CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

Implementation of the EPB Belgium - Flemish Region

Status in 2020

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NATIONAL WEBSITES
www.energiesparen.be, www.omgevingvlaanderen.be

1. Introduction

In Belgium, the implementation of the EPBD is the responsibility of the regional governments. The Flemish Energy Agency (VEA, as of 2021 Flemish Energy and Climate Agency - VEKA) and the Department of Environment and Spatial Development 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.

An evaluation process of the legislation concerning the requirements for new and renovated buildings as well as the different certification schemes was finalised in 2019. The evaluation revealed that no update was needed of the respective NZEB requirements which were set and implemented in 2013 for residential buildings, offices and schools, and in 2017 for other non-residential buildings.

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

2. Current Status of Implementation of the EPBD

2.1. 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.

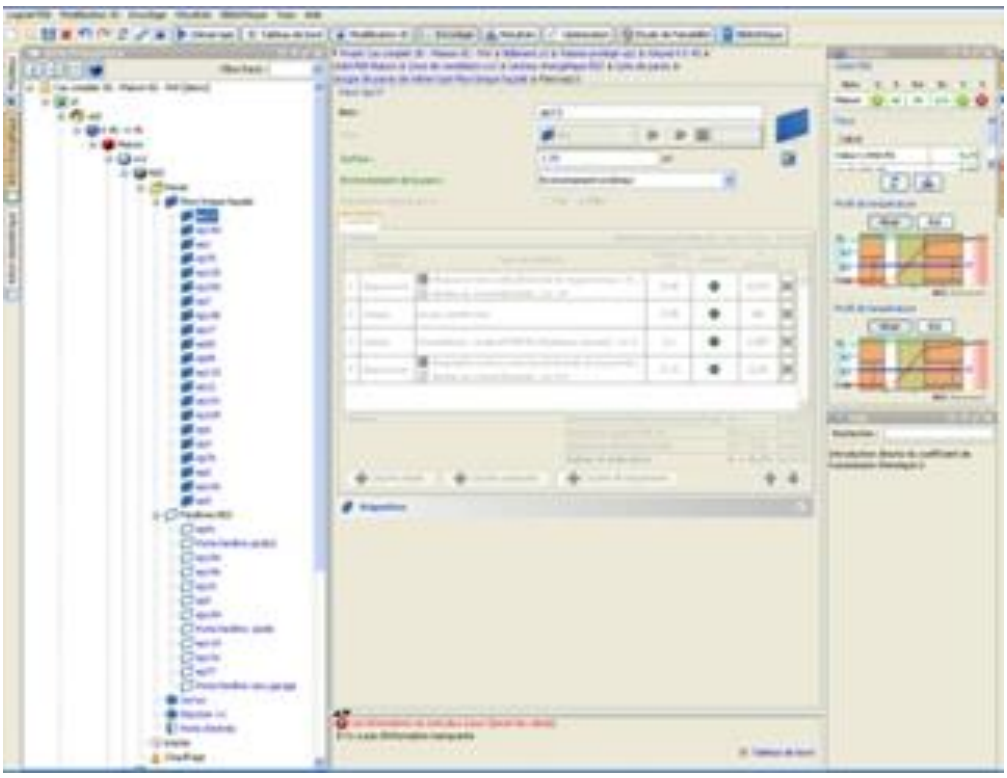


Figure 1. Software tool for the calculation of the building energy performance of new and refurbished buildings.

2.I.i. Progress and current status of new buildings (regulation overall performance)

The most important requirement for new buildings concerns the dimensionless E-level[1]. The E100-level was introduced in 2006 for new houses, offices and schools. Up to 2019, it was subsequently reduced by 60% to E40, based on cost-optimal studies. Following the cost optimal study of 2012, the path to E30 for NZEB houses was set out in 2013 and confirmed by new cost-optimal calculations in 2015 and 2017.

In 2017, the E-level, including an NZEB-path towards 2021, was introduced for all non-residential buildings (hotels, hospitals, retail, etc.). A new cost-optimal study was carried out in 2018.

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, in 2018 a replacement for the K-level, i.e. the S-level[2]). This set of requirements and its cost-optimal levels were evaluated in 2018, mainly based on cost-optimal studies[3].

Until 2019, more than 395,000 final declarations (calculations of the energy performance requirements in as-built situations) were collected in the central register (Figure 2).

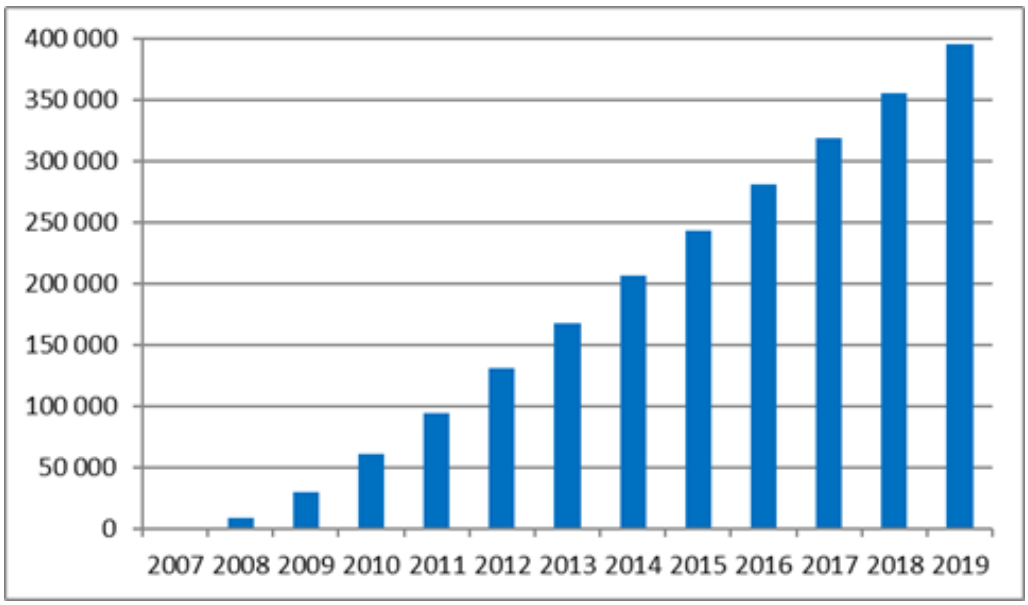


Figure 2. Total number of final energy performance declarations (cumulative).

The analysis by the Flemish Energy Agency[4] indicates that the average E-level decreases every year (Figure 3). This evolution is most evident for new single-family houses. The number of NZEB single-family houses with an E-level lower than E30 rises from only 4% for building permits in 2010 to more than 30% for building permits in 2014 and more than 60% for building permits in 2017 (Figure 4).

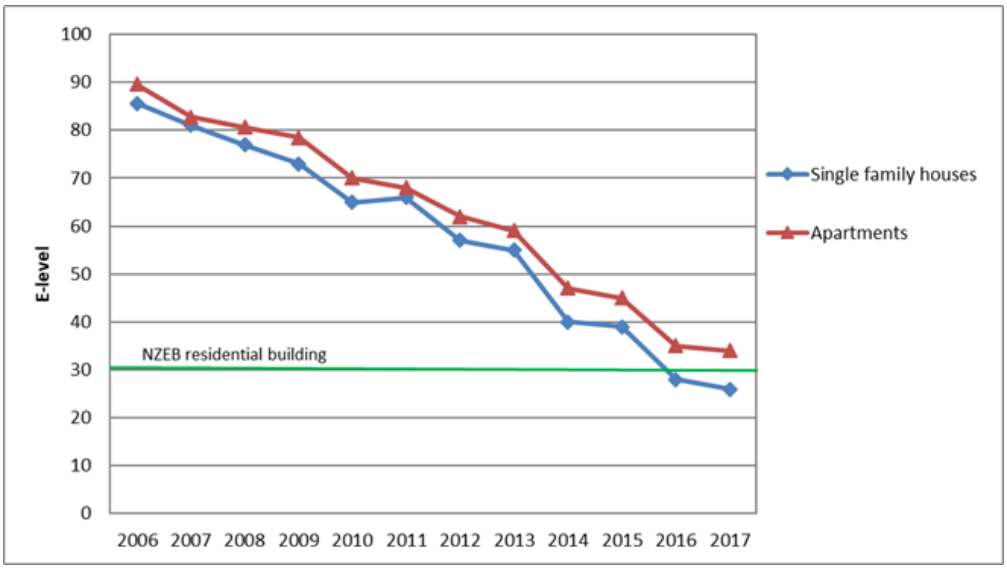


Figure 3. Evolution of the average energy performance level of new residential buildings, per year of the building permit application.

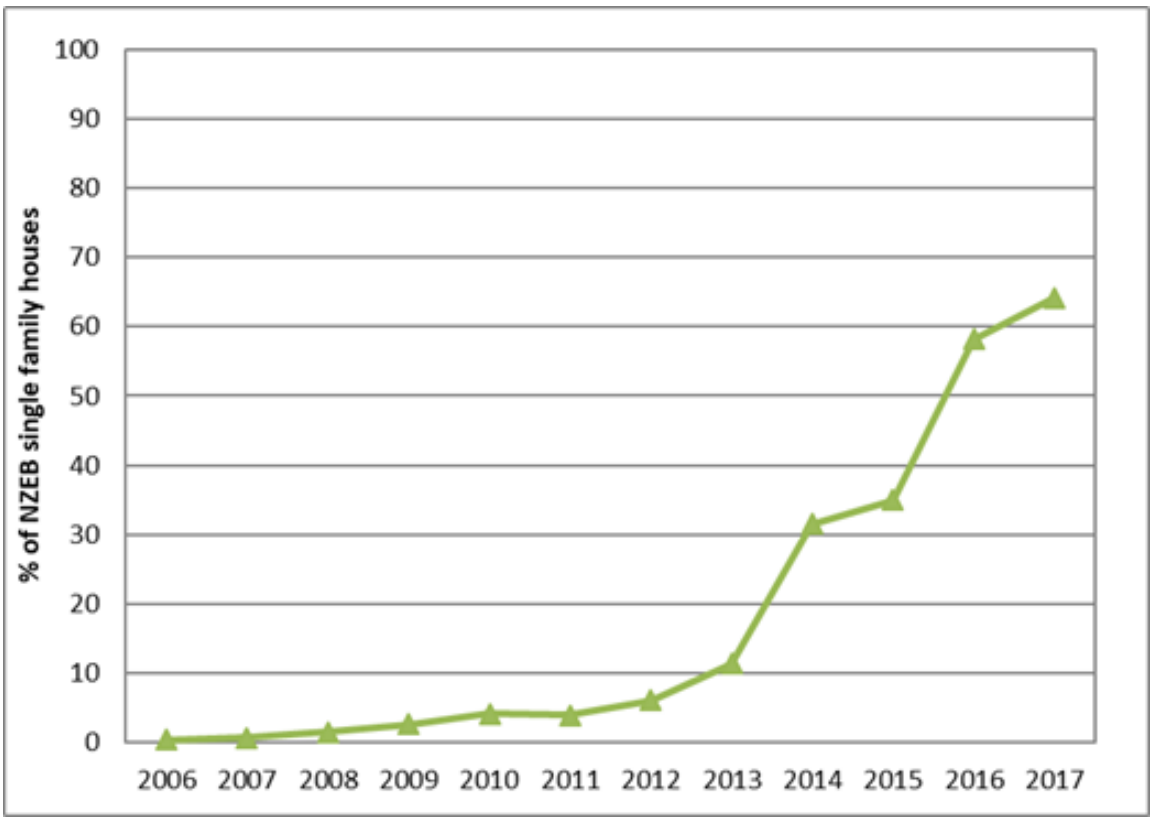


Figure 4. Share of NZEB single-family houses per year (application of building permit).

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) 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 based on CEN methods since 2017 for all non-residential buildings, substituting for the former method that covered only offices and schools). 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.

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 local authorities 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[7,8].

An important action consists of clearly defining and communicating NZEB regulations and supporting NZEB frontrunners by providing financial grants. The NZEB-levels are defined by the cost-optimal studies that comply with the methodological framework provided by the European Commission[9]. The cost-optimal studies on residential and non-residential buildings resulted in the following levels of the energy performance indicator (E-level)[10]:

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

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

Table 1. E-level tightening scheme for non-residential buildings.

E-level, function	2018	**FROM 2019**
Offices	50	50
Meeting areas: high occupancy	65	65
Meeting areas: cafeteria/refectory	60	60
Kitchens	55	55
Technical plants/control rooms	45	45
Common areas	50	50

Table 2. E-level tightening scheme for public administration buildings.

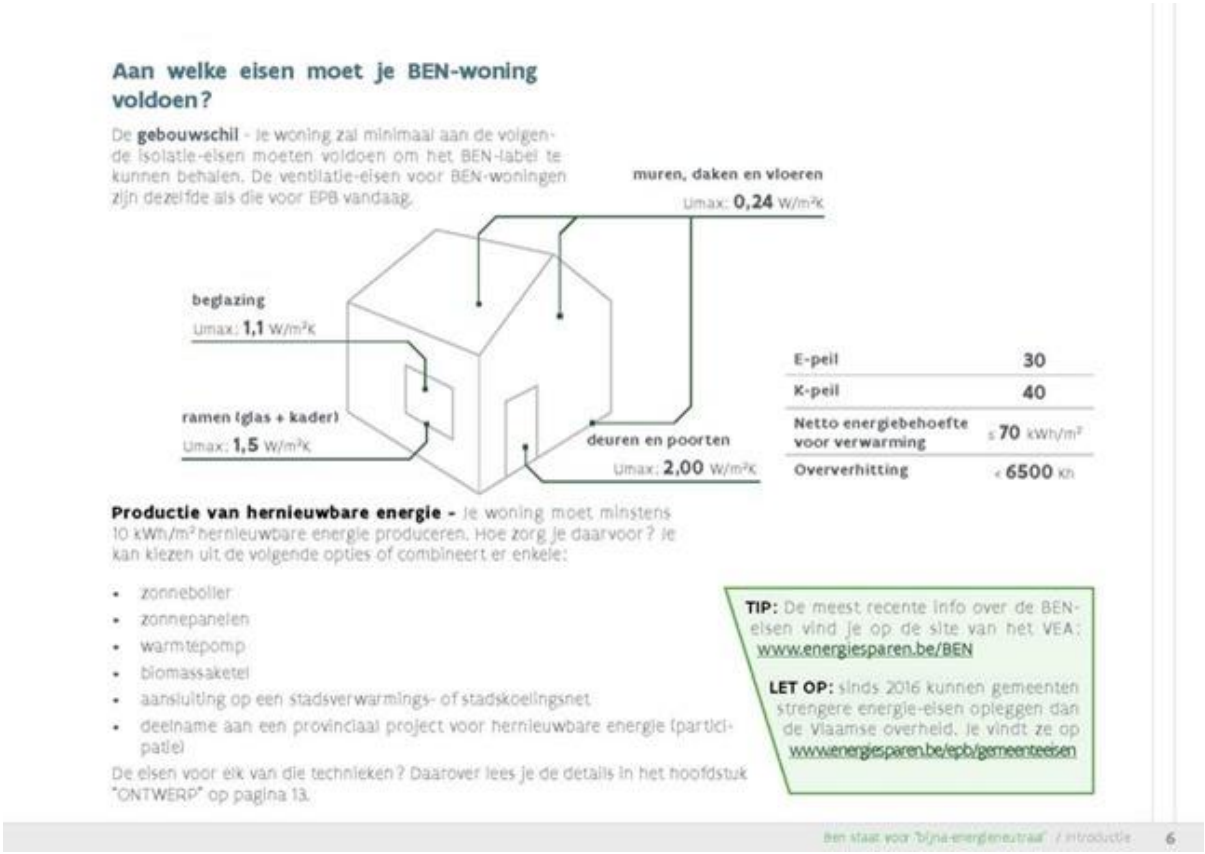
Apart from the E-level, the NZEB definition for new buildings includes additional requirements such as a minimal share of RES.

In general, with NZEB becoming the norm as of 2021, continuous actions focus on providing builders, contractors, architects and local authorities with educational information on all the aspects that need to be taken into consideration when constructing NZEB. Educational institutions updated their curricula by integrating the know-how that is required for working on NZEB. The aim is to enhance knowledge and therefore improve the quality of the work.

Specific tools aimed to the public are the NZEB-label (Figure 5), a NZEB-handbook (Figures 6 to 8), and the website www.BEN-architect.be where one can search for existing NZEB projects and training. The BEN-architect website holds a catalogue of 217 residential, public, office and commercial buildings, and provides details on the designer, the energy performance, the applied techniques and insulations (Figures 9 to 11). During building fairs, these tools are actively promoted to the public. The NZEB-handbook and BEN-architect website are popular. Contractors and suppliers of (innovative) building products keep on registering so they can use the NZEB-frontrunners label.

Figure 5. Branding the NZEB-label, available for NZEB frontrunners.

Figure 6. NZEB-handbook: cover.



Aan welke eisen moet je BEN-woning voldoen?

De **gebouwschil** - je woning zal minimaal aan de volgende isolatie-eisen moeten voldoen om het BEN-label te kunnen behalen. De ventilatie-eisen voor BEN-woningen zijn dezelfde als die voor EPB vandaag.

E-peil	30
K-peil	40
Netto energiebehoefte voor verwarming	≤ 70 kWh/m²
Oververhitting	≤ 6500 Kh

Productie van hernieuwbare energie - je woning moet minstens 10 kWh/m² hernieuwbare energie produceren. Hoe zorg je daarvoor? Je kan kiezen uit de volgende opties of combineert er enkele:

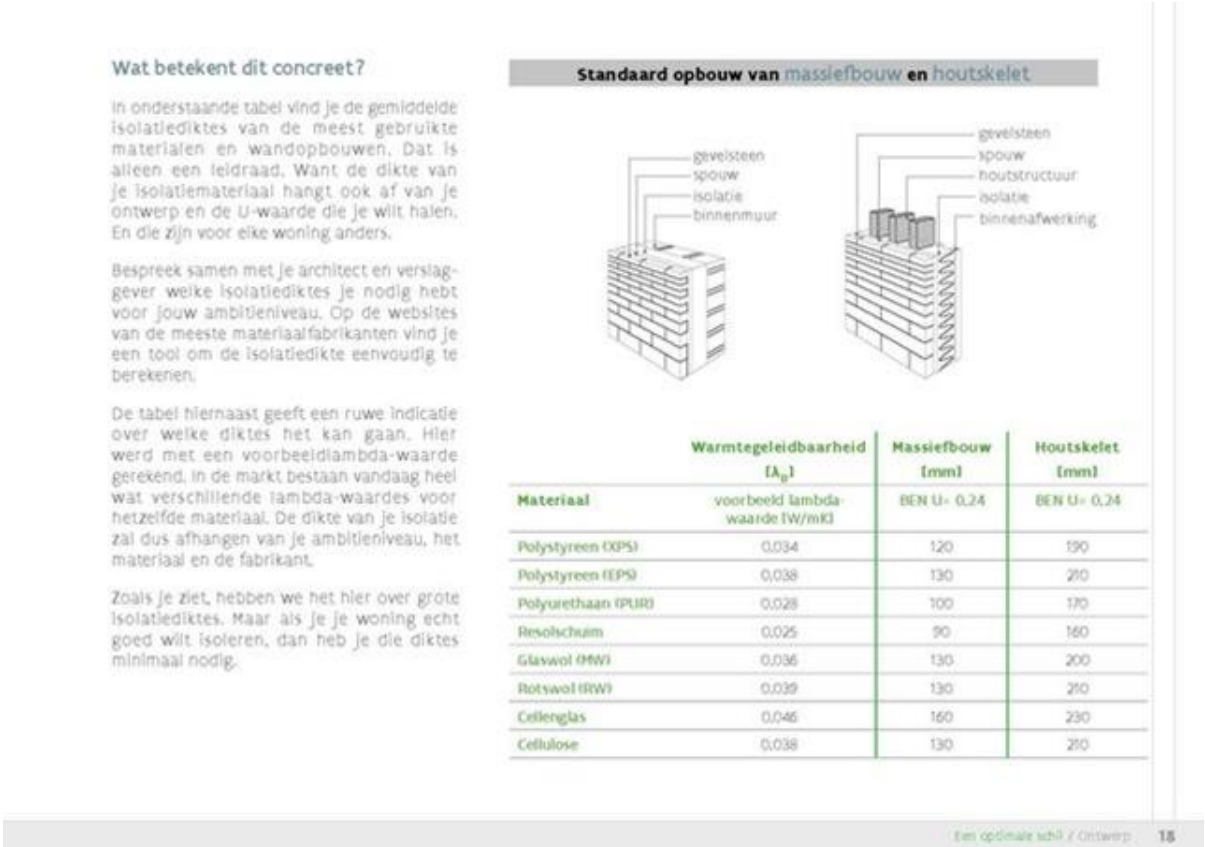
- zonneboiler
- zonnepanelen
- warmtepomp
- biomassaketel
- aansluiting op een stadsverwarmings- of stadskoelingsnet
- deelname aan een provinciaal project voor hernieuwbare energie (participatie)

De eisen voor elk van die technieken? Daarover lees je de details in het hoofdstuk "ONTWERP" op pagina 13.

TIP: De meest recente info over de BEN-eisen vind je op de site van het VEA: www.energiesparen.be/BEN

LET OP: sinds 2016 kunnen gemeenten strengere energie-eisen opleggen dan de Vlaamse overheid. Je vindt ze op www.energiesparen.be/epb/gemeenteeisen

Figure 7. NZEB-handbook: NZEB requirements.



Wat betekent dit concreet?

In onderstaande tabel vind je de gemiddelde isolatiedikten 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 isolatiedikten 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 8. NZEB-handbook: guidelines for design and execution.

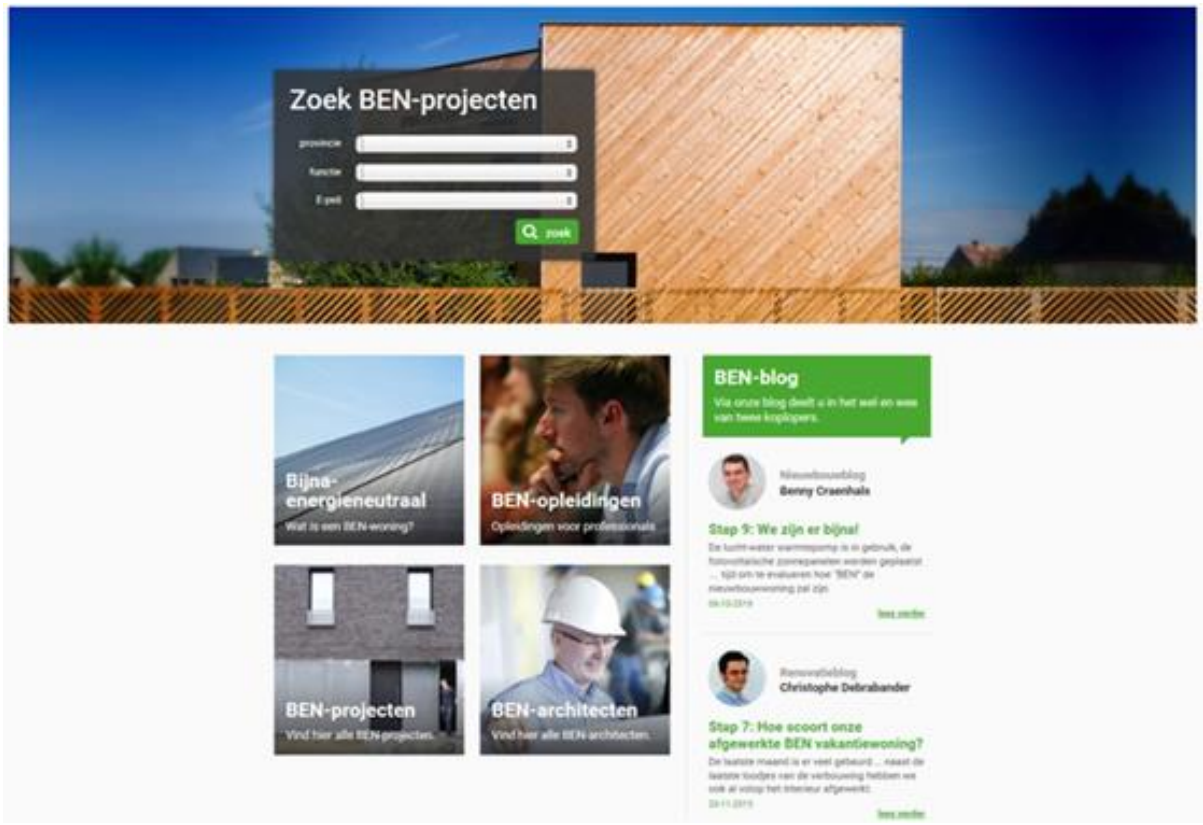


Figure 9. NZEB website with 217 nearly zero-energy residential, office, commercial and public buildings, providing energy performance details, information on material, installations, NZEB architects and NZEB training.

Figure 10. Zero-energy office, bank office in Gooik: E-level 1, K-level 25.

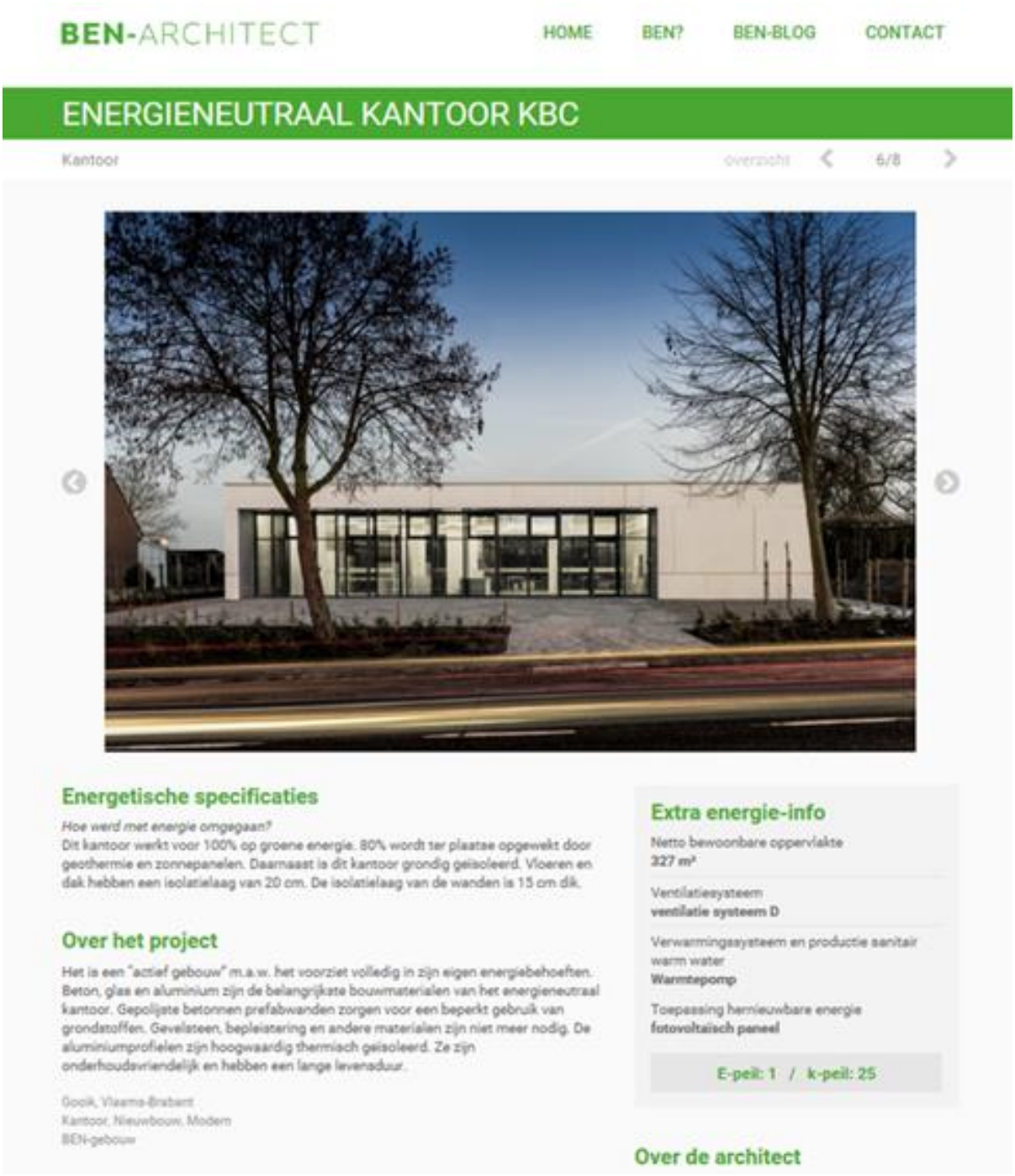


Figure 11. Energy performance details on www.BEN-architect.be of the office building in Figure 10: E-level 1, K-level 25.

Regarding future professionals, NZEB actions are a collaboration with the professional associations and cover quality control, including education (competences and knowledge), execution (study as well as execution on the building site), and definition of 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.

For the local authorities, a region-wide roadshow of good examples (one in each of the five provinces, with diverse functions, e.g., schools, small and big office buildings, public buildings, kindergarten) was set up in 2015-2016 to enhance their NZEB knowledge and motivation. The roadshow was hosted by the mayors, members of the city council and the building teams (Figures 12 to 15) who presented their NZEB project:

- General explanation of NZEB-requirements
- Technical comment by architect
- Information on the user experiences and motivation of the choice to realise NZEB
- Guided tour
- Q&A and interaction

A total of 147 participants were registered. A guide with a description of the legal and policy context and including ample descriptions of the five (5) good practices was prepared, distributed and made available on websites.

During an 18-month period, the local governments could apply for free assistance and NZEB advice and guidance in the building process to set up their own NZEB building projects. Thirty-one (31) local authorities benefited from this offer.

Figure 12. A good example for local governments: a nearly zero-energy after-school day-care centre: (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 deelgebouw 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 warmteterugwinning 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 predallen / 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, predallen, 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 13. A good example for local governments: a nearly zero-energy after-school day-care centre: energy performance (source: BEN-guide for local governments).

BUITENSCHOOLSE KINDEROPVANG BEKKEVOORT

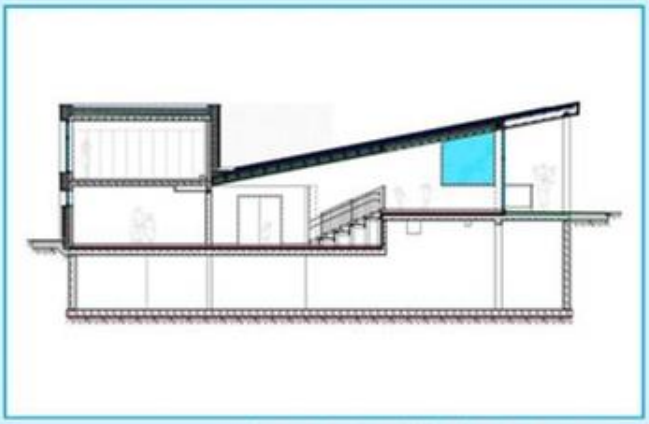
Gebruikte technieken en materialen

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 oversteek

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Figure 14. A good example for local governments: a nearly zero-energy after-school day-care centre: materials and installations (source: BEN-guide for local governments).

Figure 15. A good example for local governments: a nearly zero-energy after-school day-care centre: materials and installations (source: BEN-guide for local governments).

2.I.iv. Requirements for building components for new buildings

Since 2006, maximal U-values have been in place for new building components. The levels were systematically strengthened over the years and are meeting current cost-optimal levels (Table 3).

	Maximum U-value (in W/m².K)					
	from 2006 to 31 Dec 2009	**from 2010 to 31 Dec 2011**	**from 2012 to 31 Dec 2013**	**from 2014 to 31 Dec 2014**	**from 2015 to 31 Dec 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

Table 3. Overview of the maximum U-values for new buildings since 2006.

2. I.v. Enforcement systems new buildings

The Flemish Energy Agency checks compliance with the procedures (submitting, to a central database, a calculation of the energy performance at the start of the process and again at the as-built stage) and compares the results 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 then automatically checks if each individual building meets all the requirements. The compliance rate of new buildings with the E-level is very high (> 99%), as it is for most other requirements. For the ventilation requirements, the compliance rate is lower, whereas the systematic tightening of the requirements on E-level has not led to a decrease of the high compliance rate.

The number of non-compliance cases had stabilised since 2009 but has been rising again in more recent years (Figure 16). Because of the low numbers of declarations available in these years, it is not yet clear whether this is a trend and the rise could be linked to other uncertainties. Since 2016, the performance of ventilation systems in residential buildings has to meet the requirements of a new quality-assurance scheme. The aim is to significantly lower the number of non-compliant ventilation systems. 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 4).

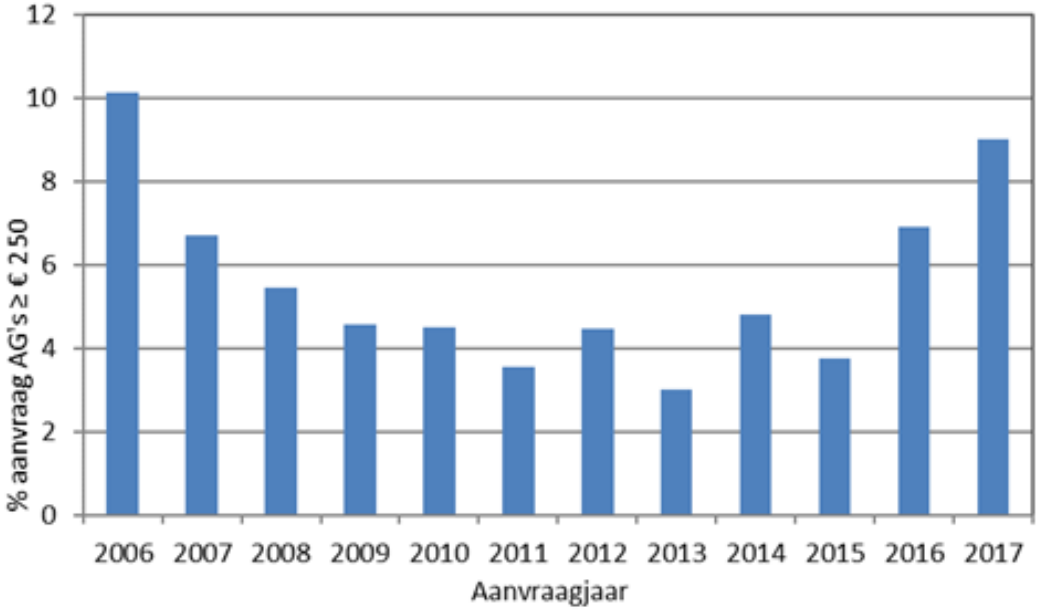

Figure 16. The share of energy performance declarations with an administrative fine for non-compliance per year (application of building permit).

		2017	2018	2019
Procedures	at start	26	40	18
	as-built	69	109	242
Requirements		2,017	1,819	1,951
Experts		20	25	34

Table 4. 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 2018, 52 calculations were checked, and in 2019, 160 calculations were checked. In order to further improve the quality of the reports, experts must attend periodic additional education as of 2015. In 2016, 3,453 experts were suspended, most of them non-active experts who did not attend any educational courses. The number of active experts has dropped every year since 2013 and has seemingly stabilised since 2016 to around 800. However, a small but growing group of 180 experts are very active and were responsible for 87% of all declarations in 2020.

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 (regulation overall performance)

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 maximum E90 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 also added. The set of requirements and related cost-optimal levels were thoroughly evaluated in 2015. Based on the Long-Term Renovation Strategy and the cost optimal level, the required E-level is strengthened in 2020 to E70 and will evolve to E60 (the long-term goal for the building stock) in the near future.

2.II.ii. Regulation on individual parts, distinct from whole building performance

In 2015, maximal U-values were added for the insulation of existing walls. These requirements are applicable if the building owner chooses to insulate (in case of a renovation with permit) but do not include any obligations to insulate existing walls.

Maximum U-value (in W/m².K)						
	from 2006 to 31 Dec 2009	**from 2010 to 31 Dec 2011**	**from 2012 to 31 Dec 2013**	**from 2014 to 31 Dec 2014**	**from 2015 to 31 Dec 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 5. Overview of maximum U-values for renovations since 2006.

2.II.iii. Initiatives/plans to improve the existing building stock

As part of the implementation of the European Directive on Energy Efficiency (Article 4), the Flemish Government defined in March 2014 a first basic long-term vision for the renovation of the existing building stock and submitted this to the European Commission.

The Flemish strategy for the renovation of existing residential buildings was built upon the Energy Renovation Programme 2020, launched in 2007. The ambition of this programme was that by 2020, every citizen of the Flemish Region would live in an energy-efficient house with roof insulation, no single glazing and an efficient heating installation. The Energy Renovation Programme 2020 was completed with the strategy 'On the road to NZEB', supporting early adopters.

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. The definition of a long-term 2050 target for energy performance of Flemish houses was one of the many key features of this pact (Figure 17).

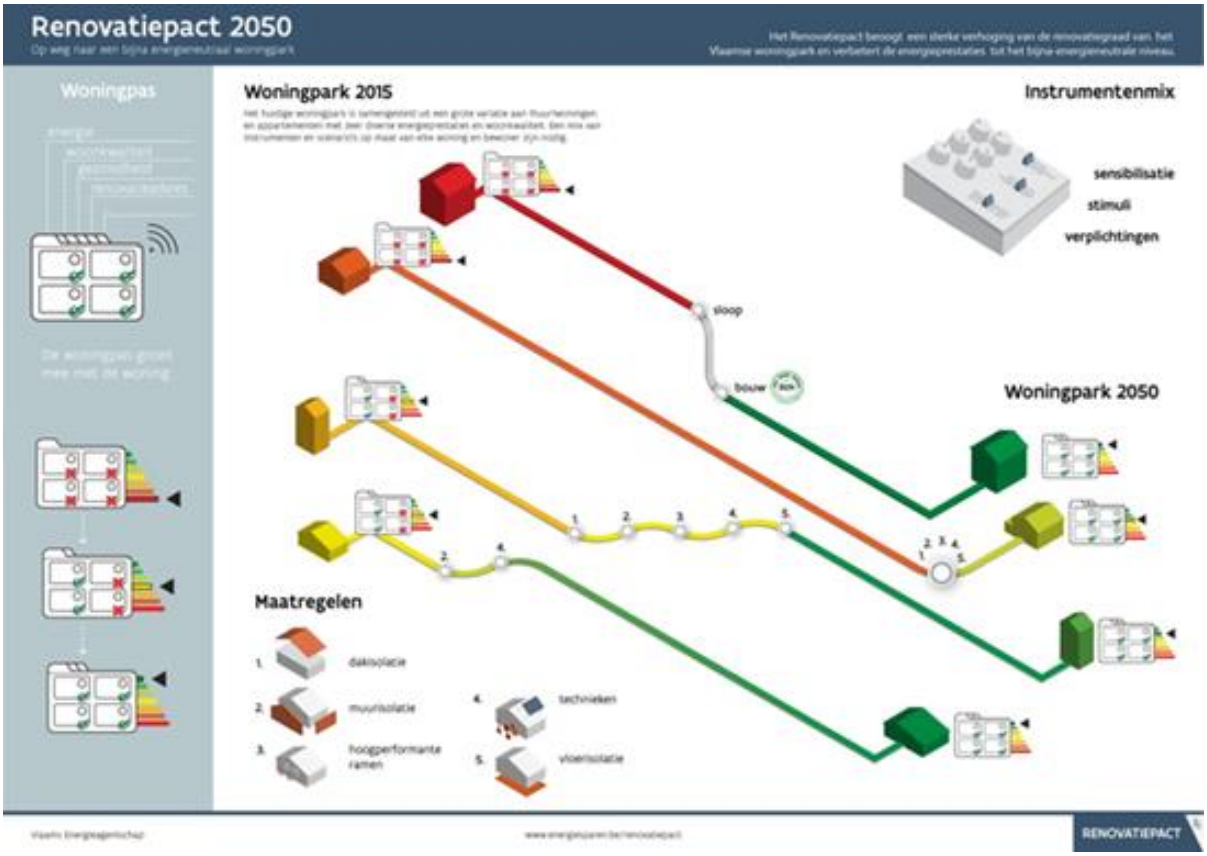

Figure 17. Visualisation of the 'Renovation Pact' strategy with long-term goals towards 2050.

For the renovation of public buildings (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. 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. The goal is that the public buildings that fall under EED Article 5 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%.

The fourth Flemish Energy Efficiency Action Plan (EED Article 4) was submitted to the European Commission in April 2017 and contained in its annex the revised roadmap for the renovation of the Flemish building stock. The key points of the long-term residential renovation strategy were the definition of a long-term target for 2050, the development of a housing passport (launched end of 2018), an update of the energy performance certificate (launched in 2019) and the further implementation of the 2016 Energy Poverty Programme. For non-residential buildings, the main focus was on the exemplary role of public buildings as well as support mechanisms for schools and healthcare buildings.

2. II.iv. Long Term Renovation Strategies, status

Based on stakeholder consultations, the Flemish Long-Term Renovation Strategy (LTRS) 2050 was updated and validated by the Flemish Government on 29 May 2020 (EPBD, Article 2bis). The LTRS 2017 was enriched with a scenario analysis resulting in a roadmap with milestones for both residential and non-residential buildings. This exercise showed:

- that 95% of buildings need to be renovated to comply with the 2050 target;
- that in order to realise this, a substantial growth in both pace and depth of renovation activity is needed.

Specific trigger points in the life course of a building were identified as the ideal moments to undertake deep and cost-effective renovations. Using the potential of these trigger points (sales, inheritance, change of renter) to the max, helps to spread the renovation efforts. Also, a fast improvement of the energy performance is crucial to reach the 2030 greenhouse gas emissions reduction goals. The general ambition of the LTRS 2050 is as follows:

- For the residential sector: before 2050, all existing houses have to reach label A on the Energy Performance Certificate (comparable to the energy performance of new houses in 2015) and the electricity and heating needs will shift towards a very high share of RES;
- For the non-residential sector: evolution to carbon neutrality for heating, cooling, hot water and lighting by 2050.

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

In order to stimulate energy renovation, a package of financial incentives and subsidies for individual measures is available. The main focus for individual insulation measures is roof insulation, wall (outside, cavity, inside) insulation, floor insulation and high efficiency glazing. For individual RES measures there are grants for thermal boilers, heat pumps and domestic hot water heat pumps. Each year, substantial budgets are spent. The most popular measures are roof insulation (45,000/year) and double glazing (30,000/year).

ENERGY GRANTS	2014	2015	2016	2017	2018	2019
TOTAL GRANTS	136,866	159,660	151,294	143,961	123,289	133,819
TOTAL BUDGET (million Euro)	76.0	98.0	96.4	85.1	61.1	62.8

Table 6. Energy grants Flemish Region (2014-2019); source: Flemish Energy Agency.

In order to promote integrated renovations, the 'total renovation bonus' was introduced in 2017. If combined within a period of five (5) years, substantial bonuses are granted on top of the basic grants, starting from the third measure and for each following measure (max. 7).

Since October 2016, a new fiscal incentive for a period of five (5) years has been introduced for 'IER-EPBD-renovations', or deep energy renovations, achieving an E-level of max. E90. A reduction of 50% (E90 or below) or 100% (E60 or below) is granted on property taxes for a period of five (5) years. In order to put the emphasis on the frontrunners, only the E60 reduction is available from 2020 on.

Since 2015, public funded zero-interest loans for renovation of up to 15,000 € over ten (10) years are granted for a total budget of 175 million €. In 2018, this loan became exclusively targeted towards vulnerable families that meet one of a series of well-defined criteria, e.g. income level, being under guidance for energy poverty by a local authority, or a beneficiary of the social energy tariff.

2.II.vi. Information campaigns / complementary policies

The communication about the EPBD mainly focuses on the E-level to be achieved by law, and minimum performance levels financial incentives as well as the path to NZEB (E30 for houses) 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 frontrunners (companies, public authorities, architects, material producers, registered on www.energiesparen.be/BEN (http://www.energiesparen.be/BEN)). The slogan is '*ik BEN mee*' (I get it).

Since monitoring of the as-built performance started, a constant over-performance was noticed compared to the actual legal requirements, showing that builders can successfully achieve ambitious performance objectives if the legal framework is clear and stable.

For deep renovations, since the end of 2016, several waves of a new campaign called '*BENOveren*' (Figure 18) started. 'BENOveren' means 'to renovate better' and focuses on the long-term goals for 2050. Communication material is developed and made available to various stakeholders.

Figure 18. Branding deep renovations with long-term goals towards 2050.

In December 2018, the 'Woningpas', a free individual housing passport, was launched, showing all the data of the house and the building plots that is available in public databases, including the Energy Performance Certificate. This last one was updated and launched early 2019, showing the energy performance in terms of labels (F to A) and offering a more detailed advice for (staged) renovation for the 2050 goal. In 2020, a free online demo-tool will be launched which will give the public the possibility to get an indicative energy performance score together with some benchmark data.

2.III. Energy performance certificate requirements

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

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 265,000 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 1.5 million EPCs for existing residential buildings have been issued since then. For small non-residential buildings, certification started on 1 January 2020 in case of sale or rental. Approximately 2,300 certificates were issued from January to mid-April. The implementation of the energy certification scheme for large non-residential buildings is still under development and is expected to start in 2022.

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 the 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 was updated and the new EPC was launched in the beginning of 2019, showing the energy performance in terms of labels (F to A) and offering a more detailed advice for (staged) renovation towards achieving the 2050 goal (depending on the qualified expert's input). For single-family houses the EPC also shows the renovation costs.

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 has to pay a fine when they do not report the absence of the EPC to the Flemish Energy Agency. When an EPC is not available by the time of advertising, the seller has to pay a fine.

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

From 2022, an EPC will also have to be available for the common parts of an apartment building. This obligation is separate from sales and rentals. It is an instrument to familiarise the owners and the building manager with the energy performance of the building and to inform them about the best steps to be taken to start the energy-efficient renovation.

The EPC for common parts contains information and advice concerning the common parts of the building, e.g. building envelope, collective central heating installations or ventilation systems covering multiple units, etc. As not all information is available for the certifier (information about the individual heating systems, etc. is encapsulated within the individual EPCs), the EPC does not contain a global energy score of the building. The EPC information of the common parts is used when the EPC of an apartment in the building is prepared. The two certificates (for the apartment unit and for the building's common parts) complement each other.

The EPC for common parts is also valid for ten (10) years. However, since this EPC serves as the basis for the EPCs of the individual apartments in the building at any moment in time, it is mandatory to update it when major energy renovation measures have been performed.

2.III.ii. Quality Assessment of EPCs

In addition to the checks on new buildings, the Flemish Energy Agency executes a quality check on the work of a number of qualified experts, based on the detection of inconsistent data and on random checks. Each month, a sample of EPCs issued in the previous month is extracted and checked by means of desk controls.

In addition, the Flemish Energy Agency also handles complaints regarding the quality of EPCs. In case of a complaint, quality checks often involve on-site investigations.

In 2018, 216 EPCs were checked using the random sampling method and 16 EPCs by targeted control. After checking, 207 EPCs were evaluated as adequate (though some experts received a warning). The quality of 25 EPCs was considered insufficient. The experts responsible for those EPCs had to pay a fine. In addition, six (6) experts were suspended.

Further to the above, there were 14 complaints and nine (9) of the qualified experts had to pay a fine. As these statistics are based on targeted controls, they cannot lead to any conclusions on the overall quality of EPCs.

Since December 2015, the minimum fine for the issuance of an invalid EPC is reduced. Experts now risk a fine which ranges between 250 € and 5,000 € if the control shows that the certificates issued are invalid.

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

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 rely on the EPC for new buildings to meet the above requirement. In the future, it will also be possible to rely on the EPC 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 2019, more than 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 used by the federal, regional and local governments, schools and health, as well as 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 2019, 2,040 controls were executed regarding the advertising requirements. Ninety percent (90%) of the controlled advertisements complied with requirements.

Since December 2015, the minimum fine for not publishing the required data was reduced to 250 €. Both private individuals and broker agencies can be fined between 250 € and 5,000 € for not publishing the required EPC data.

In the period from January 2012 to December 2019, 768 fines were imposed.

2.IV. Smart buildings and building systems

2.IV.i. Status and plans on smart buildings

The Flemish Energy Agency closely follows developments at the European level regarding the Smart Readiness Indicator. For the elaboration of the European regulations (delegated and implementation acts regarding the Smart Readiness Indicator), the European Commission has composed an expert group with experts from the different Member States, among which is the Flemish Energy Agency. This expert group

has already met three times to discuss the content of the regulations. There are currently no concrete plans for the implementation of the Smart Readiness Indicator. Therefore, specific stakeholder consultation in the Flemish Region will be necessary. The Flemish Energy Agency will investigate whether a test phase would be necessary before deciding on the effective implementation of the Smart Readiness Indicator.

2.IV.ii. Regulation of system performance

There are no specific requirements for the 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 the freedom in design without a proportionate benefit.

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 7).

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 7. 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 in existing buildings which are altered or expanded 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 can be 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.

Since 2017, the requirements on technical building systems for renovations also apply to new industrial buildings, since this type of building does not have a defined E-level.

In 2019, a study was carried out to evaluate the existing requirements and the changes needed because of the new definitions introduced by the revision of the EPBD in 2018. The implementation process for the proposed changes is running and is planned to come into force in 2022.

2.IV.iii. Building Automation and Controls (BACs)

The Flemish Government is implementing a set of new requirements for BACS in large non-residential buildings starting in 2025. The feedback collected from stakeholders suggests possible issues with the introduction of BACS in existing public buildings, especially schools. The high installation costs could disrupt already tight budgeted renovation schemes for these buildings. VEA will, in collaboration with different stakeholders, examine in which cases there need to be exceptions because of economic or functional feasibility.

It is also the intention to implement a certification scheme for all existing large non-residential buildings based on metered consumption. Compliance with the requirements on the installation of BACS could be checked as part of this certification scheme.

2.IV.iv. Status and encouragement of intelligent metering

The energy performance regulations for technical building systems include requirements for energy metering of large installations. Table 8 gives an overview of the requirements. The presence of such metering systems is obligatory, but it has no direct impact on the energy performance of the building. The meters need to comply with standards, and they must 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 residential buildings starting from 2019. The introduction is gradual, starting with the replacement of limited and outdated meters and meters of households with a PV installation.

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 8. Overview of legally required meters.

2.IV.v. Progress and current status on heating systems (Inspection / Equivalence)

Flanders has adopted inspections for heating systems that use a boiler or a heat generator. For other heating systems, Flanders will adopt measures to ensure the provision of advice and other alternative solutions to assess the efficiency and appropriate size of those systems.

Boilers must be inspected, in terms of safety and proper functioning, by a certified technician before first brought into use. To be ‘certified’ by the responsible public administration, these experts have to meet certain requirements, attend a specific training course and pass a specific exam imposed by the responsible public administration. Additional training every five (5) years is required as well. Boilers with a nominal output of 20 kW and above, must be frequently maintained and inspected by a recognised technician who checks the safety, proper functioning and energy efficiency. If it is found not compliant, the boiler must be adjusted or replaced. Finally, the certified recognised technician periodically checks the energy efficiency of the entire central heating system and suggests possible energy-saving methods (Table 9).

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 (2) years		RTG
	Liquid		At least each year		RTL
	Solid	All			SC
Heating audit	Gaseous	≥ 20 kW and ≤ 100 kW	At least every five (5) 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 (4) years		RTH
	Liquid	≥ 20 kW and ≤ 100 kW	At least every five (5) years		RTL
		>100 kW	At least every five (5) years		RTH
	Solid	All	At least every five (5) years		RTH

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

Table 9: Summary of inspection types on central heating systems powered by a boiler on gaseous, liquid or solid fuel.

All results of inspections are documented in reports. In 2018, a new web application was launched allowing the digital documentation of inspection results and the storage of data in a central database as well as the generation of statistics on heating systems. The certified recognised technicians are not obliged to use the application.

In the nearby future, these reports will be further digitalised and stored in a regional database. For household installations, the heating audit will be part of the digitalised inspection and maintenance reports. This way, the owners of these heating systems will be regularly informed on the periodic maintenance and the performance of their systems. The reports will further be developed to include information on the proper regulation of the heating boilers and available alternative and sustainable options to choose from when a replacement of the boiler is needed.

In 2018, energy efficiency requirements of older boilers using gaseous fuels and premix-technology boilers using liquid fuels were strengthened. A website supports general communication and campaigns about the inspections. Further communication initiatives will follow (Figure 19).

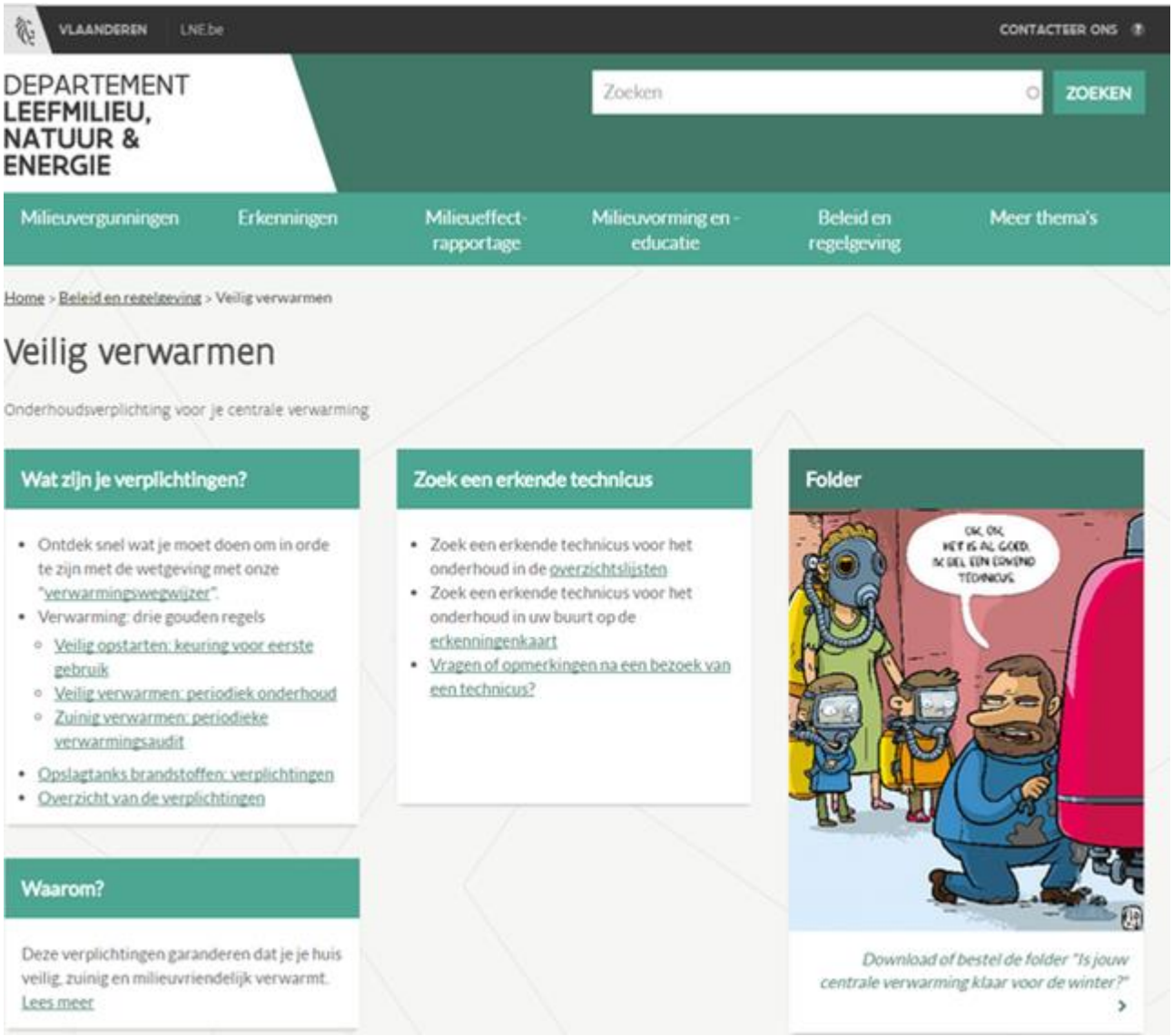

Figure 19: Communication campaign website www.veiligverwarmen.be.

2.IV.vi. Progress and current status on AC systems (Inspection / Equivalence)

AC systems with a cooling capacity above 12 kW require inspection within 12 months of commissioning and regular inspections every five (5) years by a recognised certified expert. The frequency of inspections is dependent on the nominal cooling capacity (Table 10). The nominal cooling capacity is determined at the building level. The Flemish Government will further alter the inspection requirements following the updates of provisions introduced by the revision of the EPBD in 2018.

A web application was developed in 2015 to carry out the inspections. This system generates a report including recommendations for cost-effective energy performance improvements.

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 (5) years is required as well.

A website supports general communication and campaigns about the inspection of AC systems (Figure 20).

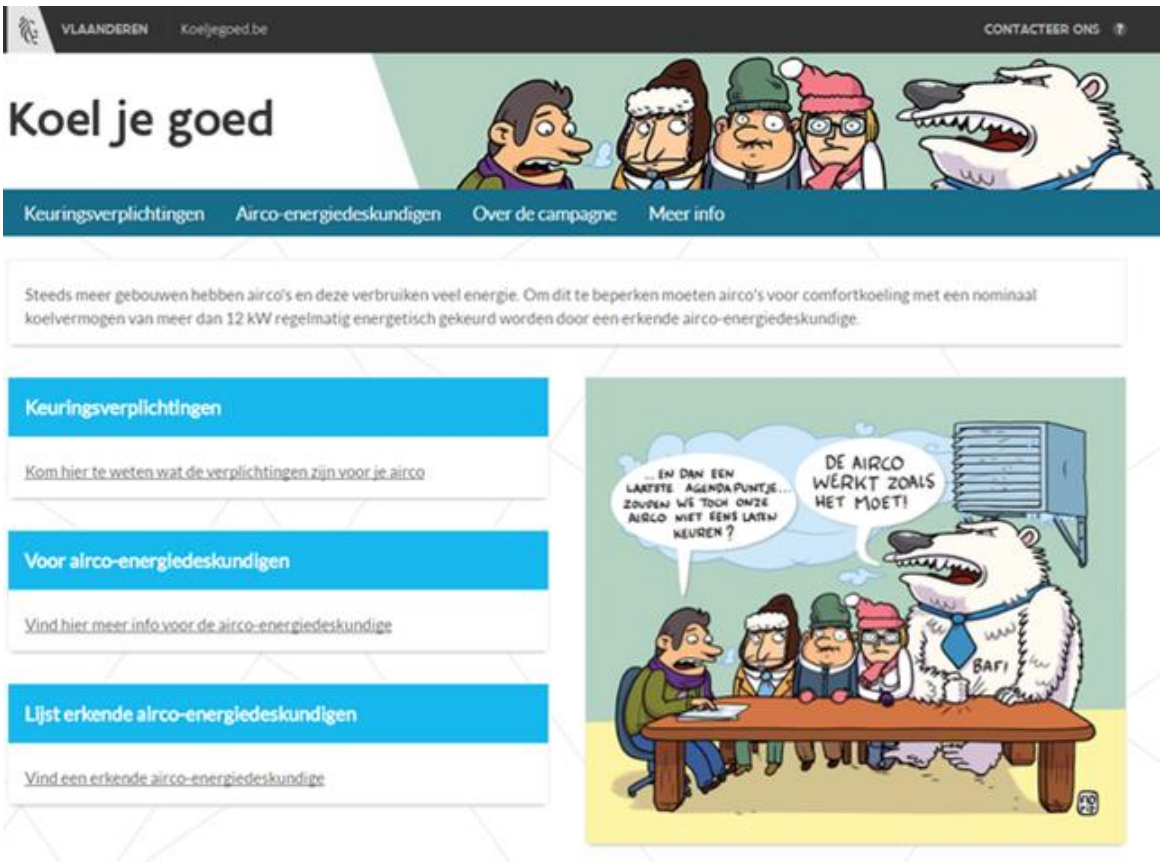

Figure 20: Communication campaign website www.koeljegoed.be.

2.IV.vii. 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

The number of technicians recognised to inspect liquid or gaseous fuels exceeds 5,000 and 8,000, respectively. Over the years, hundreds of randomly selected recognised technicians as well as technicians against whom complaints had been made were subject 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. Non-recognised technicians performing any of the aforementioned mandatory inspections that are reported to the government are prosecuted as well.

Around 250 AC-energy experts have been accredited**.** Recognised AC-energy experts must provide information on all inspections conducted in the last three (3) years to the supervising government upon request. The government can suspend or withdraw the recognition in specific cases. A statistically significant number of issued reports will be subject 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 press release below was used to promote the Woningpas to the general public in 2019. It is written by the public administrations that collaborated to develop this public tool.

The Housing passport (Woningpas): data on the house!

Paperwork, wasting time by looking everything up in your personal files, not knowing where to start? If you rebuild, sell or buy a house, you know what I'm talking about. That's why we present to you the Housing passport: a free and personalised handy digital passport showing all available data on your house.

(quote from campaign at the occasion of the launch December 2018)

The Flemish Energy Agency (VEA), the Department of Environment, Wonen Vlaanderen and the 'Openbare Vlaamse Afvalstoffenmaatschappij' (OVAM) are working together to offer building owners advice and information on their house(s) through the so-called Housing passport (Woningpas) which is being released progressively. This free digital housing passport was first released in December 2018. Looking into the future, even more functionalities and possibilities will be offered in order to help building owners rebuild, sell and buy their property without stress. The only thing you have to do is to log in at **woningpas.vlaanderen.be** with your e-ID or token, and your building passport is automatically produced.

What can you do now?

Woningpas offers you three main functions at the moment: access to information about your house, about the environment and about available certificates.

The provided information about your house is very extensive and offers you a series of advantages. Information on energy, insulation, installations, general building information, solar potential, mobility rate and dwelling quality is now all centralised and easily accessible. Information on possible soil contamination and building permits will save you sleepless nights. We wish to achieve the climate targets together with you. That's why, together with your home's insulation scores you will also find your Energy Performance Certificate (EPC) which you can compare with that of other houses. Through the insulation scores of individual building elements (roof, floor, etc.), you will be informed how your house can become the greenest in the neighbourhoud. A renovation roadmap, including reference to renovation costs and available grants, is displayed in your Woningpas.

Information about your home's environmental status, i.e. flood sensitivity, information on non-movable heritage, spatial planning, air quality, etc., is visualised in the form of maps so that you can discover all relevant information at a glance.

Finally, owners will have an overview of all certificates they need when they wish to rebuild, sell or buy a house. By means of a useful roadmap, owners will be able to tell whether their plans are executable, answering questions such as 'What do I need?' and 'Where and how should I apply?'

It keeps getting better

In 2020, we will enrich the Woningpas with new additional functions. Our goal is to let the homeowner actively control their own Woningpas. For instance, if you are the homeowner you can authorise potential buyers and architects to consult your Woningpas information, or you can test the living quality yourself on several topics. Besides that, you will be able to upload documents from your own computer and complete the data available in the Woningpas. By the end of the year, you will be able to add your own renovation

works in a useful timeline. All renovation works since 2008 with assigned grants will show up automatically in the passport. As such, you will have all information about your house(s) available in a centralised digital vault that you can access at any time.

And this is not all. In the following years, we want to add new information about:

- vacant plots;
- water installations (drinking and sewage): general information and certificates;
- metered energy consumption (in cooperation with the network operators);
- immovable heritage;
- sustainable heating.

Please visit **woningpas.vlaanderen.be** for more information.

4. Conclusions, future plans

The EPBD (Directive 2010/31/EU) has been a strong driver in taking energy performance to a higher level, and rising ambitions have been a driver for progress in the Flanders region.

Requirements for new buildings were strengthened multiple times so that a clear path towards 2021 has been laid out; the average energy performance of new buildings now improves by the year and builders go beyond the legal requirements. A good functioning enforcement strategy is one of the keys to this success. The close follow-up of the cost-optimal level has led to clear goals defined up to 2021. Future requirements or goals will rely on regular cost-optimal studies. The roll-out of the NZEB action plan allowed for successful introduction of the NZEB level. Many frontrunner companies support the NZEB concept and its implementation.

For new buildings, the legal requirements seem systematically met, based on the achieved as-built performance. The renovation of existing buildings offers a bigger challenge, however, in both the number of buildings and the numerous thresholds that need to be met.

In order to increase the level of ambition from fragmented improvements towards deep renovation of all existing houses, the government decided to set up the multi-stakeholder partnership Renovation Pact by the end of 2014. A long-term renovation goal was defined based on a consensus between concerned stakeholders. In 2017, all energy grants conditions were aligned with the 2050 goals and new subsidy schemes favouring multiple improvements and deep renovation became available.

At the end of 2018, the housing passport 'Woningpas' was introduced, followed a month later by the revised EPC.

In February 2020, almost 50% of the existing residential buildings had a valid EPC. The Flemish Energy Agency puts a continuous effort in improving the quality of EPCs. Tools and accreditation schemes on inspections were improved over the past years to achieve a larger impact.

In accordance with the EPBD, a more detailed LTRS was defined and added as an annex to the NECP 2021-2030. Together with the Government Declaration 2019-2024, these documents include a wide variety of strategic goals for the different segments of the building stock, as well as an overview of existing and newly

approved policy measures. In the months and years to come, respective policies will be prepared and implemented in consultation with a variety of key stakeholders. Special attention will in addition be put to non-residential buildings, including improved data collection and stakeholder consultation.

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 first set at E100. For non-residential buildings, the reference consumption is calculated on the same building geometry with a set of reference measures.

2. 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. The K-level was replaced by the S-level in 2018. The S-level is a global indicator of the building envelope. Next to thermal transmission, it also includes airtightness, solar gains and a new indicator based on the efficiency of the geometry, comparing the surface of the building to the surface of a globe with the same volume.

3. https://www.energiesparen.be/bouwen-en-verbouwen/epb-pedia/epb-beleid/studies

4. https://www.energiesparen.be/bouwen-en-verbouwen/epb-pedia/epb-beleid/epb-in-cijfers

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. vlaanderen.be/economie/energiesparen/epb/BEN/Vlaams_actieplan/Monitoringrapport-BEN-actieplan_20150924.pdf

8. vlaanderen.be/economie/energiesparen/epb/BEN/Actieplan_BEN_versie_juni2012.pdf

9. A comparative methodological framework for calculating cost-optimal levels of minimum energy performance ((EU) No 244/2012) - https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32012R0244

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 exempt, 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 sufficient, 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

Annexes -Key Indicators & Decisions

Key Indicators & Decisions – General Background

no	Key Implementation Decisions – General Background	Description / value / response	Comments
01.01	Definition of public buildings (according to Article 9 b)	Office buildings of public authorities	Which types of organisations are considered to be 'public authorities' is defined in the *Energiebesluit*. From 2018 onwards, the requirements for almost all non-residential buildings are set at the NZEB-level; however office buildings follow a slightly slower path. In the *Energiebesluit* it is stated that office buildings of the mentioned authorities have to comply as of 2019 with the same requirements as other new offices have to comply with in 2021. The Flemish scope is thus broader than the EPBD.
01.02	Definition of public buildings used by the public (according to Article 13)	Buildings frequently visited by the public because they are occupied by a public authority	There is no explicit definition adopted for the public display of a certificate for public buildings used by the public. The obligation of public display is set in the text of the *Energiebesluit* itself, not in the definitions.
01.03	Number of residential buildings	Total number of residential buildings: 2,282,268 (135,479 apartment buildings included) Total number of dwellings: 3,083,936, of which: • single-family houses: 2,146,987 • apartments in apartment buildings: 881,867 Data on the built ground surface (apartment buildings not included): • less than 45 m²: 31,221 • between 45 m² and 64 m²: 146,299 • between 65 m² and 104 m²: 622,652 • larger than 104m²: 1,346,617	Source: Land register (202019)
01.04	Number of non-residential buildings	416,573	Source: Land register (2020)
01.05	If possible, share of public buildings included in the number given in 01.04	Data not available	
01.06	If possible, share of commercial buildings included in the number given in 01.04	76,141	Source: Land register (2020)
01.07	Number of buildings constructed per year (estimate)	± 29,000 building units Mean value of last years. Based on new building units rather than on building level.	Source: database of final declarations (EPB) Covers residential, non-residential and industry units

no	Key Implementation Decisions – General Background	Description / value / response	Comments
01.08	If possible, share of residential buildings constructed per year (estimate, included in the number given in 01.07)	94% building units Analysis of the data in the EPB-database	Source: database of final declarations (EPB)
01.09	If possible, share of non-residential buildings constructed per year (estimate, included in the number given in 01.07)	5% building units Analysis of the data in the EPB-database	Source: database of final declarations (EPB) The remaining 1% of building units concerns industry units
01.10	Useful floor area of buildings constructed per year in million square meters (estimate)	4.2 million m²/year Only residential building units + gross floor area instead of useful floor area	Estimated by multiplying the mean gross floor area (± 158 m²) of residential building units with the number of residential building units (94% of 29,000)

Key Indicators & Decisions – New Buildings

<table>
<tr><th>no</th><th>Key Implementation Decision – New Buildings</th><th>Description / value / response</th><th>Comments</th></tr>
<tr><td>02.01</td><td>Are building codes set as overall value, primary energy, environment (CO_2), reference building or other?</td><td>E-level = primary energy use (kWh/m²), divided by a reference value</td><td></td></tr>
<tr><td>02.02</td><td>Requirements for energy performance of residential buildings in current building code</td><td>Since 2020: E-level E35
Includes: heating, cooling, hot water, auxiliaries, local production</td><td>E-level = primary energy use (kWh/m²), divided by a reference value</td></tr>
<tr><td>02.03</td><td>Requirements for energy performance of non-residential commercial buildings in current building code</td><td>Since 2017: E-level set on building level, but based on the relevant functions in the building:
<table>
<tr><td>$E_{eis,\ fct}$</td><td>2018</td></tr>
<tr><td>Lodging</td><td>70</td></tr>
<tr><td>Office</td><td>55</td></tr>
<tr><td>School</td><td>55</td></tr>
<tr><td>Healthcare: with stay</td><td>70</td></tr>
<tr><td>Healthcare: without stay</td><td>65</td></tr>
<tr><td>Healthcare: operating rooms</td><td>50</td></tr>
<tr><td>Gathering: high occupation</td><td>65</td></tr>
<tr><td>Gathering: low occupation</td><td>65</td></tr>
<tr><td>Gathering: refectory</td><td>60</td></tr>
<tr><td>Kitchen</td><td>55</td></tr>
<tr><td>Commerce</td><td>60</td></tr>
<tr><td>Sports: hall</td><td>50</td></tr>
<tr><td>Sports: fitness, gym</td><td>40</td></tr>
<tr><td>Sports: sauna, pool</td><td>50</td></tr>
<tr><td>Technical function</td><td>45</td></tr>
<tr><td>Common function</td><td>55</td></tr>
<tr><td>Other</td><td>80</td></tr>
<tr><td>Unknown</td><td>80</td></tr>
</table></td><td>E-level = primary energy use (kWh/m²), divided by the primary energy use of the same building with a reference set of measures
Includes: heating, cooling, hot water, auxiliaries, lighting, local production
Requirement for a building with multiple functions is calculated, based on the share of gross floor area:
$E_{eis} = \frac{\sum_f A_{gross,\ fct\ f} \cdot E_{eis,\ fcf\ f}}{\sum_f A_{gross}}$</td></tr>
<tr><td>02.04</td><td>Requirements for energy performance of non-residential public buildings in current building code</td><td>Same as in 02.03, except:
$E_{eis,\ fct:}$ 2018
Office: 50</td><td></td></tr>
<tr><td>02.05</td><td>Is the performance level of nearly zero energy (NZEB) for new buildings defined in national legislation?</td><td>Yes, but only implicit. There is a path towards NZEB in 2021, but there is no explicit mentioning of ‘NZEB’.
Yes + only in regional (Flemish) legislation</td><td>The Energy decree of the Flemish Government sets the requirements of 2021 (E-level)</td></tr>
<tr><td>02.06</td><td>Nearly zero energy (NZEB) level for residential buildings (level for building code)</td><td>E30 (+ all other requirements)</td><td>Other requirements also apply:
Maximal U-values
Ventilation requirements
Minimal share of RES
Maximal indicator for overheating
Maximal S-level (building envelope)</td></tr>
<tr><td>02.07</td><td>Year/date for nearly zero energy (NZEB) as</td><td>2021</td><td>Building permit application in 2021</td></tr>
</table>

<table>
<tr><th>no</th><th>Key Implementation Decision – New Buildings</th><th>Description / value / response</th><th>Comments</th></tr>
<tr><td></td><td>level for residential buildings (as indicated in 02.06)</td><td></td><td></td></tr>
<tr><td>02.08</td><td>Nearly zero energy (NZEB) level for all non-residential buildings (level for building code)</td><td><table><tr><td>$E_{eis, fct}$</td><td>2021</td></tr><tr><td>Lodging</td><td>70</td></tr><tr><td>Office</td><td>50</td></tr><tr><td>School</td><td>55</td></tr><tr><td>Healthcare: with stay</td><td>70</td></tr><tr><td>Healthcare: without stay</td><td>65</td></tr><tr><td>Healthcare: operating rooms</td><td>50</td></tr><tr><td>Gathering: high occupation</td><td>65</td></tr><tr><td>Gathering: low occupation</td><td>65</td></tr><tr><td>Gathering: refectory</td><td>60</td></tr><tr><td>Kitchen</td><td>55</td></tr><tr><td>Commerce</td><td>60</td></tr><tr><td>Sports: hall</td><td>50</td></tr><tr><td>Sports: fitness, gym</td><td>40</td></tr><tr><td>Sports: sauna, pool</td><td>50</td></tr><tr><td>Technical function</td><td>45</td></tr><tr><td>Common function</td><td>50</td></tr><tr><td>Other</td><td>80</td></tr><tr><td>Unknown</td><td>80</td></tr></table></td><td>Other requirements also apply:
Maximal U-values
Ventilation requirements
Minimal share of RES</td></tr>
<tr><td>02.09</td><td>Year/date for nearly zero energy (NZEB) as level for non-residential buildings (as indicated in 02.08)</td><td>2021
But all NZEB-levels are in place since 2018, except for office function, see 02.03</td><td>Building permit application in 2021</td></tr>
<tr><td>02.10</td><td>Are nearly zero energy buildings (NZEB) defined using a carbon or environment indicator?</td><td>No</td><td></td></tr>
<tr><td>02.11</td><td>Is renewable energy a part of the overall or an additional requirement?</td><td>Additional requirement + influence on the E-level</td><td></td></tr>
<tr><td>02.12</td><td>If renewable energy is an additional requirement to NZEB, please indicate level</td><td>Residential: 15 kWh/m².year (since 2017)
Non-residential: 20 kWh/m².year (since 2019)</td><td>kWh primary energy use per m² gross floor area, annually</td></tr>
<tr><td>02.13</td><td>Specific comfort criteria for new buildings, provide specific parameters for instance for airtightness, minimum ventilation rates</td><td>There are ventilation requirements (as additional requirements) + influence on the E-level (airtightness and quality of the ventilation system). For new residential buildings there is also an additional requirement considering overheating (with a maximal value).</td><td>Since 2016, there is also an obligatory quality check of the as-built ventilation system for residential buildings</td></tr>
</table>

Key Implementation Decision – Existing Buildings

no	Key Implementation Decision – Existing Buildings	Description / value / response	Comment
03.01	Is the level of nearly zero energy (NZEB) for existing buildings set in national legislation?	Partly: only for deep renovations that are considered equivalent to new buildings	Deep renovations (in this context): large new or rebuilt building volumes > 800 m^3 or containing a new residential unit. 'Deep renovations' as described in 2.II.i will meet the NZEB target E60 (see 03.03) for existing buildings in the near future. Maximum U-values for all renovations are the same as the requirements for new buildings.
03.02	Is the level of nearly zero energy (NZEB) for existing buildings similar to the level for new buildings?	Partly: only for deep renovations that are considered equivalent to new buildings	See 03.01 and 03.03
03.03	Definition of nearly zero energy (NZEB) for existing residential buildings (if different from new buildings)	In 2050, existing residential buildings should be as efficient as a new building in 2016 Two possibilities: • Package of measures: maximal U-values for the components of the building envelope (roof, walls and floors U_{max}=0.24 W/m^2.K, doors U_{max}=2 W/m^2.K, windows 1.5 W/m^2.K, and glass U_{max}=1.0 W/m^2.K) + minimal standards for heating installations (highly energy efficient installation, cogeneration, heat pump, district heating or electrical heating of max 15 kW) • Energy performance score E60 of 100 kWh/m^2	1. Package of measure: additional to requirements, awareness raising in communication on proper ventilation, airtightness and solar protection 2. Energy performance score: next to E-level, information on the performance of the envelope (S-level)
03.04	Definition of nearly zero energy (NZEB) for existing non-residential buildings (if different from new buildings)	No specific definition	
03.05	Overall minimum requirements in case of major renovation	Major renovation (as in EPBD) can be: • Renovation equivalent to new buildings: see above • Major energy renovation (75% of the envelope + replacement of the installations): E70 • Renovation: no E-level, but requirements on renovated building parts and renovated systems	
03.06	Minimum requirements for individual building	Maximal U-values for all renovations correspond with the requirements for new buildings.	

<table>
<tr><th>no</th><th>Key Implementation Decision – Existing Buildings</th><th>Description / value / response</th><th>Comment</th></tr>
<tr><td></td><td>parts in case of renovation</td><td>
<table>
<tr><th>Building parts</th><th>U_{max} (W/m²K)</th></tr>
<tr><td>New building parts</td><td></td></tr>
<tr><td>Transparent constructions</td><td>1.5, U_g=1.1</td></tr>
<tr><td>Opaque constructions (walls, ceilings, floors)</td><td>0.24</td></tr>
<tr><td>Doors, curtain façades, glass bricks, transparent pieces other than glass</td><td>2.0, U_g=1.1, U_{fp}=1.4</td></tr>
<tr><td>Existing building parts in contact with the outdoor environment that are insulated</td><td></td></tr>
<tr><td>On the outside</td><td>0.24</td></tr>
<tr><td>By filling the existing cavity</td><td>0.55</td></tr>
</table>
The requirements only apply to building parts that are renovated or insulated.
The table contains requirements for 2016.
The table is simplified.
Other maximum U-values are applied for certain types of internal walls and walls to adjacent parcels.
</td><td></td></tr>
<tr><td>03.07</td><td>National targets for renovation in connection to Long-Term Renovation Strategy (number or percentage of buildings)</td><td>Evolution to a yearly 3% renovation rate of residential buildings towards label A (95,000 dwellings/year)</td><td>If renovations are staged (e.g. starting with an evolution from label F to label C, and in a next phase to label A) then the actual percentage of buildings that need works each year will be higher (up to 10%).</td></tr>
<tr><td>03.08</td><td>National targets for renovation in connection to Long-Term Renovation Strategy (expected reductions and relevant years)</td><td>Final energy use residential:
2030: - 23%
2040: - 46%
2050: - 69%</td><td></td></tr>
</table>

Key Implementation Decision - Energy Performance Certificates

no	Key Implementation Decision – Energy Performance Certificates	Description / value / response	Comment
04.01	Number of energy performance certificates per year	**EPC residential buildings:** • 2017: 96,093 • 2018: 97,810 • 2019: 107,293 **EPC Public buildings:** • 2017: 171 • 2018: 338 • 2019: 978 **EPC new buildings:** Residential: • 2017: 29,549 • 2018: 28,888 • 2019: 31,649 Non-residential: • 2017: 451 • 2018: 430 • 2019: 540 **EPC after major energy renovation:** • 2017: 443 • 2018: 952 • 2019: 1,366	
04.02	Number of EPCs since the start of the scheme	**EPC residential buildings:** • Total: 1,331,032 • Valid: 969,078 **EPC public buildings:** • Total: 11,408 • Valid: 5,304 **EPC new buildings:** • Total: 306,555 • Valid: 270,755 **EPC after major energy renovation:** • Total: 2,868 • Valid: 2,868	EPC residential buildings: from September 2008 until December 2019 EPC public buildings: from December 2008 until December 2019 EPC new buildings: from January 2007 until December 2019
04.03	Number of EPCs for different building types	See 04.01 and 04.02	
04.04	Number of assessors	**EPC residential buildings:** • 2,887 registered qualified experts • 1,010 active qualified experts **EPC public buildings:** • 1,376 registered qualified experts • 993 internal qualified experts **EPC new buildings:** • 1,664 registered qualified experts • 812 active qualified experts	Registration is mandatory for each type of qualified expert. Active qualified experts for residential buildings: a qualified expert is considered active when they have issued at least one EPC in the past year and have issued at least ten (10) EPCs during their recognition as a qualified expert. There are two (2) types of qualified experts for public buildings. An external expert follows a recognised training course and passes an exam. An internal expert is an employee of the public organisation with two

no	Key Implementation Decision – Energy Performance Certificates	Description / value / response	Comment
			(2) years of experience in energy efficiency. No exam is needed for internal experts. Active qualified experts for new buildings: a qualified expert is considered active when they have issued at least one (1) initial declaration or one (1) final declaration in the past year.
04.05	Basic education requirements for assessors	**EPC residential buildings:** No predefined qualifications are needed for qualified experts. **EPC public buildings:** No predefined qualifications are needed for qualified experts. **EPC new buildings:** A degree in architecture or engineering is needed.	There is no practical experience needed before the approval as assessor.
04.06	Additional training demands for assessors	**EPC residential buildings: Yes** A candidate qualified expert should follow a recognised training programme and pass an exam. A mandatory scheme of permanent training must be followed each year. **EPC public buildings: Yes** A candidate qualified expert should follow a recognised training course and pass an exam. **EPC new buildings: Yes** A candidate qualified expert should follow a recognised training course and pass an exam. A mandatory scheme of permanent training must be followed each year.	
04.07	Quality assurance system	**EPC residential buildings:** Sample tests on availability and advertisements: • Desk controls • Sanction: Fine Quality checks: • Desk controls • Site visits • Sanction • Fine • Suspension **EPC public buildings:** Sample tests on availability • Desk controls • Sanctions: fine Quality checks • Desk controls • Sanction • Fine • Suspension **EPC new buildings:**	

no	Key Implementation Decision – Energy Performance Certificates	Description / value / response	Comment
		Sample tests on availability of initial and final declarations • Desk controls • Site visits • Sanctions: fine Quality checks: • Desk controls • Site visits • Sanction • Fine • Suspension Requirements: • Automatic control of final declarations in database • Sanction • Fine	
04.08	National database for EPCs	Regional	EPC database for the Flemish Region. This database contains EPCs for residential, non-residential and public buildings.
04.09	Link to national information on EPCs / Database	Information: https://www.energiesparen.be/epc	The EPC database has restricted access, only for experts and VEA

Key Indicators & Decisions – Smart Buildings and Building Systems

no	Key Implementation Decision – Smart Buildings and Building Systems	Description / value / response	Comment
05.01	Is there a national definition of smart buildings?	No	
05.02	Are there current support systems for smart buildings?	No	
05.03	Are there currently specific requirements for technical building systems (for instance in building codes)?	Yes	
05.04	Are there current requirements for automatics (for instance in building codes)?	Yes	
05.05	Chosen option A or B for heating systems (inspection or other measures)	A and B	Option B for technical building systems added in the EPBD as part of the 2018 revision
05.06	Number of heating inspections; reports per year (if option A)	Unknown	Since its launch in 2018, around 1,000 reports were generated with the free application of the government.
05.07	Chosen option A or B for cooling systems (inspection or other measures)		
05.08	Number of air-conditioning / cooling system inspections; reports per year (if option A)	679	Exact amount, derived from the central database.
05.09	Is there a national database for heating inspections?	No	An application feeding a database has been released in 2018. (It is used on a voluntary basis)
05.10	Is there a national database for cooling / air-conditioning inspections?	Yes (Flanders)	
05.11	Are inspection databases combined with EPC databases for registration of EPCs and inspection reports?	No	
05.12	Link to national information on Inspection / database		https://omgeving.vlaanderen.be/webtoepassing-centrale-verwarming https://omgeving.vlaanderen.be/informatie-voor-erkende-airco-energiedeskundigen

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