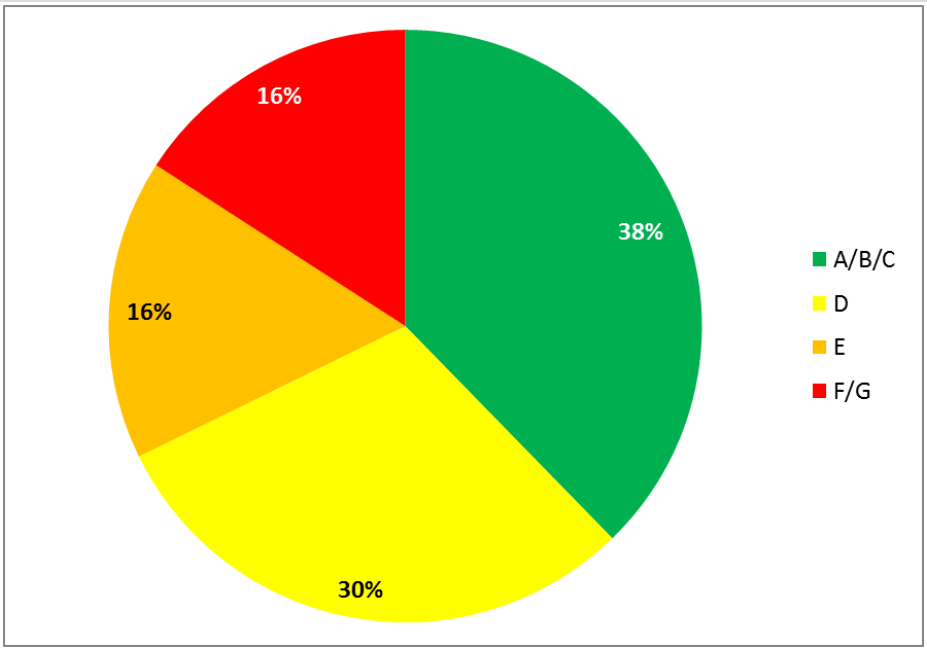


Figure 6. Distribution of non-residential EPCs in Wales, 2008 to December 2016.

2.II.i. Progress and current status of existing buildings

Similarly to England, an elemental approach has been adopted for existing buildings. See England report for details. The 2014 revision of the Building Regulations introduced consequential energy performance improvements to all existing buildings that are extended.

2.II.ii. Plans to improve the existing building stock

The 2014 UK National Energy Efficiency Action Plan includes a Building Renovation Strategy in compliance with EED Article 4. The Welsh policies and programmes to deliver this strategy include:

- the National Energy Efficiency and Savings Plan (2011);
- the Fuel Poverty Strategy (2010);
- "Nest", a fuel poverty programme that provides energy efficiency advice, alongside installation of "whole house" measures, for qualifying properties;
- "Arbed" a whole house retrofit programme;
- the availability of an additional funding to leverage investment from the Energy Company Obligation (ECO);
- Building Regulations updates which include consequential improvements for all existing residential and non-residential buildings when extension or renovation work is undertaken.

The UK decided to implement the alternative approach allowed by Article 5(6). See England report for details. The Welsh Government's Climate Change Strategy aims to cut emissions from the Welsh Government estate by at least 30% in 2019/2020 from a 2010/2011 baseline. The Welsh Government estimates that the Strategy will save 3.4 GWh of energy which will contribute towards the UK equivalence target of 163.6 GWh savings.

2.II.iii. Regulation of system performance, distinct from whole building performance

See England report for details.

2.II.iv. Encouragement of intelligent metering

See England report for details.

2.II.v. Financial instruments and incentives for existing buildings

See UK National Energy Efficiency Action Plan details above.

2.II.vi. Information campaigns / complementary policies

"Resource Efficient Wales"[5] is a single point of contact to help people and organisations in Wales access information, advice and support on:

- using energy more efficiently;
- generating renewable energy;
- using water more efficiently; and
- reducing material waste.

The service helps people and organisations understand how they can reduce their energy use and bills through changing their behaviour and installing suitable measures within buildings. The service contains a mixture of information and advice, combined with more detailed and bespoke advice in addition to ensuring that people are aware of the wider initiatives and incentive schemes that are available.

2.III. Energy performance certificate requirements

The Energy Performance of Buildings Regulations apply to both England and Wales. See England report for details.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Tables 2 & 3 and Figures 7 & 8 provide Wales-specific data.

	Domestic EPC lodgements by band								
	Total EPCs	A	B	C	D	E	F	G	not recorded
Total	823,247	1,288	57,147	196,326	317,500	169,911	57,875	23,178	22
Percentage	100%	0.2%	6.9%	23.8%	38.6%	20.6%	7.0%	2.8%	0.0%

Table 2. Residential EPCs, 2008 to December 2016, Wales.

"not recorded" = faulty EPC (cancelled, withdrawn, etc.)

	Non-domestic EPC lodgements by band									
	Total EPCs	A+	A	B	C	D	E	F	G	not recorded
Total	32,072	22	424	2,722	8,920	9,629	5,257	2,412	2,673	13
Percentage	100%	0.1%	1.3%	8.5%	27.8%	30.0%	16.4%	7.5%	8.3%	0.0%

Table 3. Non-residential EPCs, 2008 to December 2016, Wales.

"not recorded" = faulty EPC (cancelled, withdrawn, etc.)

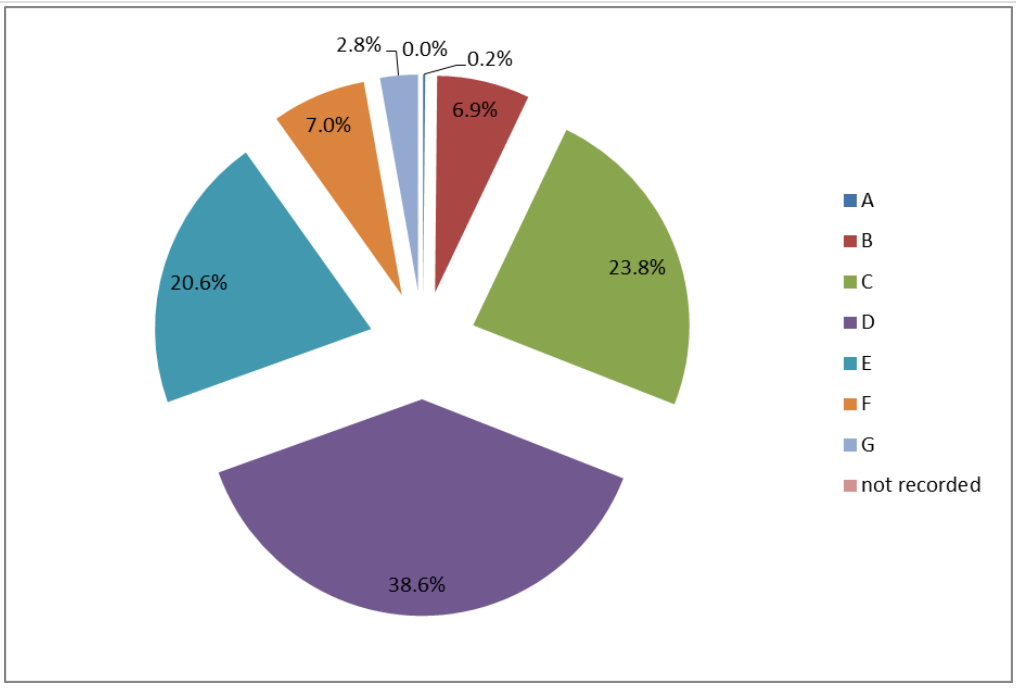


Figure 7. Residential EPCs, 2008 to July 2014, Wales. Percentages by EPC band.

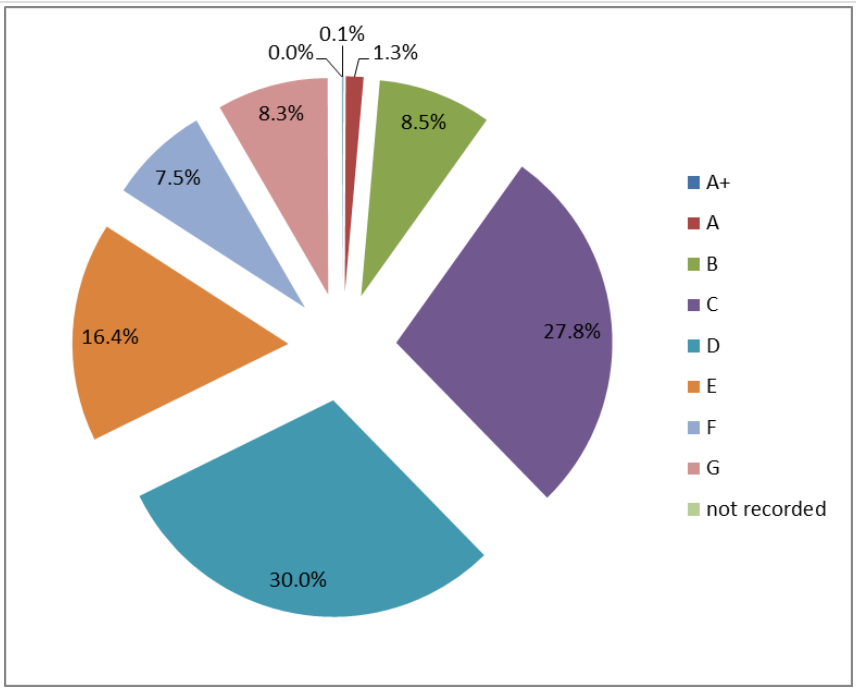


Figure 8. Non-residential EPCs, 2008 to July 2014, Wales. Percentages by EPC band.

2.III.ii. Quality Assurance of EPCs

Wales adopted the same approach as England. See England report for details.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Wales adopted the same approach as England. See England report for details. Display Energy Certificates (DECs) data from 2008 to December 2016 is included in Table 4 and Figure 9.

	DEC lodgements by band								
	Total	A	B	C	D	E	F	G	not recorded
Total	16,589	182	1,360	4,903	5,606	2,637	915	978	8
Percentage	100%	1.1%	8.2%	29.6%	33.8%	15.9%	5.5%	5.9%	0.0%

Table 4. Display Energy Certificates (DECs), 2008 to December 2016, Wales.

"not recorded" = faulty EPC (cancelled, withdrawn, etc.)

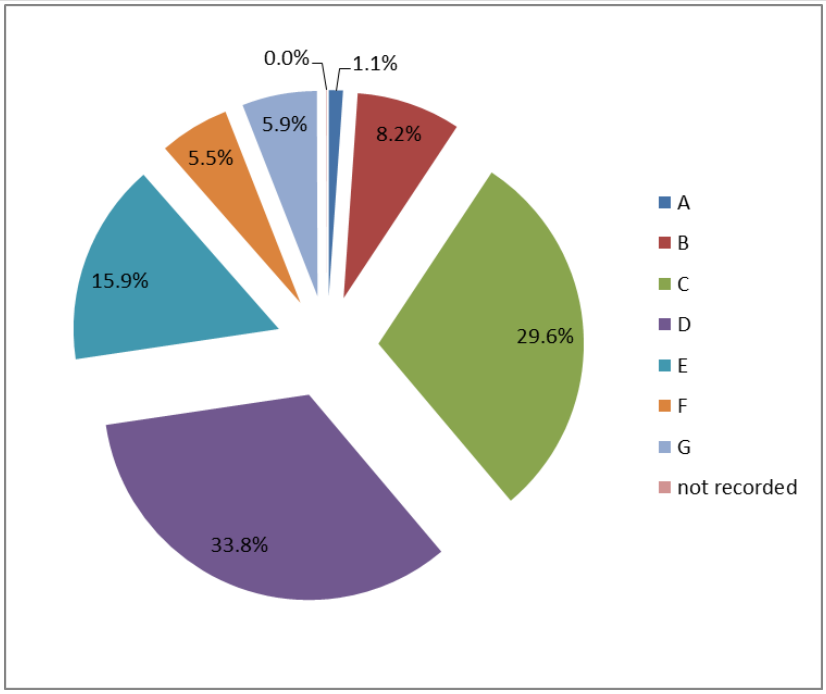


Figure 9. Display Energy Certificates (DECs), 2008 to December 2016, Wales. Percentages by DEC band.

2.III.iv. Implementation of mandatory advertising requirement - status

Wales adopted the same approach as England. See England report for details.

2.IV Inspection requirements - heating systems, air conditioning

The UK[6] adopted alternative measures for heating systems and inspections for AC systems. Wales-specific programmes include "Nest" and "Arbed" which aim to address fuel poverty. "Nest" also provides access to advice and support. See England report for details.

2.IV.i. Report on equivalence of model A and B for Heating Systems

See England report for details.

2.IV.ii. Progress and current status on heating systems

See England report for details.

2.IV.iii. Progress and current status on AC systems

See England report for details.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Activity level and statistics on penalties already levied. Ref. Article 27

Quality control of inspection reports

Ref. Art. 18 and Annex II

Impact assessment

See England report for details.

3. A success story in EPBD implementation

The Welsh Government "Warm Homes" programme, which includes the "Warm Homes Nest" and "Warm Homes Arbed" schemes, is designed to improve the energy efficiency of existing housing, targeting low income households or those living in the most deprived areas of Wales.

"Warm Homes Nest"[7] is a demand-led fuel poverty scheme. It combines free impartial advice and support to help reduce energy bills with a package of free home energy improvement measures to eligible low-income households living in the most energy inefficient homes.

"Warm Homes Arbed"[8] is a strategic area-based fuel poverty scheme focused on improving the energy efficiency of homes in some of the most deprived areas. Arbed aims to reduce the carbon footprint of Wales' existing housing stock and, in doing so, provide resilience for households against rising energy costs.

Welsh Government "Warm Homes"[9] programme takes a whole house approach to improving the energy efficiency, making homes more efficient and cheaper to heat. Between 2014 and 2016, the Welsh Government invested over £117 million (~136 M€) in Warm Homes. This enabled the provision of advice and support to over 28,000 households and an improvement in the energy efficiency of over 17,000 homes.

"Warm Homes Nest and "Warm Homes Arbed" are designed to leverage additional funding from sources such as the Energy Company Obligation (ECO) with Warm Homes Nest leveraging in over £5.5 million (~6 M€) of ECO funding between 2014 and 2016.

4. Conclusions, future plans

The UK is divided into four jurisdictions. Historically, England and Wales shared the same Building Regulations. In 2011, Wales became responsible for its own Building Regulations, and the new Welsh Regulations came into force in 2014.

The 2014 Building Regulations in Wales were expected to improve new residential units' performance by 8% and non-residential buildings by 20% over the previous standards. A Primary Energy Consumption target for new non-residential buildings and improved minimum fabric standards for new residential units were introduced with an emphasis on reducing energy demand.

A review of the energy performance requirements within the Building Regulations is scheduled for 2017, to consider the next step in the Welsh commitment to NZEB by 2018/2020.

Regulations for the Energy Performance of Buildings, including EPCs, cover both England and Wales.

Endnotes

1. Available at www.planningportal.gov.uk.
2. Regulation 25B: www.legislation.gov.uk/wsi/2013/747/regulation/15/made
   Coming into force date: www.legislation.gov.uk/wsi/2013/747/schedule/made
3. CIBSE Commissioning Codes: www.cibse.org/knowledge/cibse-publications/cibse-commissioning-codes
4. UK National Energy Efficiency Action Plan, Department of Energy & Climate Change, April 2014
5. www.resourceefficient.gov.wales
6. The UK refers to England, Wales, Scotland and Northern Ireland
7. www.nestwales.org.uk/
8. http://arbed.org/en/home; www.warmwales.org.uk/arbed-energy-saving-program-underway/
9. http://gov.wales/topics/environmentcountryside/energy/efficiency/warm-homes/?lang=en

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the United Kingdom - Northern Ireland

Status in December 2016

AUTHORS

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NATIONAL WEBSITES

www.finance-ni.gov.uk/topics/building-regulations-and-energy-efficiency-buildings

1. Introduction

This report provides information about the implementation of the EPBD in Northern Ireland. It updates the previous reports published in 2010, 2012 and 2016. The implementation of the EPBD in the other three UK jurisdictions (England, Wales and Scotland) is addressed in separate reports.

The implementation of the EPBD in Northern Ireland is the responsibility of the Department of Finance (DoF) and is implemented through the Building Regulations[1] and the Energy Performance of Buildings Regulations[2].

DoF relies heavily on research and development from other UK jurisdictions (principally England) in the development of its Regulations and technical guidance. This report introduces the most recent requirements. It addresses certification and inspection, the training of Energy Assessors, information campaigns, incentives and subsidies. For more details, visit the website[3].

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status

Northern Ireland implements the EPBD energy performance requirements through Part F "Conservation of Fuel and Power" of the Building Regulations. Amendments to Part F in 2012 followed England's Regulations and guidance and implemented a performance uplift of 25% on previous standards (Figures 1 and 2). Minor

amendments were introduced in 2014 and 2016 to comply with, or to help clarify, other EPBD requirements.

Changes to Building Regulations will be required to meet 2018 and 2020 NZEB requirements, and to follow England's 2016 zero carbon target. To this end, DoF is updating technical guidance to mirror the English Regulations.

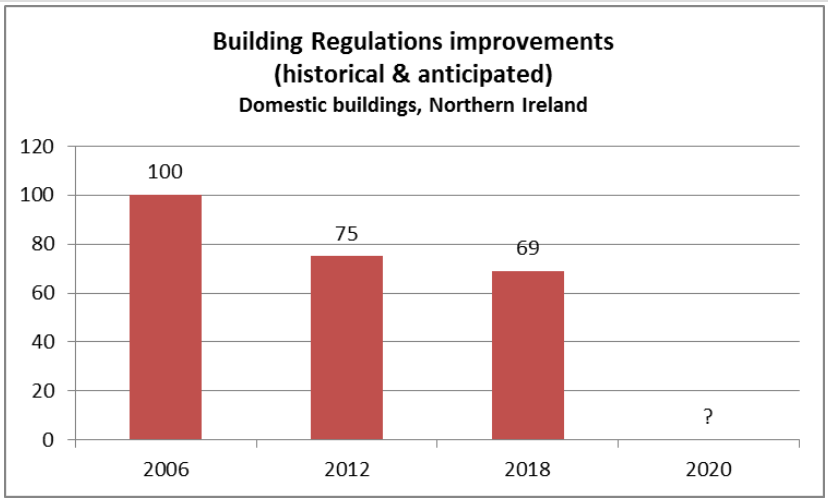


Figure 1. New residential Building Regulations improvements, Northern Ireland.

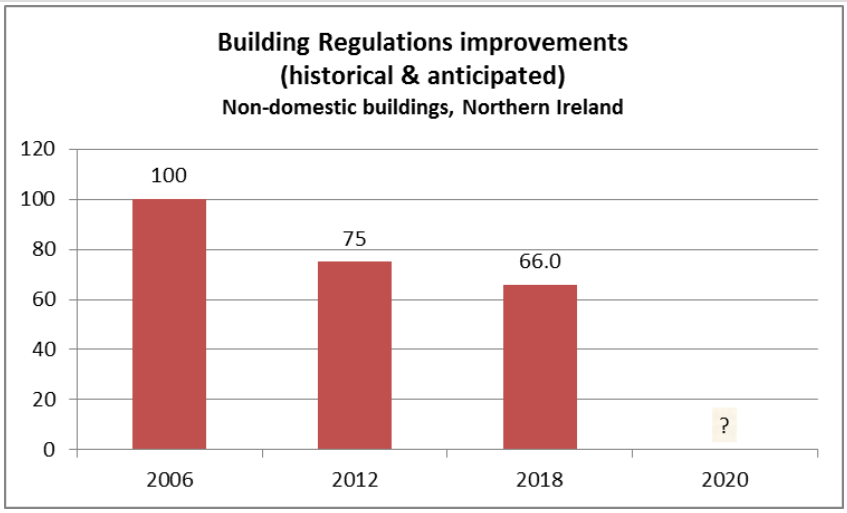


Figure 2. New non-residential Building Regulations improvements, Northern Ireland.

2.I.ii. Format of national transposition and implementation of existing regulations

Technical Booklets F1[4] and F2[5] (Figure 3) support the implementation of the Building Regulations Part F. The booklets include references to best practice guides such as Eurocodes (EN). Five criteria are set for new residential units and non-residential buildings (Table 1):

Criteria	Definitions
1	Ensure the calculated Building CO_2 Emission Rate does not exceed the Target Emission Rate.
2	Meet minimum acceptable standards, including minimum fabric, air permeability, and building services efficiencies standards.
3	Limit the effects of summer solar gains. This references industry best practice e.g. CIBSE TM37 "Design for improved solar shading control".
4	Ensuring quality of construction and commissioning: building envelope, air permeability, commissioning building services and, in non-residential buildings, air leakage testing of ductwork.
5	Provide instructions for energy efficient building operation and maintenance.

Table 1. Requirements for new buildings[6] and certain large extensions to non-residential buildings, Northern Ireland.

The National Calculation Methodology (NCM) implements these criteria. For residential units, the Standard Assessment Procedure (SAP 2009) is used, and for non-residential buildings the Simplified Building Energy Model (SBEM V4.1) or approved Dynamic Simulation Models (DSMs) are used. Both residential and non-residential methodologies use predicted energy consumption and provide an Asset Rating for EPCs on construction, sale and rent.

The use of Accredited Construction Details (ACDs) is permitted. The English ACDs have been adopted in Northern Ireland. Figure 4 gives an example. Airtightness testing is required for most residential and non-residential developments with some exemptions.

Building Regulations applications are submitted to local District Councils for checking and enforcement. Building Control Officers check compliance, which includes site inspections, and they have the power to take enforcement action.



Figure 3. Technical Booklets F1 & F2, Conservation of fuel and power in dwellings & buildings other than dwellings.

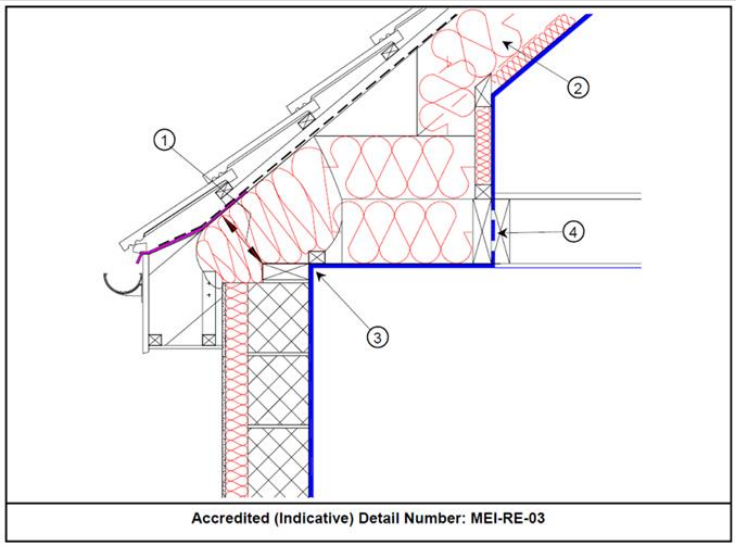


Figure 4. Illustration from ACD for Pitched Roof. Extracted from ACDs for Masonry External Wall Insulation.

Cost optimal procedure for setting energy performance requirements

A UK-wide cost-optimal report, which addresses Northern Ireland, was published in May 2013. See England report for details.

2.I.iii. Action plan for progression to NZEB

The UK national plan titled "Increasing the number of Nearly Zero-Energy Buildings" covers all four UK jurisdictions: England, Wales, Northern Ireland and Scotland. See England report for details.

NZEB statistics are not maintained in Northern Ireland. The following records of EPC A/A+ rated buildings provide an alternative proxy for high performance buildings.

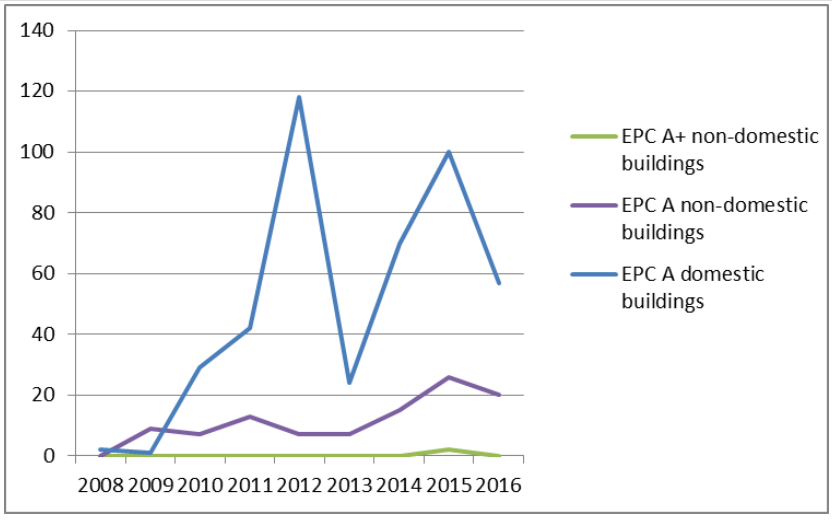


Figure 5. Historical EPCs classes A and A+, Northern Ireland.

2.I.iv. Requirements for systems and / or building components

Northern Ireland adopted England's 2010 "Domestic and Non-domestic Building Services Compliance Guides" to recommend minimum energy efficiency standards. See England report for details.

The commissioning of technical building systems is addressed in the Technical Booklets and the Building Services Compliance Guides. They require commissioning to be done in accordance with industry guidance, e.g., the Chartered Institution's of Building Services Engineers (CIBSE)[7] Commissioning Code M: Commissioning management.

2.II. Energy performance requirements: EXISTING BUILDINGS

The 2014 UK National Energy Efficiency Action Plan (NEEAP)[8] gives a statistical overview of the UK building stock. See England report for details.

The UK has 27 million homes, of which 0.77 million are in Northern Ireland. Figure 6 shows the distribution of about 406,000 residential EPCs. There are over 1.8 million non-residential premises in the UK, of which 73,000 are in Northern Ireland. Figure 7 shows the distribution of about 13,000 non-residential EPCs. EPCs are required under specific circumstances only, so Figures 6 and 7 are not representative of the whole Northern Ireland building stock.

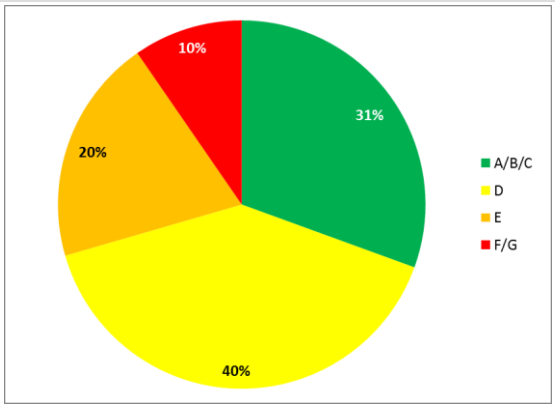


Figure 6. Distribution of residential EPCs (Northern Ireland) to February 2017.

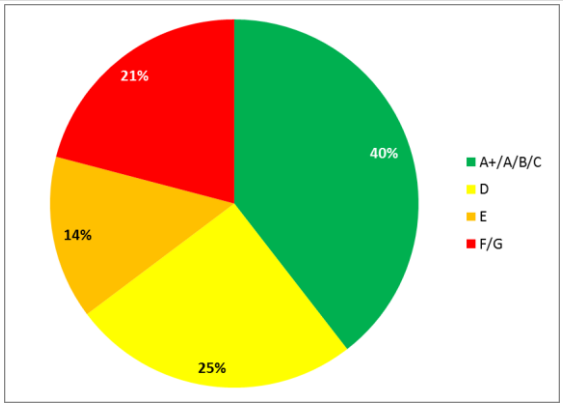


Figure 7. Distribution of non-residential EPCs (Northern Ireland) to February 2017.

2.II.i. Progress and current status of existing buildings

Similarly to England, an elemental approach has been adopted for existing buildings. See England report for details. Under certain circumstances (i.e. buildings >1,000 m^2, where the habitable area is extended, or where fixed building services are installed for the first time, or their capacity is increased) additional energy efficiency measures (i.e. "consequential improvements") must be undertaken[9].

2.II.ii. Plans to improve the existing building stock

The UK National Energy Efficiency Action Plan includes a Building Renovation Strategy in compliance with EED Article 4. The Northern Ireland policies and programmes to deliver this strategy include:

- the "Northern Ireland's Strategic Energy Framework" (2010);
- the "Affordable Warmth and Boiler Replacement Schemes" supporting energy efficiency improvements in fuel-poor households;
- the "Northern Ireland Sustainable Energy Programme" (NISEP), providing grants for energy efficiency and renewable energy for residential and non-residential buildings.

In addition:

- Northern Ireland is developing proposals to provide financial support for energy efficiency improvements. Subject to approvals, this scheme is expected to be launched in 2018.
- DoF is consulting on proposed Rates Relief measures to encourage highly efficient new residential buildings exceeding current building regulations standards and with a view to forthcoming NZEB requirements.
- The Department for Communities is consulting on proposed measures to mirror England's Private Rental Sector Regulations in relation to residential buildings rental.
- "Invest NI" funds the Carbon Trust to deliver the Energy Efficiency Loan Fund. This provides interest-free energy efficiency loans from £3,000 (~3,480 €) to £400,000 (~464,000 €) to Northern Ireland businesses. The size of loans depends on the energy savings potential of particular projects, with loan repayments aligned with the anticipated energy savings. Typically, loans are repaid within 3 to 4 years.
- In relation to Article 5 of the EED, the UK decided to implement the alternative approach allowed by Article 5(6). See England report for details. In Northern Ireland, Energy Efficiency Plans for the Government Office Estate, covering the periods 2011/2014 and 2014/2017 targeted energy savings of 10% and 5% respectively. The Plans focused on three areas: reduction in the footprint of the estate, capital investments in energy efficiency, and behavioural change. A new three-year Plan will be implemented for the period 2017/2019.

2.II.iii. Regulation of system performance, distinct from whole building performance

An approach similar to England was adopted. See England report and Technical Booklets for details. The local District Council (the enforcement authority) must be notified on completion of commissioning so that a Building Regulations Completion Certificate may be issued.

2.II.iv. Encouragement of intelligent metering

An approach similar to England was adopted. See England report and Technical Booklets for details. Technical Booklet F2 (non-residential buildings) references industry best practice[10].

The UK Government aims for all homes to be offered to have smart meters by the end of 2020. A policy decision has not yet been made on the rollout of smart meters in Northern Ireland. Some energy suppliers started installing smart meters in 2014.

2.II.v. Financial instruments and incentives for existing buildings

See UK National Energy Efficiency Action Plan details above.

2.II.vi. Information campaigns / complementary policies

Since the introduction of EPBD requirements in 2008, information campaigns have used diverse outlets including website, advertising (radio, press and information leaflets) (Figure 8), targeted seminars, guidance documents, roadshows, and proactive enforcement. Information is also available from www.finance-ni.gov.uk.

Other initiatives to improve buildings energy efficiency have benefited from publicity campaigns e.g., "Energy Wise" (Figure 9) and "Invest NI"[11] which supports companies to implement resource and energy efficiency improvements.



Figure 8. EPC information leaflet cover[12].

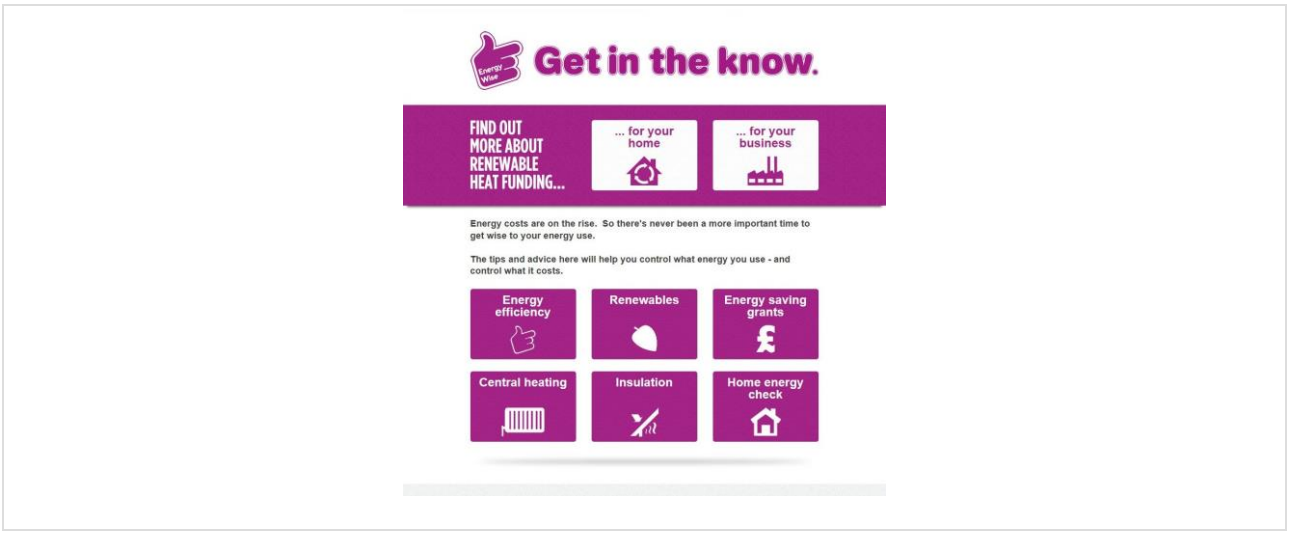


Figure 9. Extract from www.nidirect.gov.uk/energy-wise.

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Overview and administration

The Northern Ireland approach generally mirrors the England provisions. The same English Accreditation Schemes accredit Energy Assessors to produce Energy Performance of Buildings Regulations outputs, i.e. EPCs and Recommendations Reports. See England report for details.

Regulatory outputs are recorded on the Northern Ireland registers[13] and are publicly available using the building's address, postcode, or the outputs' unique reference number. Selected organisations have access to limited bulk data, and anyone with an EPC can opt-out of having their data publicly available.

Format and content of the EPC

Residential buildings

The EPC shows the "asset rating" (a calculated energy rating) of the current and potential energy efficiency of the building on a scale from A (very efficient) to G (least efficient) (Figure 10). The rating is based on the building's characteristics, its services, a standardised occupancy profile and estimated energy consumption costs. In 2014, the average residential EPC rating is 60, which is in band D.

Figure 10 shows the first page of the EPC for new residential units. The EPC for existing residential units is very similar. The EPC includes a list of cost-effective energy efficiency recommendations, and indicates the potential energy rating if all recommendations were installed.

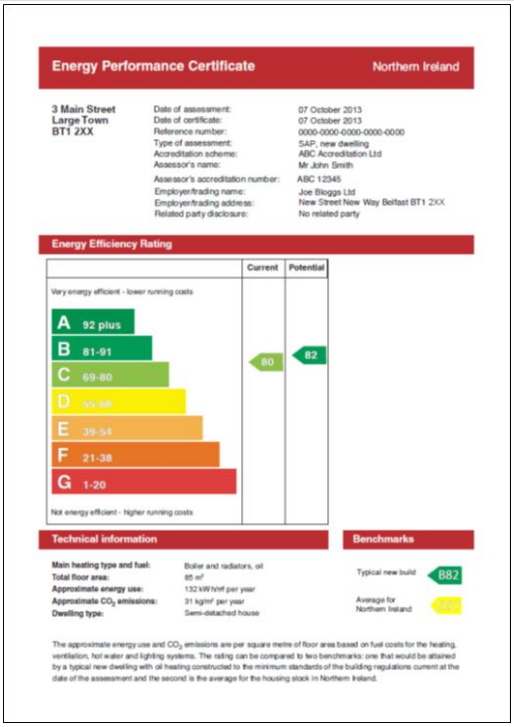


Figure 10. First page of Northern Ireland EPC for new residential units

Non-residential buildings

The EPC for non-residential buildings is identical to England except for the reference to Northern Ireland (Figure 11).

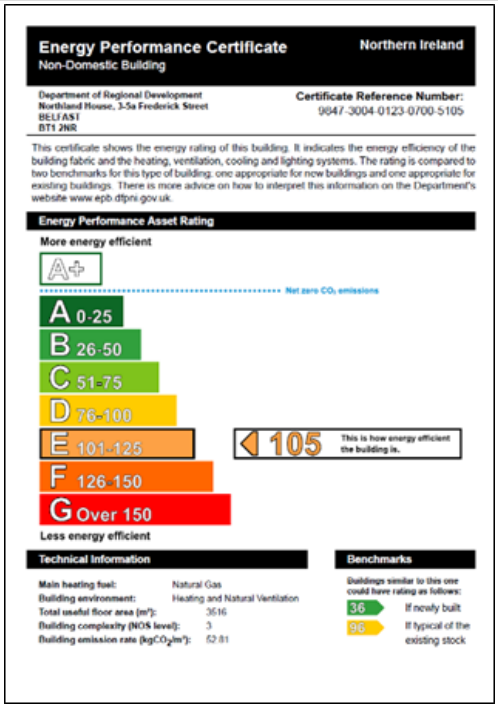


Figure 11. First page of Northern Ireland non-residential EPC.

EPC activity levels

As in England, residential and non-residential EPCs produced on construction, sale and rent are valid for 10 years. All EPCs become legally valid after they are recorded on the national register. Historical data to February 2017 is included in Tables 2 and 3, Figures 12 and 13.

		Domestic EPC lodgements by band						
	Total EPCs	A	B	C	D	E	F	G
Total	406,096	471	30,685	92,875	162,352	80,639	32,497	6,577
Percentage	100%	0.1%	7.6%	22.9%	40.0%	19.9%	8.0%	1.6%

Table 2. Residential EPCs Northern Ireland to February 2017.

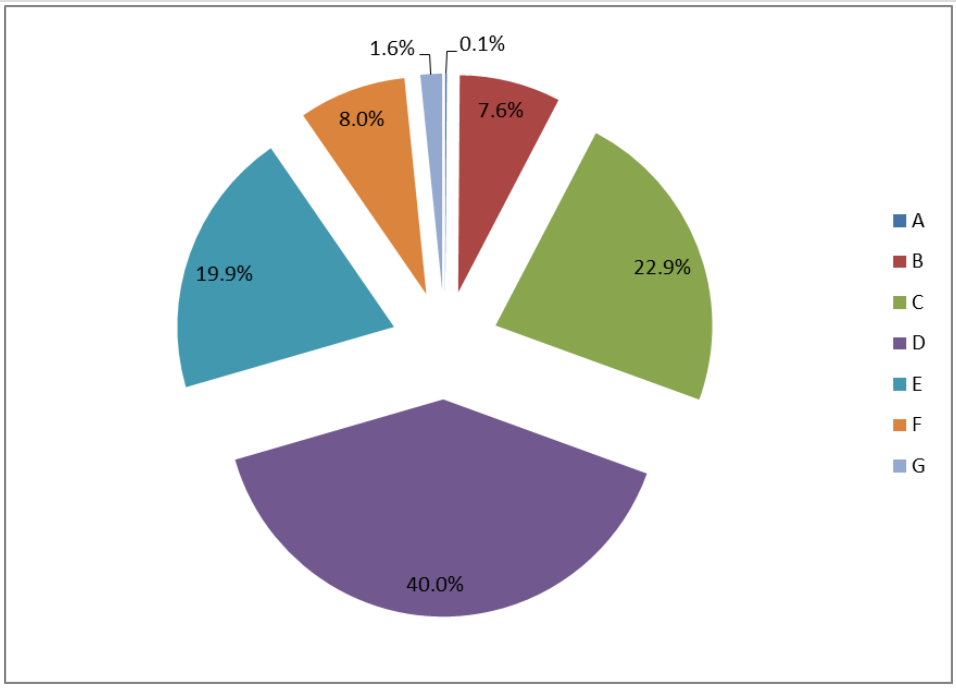


Figure 12. Residential EPCs Northern Ireland to February 2017. Percentages by EPC band.

Non-domestic EPC lodgements by band									
	Total EPCs	A+	A	B	C	D	E	F	G
Total	13,307	2	103	1,280	3,872	3,358	1,910	1,148	1,634
Percentage	100%	0.0%	0.8%	9.6%	29.1%	25.2%	14.4%	8.6%	12.3%

Table 3. Non-residential EPCs Northern Ireland to February 2017.

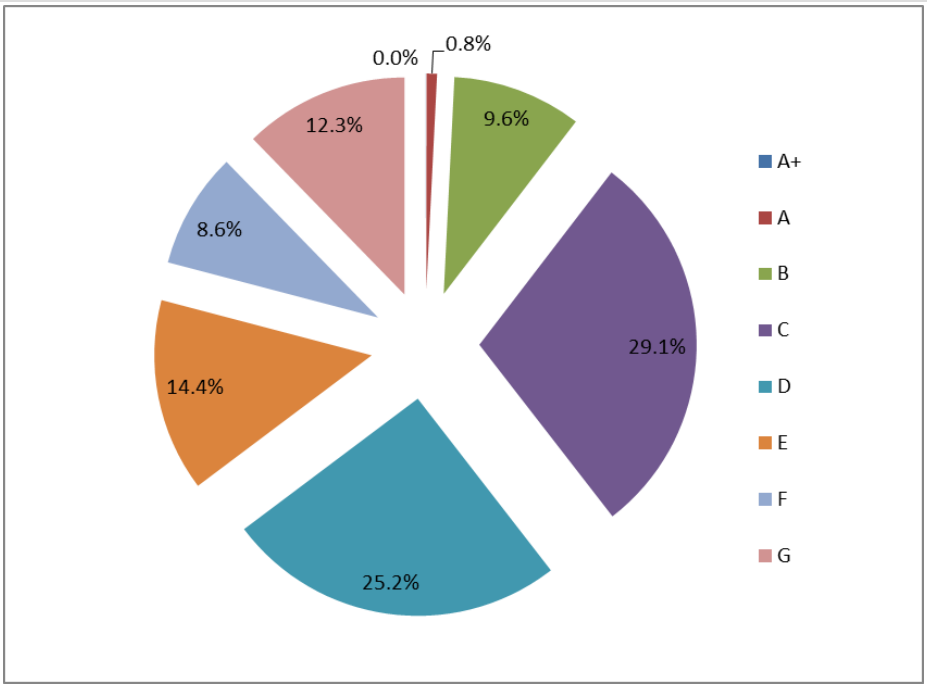


Figure 13. Non-residential EPCs to February 2017. Percentages by EPC band.

Typical EPC costs

EPC costs vary greatly. Indicative starting costs (lowest market costs based on internet search), including the registration fee (payable each time an EPC is recorded on the register), are:

- for a residential EPC: ~£50 (~58 €);
- for a non-residential EPC: ~£200 (~232 €).

Assessor corps

The English National Occupational Standards (NOS) were adopted in Northern Ireland. See England report for details. Table 4 details Energy Assessors with a registered address in Northern Ireland as of March 2017. Assessors accredited to operate in England and Wales are also accredited to operate in Northern Ireland.

Assessor types	Assessor numbers
Domestic EPCs (existing buildings) RdSAP	887
Domestic EPCs (new buildings) SAP	209
Non-domestic EPCs (level 3)	170
Non-domestic EPCs (level 4)	114
Non-domestic EPCs (level 5)	8
Display Energy Certificate (DEC)	97
AC inspection (level 3, simple)	39
AC inspection (level 4, complex)	36
Total Assessors	***1,560***

Notes
RdSAP: Reduced Standard Assessment Procedure
SAP: Standard Assessment Procedure
EPC: Energy Performance Certificate
DEC: Display Energy Certificate
AC: Air-Conditioning
EPC level 3: simple non-domestic buildings
EPC level 4: medium complexity non-domestic buildings
EPC level 5: complex non-domestic buildings
AC level 3: simple packaged AC
AC level 4: complex central AC

Table 4. Energy Assessors' qualifications and numbers Northern Ireland at March 2017.

Minimum Continuous Professional Development (CPD) requirements apply. Typically, assessors must attend 10 to 20 hours CPD/ year. If this requirement is not met, penalties include temporary expulsion from the Accreditation Scheme, which prevents the assessor from producing EPCs.

Enforcement with building owners and real estate actors

District Councils enforce the Regulations. They have powers to require the "relevant person" (i.e. the seller or prospective landlord) to produce copies of the EPC for inspection. In 2013 these powers were extended to include the "relevant person's agent" e.g. Estate or Letting Agents. District Councils operate a three-stage enforcement process: first a letter to encourage compliance, followed by a stronger enforcement letter, and then a penalty charge notice. By January 2017, >5,720 enforcement letters had been issued. The Department of Finance is responsible for enforcement on District Councils' buildings. DoF also funds awareness-raising, a telephone helpline, and general coordination and reporting of compliance activities.

The annual compliance rate for real estate agents is on average 70%. This compliance percentage reflects a combination of both visiting agents on-site and scrutinising properties advertised on websites. The compliance with Display Energy Certificates (DECs) in the audited buildings of four District Councils was 100% at the end of September 2016.

Penalties vary depending on the type of building

For residential properties, the penalty is £200 (~232 €), whereas for non-residential properties, the penalty is 12.5% of the rateable value of the building, subject to a minimum of £500 (~580 €) and a maximum of £5,000 (~5,800 €).

2.III.ii. Quality Assurance of EPCs

English Accreditation Schemes are approved to operate in Northern Ireland. In 2016, there were no Accreditation Schemes approved to operate in Northern Ireland only. Therefore, the English Quality Assurance requirements apply in Northern Ireland. See England report for details.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Northern Ireland adopted the same approach as England. See England report for details.

Display Energy Certificates (DECs) are required to be displayed in certain public authority buildings which are frequently visited by the public. DECs provide Operational Ratings based on actual energy consumption. DECs are accompanied by a Recommendation Report. In Northern Ireland, DECs must be updated annually, and Recommendation Reports are updated every seven years.

DECs data to February 2017 is included in Table 5 and Figure 14.

	DEC lodgements by band							
	Total	A	B	C	D	E	F	G
Total	14,279	125	1,016	3,848	4,670	2,404	983	1,233
Percentage	100%	0.9%	7.1%	26.9%	32.7%	16.8%	6.9%	8.6%

Table 5. Display Energy Certificates Northern Ireland to February 2017.

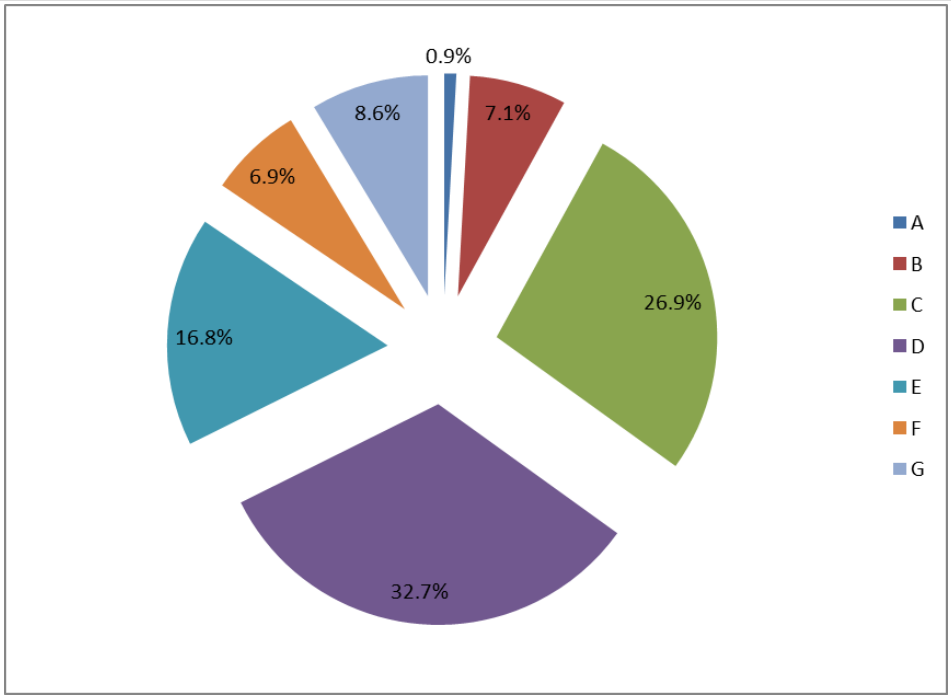


Figure 14. Display Energy Certificates Northern Ireland to August 2014. Percentages by DEC band.

2.III.iv. Implementation of mandatory advertising requirement - status

Since 2013 a property cannot be advertised for sale or rent without an EPC. Estate or Letting Agents must ensure that an EPC is available, or has been commissioned, before the property is marketed.

Any commercial media used to advertise a property (e.g. websites, classified ads) must contain the coloured bar chart energy indicator from the EPC or the EPC energy rating, e.g., EPC F36.

The landlord or seller must ensure a copy of the EPC is shown, free of charge, to interested parties when they first enquire about the property.

2.IV Inspection requirements - heating systems, air conditioning

The UK[14] adopted alternative measures for heating systems and inspections for AC systems. See England report for details. Heating systems measures specific to Northern Ireland include the "Affordable Warmth Scheme"[15] (for advice and insulation/heating measures), a boiler replacement scheme (for low income households), the Northern Ireland Housing Executive advice and information line, etc.

2.IV.i. Report on equivalence of model A and B for Heating Systems

See England report for details.

2.IV.ii. Progress and current status on heating systems

See England report for details.

2.IV.iii. Progress and current status on AC systems

The Northern Ireland arrangements for AC inspections mostly mirror the English provisions. The English Accreditiation Schemes, which accredit AC inspectors, are approved by The DoF so inspectors can operate in Northern Ireland. See England report for details. Provisions specific to Northern Ireland include:

- the mandatory registration of AC inspection reports on the Northern Ireland EPC Register since 2013; to date > 1,800 reports are recorded in total;
- promotional activities for AC inspections including an Energy Wise[16] media campaign with radio coverage, posters and leaflets, workshops and presentations to key stakeholders' groups, etc.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

District Councils are responsible for ensuring that owners of AC systems (>12 kW) possess a valid inspection report, except for their own buildings for which DoF is the enforcement authority. The penalty for failing to possess a valid inspection report is £300 (~348 €).

District Councils have a three-stage enforcement process: first a letter to encourage compliance, followed by a stronger enforcement letter, and then a penalty charge notice. Although ~450 enforcement letters have been issued, DoF is not aware of penalties issued for non-compliance since the coming into force of the AC requirements.

Quality control of inspection reports

See England report for details.

Impact assessment.

Two Regulatory Impact Assessments[17] were undertaken. The costs of mandatory inspections and reporting (every five years for systems >12 kW) were estimated at £600 (~696 €) for centralised systems and £100 (~116 €) for packaged units. Benefits were difficult to quantify and included reduced electricity consumption from improved efficiency (where recommendations were implemented) and from the replacement of older systems. Other benefits, e.g., improved workplace conditions were also expected.

Mandatory recording of AC inspection reports on the register brings together a central source of information, which aims to facilitate compliance checks. Since 2016, the registration fee is £12.82 (~14.87 €), plus the Accreditation Scheme fee.

3. A success story in EPBD implementation

District Councils enforce the Regulations. They have powers to require the building seller or prospective landlord to produce copies of EPCs for inspection. In 2013 these powers were extended to include the "relevant person's agent", e.g., Estate or Letting Agents. District Councils operate a three-stage enforcement process: first a letter to encourage compliance, followed by a stronger enforcement letter, and then a penalty charge notice. By January 2017, almost 6,000 enforcement letters had been issued.

The Department of Finance (DoF) enforces the Regulations on District Councils' buildings. In 2010, DoF funded a dedicated Enforcement Team to facilitate cross-council working, deliver awareness-raising, and ensure consistency across the 11 District Councils following the Local Government reform (previously Northern Ireland was made up of 26 District Councils). DoF carried out audits of four District Councils in 2015 – 2016, which confirmed the effectiveness and benefits provided by the Enforcement Team. The team also provides quarterly reports to DoF detailing Councils' enforcement activities and it helps Councils reduce their administrative burden.

The annual compliance rate for real estate agents is on average 70%. This compliance percentage reflects a combination of both visiting agents on-site and scrutinising properties advertised on websites. The compliance with DECs in the audited buildings of four District Councils was 100% at the end of September 2016. DoF has continued to fund the Enforcement Team to ensure monitoring of enforcement levels.

4. Conclusions, future plans

The UK is divided into four jurisdictions. Northern Ireland is the smallest jurisdiction, with the smallest population, least number of homes, etc. Northern Ireland relies heavily on research and development from other jurisdictions (principally England) for its own Regulations, technical guidance and development of governance arrangements. To date, Northern Ireland has adopted the majority of the English provisions in its transposition of the EPBD.

Northern Ireland has also implemented measures specific to its jurisdiction, including AC inspection information campaigns, and a successful compliance and enforcement approach.

The transposition of the EPBD continues to be reviewed by each UK jurisdiction as part of their respective programmes to achieve national energy efficiency objectives and carbon emissions reduction.

Endnotes

1. The Building Regulations (Northern Ireland) 2012. S.R. 2012 No.192 as amended by S.R.2012 No. 375, S.R. 2014 No. 44 and S.R.2016 No.412 and the Building (Prescribed Fees) Regulations (Northern Ireland) 1997. S.R.1997 No.482 as amended by S.R.2016 No. 60

2. The Energy Performance of Buildings (Certificates and Inspections) Regulations (Northern Ireland) 2008. S.R. 2008 No. 170, as amended by S.R. 2008 No. 241, S.R. 2009 No. 369, S.R. 2013 No.12, S.R. 2014 No.43 and S.R.2016 No.395

3. www.finance-ni.gov.uk/topics/building-regulations-and-energy-efficiency-buildings

4. Technical Booklet F1, Conservation of fuel and power in dwellings, Department of Finance and Personnel, October 2012
5. Technical Booklet F2, Conservation of fuel and power in buildings other than dwellings, Department of Finance and Personnel, October 2012
6. Note that Internal Air Quality (IAQ) is addressed under Technical Booklet K, Ventilation.
7. CIBSE Commissioning Codes: www.cibse.org/knowledge/cibse-publications/cibse-commissioning-codes
8. UK National Energy Efficiency Action Plan, Department of Energy & Climate Change, April 2014
9. Further details at: Section 3 of Technical Booklet F2
10. Further details at: Section 3 of Technical Booklet F2
11. www.investni.com
12. www.buildingcontrol-ni.com/assets/pdf/EPCLeaflet.pdf
13. The residential buildings register is accessed at www.epbniregister.com . The non-residential buildings register (including EPCs and AC inspection reports) is accessed at www.epbniregisternd.com
14. The UK refers to England, Wales, Scotland and Northern Ireland
15. www.nihe.gov.uk/index/benefits/affordable_warmth_scheme.htm
16. www.nidirect.gov.uk/campaigns/energy-wise
17. www.finance-ni.gov.uk/consultations/2012-consultation-energy-performance-buildings-certificates-and-inspection-regulations

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CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the United Kingdom - Scotland

Status in December 2016

AUTHORS

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NATIONAL WEBSITES
www.gov.scot/Topics/Built-Environment/Building/Building-standards

1. Introduction

This report provides information about the implementation of the EPBD in Scotland. It updates the previous reports published in 2010, 2012 and 2016. The implementation of the Directive in the other three UK jurisdictions (England, Wales and Northern Ireland) is addressed in separate reports.

The implementation of the EPBD in Scotland is the responsibility of the Local Government and Communities Directorate, Building Standards Division. Scotland controls both its Building Regulations and Energy Performance of Buildings Regulations.

This report introduces the most recent requirements. It also addresses certification and inspection of systems including quality control mechanisms, the training of Energy Assessors, information campaigns, incentives and subsidies. For more details, visit the relevant websites[1].

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

2.I.i. Progress and current status

Minimum energy performance requirements, for new and existing buildings, are set out in the Building Regulations. These standards were reviewed and improved in 2015 (Figures 1 and 2) based on percentage CO_2 emissions reductions (2002 standards are the reference). Technical Handbooks[2], issued in 2016,

provide guidance on achieving compliance with the Regulations and they are the most commonly referenced documents for building standards systems.

Regulations[3] requiring new buildings to be NZEB and transposing the EPBD deadlines have been published.

Scotland continues to make significant progress towards NZEB requirements, though a definition of NZEB in numerical terms within national standards is yet to occur. The Government is investigating whether further reduction in CO_2 emissions will also deliver new NZEB buildings. This further review of energy standards within Building Regulations will commence in spring 2017.

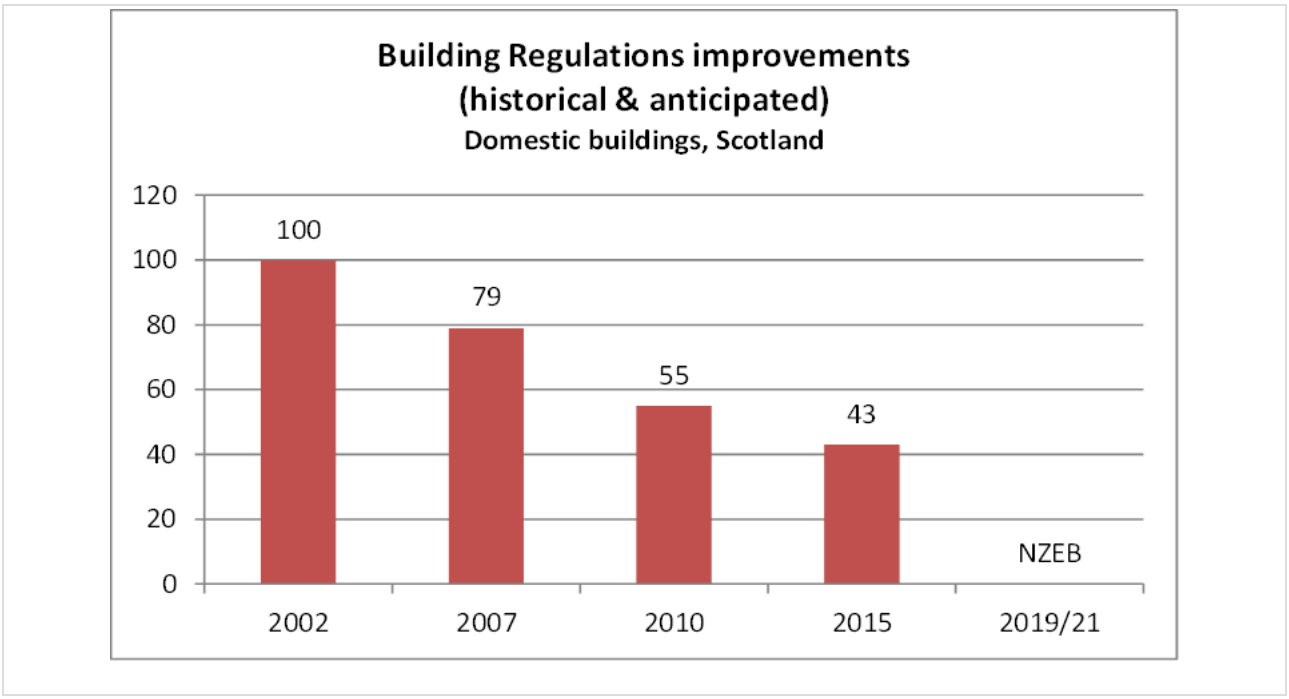


Figure 1. New residential Building Regulations improvements, Scotland.

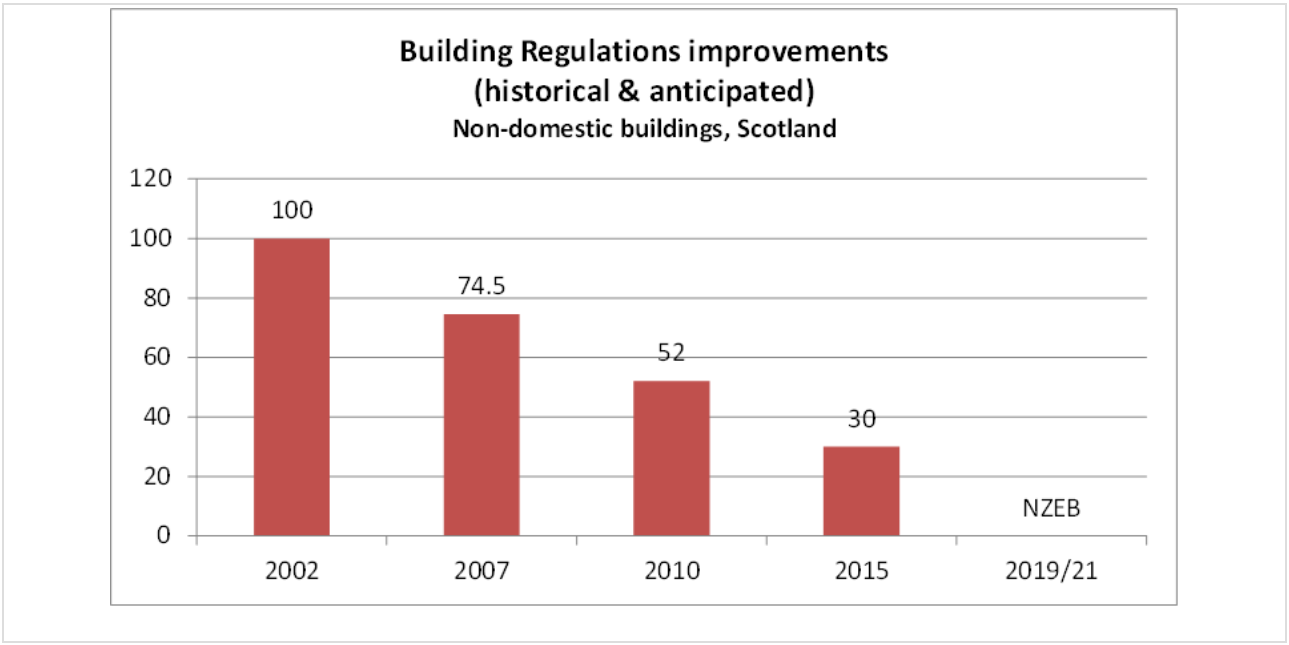


Figure 2. New non-residential Building Regulations improvements, Scotland.

2.I.ii. Format of national transposition and implementation of existing regulations

The following Technical Handbooks address the Building Regulations energy requirements: the "Technical Handbook Domestic" (for new and existing residential buildings) and the "Technical Handbook Non-domestic" (for new and existing non-residential buildings). They include references to best practice guides, e.g., Eurocodes (EN).

Ten criteria are set for new residential and non-residential buildings (Table 1).

Criteria	Definitions
1	Ensure the Building CO_2 Emission Rate is no greater than the Target Emission Rate. The target emission rate is set using a notional building specification which includes a low carbon equipment element, e.g., photovoltaic panels.
2	Reduce heat losses through the envelope (including minimum fabric performance, thermal bridging and air permeability). Scottish Accredited Construction Details for linear thermal bridging are available and airtightness testing is generally required.
3	Energy efficient space heating and hot water systems, including controls, minimum performance, etc.
4	Minimum insulation levels for pipes, ducts and vessels.
5	Energy efficient lighting (e.g., minimum 60 lamp lumens/circuit-watt in offices) and controls.
6	Reduce overheating (e.g., through the proportion and orientation of translucent glazing, solar shading/control, thermal mass, etc.) and ensure energy efficient mechanical ventilation and AC and controls.
7	Commissioning of building services to achieve optimum energy efficiency.
8	Information for building occupiers on the operation and maintenance of building services and energy supply.
9	The provision of EPCs.
10	Metering of fuel and power of buildings (or parts) and of end-uses.

Table 1. New buildings criteria, Scotland.

The Technical Handbooks provide the specifications to calculate the Target Emission Rate, and reference the *"Scottish Building Services Compliance Guides",* which recommend minimum standards. The recommended minimum standards must be exceeded to achieve the Target Emission Rate.

For residential buildings, the Standard Assessment Procedure (SAP[4]) 2012 is used to calculate energy performance, demonstrate compliance with Building Regulations, and produce EPCs. For non-residential buildings, the Simplified Building Energy Model (SBEM[5]) 2014 is used. Government has developed the SBEM software, available free of charge. Government-approved proprietary software tools may be used for complex buildings. SAP, SBEM and proprietary tools use predicted energy consumption based on standard

conditions. The NCM Modelling Guide[6] supports carbon compliance calculations for all new non-residential buildings.

Scottish Accredited Construction Details (ACDs[7]) may be used to assist with compliance. ACDs focus on providing insulation continuity at junctions (thermal bridges) and airtightness (e.g., Figure 3).

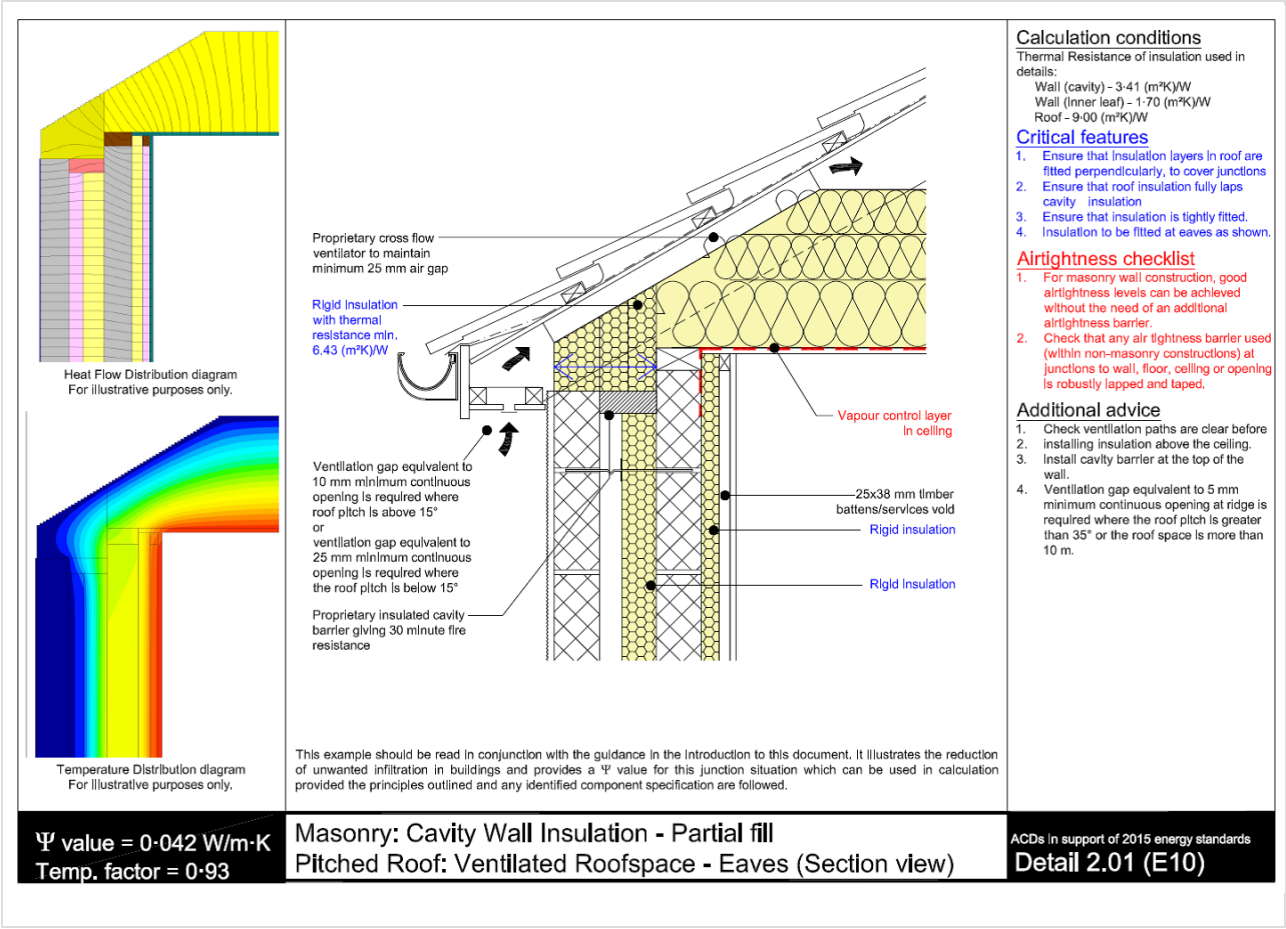


Figure 3. Illustration from ACD for Pitched Roof. Extracted from ACDs for Masonry External Wall Insulation.

The 32 Local Authorities in Scotland are appointed by Scottish Ministers as "*verifiers*" for their respective geographical area and they are responsible for the operation of the building standards system. As verifiers, they are responsible for granting permission for building work, undertaking reasonable enquiry to establish compliance and issuing a completion certificate before occupation.

Cost optimal procedure for setting energy performance requirements

A UK-wide cost-optimal report, covering Scotland, was published in May 2013. Tables 2 to 5 show outcomes for Scotland. See England report for details.

Reference building	Cost-optimal level (kWh/m².year)	Current requirements (kWh/m².year)	Gap (%)
Semi-detached	141	110	+22% better than cost-optimal
Mid-floor apartment	116	91	

Table 2. New residential units, Scotland.

Reference building (averages)	Cost-optimal level	Current requirements	Gap (%)
Cavity walls	U=0.55 W/m².K	U=0.22 W/m².K	+60% better than cost-optimal
Solid walls	U=0.4 W/m².K	U=0.22 W/m².K	+45% better than cost-optimal
Windows	U=1.6 W/m².K	U=1.6 W/m².K	Cost-optimal
Roof	U=0.20 W/m².K	U=0.18 W/m².K	Cost-optimal
Heating	88% (gas boiler)	88% (gas boiler)	Cost-optimal

Table 3. Existing residential units, Scotland.

Reference building	Cost-optimal Level (kWh/m².year)	Current requirements (kWh/m².year)	Gap (%)
Office (AC)	163	162	-7% worse than cost-optimal
Office (not ventilated)	89	76	
Secondary school	143	122	
Hospital	279	230	
Hotel (AC)	419	443	
Distribution warehouse	131	134	
Retail warehouse (AC)	193	348	
Average	202	216	

Table 4. New non-residential buildings, Scotland.

Reference building (averages)	Cost-optimal level	Current requirement	Gap (%)
Cavity walls	U=0.30 W/m².K	U=0.30 W/m².K	Cost-optimal
Other walls	U=0.20 W/m².K	U=0.30 W/m².K	-50% worse than cost-optimal
Roof	U=0.24 W/m².K	U=0.25 W/m².K	-4% worse than cost-optimal
Heating	84% (gas boiler)	86%	Cost-optimal
Floor	U=0.22 W/m².K	U=0.25 W/m².K	-14% worse than cost-optimal
Windows	U=1.64 W/m².K	U=1.6 W/m².K	Cost-optimal
Lighting	61 lm/W	55 lm/W	-10% worse than cost-optimal
Chiller	3.9	3.5	-10% worse than cost-optimal

Table 5. Existing non-residential buildings, Scotland.

2.I.iii. Action plan for progression to NZEB

Key elements and milestones, including national application of the definition of NZEB for new buildings

The Climate Change (Scotland) Act 2009 creates a statutory framework to deliver greenhouse gas emissions reductions. The Act sets an interim target of a 42% reduction by 2020 (compared to 1990), and 80% by 2050.

The Scottish Government's "Low Carbon Scotland: Meeting the Emissions Reductions Targets 2010 - 2022" sets out how Scotland can deliver its 42% target. This includes improving new-build energy standards through Building egulations changes (Figures 1 and 2). A new draft Climate Change Plan and draft Energy Strategy (expected publication January 2017) will continue this process.

Examples of existing NZEBs

A numerical NZEB definition is not yet available in the UK[8]. Therefore, NZEB statistics are not maintained in Scotland. Figure 4 shows historical EPC records for Classes A and A+. The graph shows a sharp increase for residential and non-residential buildings from 2012 to 2015, and a sharp drop in 2016 in both sectors. Note that new building construction rates also affect these data, and non-residential EPCs were only registered from 2013[9].

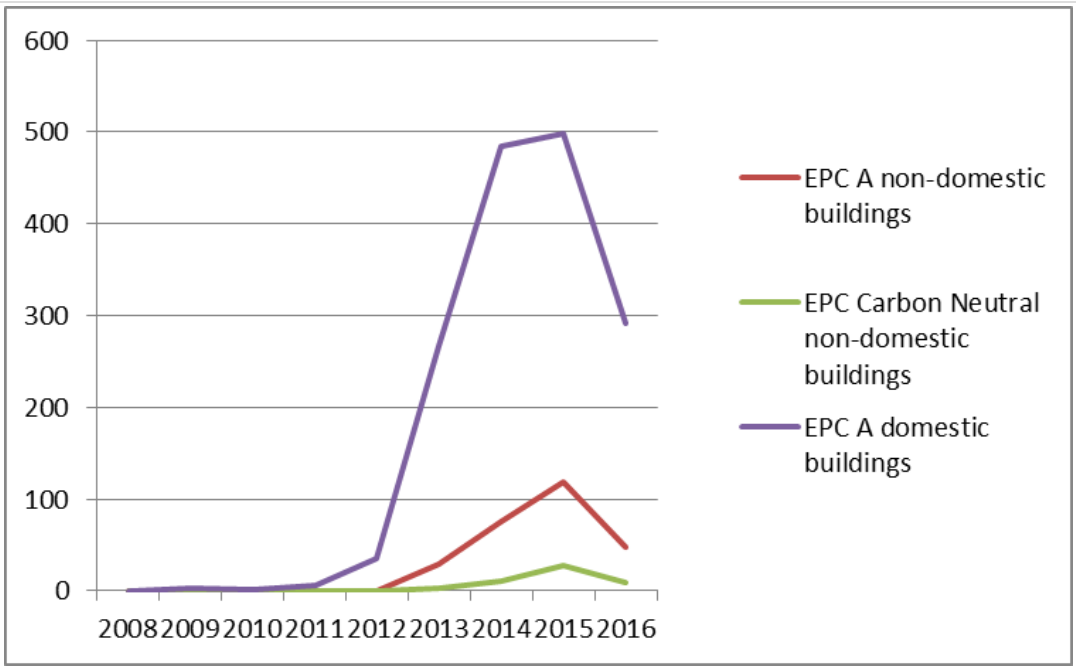


Figure 4. Historical EPCs Classes A and A+, Scotland.

2.I.iv. Requirements for systems and / or building components

Scotland adopted a similar approach as England, where the "Scottish Domestic and Non-domestic Building Services Compliance Guides" recommend minimum energy efficiency standards for technical building systems.

Scotland published its own "2015 Domestic and Non-domestic Building Services Compliance Guides[10]" (Figure 5) for use with the Technical Handbooks. Selected extracts from the Non-domestic Guide are included in Table 6.



Figure 5. Domestic and Non domestic Building Services Compliance Guides, Scotland.

Building Services Type	Recommended minimum energy efficiency standard
Natural gas, single boiler system ≤ 2MW output (for new buildings)	Gross seasonal efficiency: 91%
Biomass, independent boiler, automatic [feed], pellet/ woodchip (for new buildings)	Gross seasonal efficiency: 75%
Oil, single boiler system (for new buildings)	Gross seasonal efficiency: 84%
Heat pump – electrically driven (not air to air): space heating	Heat generator coefficient of performance 2.5 at rating conditions in EN 14511
Heat pump – electrically driven (not air to air): domestic hot water	Heat generator coefficient of performance 2.0 at rating conditions in EN 14511
Air distribution systems, central balanced mechanical ventilation with heating only	Specific fan power (max): 1.5 W/(l.s)
Air distribution systems, plate heat exchanger	Dry heat recovery efficiency: 50%
Internal lighting, general lighting in office, storage and industrial areas	Effective lighting efficacy: 60 luminaire lumens per circuit-watt
Comfort cooling, vapour compression cycle chillers, water cooled > 750 kW	Energy efficiency ratio: 4.7

Table 6. Examples of recommended minimum energy efficiency standards, Scotland[11].

2.II. Energy performance requirements: EXISTING BUILDINGS

The 2014 National Energy Efficiency Action Plan[12] gives a statistical overview of the UK building stock. See England report for details.

The UK has 27 million homes, 2.4 million of which are in Scotland. Figure 6 shows the distribution of about 1.2 million residential EPCs. There are over 1.8 million non-residential premises in the UK, of which about 200,000 are in Scotland. Figure 7 shows the distribution of about 25,000 non-residential EPCs. Note that EPCs are required under specific circumstances only, so Figures 6 & 7 are not representative of the whole Scottish building stock.

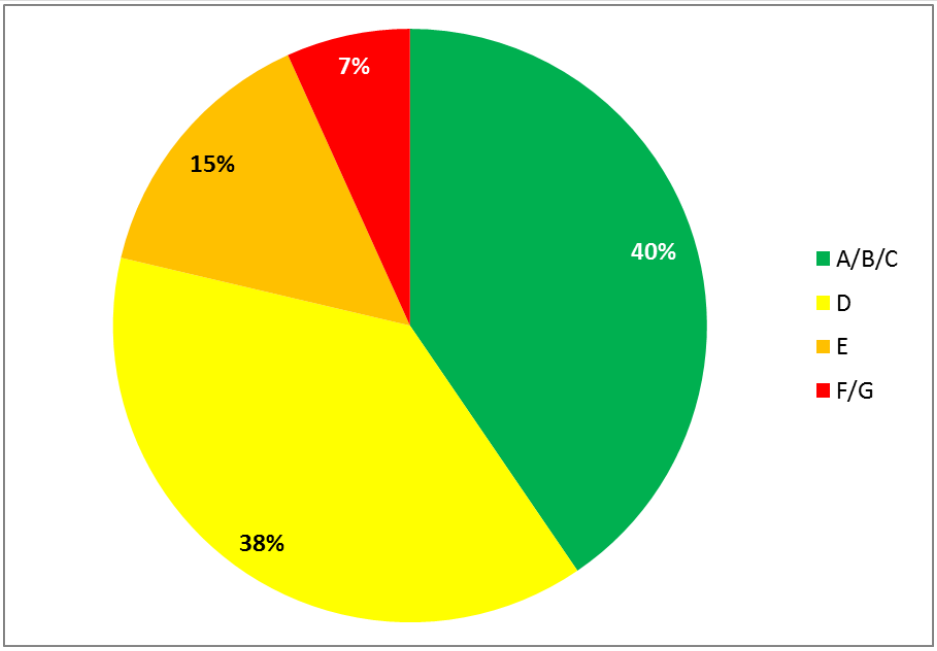


Figure 6. Distribution of residential EPCs to 2016, Scotland.

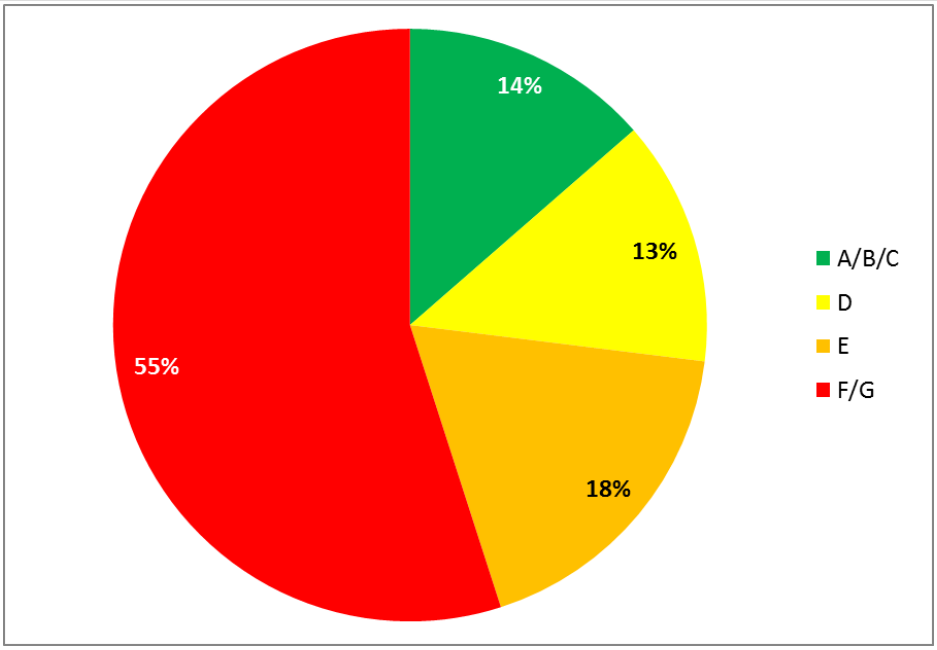


Figure 7. Distribution of non-residential EPCs to 2016, Scotland.

2.II.i. Progress and current status of existing buildings

Similarly to England, an elemental approach has been adopted for existing buildings. See England report for details. In non-residential buildings, under certain circumstances (e.g., where work to an existing building includes the provision of new fixed building services or extends the capacity of existing services), the existing services must be improved to meet the current performance recommendations in the Technical Handbook[13]. This approach is referred to as "*consequential improvements*".

2.II.ii. Plans to improve the existing building stock

Energy efficiency is fundamental to Scotland meeting its climate change targets. Following the announcement in June 2015 that improving the energy efficiency of Scotland's homes and non-residential building stock is a National Infrastructure Priority, the Scotland's Energy Efficiency Programme[14] (SEEP) will be at the heart of activities led by the Scottish Government and its partners to improve the energy efficiency of all Scottish buildings over the next 15 – 20 years. The SEEP has been organised into two delivery phases:

- Phase 1 (2016 – 2018) to focus on piloting new approaches and programme scoping; and
- Phase 2 (commencing in 2018), the initial phase of the integrated programme of support for the residential and non-residential sectors.

The National Energy Efficiency Action Plan includes a Building Renovation Strategy in compliance with EED Article 4. The policies and programmes to deliver this strategy include:

- A programme of interest free and low interest loans is available to SME's, householders and other organisations to incentivise the uptake and installation of energy and resource efficiency measures, micro-renewables and district heating:
- the "Sustainable Housing Strategy", which sets targets for 2020 on insulation, boiler efficiency, and uptake of renewable heat for space and water heating;
- the "Home Energy Efficiency Programmes for Scotland" (HEEPS), which includes grant- and loan-funded insulation programmes;
- the "Energy Company Obligation" (ECO) mandating large energy suppliers to deliver energy efficiency measures to residential premises;
- section 63 of the "Climate Change (Scotland) Act 2009[15]" which requires non-residential building owners to improve energy performance and reduce emissions. Regulations introduced in September 2016 apply initially to the sale and rental of buildings > 1,000 m².
- the "Energy Efficiency Standard for Social Housing" which requires landlords of socially rented homes to ensure their properties meet a minimum energy efficiency rating by 2020.
- Since 2009, over £650 million (754 M€) has been allocated to tackle fuel poverty and improve energy efficiency.
- The UK decided to implement the alternative approach allowed by Article 5(6). See England report for details. The Scottish Government publishes an annual assessment[16] of energy efficiency improvements of Civil Estate buildings. Government updated its Environmental Policy setting out targets for the performance of the Civil Estate, and actions under their Carbon Management Plan, which is expected to save 27.5 GWh by 2020. One and a half million pounds (£1.5 million or ~2 M€) has been spent on energy efficiency projects in Civil Estate buildings, including voltage optimisation, lighting upgrades, building management systems, and building fabric improvements.

2.II.iii. Regulation of system performance, distinct from whole building performance

An approach similar to England was adopted. See England report and Technical Handbooks for details: the Technical Handbooks reference industry guidance, e.g., the Chartered Institution of Building Services Engineers (CIBSE) Commissioning Codes[17], and the Building Services Research and Information Association (BSRIA) Commissioning Guides[18].

2.II.iv. Encouragement of intelligent metering

Energy metering requirements are included in the "Technical Handbook Non-domestic" buildings. Each building (or part) should be fitted with fuel and power meters. Sub-metering should allow monitoring of end uses. The handbook references industry best practice, e.g., CIBSE TM 39[19]. Automatic meter reading is referenced as good practice but is not mandated.

There are no metering requirements for residential buildings in the "Technical Handbook Domestic" buildings. Utilities metering in residential buildings is reserved to the UK Government, i.e., it is addressed at the UK level, not by Scotland. See England report for details.

2.II.v. Financial instruments and incentives for existing buildings

See National Energy Efficiency Action Plan details above.

2.II.vi. Information campaigns / complementary policies

The Scottish Government invested > £45 million (~52 M€) since 2007 to support households, businesses and organisations finance energy efficiency, renewable energy and district heating. This has generated loans in excess of £65 million (~75 M€) to over 4,000 applicants. The Energy Saving Trust[20] is funded to manage specialist advice and support services via "Resource Efficient Scotland" and the "Home Energy Scotland advice centres" (HESac) to businesses, public sector organisations, and householders to reduce energy consumption through improved energy efficiency, renewable technologies and carbon management.

National information campaigns have used diverse outlets including website, advertising (e.g., radio, press and information leaflets), targeted seminars, webinars, specialist web portal tools, guidance documents, roadshows, and proactive enforcement. Information is also available on the Government website[21].

2.III. Energy performance certificate requirements

2.III.i. Progress and current status on sale or rental of buildings and EPCs

Overview and administration

The Scottish approach generally mirrors English provisions. The Scottish Government entered into protocols with Approved Organisations to deliver EPCs. Approved Organisations "*ensure that members are*

fit and proper persons [qualified to prepare and issue] EPCs". Approved Organisations' members produce EPCs (and other regulatory outputs) using Government-approved methodologies and tools.

All EPCs are produced from data recorded on the Scottish EPC Register[22]. EPCs are publicly accessible from the register using the EPC unique Report Reference Number (RRN). Regulations require that the EPC is "affixed[23]" to the building.

Format and content of the EPC

Residential buildings

The EPC (Figure 8) shows a calculated rating (asset rating) of the current and potential energy efficiency of the building on a scale from A (most efficient) to G (least efficient). The Energy Efficiency rating is based on the building's characteristics, its services, standardised occupancy and energy cost. The average rating for a residential building in Scotland is class D (63).

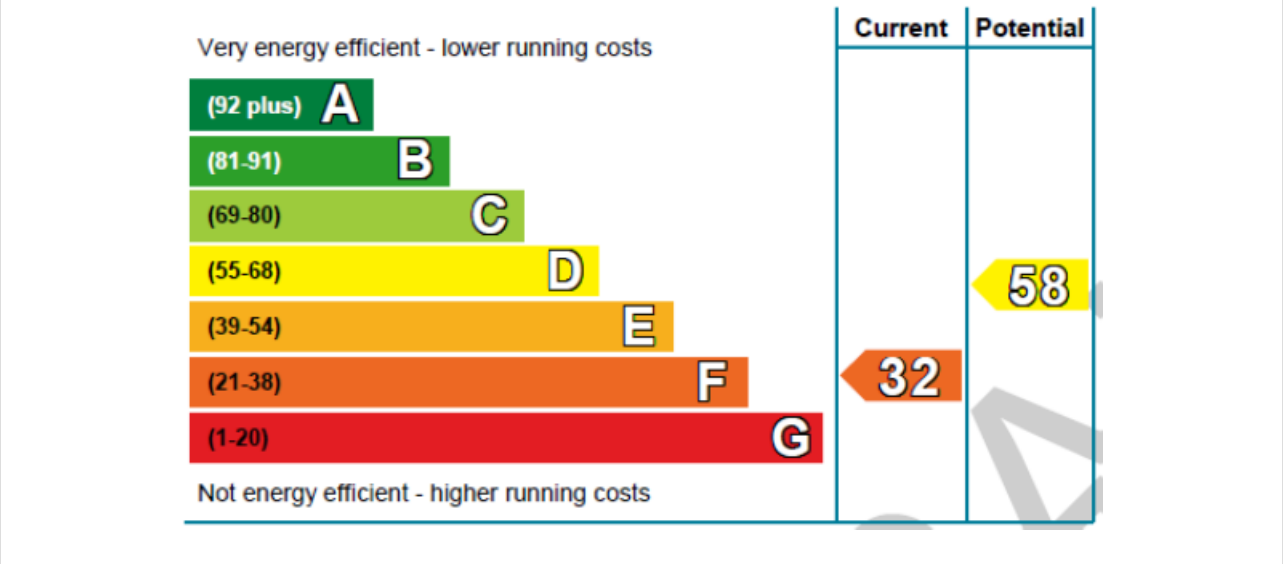


Figure 8 – Example of current and potential Energy Efficiency ratings, Scotland.

The EPC also includes an Environmental Impact rating, showing the calculated current and potential CO_2 emissions from the building (Figure 9). The average Environmental Impact rating for a residential unit in Scotland is class (59).

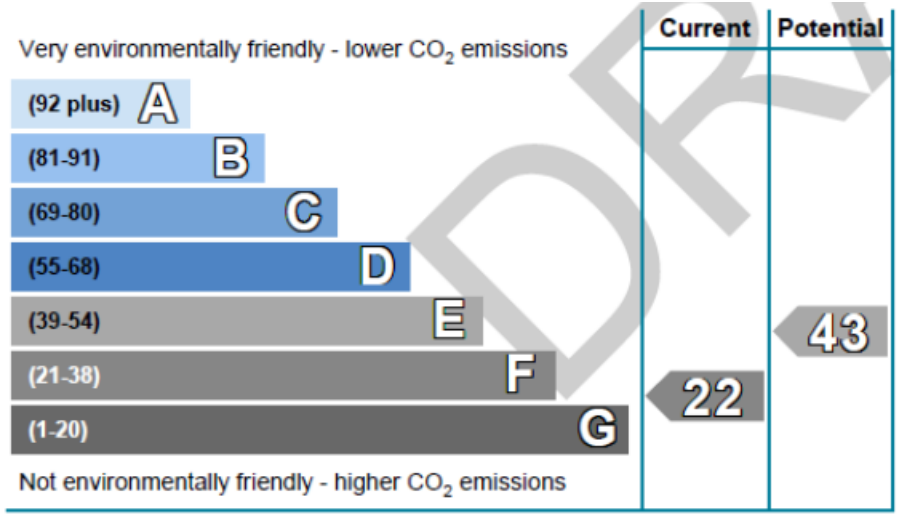


Figure 9 – Example of current and potential Environmental Impact ratings, Scotland.

The first page of the EPC for residential units is shown in Figure 10. The EPC includes a list of cost-effective recommendations to improve the building's energy efficiency and indicates the potential Energy Efficiency and Environmental Impact ratings if all cost-effective measures were implemented.

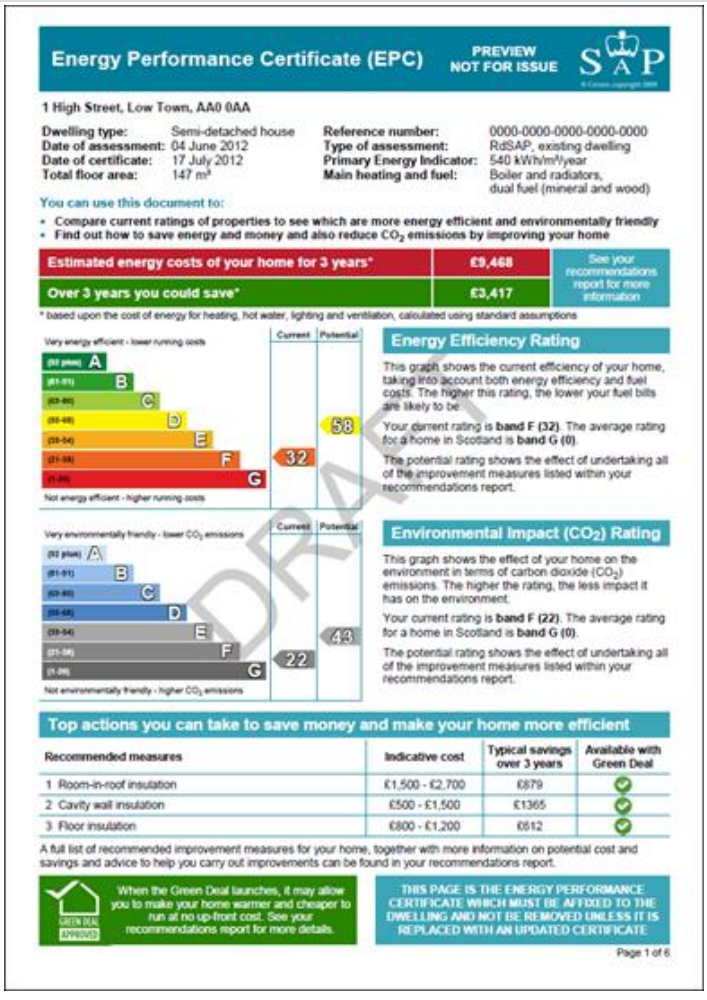
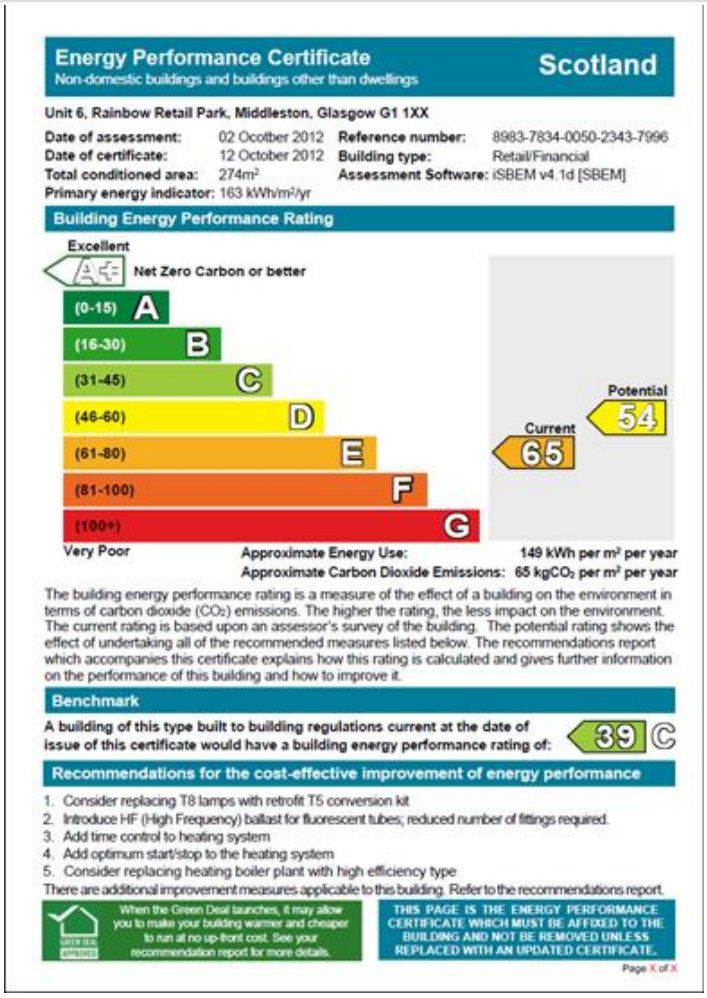


Figure 10 – First page of residential EPC[24], Scotland.

Non-residential buildings

Figure 11 shows the first page of the EPC for non-residential buildings. Energy performance is shown as a calculated CO_2-based asset rating against an A to G scale. The rating is based on absolute CO_2 emissions, rather than the relative approach (actual vs reference/notional building) adopted in the rest of the UK. Primary and delivered energy consumptions are also shown. The EPC includes one benchmark, the energy rating if the building were constructed according to Building Regulations applicable at the time of the assessment (Figure 12). Recommendations, based on the assessor's inspection, are included in the accompanying Recommendations Report.



Energy Performance Certificate — **Scotland**
Non-domestic buildings and buildings other than dwellings

Unit 6, Rainbow Retail Park, Middleston, Glasgow G1 1XX

Date of assessment: 02 Ocotber 2012 Reference number: 8983-7834-0050-2343-7996
Date of certificate: 12 October 2012 Building type: Retail/Financial
Total conditioned area: 274m² Assessment Software: iSBEM v4.1d [SBEM]
Primary energy indicator: 163 kWh/m²/yr

Building Energy Performance Rating

Excellent
Net Zero Carbon or better
(0-15) A
(16-30) B
(31-45) C
(46-60) D
(61-80) E
(81-100) F
(100+) G
Very Poor

Potential 54
Current 65

Approximate Energy Use: 149 kWh per m² per year
Approximate Carbon Dioxide Emissions: 65 kgCO₂ per m² per year

The building energy performance rating is a measure of the effect of a building on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating, the less impact on the environment. The current rating is based upon an assessor's survey of the building. The potential rating shows the effect of undertaking all of the recommended measures listed below. The recommendations report which accompanies this certificate explains how this rating is calculated and gives further information on the performance of this building and how to improve it.

Benchmark

A building of this type built to building regulations current at the date of issue of this certificate would have a building energy performance rating of: 39 C

Recommendations for the cost-effective improvement of energy performance

1. Consider replacing T8 lamps with retrofit T5 conversion kit
2. Introduce HF (High Frequency) ballast for fluorescent tubes, reduced number of fittings required.
3. Add time control to heating system
4. Add optimum start/stop to the heating system
5. Consider replacing heating boiler plant with high efficiency type

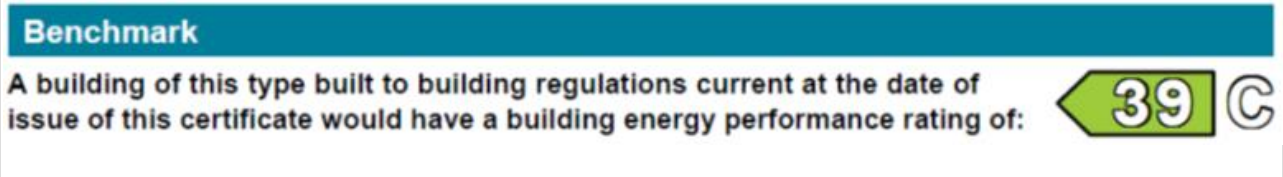
There are additional improvement measures applicable to this building. Refer to the recommendations report.

When the Green Deal launches, it may allow you to make your building warmer and cheaper to run at no up-front cost. See your recommendation report for more details.

THIS PAGE IS THE ENERGY PERFORMANCE CERTIFICATE WHICH MUST BE AFFIXED TO THE BUILDING AND NOT BE REMOVED UNLESS REPLACED WITH AN UPDATED CERTIFICATE.

Page X of X

Figure 11 – First page of non-residential EPC[25], Scotland.



Benchmark

A building of this type built to building regulations current at the date of issue of this certificate would have a building energy performance rating of: 39 C

Figure 12 – Non-residential EPC benchmark, Scotland.

EPC activity levels

Until 2012, only EPCs for existing residential units were recorded on the Scottish register[26]. EPCs for new buildings were submitted to Local Authorities as part of the Building Warrant process, and EPCs for existing non-residential buildings were not recorded. A new Scottish register[27] was implemented in 2013, and EPCs for all buildings have since been recorded. Tables 7 and 8, Figures 13 and 14 show data to December 2016 and reflect these historical arrangements.

Asset rating EPCs are produced on construction, sale, rent and for display. EPCs become valid after the data used to produce them is recorded on the register. All EPCs are valid for 10 years.

		Domestic EPC lodgements by band						
	Total EPCs	A	B	C	D	E	F	G
Total	1,227,728	1,590	73,773	421,423	469,128	179,006	62,824	19,984
Percentage	100%	0.1%	6.0%	34.3%	38.2%	14.6%	5.1%	1.6%

Table 7 – Residential EPCs to December 2016, Scotland.

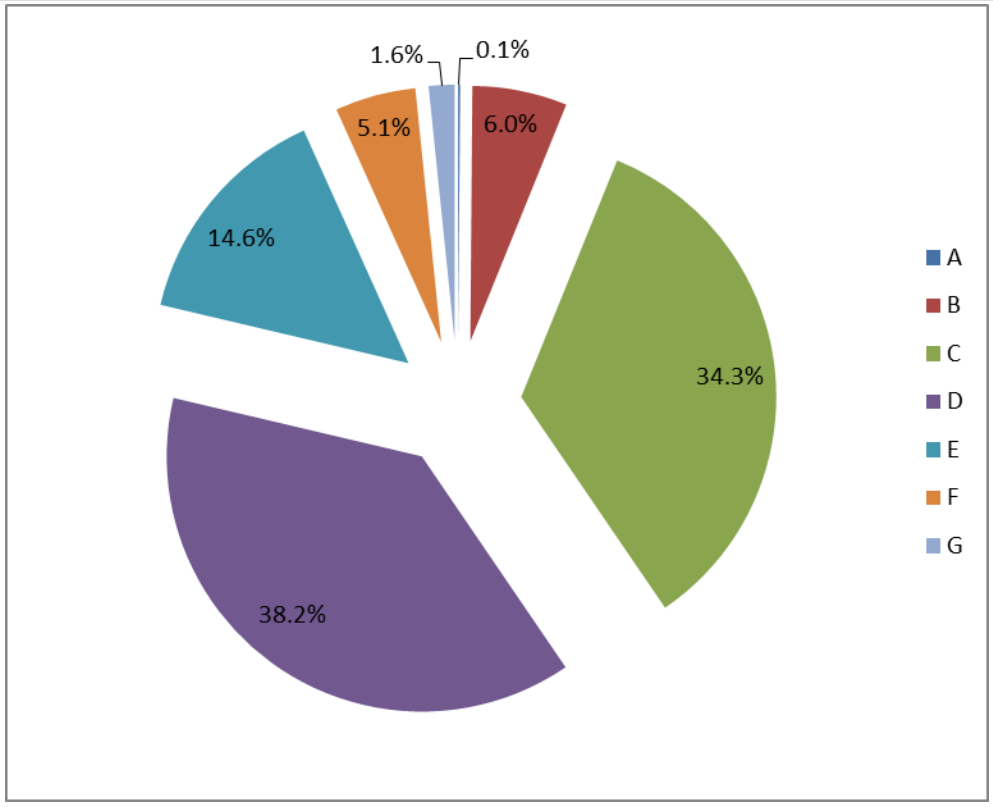


Figure 13 – Residential EPCs to December 2016. Percentages by EPC band, Scotland.

	Non-domestic EPC lodgements by band								
	Total EPCs	Carbon	A	B	C	D	E	F	G
Total	25,043	49	270	866	2,215	3,351	4,530	3,595	10,167
Percentage	100%	0.2%	1.1%	3.5%	8.8%	13.4%	18.1%	14.4%	40.6%

Table 8 – Non-residential EPCs to December 2016, Scotland.

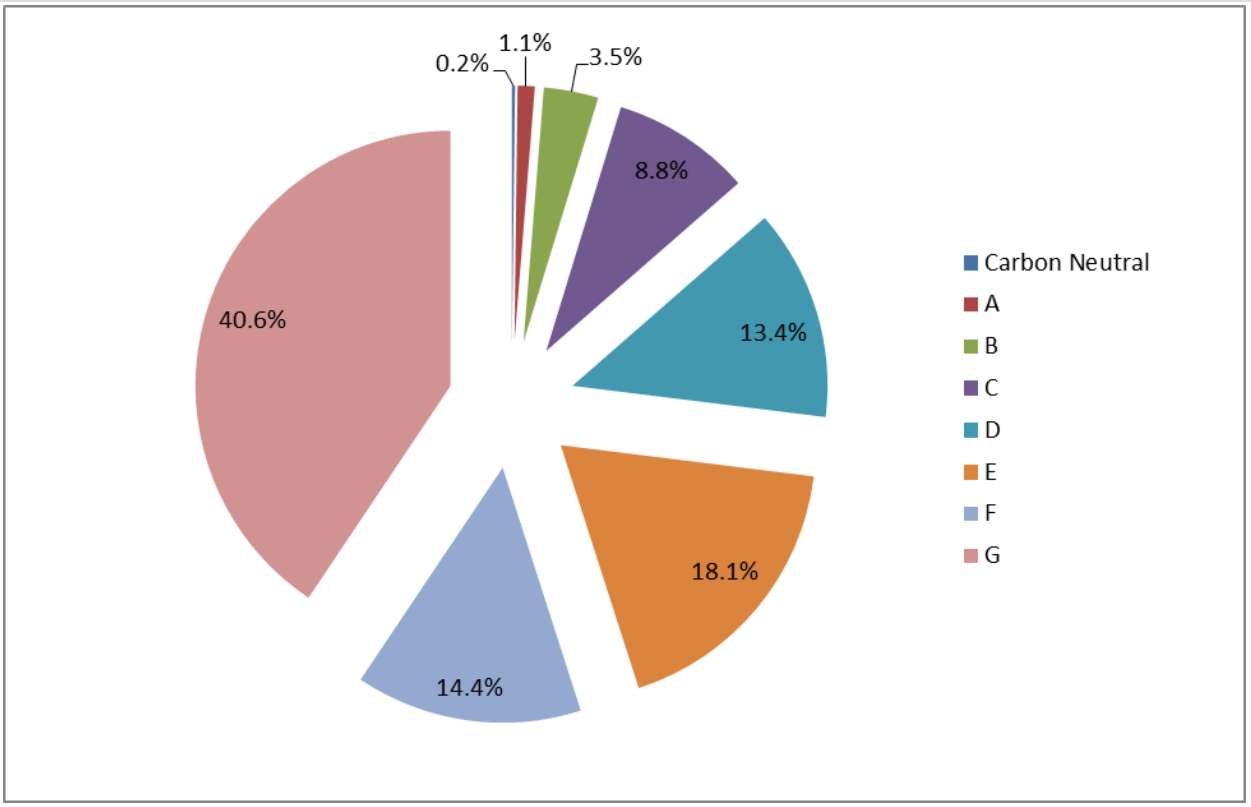


Figure 14 – Non-residential EPCs to December 2016. Percentages by EPC band, Scotland.

Typical EPC costs

EPC costs vary greatly. Indicative starting costs (lowest market costs based on internet search), including the registration fee[28] payable each time an EPC is recorded on the register, are:

- for residential EPCs: from £35 to £60 (~41 € to 70 €);
- for non-residential EPCs: from £129 to £150 (~150 € to 174 €).

Assessor corps

The Operating Framework requires Approved Organisations to reference the UK National Occupational Standards (NOS) when establishing requirements for Energy Assessors. See England report for details. Four levels of registration are available for EPCs, instead of eight for the rest of the UK (Table 9). The Operating Framework requires Continued Professional Development (CPD). A minimum level of CPD hours is specified by each Approved Organisation.

Assessor types	Assessor numbers
Domestic EPCs (existing buildings)	1,844
Domestic EPCs (new buildings)	367
Non-domestic EPCs (existing buildings)*	415
Non-domestic EPCs (new buildings)	425
AC inspection (level 3, simple)	10
AC inspection (level 4, complex)	170
Total Assessors	***3,231***

Notes
* includes public buildings
EPC: Energy Performance Certificate
AC: Air-Conditioning
AC level 3: simple/ packaged AC
AC level 4: complex/ central AC

Table 9 – Energy assessors' qualifications and numbers, Scotland

Enforcement with building owners and real estate actors

Local Authorities enforce the Regulations in their jurisdiction. They have the powers to require copies of EPCs. Failing to include the EPC rating in commercial media (when marketing a property) can result in enforcement actions. Penalties vary from £500 (~580 €) for residential units, to £1,000 (~1,160 €) in any other case. Local Authorities can also consider criminal action[29].

Government has no statistical information on enforcement proceedings or penalties since the coming into force of the requirements in 2008. Government is aware that complaints have been investigated and, where appropriate, EPCs obtained.

2.III.ii. Quality Assurance of EPCs

Under the Operating Framework, Approved Organisations have Quality Assurance responsibilities. Since 2013, Approved Organisations must check a representative sample of EPCs, e.g., a minimum 2% of all EPCs produced must be checked. Checks repeat the EPC calculations using data on the register. In 2016, 260,206 EPCs were produced and 6,604 (2.53%) were checked. Most checks are desk-based. Assessors' outputs are checked every six months minimum. Poor performance can lead to targeted auditing, retraining, suspension, or being struck off.

Government audits Approved Organisations to ensure compliance with the Operating Framework. Approved Organisations who fail to meet the terms of the Framework are subject to a schedule of corrective action and may have their agreement terminated.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Unlike other UK jurisdictions, in Scotland the calculated EPC required on construction, sale or rental is also displayed in public buildings. The requirement applies to two building categories:

- Buildings occupied by public authorities with a floor area > 250 m² and frequently visited by members of the public. Qualifying occupiers must obtain and display an EPC.
- Other non-residential buildings with a floor area > 500 m² and frequently visited by members of the public. Qualifying occupiers must display the EPC only if they have one.

Activity levels for the display of EPCs within Local Authority public buildings are monitored by the Scottish Government. Non-residential EPCs activity levels are provided above.

2.III.iv. Implementation of mandatory advertising requirement – status

An EPC must be produced when a new building is constructed and the owner intends to sell or rent the building. Valid existing EPCs can be used for sale or rent, otherwise a new EPC must be obtained. The EPC and Recommendations Report must be provided to prospective buyers or tenants. Since 2013, building owners must ensure that commercial advertising for sale or rent include the "*energy performance indicator*", e.g., EPC = C.

2.IV Inspection requirements – heating systems, air conditioning

The UK adopted alternative measures for heating systems and inspections for AC systems. See England report for details. Heating systems measures specific to Scotland include the "Energy Assistance Package", which targets fuel poverty and aims to reduce fuel bills and improve the energy efficiency of homes, the "Home Energy Efficiency Programmes" and the "Warmer Homes Scotland".

2.IV.i. Report on equivalence of model A and B for Heating Systems

See England report for details.

2.IV.ii. Progress and current status on heating systems

See England report for details.

2.IV.iii. Progress and current status on AC systems

AC inspections were phased in between 2011 and 2013. In the same building, multiple systems < 12 kW but totalling 12 kW or more, qualify if they are centrally controlled. Portable systems and AC of process only loads do not qualify.

Inspections are required throughout the life of the building, as long as AC is present. Building owners must ensure AC systems are inspected by an accredited expert who issues a report setting out recommendations and timescales for the next inspection. AC inspection reports are not recorded on a central register.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Local Authorities ensure that building owners possess a valid inspection report or have commissioned an inspection. Local Authorities may serve enforcement notices and, if building owners do not comply, Local Authorities can undertake remediation work for compliance and recover expenses from building owners. There are no published records of enforcement notices imposed by Local Authorities for non-compliance.

Quality control of inspection reports

The procedures for AC inspections are set out in the Technical Handbook which refers to industry guidance[30]. An Operating Framework has been established for *"Protocol Organisations"* accrediting AC inspectors. The Framework requires Protocol Organisations to reference the UK National Occupational Standards for AC inspections, which set minimum competencies, and skills inspectors must demonstrate accreditation. See England report for details.

The Operating Framework sets minimum requirements for the quality assurance of inspectors, and for the audit of Protocol Organisations by the Government, including:

- at least 2% of all inspection reports are checked for accuracy;
- outputs from inspectors are checked at least every six months;
- Protocol Organisations maintain records to allow Government compliance audits.

In 2016, 600 AC inspection reports were produced and 20 reports were checked, i.e., 3.3%. Note that due to the Scottish climate, there are few qualifying AC systems.

Impact assessment

Similar to England. See England report for details.

3. A success story in EPBD implementation

In Scotland, the introduction of EPCs coincided with new legislation to provide information to prospective home buyers. Sellers of residential units must provide a "*Home Report*"[31] which includes: a Single Survey, an Energy Report (including the EPC) and a Property Questionnaire.

The Single Survey (Figure 15) includes an assessment of the condition of the property, a valuation and an accessibility audit. The Energy Report contains an energy efficiency assessment of the home, its environmental impact, and energy efficiency recommendations. The EPC and Rrecommendations Report are provided with the Energy Report. The Property Questionnaire (Figure 16) contains information such as Council Tax banding.

The inclusion of the EPC in this process provides a "*one-stop-shop*" for the seller as experts produce all documents from one site visit. This ensures EPC ratings are available for inclusion in any advertisement thus a high rate of regulatory compliance. Including the Recommendation Report within the Home Report assists prospective buyers to make informed choices on energy efficiency improvements.

single survey

2. Condition

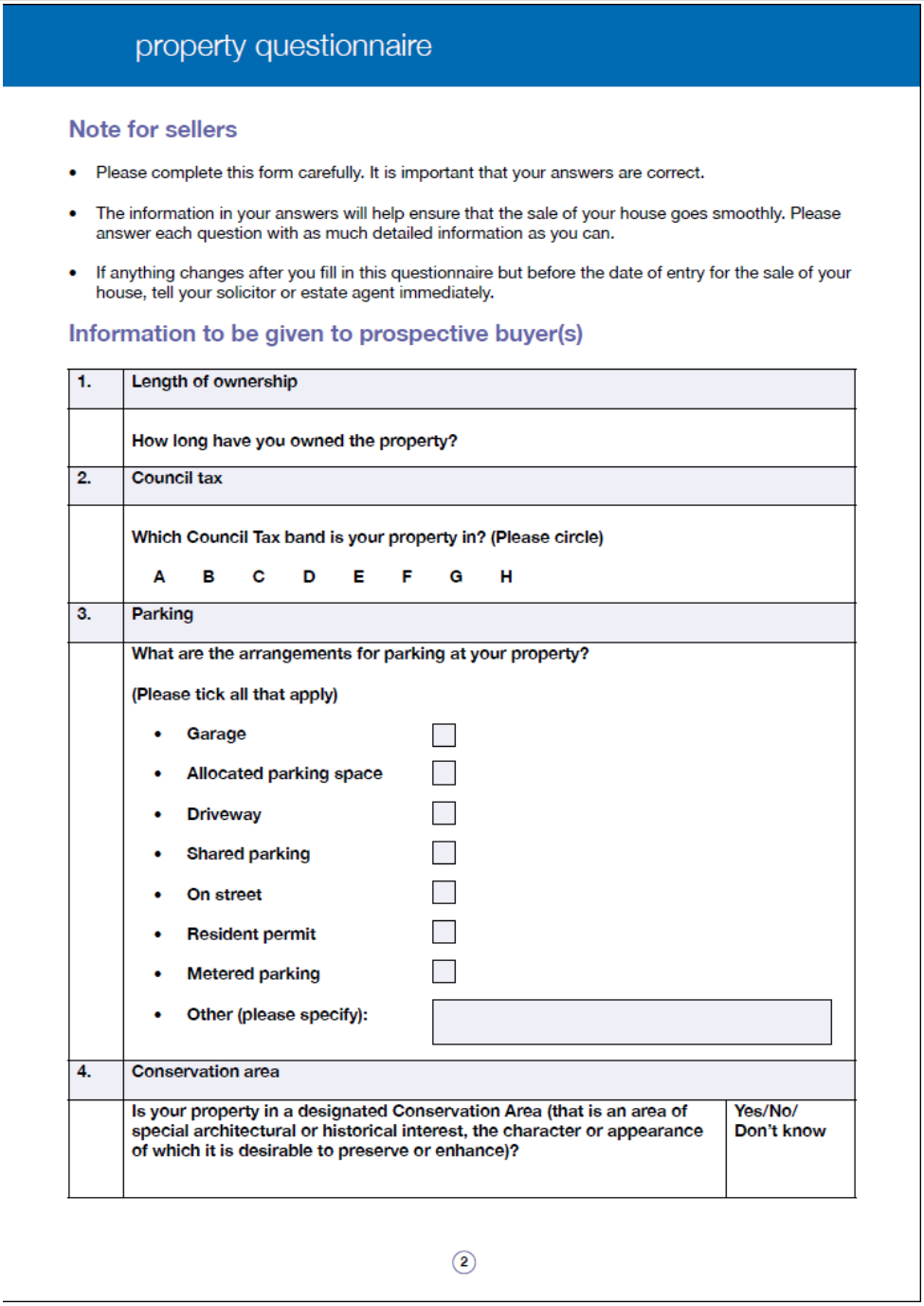
This section identifies problems and tells you about the urgency of any repairs by using one of the following three categories:

Category 3	Category 2	Category 1
Urgent repairs or replacement are needed now. Failure to deal with them may cause problems to other parts of the property or cause a safety hazard. Estimates for repairs or replacement are needed now.	Repairs or replacement requiring future attention, but estimates are still advised.	No immediate action or repair is needed.

Structural movement	
Repair category	
Notes	
Dampness, rot and infestation	
Repair category	
Notes:	
Chimney stacks	
Repair category	
Notes	
Roofing including roof space	
Repair category	
Notes	
Rainwater fittings	
Repair category	
Notes	
Main walls	
Repair category	
Notes	
Windows, external doors and joinery	
Repair category	
Notes	
External decorations	
Repair category	
Notes	
Conservatories/porches	
Repair category	
Notes	

[Property address, date of inspection, ref. no. (if applicable)] [page x of y]

Figure 15 – Extract from the Single Survey template.



property questionnaire

Note for sellers

- Please complete this form carefully. It is important that your answers are correct.
- The information in your answers will help ensure that the sale of your house goes smoothly. Please answer each question with as much detailed information as you can.
- If anything changes after you fill in this questionnaire but before the date of entry for the sale of your house, tell your solicitor or estate agent immediately.

Information to be given to prospective buyer(s)

1.	Length of ownership	
	How long have you owned the property?	
2.	Council tax	
	Which Council Tax band is your property in? (Please circle) A B C D E F G H	
3.	Parking	
	What are the arrangements for parking at your property? (Please tick all that apply) • Garage ☐ • Allocated parking space ☐ • Driveway ☐ • Shared parking ☐ • On street ☐ • Resident permit ☐ • Metered parking ☐ • Other (please specify):	
4.	Conservation area	
	Is your property in a designated Conservation Area (that is an area of special architectural or historical interest, the character or appearance of which it is desirable to preserve or enhance)?	Yes/No/ Don't know

2

Figure 16 – Extract from the Property Questionnaire template.

4. Conclusions, future plans

The UK is divided into four jurisdictions. The mix of approaches transposing the EPBD differs between jurisdictions, with significant differences between the English and Scottish approaches.

The recommendations of "The Sullivan Report, A Low Carbon Building Standards Strategy for Scotland" have steered work to reduce energy use and CO_2 emissions from buildings since 2007. The 2013 report update recommended the review of energy standards beyond 2015 to be aligned with the EPBD timetable for NZEB.

In addition to transposing EPBD requirements, Scotland introduced in 2016 the Display Energy Certificates (DECs) to report operational energy as part of the legislation for the assessment and improvement of existing non-residential buildings under Section 63 of the Climate Change (Scotland) Act 2009.

Government recognises the value of data recorded on the EPC register, which is already used to support a broad range of policies and other initiatives. Government plans to publish register data to support research and broader carbon and energy efficiency improvements of the building stock.

The transposition of the EPBD and associated benefits continues to be reviewed by each UK jurisdiction as part of their respective programmes to achieve national energy efficiency and CO_2 objectives.

Endnotes

1. www.gov.scot/Topics/Built-Environment/Building/Building-standards, www.gov.scot/epc, www.energysavingtrust.org.uk/scotland
2. All Technical Handbooks (Domestic and Non-Domestic Handbooks, including Energy and Sustainability Handbooks) are available at www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks
3. www.legislation.gov.uk/ssi/2016/71/contents/made
4. www.bre.co.uk/sap2012
5. www.uk-ncm.org.uk
6. www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks/ncmg2015
7. www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks
8. The UK refers to England, Wales, Scotland and Northern Ireland
9. Visit www.scottishepcregister.org.uk/ for details of EPCs recorded on the register
10. www.gov.scot/Topics/Built-Environment/Building/Building-standards/techbooks/techhandbooks
11. Non-domestic Building Services Compliance Guide for Scotland, The Scottish Government, 2015 Edition
12. UK National Energy Efficiency Action Plan, Department of Energy & Climate Change, April 2014
13. www.gov.scot/resource/buildingstandards/2016NonDomestic/chunks/ch07s15.html
14. www.gov.scot/Topics/Business-Industry/Energy/Action/lowcarbon/LCITP/SEEP
15. www.gov.scot/section63
16. www.scotland.gov.uk/Topics/Government/sustainabilityperformance/reporting/climatechangeact
17. CIBSE Commissioning Codes: www.cibse.org/knowledge/cibse-publications/cibse-commissioning-codes

18. BSRIA Commissioning Guides: www.bsria.co.uk/information-membership/bookshop/category/commissioning-guides/

19. Building energy metering. A guide to energy sub-metering in non-domestic buildings. Technical Memorandum (TM) 39: 2006, CIBSE

20. www.energysavingtrust.org.uk/scotland

21. www.scotland.gov.uk

22. www.scottishepcregister.org.uk

23. The Scottish Government Guidance Leaflet states: "*It is a requirement under law that the EPC must be 'affixed' to the building. Building standards guidance suggests that the EPC be located in the boiler or meter cupboard. A copy should be retained with other legal papers relating to your property.*" Guidance Leaflet EPC 01 04/16, An introduction to energy performance certificates, Local Government and Communities Directorate, Building Standards Division, The Scottish Government, available at www.gov.scot/Resource/0049/00499867.pdf

24. www.scotland.gov.uk/Resource/0041/00414384.pdf

25. www.scotland.gov.uk/Resource/0041/00414385.pdf

26. Home Energy Efficiency Database (HEED) www.energysavingtrust.org.uk/scotland/businesses-organisations/data-services/heed

27. www.scottishepcregister.org.uk/

28. Registration fees: residential = £ 1.15 / ~1.33 € and non-residential = £ 5.36 / ~6.22 €

29. "*The legal system in Scotland has two distinct sections for:*

    - cases which involve disputes between individuals or organisations, for example eviction or divorce. These are civil cases.
    - cases which involve charges being brought against individuals or organisations, for example rape or assault. These are criminal cases. […]

    Criminal cases are dealt with under one of two procedures depending on the seriousness of the offence […]"

    For more information visit www.citizensadvice.org.uk/scotland/law-and-courts/legal-system-s/taking-legal-action-s/courts-of-law-s/

30. Technical Memorandum 44 (TM 44) Inspection of Air-conditioning Systems published by the Chartered Institution of Building Services Engineers (CIBSE) www.cibse.org/Knowledge/CIBSETM(1)/TM44InspectionofAirConditioningSystems

31. www.gov.scot/Topics/Built-Environment/Housing/BuyingSelling/Home-Report



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