1. Overview of the building stock (EED Article 4)

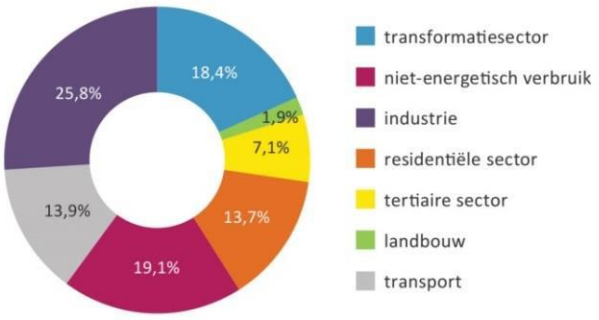
1.1. INTRODUCTION

According to the 2015 land register records, more than 2.6 million buildings are located in the Flemish region (13,522 km²).

Homes in attached structures	Homes in semi-detached structures	Homes in detached structures, farms and castles	Buildings and flat buildings with apartments	Trading houses	All other buildings	Total
647,144	570,240	887,508	115,716	83,297	333,601	**2,637,506**

Table 1: Number of buildings in Flemish Region (source: land register)

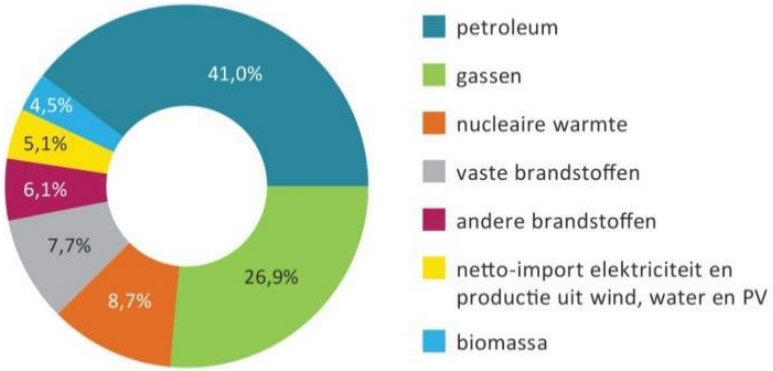
The gross domestic energy consumption in Flanders amounted to 1,489.1 PJ in 2015. The residential sector accounted for 13.7% of the total consumption.



Translation of image	
Source:	Translation:
transformatiesector	transformation sector
niet-energetisch verbruik	non-energy consumption
industrie	industry
residentiële sector	residential sector
tertiaire sector	tertiary sector
landbouw	agriculture
transport	transport

Figure 1: Distribution of gross domestic energy use in Flanders, 2015 (VITO: Energy balance sheet 2015)

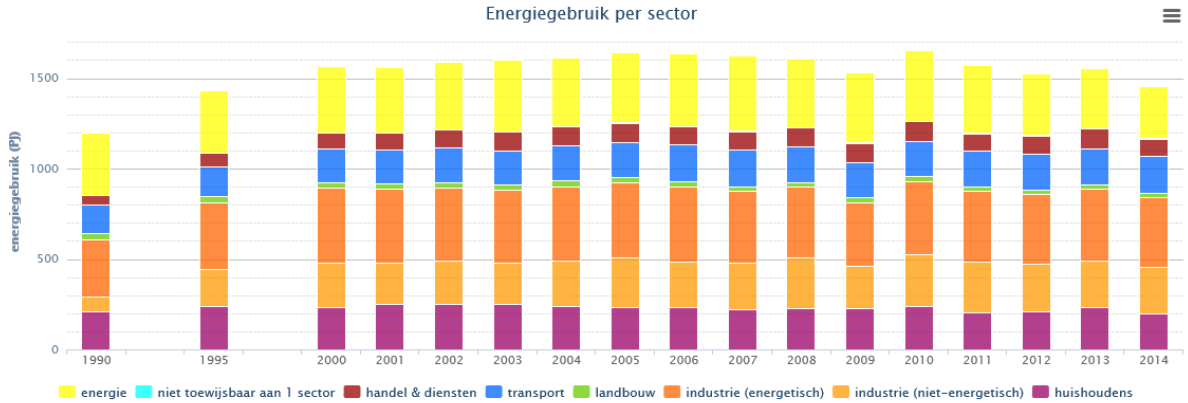
In 2015, Flemish gross domestic energy consumption was distributed as follows:



Translation of image	
Source:	Translation:
petroleum	petroleum
gassen	gasses
nucleaire warmte	nuclear power
vaste brandstoffen	solid fuels
andere brandstoffen	other fuels
netto-import elektriciteit en productie uit wind, water en PV	net import of electricity and production from wind, water and PV
biomassa	biomass

Figure 2: Distribution of gross domestic energy use in Flanders, 2015 (VITO: Energy balance sheet 2015)

Between 1990 and 2005, gross domestic energy consumption (GDEC) in Flanders increased nearly continuously. In 2008, and particularly in 2009, we see the effect of the economic crisis, after which GDEC fluctuated.



Translation of image	
Source:	Translation:
Energiegebruik per sector	Energy use per sector
energiegebruik (PJ)	energy use (PJ)
energie	energy
niet toewijsbaas aan 1 sector	not attributable to 1 sector
handel & diensten	trade & services
transport	transport
landbouw	agriculture

industrie (energetisch)	industry (energy)
industrie (niet-energetisch)	industry (non-energy)
huishoudens	households

Figure 3: Energy consumption per sector (VITO: Energy balance sheet)

Although data on energy performance are not available for each building at this time, by extrapolation the current energy performance certificate databases provide a good basis for an energy register of the building stock in Flanders.

An initial data source that can be tapped into is the energy performance certificate database (or EPC database) for newly constructed residences and for existing residences that are rented out or have been sold since the end of 2008. Consequently, both data sources are gradually being built up. For newly constructed residences (EPC data for homes with planning permission from 2006), it does not make sense to develop measures under this Directive. These shall therefore be disregarded. For existing residential buildings, data collected since the end of 2008 can be extrapolated to all residential buildings, regardless of whether or not they were ever put up for sale or rental. However, some caution is required. Housing put up for sale or rent may not be representative of the entire building stock when it comes to estimating the nature and number of works performed previously or after a performance assessment was conducted.

A second data source is the EPC database of public buildings. This database contains the energy performance certificates of the buildings located in the Flemish Region in which public organisations are located that provide public services to a large number of people and which are frequently visited by the public. The EPC for public buildings was implemented in phases, in accordance with the European buildings Directive:

- **Since 1 January 2009, the EPC has been mandatory for buildings with a useful floor area of more than 1,000 m².**
- **For buildings with a useful floor area of more than 500 m², the EPC has been mandatory since 1 January 2013.**
- **And since 1 January 2015, the EPC has been mandatory for buildings with a useful floor area of more than 250 m².**

The EPC database for public buildings was analysed by VITO in 2014.

For private non-residential buildings, various studies have been tendered in the past few years that provided useful information about their energy performance.

Based on these three data sources, the following categories of existing buildings were studied:

- **Residential buildings (single-family homes, apartments and collective residential buildings);**
- **Public buildings (buildings of the following public organisations: the federal government, the Flemish government, the provincial and municipal authorities, public companies, education, welfare and health);**

- **Private buildings (an admittedly limited sample of offices, commercial buildings, including stores, wholesale buildings and warehouses as well as utility buildings).**

1.2. RESIDENTIAL BUILDINGS

1.2.1. Analysis of the Flemish housing stock

Before considering the energy performance of the Flemish housing stock in greater depth (point 1.2.2), below is a general analysis of the housing stock, taking into account the following aspects:

- **Numbers and use: primary residence, secondary residence, vacant.**
- **Construction year of the residences.**
- **Type: apartment, homes in attached, semi-detached or detached structures.**
- **Ratio of owners/tenants.**
- **Dynamics of the housing market.**
- **Quality of the residences.**

Number of residences in Flanders

If the built-up area - based on land registry data - is viewed in relation to the total area, it appears that in 2015 the Flemish Region had a high density rate of 27.2% of a total of 13,522 km². On 1 January 2015, the Flemish Region, all of which is in the same climate zone, had approximately 3.1 million residential units. These were accommodated in 2.6 million buildings. The ratio of the number of households in the Flemish region enables the tension between supply and demand to be calculated. On 1 January 2015, the Flemish Region had 2,734,982 households. By allocating a residence to each of these households (disregarding cohousing, free housing and homelessness), it can be deduced that in Flanders there are around 360,000 homes that do not currently serve as a primary residence. At the end of 2015, according to municipal vacancy registers, 23,037 buildings were empty.

Age of the housing stock

Approximately 56% of Flemish residences date back to before 1971 and are therefore currently at least 45 years old. It goes without saying that this has a major impact on energy performance, as will become evident below.

Year of construction	%
Constructed prior to 1900	8.01
Constructed from 1900 to 1918	5.43
Constructed from 1919 to 1945	15.25
Constructed from 1946 to 1961	15.57
Constructed from 1962 to 1970	11.59

Constructed from 1971 to 1981	15.12
Constructed after 1981	29.02
Total	100.00

Table 2: Age of the residences in the Flemish Region in 2015 (source: land register)

Typology of the residences

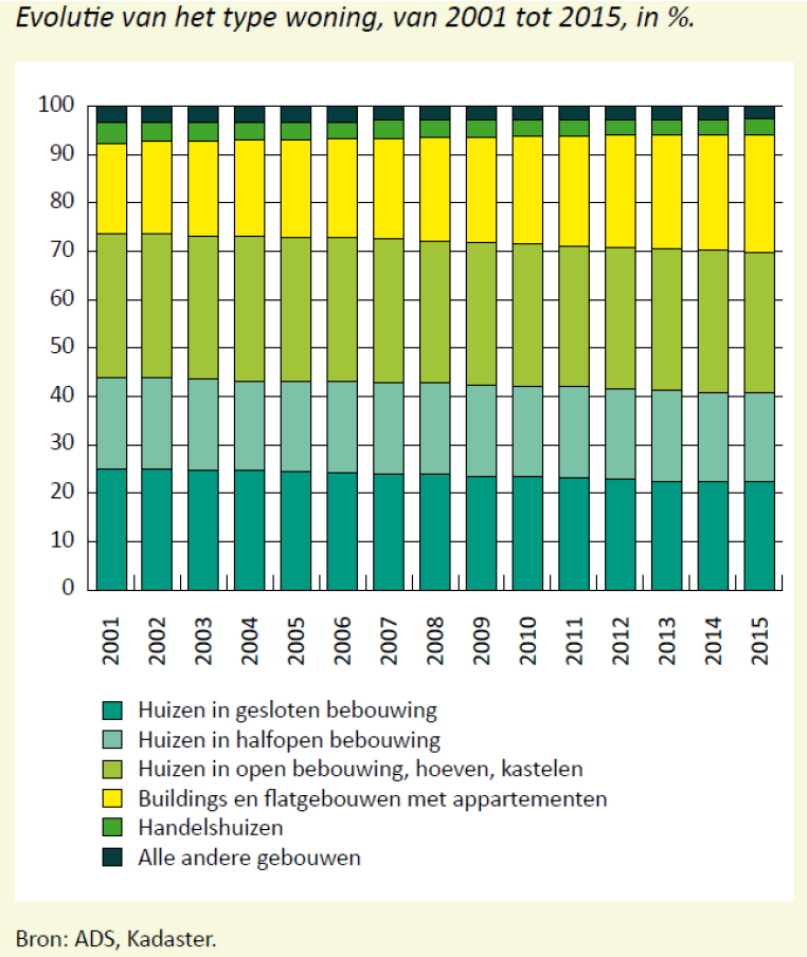
Over the past few decades, we have seen growth in the number of apartment buildings, which means that a larger proportion is newer.

	Single-family homes (*)		Apartment buildings (**)	
	Number	%	Number	%
< 1945	620,179	29.5%	17,028	14.7%
1946-1961	331,184	15.7%	14,630	12.6%
1962-1981	557,194	26.5%	36,012	31.1%
>1981	596,335	28.3%	48,046	41.5%
Total	2,104,892		115,716	

Table 3: Overview of residential buildings by age category in the Flemish Region (source: land register data on 31 December 2014)
(*) 'Single-family homes' refers to the sum of the attached, detached and semi-detached structures for residential use. (**) Average number of dwellings per apartment building: 6.5

With an average of 6.5 dwellings per apartment building, Flanders has a total of approximately 750,000 apartments. The proportion of apartment residents in Flanders is 22%. This is low in the European context. In 2014, four out of ten people in the EU-28 lived in a flat, just over one-quarter (25.6%) in a semi-detached house and just over one-third (33.7%) in a detached house.

The composition of the housing stock is changing slowly, yet there is a clear trend over the longer term. In 1995, 17.2% of the number of residences was located in an apartment building, while in 2015 this was 24.5%. Nevertheless, residences in detached structures remains the most important housing type, and the share of their relative importance has grown slightly since 1995, namely from 28.6% to 28.9%.

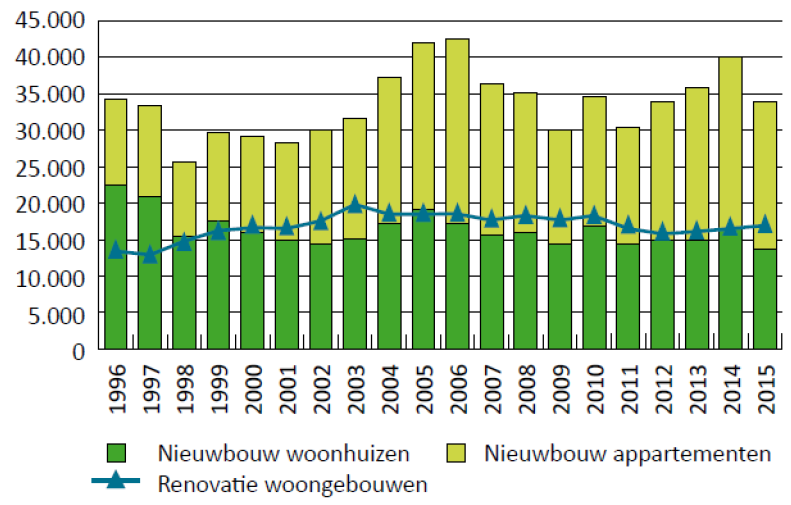


Translation of image	
Source:	Translation:
Evolutie van het type woning, van 2001 tot 2015, in %	Evolution of the type of home, from 2001 to 2015, in %
Huizen in gesloten bebouwing	Homes in attached structures
Huizen in halfopen bebouwing	Homes in semi-detached structures
Huizen in open bebouwing, hoeven, kastelen	Homes in detached structures, farms, castles
Buildings en flatgebouwen met appartementen	Buildings and flat buildings with apartments
Handelshuizen	Trading houses
Alle andere gebouwen	All other buildings
Bron: ADS, Kadaster	Source: ADS, Land register

Figure 4: Evolution of the type of residence

The new construction market in Flanders is reorienting. Since 2002, more building permits have been granted for new apartments than for homes. In 2015, 59.2% of the permits for newly constructed residences concerned an apartment. This evolution contributes to a reduction of the average living space in new construction. In 2015, the average living area for newly constructed residences fell to 97 m² from 125 m² in 2000.

Evolutie van het aantal bouwvergunningen voor nieuwbouw-woningen en voor renovatie van woongebouwen, van 1996 tot 2015.



Noot: niet elke bouwvergunning leidt tot een nieuwe woning.
Bron: ADS.

Translation of image	
Source:	Translation:
Evolutie van het aantal bouwvergunningen voor nieuwbouwwoningen em voor renovatie van woongebouwen, van 1996 tot 2015	Evolution of the number of building permits for newly constructed residences and for renovation of residential buildings, from 1996 to 2015
Nieuwbouw woonhuizen	Newly constructed homes
Renovatie woongebouwen	Renovation of residential buildings
Nieuwbouw appartementen	Newly constructed apartments
Noot: niet elke bouwvergunning leidt tot een nieuwe woning.	Note: not every building permit leads to construction of a new home.
Bron: ADS.	Source: ADS.

Figure 5: Evolution of building permits

Owners versus renters

Flanders has an exceptionally high percentage of owner-occupied properties (+ 70%). The 'social' rental housing market is relatively limited, especially in comparison with neighbouring countries: 6.3% of the Belgian population and 5.4% of the Flemish population live in a house rented by a government body such as a social housing association. The European average is 17.3% (the Netherlands 34%, United Kingdom 20%, Denmark 19%, France 17%).

The number of homeowners has fallen slightly in recent years. In 2013, the Grote Woononderzoek (national housing survey) showed that 70.5% of Flemish households owned their own home. This percentage was higher in 2005, at 74.4%. The decrease went hand in hand with an increase in the proportion of private rental housing (from 18.5% to 20.4%) and a slight increase in the social rental market (from 5.6% to 6.7%). The share of residents living for free has also risen slightly (from 1.5% to 2.5%).

Eigendomsstatuut naar graad van verstedelijking, in %, Vlaanderen naar verstedelijkingsgraad, 2013.

	Grootstedelijk gebied	Regionaal-stedelijk gebied	Kleinstedelijk gebied	Overgangs-gebied	Platteland	Vlaams Gewest
Eigenaar	**60,5**	**63,0**	**60,7**	**79,4**	**77,3**	**70,5**
Eigenaar met hypotheek	31,7	28,6	26,4	33,2	30,4	31,0
Eigenaar zonder hypotheek	28,8	34,4	34,3	46,1	46,9	39,5
Huurder	**37,9**	**34,9**	**35,2**	**18,0**	**20,3**	**27,1**
Private huurder	28,0	25,5	26,8	14,1	15,1	20,4
Sociale huurder	9,9	9,4	8,4	3,9	5,3	6,7
Gratis bewoner	**1,6**	**2,1**	**4,1**	**2,5**	**2,3**	**2,5**

Bron: Grote Woononderzoek 2013.

Translation of image	
Source:	Translation:
Eigendomsstatuut naar graad van verstedelijking, in %, Vlaanderen naar verstedelijkingsgraad, 2013	Ownership statute by degree of urbanisation, in %, Flanders according to urbanisation degree, 2013
Grootstedelijk gebied	Metropolitan area
Regionaalstedelijk gebied	Regional urban area
Kleinstedelijk gebied	Suburban area
Overgangsgebied	Transition area
Platteland	Rural
Vlaams Gewest	Flemish Region
Eigenaar	Owner
Eigenaar met hypotheek	Owner with mortgage
Eigenaar zonder hypotheek	Owner without mortgage
Huurder	Tenant
Private huurder	Private tenant
Sociale huurder	Social tenant
Gratis bewoner	Resident living for free
Bron: Grote Woononderzoek 2013.	Source: Grote Woononderzoek (Flemish housing survey) 2013.

Table 4: Ownership status

Dynamics of the housing market

In 2015, 16% fewer permits were granted for new residence construction than in 2014, when there was a 12% increase over the previous year. In 2015, this amounts to almost 34,000 permits for new homes. That is approximately the average seen over the past 20 years. However, compared to 2014 there was an increase of 2 percentage points in the number of renovation permits granted. The municipal registers of undeveloped plots reveal that 273,935 undeveloped plots are available for construction.

In addition, since 2002 17,000 to 18,000 renovation permits for residential buildings have been granted annually. Over the past three years, the number of renovation permits has been fluctuating around 16,000. In 2015, there was an increase of 2 percentage points compared to 2014.

Quality analysis

The sample results from the last Flemish housing survey in 2013 reveal that (extrapolated to the full residential stock) 350,000 homes were of structurally insufficient quality. That is 13% of the occupied housing stock. These homes exhibit serious shortcomings, which require substantial renovation, in areas such as stability, dampness, indoor climate and ventilation, basic comfort, electrical installations, etc. While a certain proportion will be irreparable, the exact amount cannot be accurately estimated based on this survey. It mainly concerns old homes (dating to before 1945), which are mainly inhabited by households from the lowest income categories.

Of the 5,000 homes surveyed, 5.1% have serious structural engineering problems. Extrapolated to the entire residential stock, this represents approximately 136,000 homes. These are homes with serious stability problems in the roof and exterior walls and/or extensive dampness issues requiring an expensive renovation.

Year of construction	Share of residences considered of 'structurally inadequate' quality (in %)	Share of residences with serious construction technical and structural defects (in %)
< 1945	20.3%	9.0%
1946 – 1960	15.8%	6.5%
1961 – 1980	12.8%	2.9%
1981 – 2000	5.3%	2.8%
< 2000	3.9%	1.5%
Total	**13%**	**5.1%**

Table 5: Share of housing of structurally insufficient quality vs. share of housing with serious construction technical and structural defects (source: Groot Vlaams Woningonderzoek 2013)

The residences in the private rental market are, on average, of poorer quality than owner-occupied residences. Of the owner-occupied residences, the proportion of 'good' homes is 71.2% compared with 45.9% of the rental properties. Broadly speaking, one in four residences in the rental market is of poor quality, compared to one in ten in the owner-occupied market. The rent for residences of 'poor' or 'very poor' quality is, however, not lower than for residences of 'moderate' quality. This suggests high demand pressure in the lowest segment of the rental market.

Landlords in the Flemish private rental market are mainly individuals. According to the housing survey, a private landlord leases 2.2 residences on average. 60% of them rent one residence and almost 85% rent a maximum of three residences. We can therefore conclude that the private segment in the rental market is very fragmented. These are often homes or apartments acquired through an inheritance.

Frequently, owners of rented homes are also elderly and retired people who often find it difficult to invest in the improvement of the rental property. Older people are also least inclined to make efficient energy use investments.

Rental homes are often poorly insulated, have outdated windows and an old heating system. 68.7% of the private rental homes have double glazing, 74.2% have central heating. The Flemish averages are 83.6% and 80.0%, respectively.

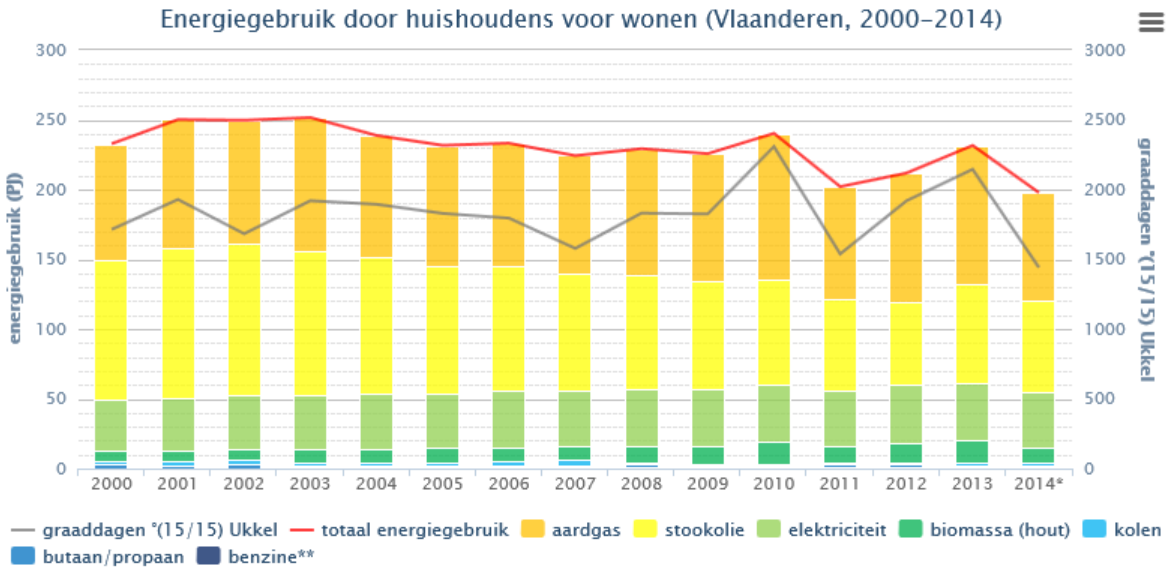
Private tenants have a lower income: 21.7% are in the lowest income quintile, 23.7% in the second-lowest income quintile. Tenants have a poverty risk that is about three times higher than that of owners, i.e. 28.4% versus 10.2%. On average, private tenants must spend a larger share of their income on housing costs: for 71.3%, the housing expense ratio is more than 20%, for 39.2% it is over 30% and for 17.3% more than 40%. The Flemish averages are 30%, 12.7% and 5.2%.

1.2.2. Energy performance of Flemish existing homes

Energy consumption in the residential sector

Household energy consumption rose by 3.7% in 2015 compared with 2014. This was mainly due to the fact that 2014 was an extremely hot year (lower number of degree days in 2014 (1,441) compared to 2015 (1,691)). Compared to 1990, household energy consumption decreased by 2.1%, while the number of households increased by 24.4% during that period. From 1990-2015 there was also a switch from fuel oil to natural gas: 42% of households consumed natural gas and 30% fuel oil in 2015, while in 1990 this was 28% and 49%, respectively.

The total degree day-adjusted energy consumption of households shows a slight downward trend over the period 2000-2014. The drop in average energy consumption per capita fell slightly more sharply than total energy consumption but less than average energy consumption per household. The latter is because the average family size is decreasing and smaller families use more energy per capita on average

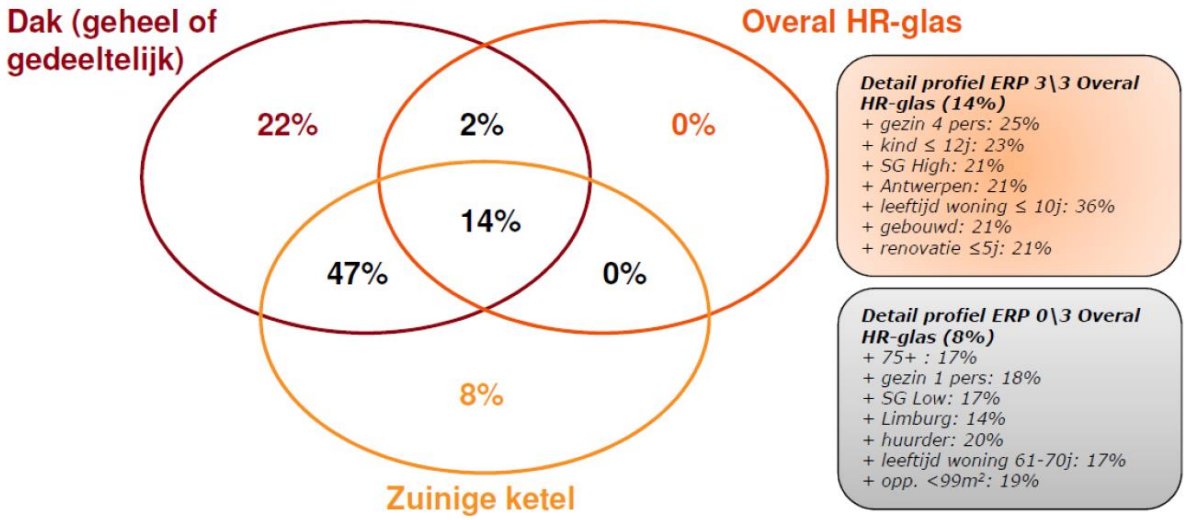


Translation of image	
Source:	Translation:
Energiegebruik door huishoudens voor wonen (Vlaanderen, 2000-2014)	Energy use for residential households (Flanders, 2000-2014)

energiegebruik (PJ)	energy use (PJ)
graaddagen º(15/15) Ukkel	degree days º(15/15) Ukkel
totaal energiegebruik	total energy use
aardgas	natural gas
stookolie	fuel oil
elektriciteit	electricity
biomassa (hout)	biomass (wood)
kolen	coal
butaan/propaan	butane/propane
benzine**	petrol**

Figure 6: Household energy consumption (source: Energy balance sheet Flanders VITO)

Although the Flemish Energy Agency's biennial survey on energy awareness and behaviour (approximately 1,000 families) shows that the housing insulation rate has risen slightly since 2011, 53% of homes had no wall insulation in 2015, 18% had no roof or attic floor insulation and 11% still had single glazing. The penetration rate of efficient heating boilers has also increased. Yet, 53% of the fuel oil users with an individual heating system still had an ordinary boiler in 2015. For natural gas, this was 21%. When looking at the combination of the insulation rating and heating system, it appears that 49% of residences have a fully insulated roof, double glazing, and an economical boiler. 14% has a fully insulated roof, high-efficiency glazing throughout and an efficient boiler.



Translation of image	
Source:	Translation:
Dak (geheel of gedeeltelijk)	Roof (whole or partial)
Overal HR-glas	HE glass throughout
Zuinige ketel	Energy-efficient boiler
Detail profiel ERP 3\3 Overaal HR-glas (14%)	ERP profile detail 3\3 HE glass throughout (14%)
+ gezin 4 pers: 25%	+ family 4 people: 25%
+ kind ≤ 12j: 23%	+ child ≤ 12y: 23%
+ SG High: 21%	+ SG High: 21%
+ Antwerpen: 21%	+ Antwerp: 21%
+ leeftijd woning ≤ 10j: 36%	+ age of home ≤ 10y: 36%
+ gebouwd: 21%	+ constructed: 21%
+ renovatie ≤ 5j: 21%	+ renovation ≤ 5y: 21%
Detail profiel ERP 0\3 Overal HR-glas (8%)	ERP profile detail 0\3 HE glass throughout (8%)

+ 75+ : 17%	+ 75+: 17%
+ gezin 1 pers: 18%	+ family 1 person: 18%
+ SG Low: 17%	+ SG Low: 17%
+ Limburg: 14%	+ Limburg: 14%
+ huurder: 20%	+ tenant: 20%
+ leeftijd woning 61-70j: 17%	+ age of home 61-70y: 17%
+ opp. <99m^2: 19%	+ opp. <99m^2: 19%

Figure 7: Combination measures (source: FEA survey on energy awareness and behaviour 2015)

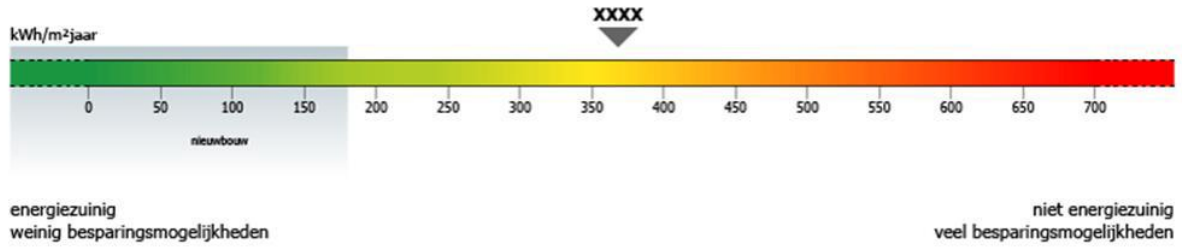
The energy performance of Flemish residences

At the end of 2016, 932,238 valid energy performance certificates had already been drawn up for existing residential buildings. The average figure from the EPCs submitted up to the end of 2016 for an apartment is 293 kWh/m2 per year. For a single-family residence, the average figure is 489 kWh/m^2 per year.

	Apartment		Collective residential building		Single-family home	
	Number	**Figure**	**Number**	**Figure**	**Number**	**Figure**
A: <=1920	***16052***	***373***	***793***	***405***	***41850***	***549***
B: 1921-1945	***17252***	***380***	***607***	***421***	***61455***	***541***
C: 1946-1970	***94671***	***343***	***939***	***394***	***155227***	***549***
D: 1971-1985	***65915***	***273***	***215***	***332***	***71023***	***418***
E: 1986-1995	***45787***	***246***	***176***	***260***	***35221***	***330***
F: 1996-2005	***57622***	***195***	***141***	***235***	***32573***	***236***
G: >2005	***26331***	***153***	***95***	***193***	***7799***	***186***
H: unknown	***73036***	***365***	***1433***	***407***	***126033***	***538***
Total (Years)	**396666**	**293**	**4399**	**386**	**531181**	**489**

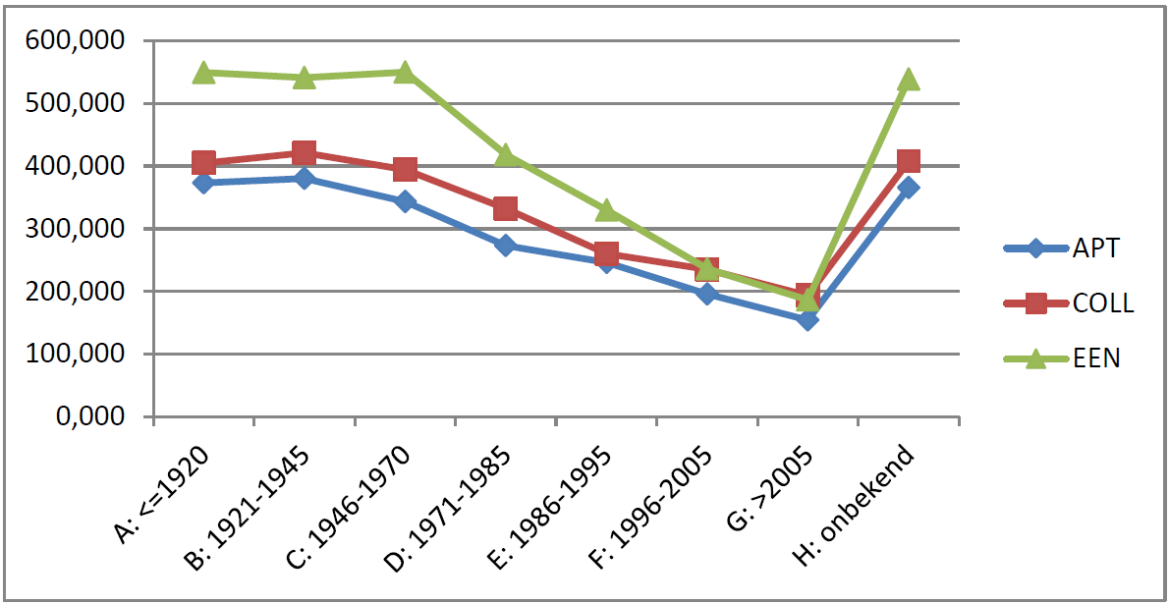
Table 6: Average figures from the EPCs (energy rating) for residential buildings according to year of construction and type of residential building

An analysis of the figures according to the year of construction shows that the newer the building, the better the energy rating. Residences that were built after the introduction of insulation regulations (1993) already score significantly better, while residences built after the implementation of the energy performance regulations (2006) tend to be more quickly placed in the green zone of the EPC colour bar.



Translation of image	
Source:	Translation:
kWh/m²jaar	kWh/m²year
nieuwbouw	new construction
energiezuinig	energy efficient
weinig besparingsmogelijkheden	limited savings opportunities
niet energiezuinig	not energy efficient
veel besparingsmogelijkheden	considerable savings opportunities

Figure 8: Image EPC



Translation of image	
Source:	Translation:
APT	APT
COLL	COLL
EEN	ONE
H: onbekend	H: unknown

Figure 9: Evolution of the energy rating for residential buildings according to the year of construction and type of residential building

Apartments usually score better in the area of energy which is largely explained by the fact that they often have less energy loss through walls, roofs and floors. Hence, row houses are generally more energy-efficient than semi-detached buildings, which in turn are more energy-efficient than detached structures. On average, a detached structure requires 20% more energy for heating than an attached structure.

	Attached structures	Semi-detached structures	Detached structures
A: <=1920	***456***	***605***	***707***
B: 1921-1945	***459***	***596***	***685***
C: 1946-1970	***448***	***554***	***625***
D: 1971-1985	***333***	***402***	***450***
E: 1986-1995	***270***	***314***	***345***
F: 1996-2005	***200***	***226***	***256***
G: >2005	***159***	***174***	***226***
H: unknown	***451***	***578***	***664***
	429	***507***	***532***

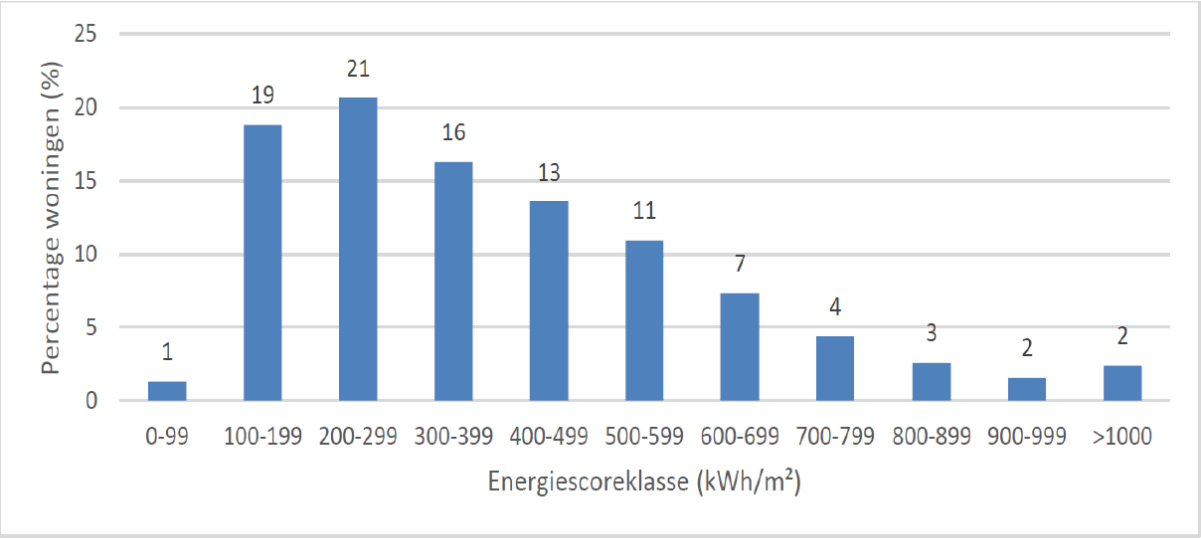
Table 7. Average energy rating according to the year of construction and type of single family home

A recent newly constructed residence, on average, scores nearly three times better in the area of energy than a house built before 1970 and twice as well as a house from the period 1971-1985. Homes that were built after 1996 also have a significantly lower energy rating (only half) compared to homes built before 1970.

A more comprehensive analysis was carried out in 2015 by the Policy Research Centre Housing (Steunpunt Wonen)[1] based on the 724,345 energy performance certificates available at that time.

The figure below shows the percentage of homes according to energy rating category. There are very few homes with a very low energy rating: only 1.4% have an energy rating below 100 kWh/m². However, 20.4% of homes have an energy rating below 200 kWh/m². By comparison: on the energy performance certificate, the colour bar – which is a graphical scale for the energy rating – new construction is given as a benchmark for homes with an energy rating below 180 kWh/m². This means that around 20% of the homes in the database will approximate the energy performance of newly constructed residences. In addition, 50.9% of homes with energy performance certificates have an energy rating of between 200 and 500 kWh/m² and 17.9% an energy rating between 500 and 700 kWh/m². And 11% homes have an energy rating higher than 700 kWh/m².

[1] The Policy Research Centre Housing is funded by the Flemish government within the programme 'Policy Research Centres 2012-2015' and is a collaboration between the KU Leuven, the University college of science and arts, Hasselt University, the University of Antwerp and the OTB Research Institute of the TUDelft (the Netherlands).

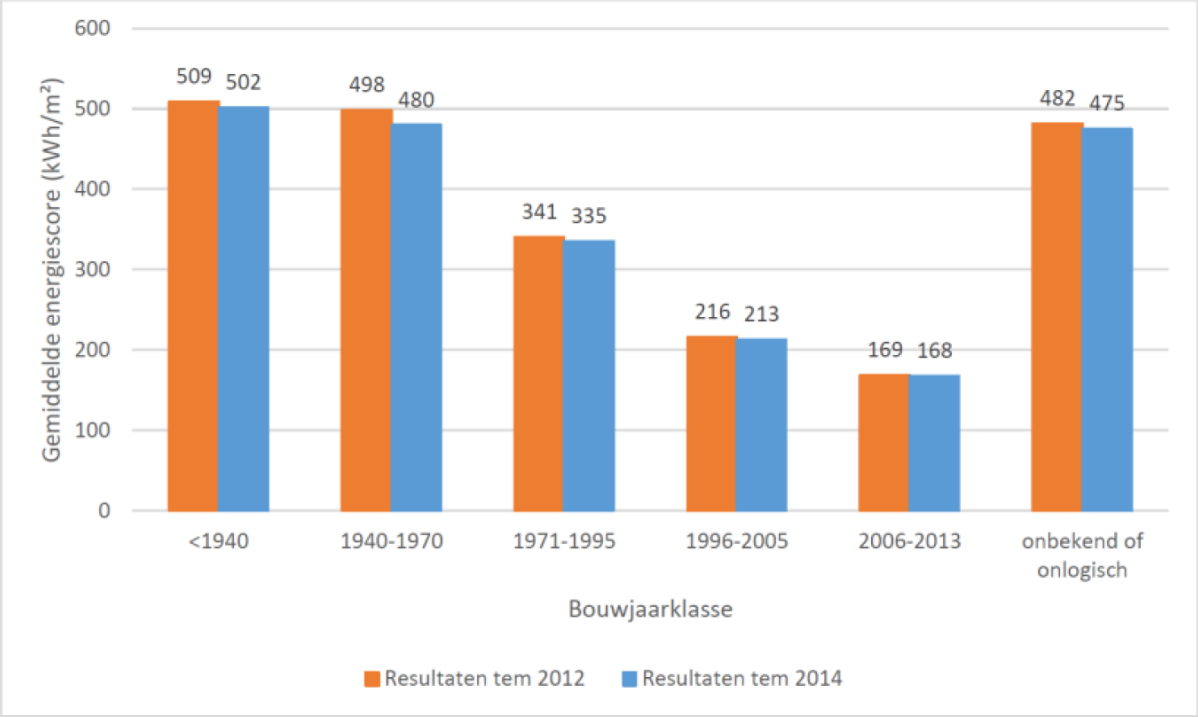


* Resultaten op basis van 724.345 woningen aanwezig in de Energieprestatiecertificatendatabank

Translation of image	
Source:	Translation:
Percentage woningen (%)	Percentage of homes (%)
Energiescoreklasse (kWh/m^2)	Energy rating category (kWh/m^2)
* Resultaten op basis van 724.345 woningen aanwezig in de Energieprestatiecertificatendatabank	* Results based on 724,345 homes included in the Energy Performance Certificate database

Figure 10: Percentage of homes according to energy rating category (source: Verbeeck G. & Ceulemans W. 2015)

If we look at the relationship between the energy rating and the construction year category, it is clear that from the 1950s/1960s, the average energy rating by construction year category systematically declines as the homes become newer. The houses built before 1960 have an average energy rating of 500 kWh/m² or more. This figure then drops below 400 kWh/m² from the 1970s, reaching under 300 kWh/m² in the 1990s and as low as 200 kWh/m² and lower from 2000. For the houses with an unknown year of construction, the energy rating is high (482 kWh/m²). This is linked on the one hand to the fact that these are most likely older homes, which means that data on the year of construction is no longer available. On the other hand, the unknown year of construction has an impact on the standard values for insulation in the different envelopes (most negative), unless a renovation year is available or information about the insulation or installations is available. In the analysis at residence level, a renovation year for the home as a whole cannot be determined, because renovation years do not always have to be submitted, and renovation years are submitted per envelope. Of course, renovations can impact the energy rating, provided that they involve energy renovations for which information is available and submitted. However, in general, the analysis of the relationship between the year of construction and energy rating shows that there is a correlation between the energy rating and the year of construction, namely that the newer the home, the better the energy rating. Compared to the 2012 results, there was a slight decline in average energy ratings for all construction year categories.



* Resultaten op basis van 617.486 woningen aanwezig in de Energieprestatiecertificatendatabank tem 2012 en 724.345 woningen aanwezig in de Energieprestatiecertificatendatabank tem 2014

Bron: ·Energieprestatiecertificatendatabank (woningen tem 2012 en tem 2014)

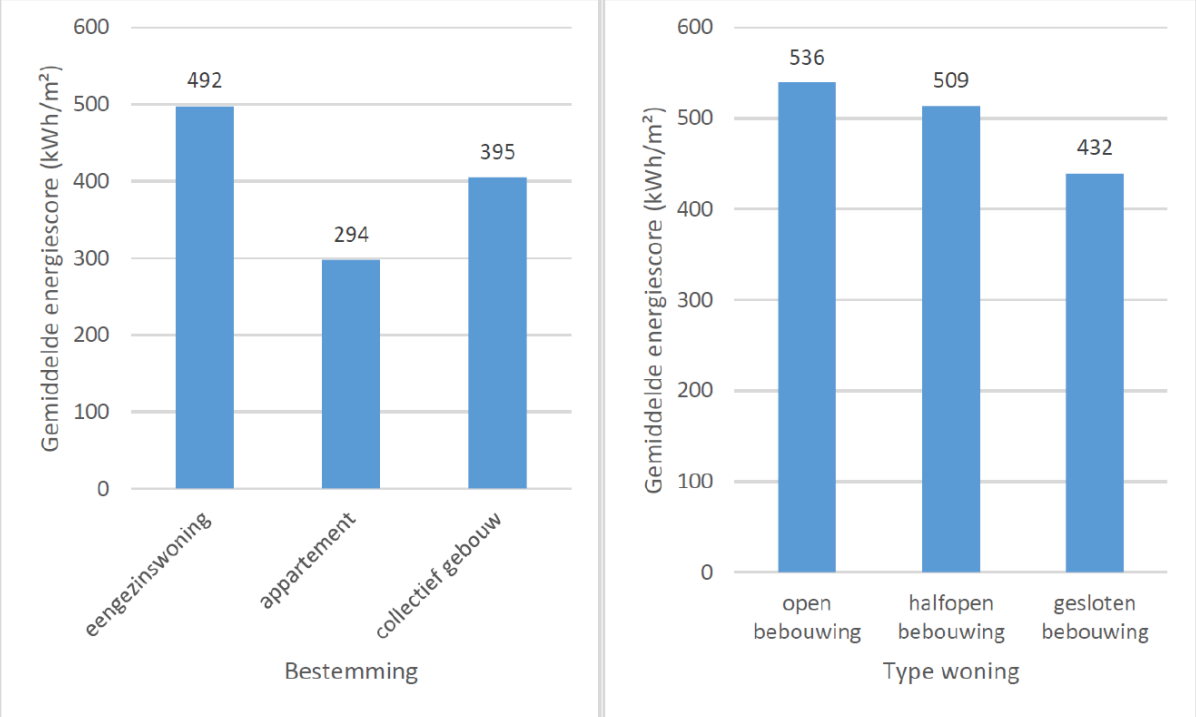
Translation of image	
Source:	Translation:
Gemiddelde energiescore (kWh/m^2)	Average energy rating (kWh/m^2)
onbekend of onlogisch	unknown or illogical
Bouwjaarklasse	Year of construction category
Resultaten tem 2012	Results through 2012
Resultaten tem 2014	Results through 2014
* Resultaten op basis van 617.486 woningen aanwezig in de Energieprestatiecertificatendatabank tem 2012 em 724.345 woningen aanwezig in de Energieprestatiecertificatendatabank tem 2014	* Results based on 617,486 homes included in the Energy Performance Certificate database through 2012 and 724,345 homes included in the Energy Performance Certificate database through 2014
Bron: Energieprestatiecertificatendatabank (woningen tem 2012 en tem 2014)	Source: Energy Performance Certificate database (homes through 2012 and through 2014)

Figure 11: Average energy rating

The designated use and type of single-family home have a clear influence on the average energy rating. For apartments, the energy rating is significantly lower than for single-family homes or collective residential buildings. If we make a distinction between the type of structure for single-family homes, it appears that a 4-storey home has a higher energy rating than a 3-storey home and that a row house has the lowest energy rating of single-family homes. The known influence of compactness on the energy performance of buildings is clearly visible here in the results. For the apartments, the year of construction can also play an additional role, as apartments on average are somewhat newer than single-family homes.

Also, the average energy ratings by designated use and type of (single-family) home are slightly lower than those in 2012. At that time, the average energy rating for a

single-family home was 498 kWh/m², for an apartment it was 298 kWh/m² and for a collective building 405 kWh/m². A detached single-family home had an average energy rating of 539 kWh/m², a semi-detached home 514 kWh/m² and an attached home 439 kWh/m².



* Resultaten op basis van 724.345 woningen (waarvan 398.467 eengezinswoningen) aanwezig in de Energieprestatiecertificatendatabank

Bron: ·Energieprestatiecertificatendatabank (woningen tem 2014)

Translation of image	
Source:	Translation:
Gemiddelde energiescore (kWh/m^2)	Average energy rating (kWh/m^2)
eengezinswoning	single-family home
appartement	apartment
collectief gebouw	collective building
Bestemming	Designated use
Gemiddelde energiescore (kWh/m^2)	Average energy rating (kWh/m^2)
open bebouwing	detached structure
halfopen bebouwing	semi-detached structure
gesloten bebouwing	attached structure
Type woning	Type of home
* Resultaten op basis van 724.345 woningen (waarvan 398.467 eengezinswoningen) aanwezig in de Energieprestatiecertificatendatabank	* Results based on 724,345 homes (of which 398,467 are single-family homes) included in the Energy Performance Certificate database
Bron: Energieprestatiecertificatendatabank (woningen tem 2014)	Source: Energy Performance Certificate database (homes through 2014)

Figure 12: Average energy rating per designated use/type

For the sake of completeness, we note that our detailed analysis also contains a lot of data on the relationship between the figure and the different envelopes (facades, roofs, walls, floors, windows) and installations (heating, sanitary hot water including solar water heater, ventilation and photovoltaic panels individually).

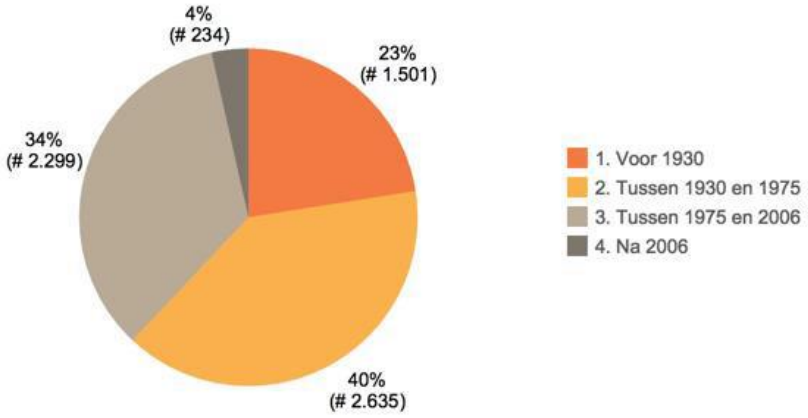
1.3. NON-RESIDENTIAL BUILDINGS

For the analysis of the Flemish building stock of non-residential buildings, the following studies were used as information sources:

- **"Strategienota renovatie niet-residentiële gebouwen" (Strategy paper on the renovation of non-residential buildings): a study conducted by Efika containing an overview of the building stock and a possible strategy to precipitate renovations (December 2016).**
- **"Studie naar kostenoptimale niveaus van de minimumeisen inzake energieprestaties van niet-residentiële gebouwen" (Study of cost-optimal levels of minimum requirements for energy performance of non-residential buildings): for the EPB requirements, a study was carried out by VK engineering, KU Leuven (department of construction physics) and Royal Haskoning (October 2016).**

Our overview of the non-residential building stock starts with the public buildings. There is a good overview of this sector given that, since 2015, it is required to create an EPC for all public buildings with an available floor area of more than 250 m². The EPC figure shows actual primary energy consumption per usable floor area (kWhp/m²) and must be calculated based on measured consumption over the period of one full year. In contrast to the EPC for residential buildings, this is not about theoretical consumption, which therefore enables us to get a realistic picture of effective consumption.

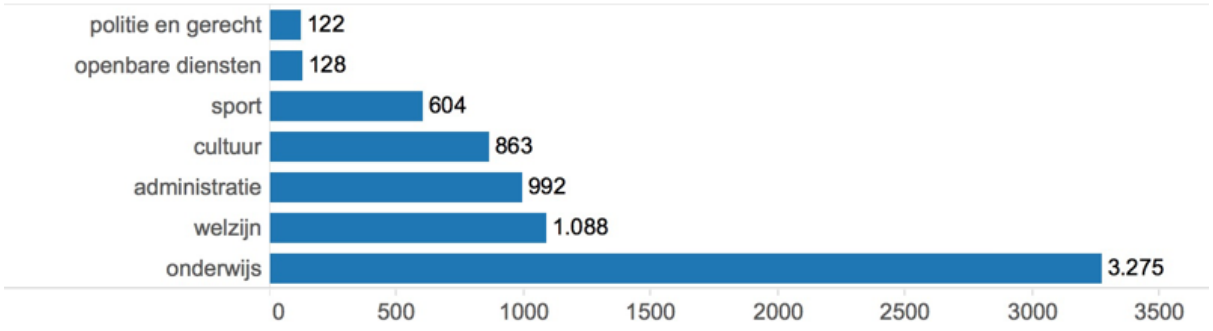
To get a general idea of the stock of public buildings, we first provide information about the age and function of the buildings. The diagram below divides the different public buildings according to year of construction:



Translation of image	
Source:	Translation:
1. Voor 1930	1. Before 1930
2. Tussen 1930 en 1975	2. Between 1930 and 1975
3. Tussen 1975 en 2006	3. Between 1975 and 2006
4. Na 2006	4. Post-2006

Figure 13: Public buildings by year of construction

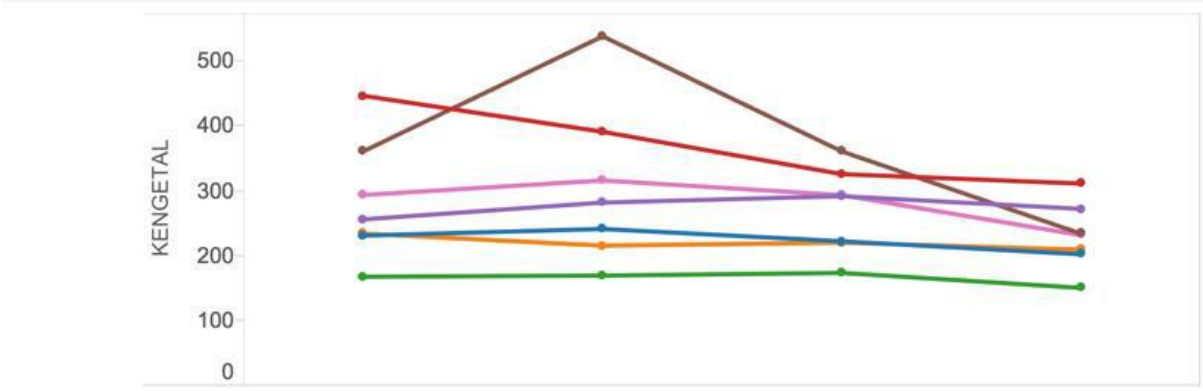
The following bar chart gives an idea of which buildings come under public buildings and how these numbers relate to each other:



Translation of image	
Source:	Translation:
politie en gerecht	police and justice
openbare diensten	public services
sport	sports
cultuur	culture
administratie	administration
welzijn	well-being
onderwijs	education

Figure 14: Number of public buildings per sector

Thanks to the EPC, we gain insight into the consumption of these public buildings; the figure below provides an overview of the EPC figures by sector and by construction period:



	1. Voor 1930	2. Tussen 1930 en 1975	3. Tussen 1975 en 2006	4. Na 2006
administratie	232 (# 245 - 16%)	242 (# 261 - 10%)	223 (# 380 - 17%)	203 (# 34 - 15%)
cultuur	235 (# 226 - 15%)	216 (# 206 - 8%)	221 (# 343 - 15%)	210 (# 45 - 19%)
onderwijs	168 (# 850 - 57%)	170 (# 1.642 - 62%)	174 (# 569 - 25%)	151 (# 47 - 20%)
openbare diensten	447 (# 14 - 1%)	392 (# 23 - 1%)	326 (# 81 - 4%)	312 (# 4 - 2%)
politie en gerecht	257 (# 20 - 1%)	283 (# 32 - 1%)	292 (# 37 - 2%)	273 (# 6 - 3%)
sport	362 (# 10 - 1%)	539 (# 150 - 6%)	361 (# 385 - 17%)	235 (# 30 - 13%)
welzijn	294 (# 136 - 9%)	317 (# 321 - 12%)	294 (# 504 - 22%)	232 (# 68 - 29%)
Gemiddeld	205 (# 1.501 - 100%)	223 (# 2.635 - 100%)	254 (# 2.299 - 100%)	210 (# 234 - 100%)

Translation of image	
Source:	Translation:
KENGETAL	FIGURE
1. Voor 1930	1. Before 1930
2. Tussen 1930 en 1975	2. Between 1930 and 1975
3. Tussen 1975 en 2006	3. Between 1975 and 2006
4. Na 2006	4. Post-2006
administratie	administration
cultuur	culture
onderwijs	education
openbare diensten	public services
politie en gerecht	police and justice
sport	sports
welzijn	well-being
Gemiddeld	Average

Figure 15: Average EPC figure according to construction year and subsector

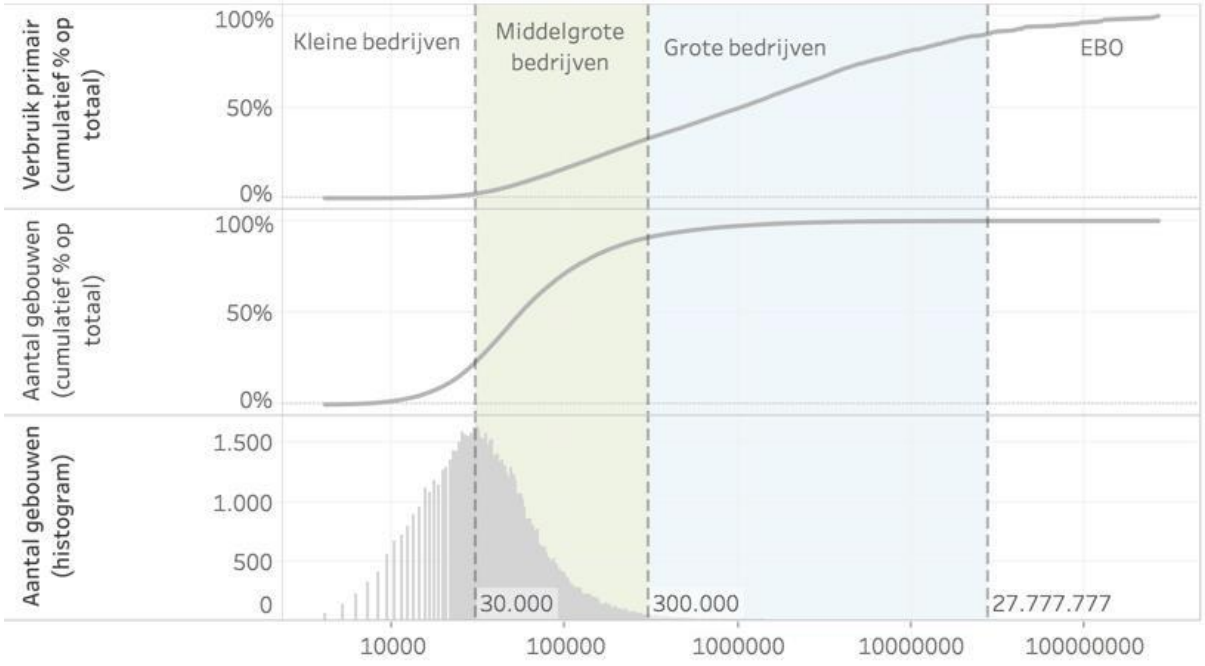
Of course the non-residential building stock goes far beyond the public sector alone. In the Efika study, three other sectors are defined as non-residential, which do not belong to the public sector: hospitality, trade and office buildings. For further analysis, we divide the non-residential building stock into five sectors and one residual category: education, care, trade, hospitality and office buildings. With respect to primary energy consumption, they relate to each other as follows (based on data from the distribution network operators):

	Elektriciteit (kWhp)	Gas (kWhp)	Verbruik totaal (kWhp)	Verbruik totaal primair (%)
Andere gemeenschaps-, sociale en ..	3.093.832.437	1.415.469.371	4.509.301.808	12%
Gezondheidszorg en maatschappel..	2.425.974.285	1.593.536.744	4.019.511.029	10%
Handel	8.038.620.789	2.614.259.621	10.652.880.410	28%
Horeca	2.296.622.766	1.339.367.790	3.635.990.556	9%
Kantoren en administraties	9.514.168.500	4.514.731.537	14.028.900.037	36%
Onderwijs	853.296.575	1.012.711.819	1.866.008.394	5%
Totaal	26.222.515.353	12.490.076.881	38.712.592.234	100%

Translation of image	
Source:	Translation:
Elektriciteit (kWhp)	Electricity (kWhp)
Gas (kWhp)	Gas (kWhp)
Verbruik totaal (kWhp)	Total consumption (kWhp)
Verbruik totaal primair (%)	Total primary consumption (%)
Andere gemeenschaps-, sociale en ..	Other community, social and ..
Gezondheidszorg em maatschappel..	Healthcare and social..
Handel	Trade
Horeca	Catering service provider
Kantoren en administratie	Offices and administration
Onderwijs	Education
Totaal	Total

Table 8: Primary energy consumption per sector

If we look specifically at the companies, the distribution of energy consumption by size of companies is as follows:



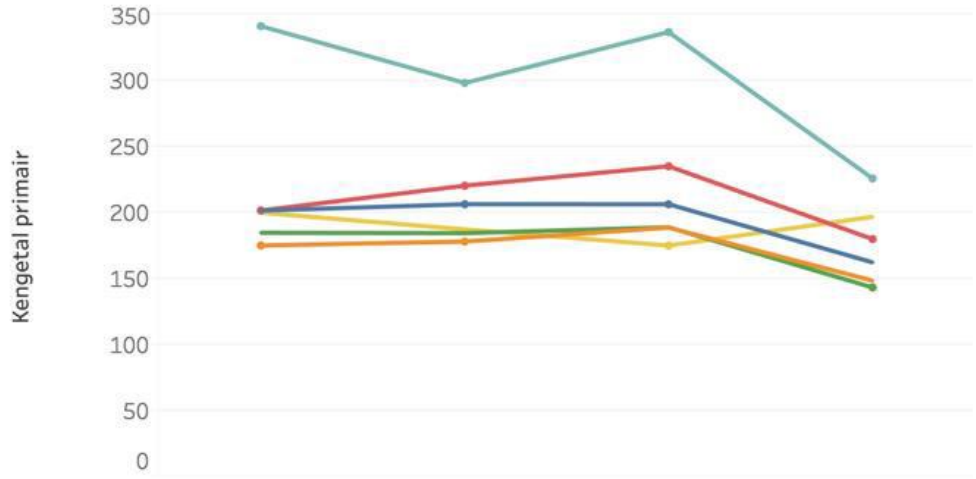
	Klein (< 30 MWh)	Middelgroot (30 tot 300 MWh)	Groot (300 MWh tot 0,1 PJ)	EBO (>0,1 PJ)
% aandeel prim. verbruik	2,36%	30,42%	57,23%	9,98%
% aandeel adressen	22,59%	68,45%	8,92%	0,03%
Aantal unieke adressen met verbuiksgegevens	27.351	82.870	10.803	38

Translation of image	
Source:	Translation:
Kleine bedrijven	Small companies
Middelgrote bedrijven	Medium-sized companies
Grote bedrijven	Large companies
EBO	EPA
Verbruik primair (cumulatief % op totaal)	Primary consumption (cumulative % of total)
Aantal gebouwen (cumulatief % op totaal)	Number of buildings (cumulative % of total)
Aantal gebouwen (histogram)	Number of buildings (histogram)
Klein (< 30 MWh)	Small (< 30 MWh)
Middelgroot (30 tot 300 MWh)	Medium-sized (30 to 300 MWh)
Groot (300 MWh tot 0,1 PJ)	Large (300 MWh to 0.1 PJ)
EBO (>0,1 PJ)	EPA (>0.1 PJ)
% aandeel prim. verbruik	% share prim. consumption
% aandeel adressen	% share addresses
Aantal unieke adressen met verbruiksgegevens	Number of unique addresses with consumption data

Figure 16: Share in energy consumption according to size

From the above figure it is clear that most consumption is concentrated in a small percentage of buildings. It will therefore be here that the biggest savings gains can be achieved. When we consider this together with the proportions of the different sectors in relation to each other, we can conclude that the policy must be geared as a first priority to the large buildings in the offices and trade categories.

Consumption could then be combined with data from the land register, thus determining the year of construction and the useful floor area per building. Using this data, the energy figure could be determined as well as the evolution of this figure over the years. The figure below gives an overview:



		Vòòr 1930	Tussen 1930 en 1975	Tussen 1975 en 2006	Na 2006
Andere gemeenschaps-, ..	Kengetal	202	207	207	163
	# gebouwen	3.406	3.432	2.399	597
Gezondheidszorg en maatschappe..	Kengetal	175	178	189	149
	# gebouwen	1.607	2.058	1.817	454
Handel	Kengetal	202	221	235	180
	# gebouwen	6.743	6.816	4.562	1.103
Horeca	Kengetal	342	299	337	226
	# gebouwen	6.586	4.115	1.488	297
Kantoren en administraties	Kengetal	185	185	189	144
	# gebouwen	7.860	8.946	8.133	2.289
Onderwijs	Kengetal	200	188	175	197
	# gebouwen	714	762	308	68
Totaal	Kengetal	**230**	**215**	**214**	**161**
	# gebouwen	**26.916**	**26.129**	**18.707**	**4.808**

Translation of image	
Source:	Translation:
Kengetal primair	Figure primary
Andere gemeenschaps-, ..	Other community, etc.
Gezondheidszorg em maatschappe..	Healthcare and social..
Handel	Trade
Horeca	Catering service provider
Kantoren en administratie	Offices and administration
Onderwijs	Education
Totaal	Total
Kengetal # gebouwen	Figure # buildings
Vòòr 1930	Prior to 1930
Tussen 1930 em 1975	Between 1930 and 1975
Tussen 1975 em 2006	Between 1975 and 2006
Na 2006	Post-2006

Figure 17: Evolution of figures per sector

In this graph, we see a clear downward trend in all sectors, except education, since 2006. This can be explained by the introduction of thermal insulation requirements. It is clear that these regulations have been effective.

2. Cost-effective approaches that are relevant to the different building categories and the climate zone (EED Article 4).

The Flemish Government regularly commissions studies on the cost-optimal levels of minimum energy performance requirements for buildings. The study reports comprise three different parts: 1) new residential construction, 2) residential renovation, and 3) new construction and renovation of non-residential buildings. The most recent reports date back to 2015 and can be consulted at http://www.energiesparen.be/bouwen-en-verbouwen/epb-voor-professionelen/epb-regelgeving/epb-evaluatie.

The studies show that, unlike the new construction, it is difficult to determine one optimal energy performance level for renovations. The cost-optimal energy performance level is highly dependent on the initial situation and the renovation options for a specific building.

In general, insulation measures in homes are quickly cost-effective if low-cost options are available such as insulating the attic floor, insulating a sloping roof if a sub-roof is present and no interior finishing is provided, cavity filling, adding to insulation in a flat roof and insulating a basement ceiling. However, when existing structures, such as the cavity wall and the roof, already have a minimum insulation layer, it will be difficult to balance the energy savings of the (more expensive) insulation measures against the investment cost. If a decision is made to go ahead with renovation work, to replace the roof cover for example, the cost-optimal insulation level will meet or even exceed the future required cost-optimal level of new construction. It is therefore more desirable to execute a solid insulation measure than to do the work in several steps, and thus only partly. The cost of the new finishing layer weighs heavily in this decision. Moreover, major renovations that combine different measures can be attractive because they can provide better solutions for thermal bridges and increased airtightness. And in a home that is well-insulated in advance, a smaller heating system can be installed. These conclusions also apply to the systems themselves. When a new heating boiler is installed, it is best to have a condensing boiler, but heat pumps or (in collective buildings) micro-CHPs can also be attractive.

For old office buildings with little or no insulation, it became clear that the overall renovation of the building is preferable to a (step-by-step) renovation of the various building envelopes. The difference is mainly due to the application of floor insulation and the ability to achieve a greatly improved airtightness in a total renovation.

2.1 RESIDENTIAL BUILDINGS

We base our conclusions on the "Study of cost-optimal EPB requirements for residential buildings" (Energy Knowledge Centre (Thomas More Kempen / KU Leuven), June 2015).

Following the evaluation of the energy performance regulations in 2013 and on the basis of the study of the cost optimisation carried out in 2012 (conducted by the non-profit Thomas More Kempen, commissioned by the FEA), the E-level of E90 was defined for construction projects with urban building permit applications from 2015 for a new 'nature of the works', the 'major energy renovation' or a renovation in which the technical installations are completely replaced and at least 75% of existing and new partition structures that are adjacent to the outside environment are insulated (during or after).

The purpose of this 2015 study was to determine the cost-optimal energy performance requirement levels for renovated existing residential buildings according to the European established methodology, to define measures or packages of measures that lead to a major energy renovation and to compare cost-optimal energy performance requirement levels with the currently applicable requirement levels.

A number of benchmark buildings were chosen, which are considered representative of the Flemish housing stock. These are fictional homes designed to match the parameters and variables of these buildings with common values in the real Flemish residential stock. In order to be representative of the Flemish housing stock in terms of typology, size, age, method of construction, etc., the following types were chosen for renovation of existing residential buildings.

- **Single-family homes**
  - **Row house 1: small row house**
  - **Row house 2: large row house**
  - **Semi-detached home 1**
  - **Semi-detached home 2 (smaller)**
  - **Detached home 1: Architectural home**
  - **Detached home 2: Farmhouse**
- **Multi-family homes and/or apartments**
  - **Apartments (different location in the building + individual and collective heating/hot water system)**

The energy saving measures were broken down into structural measures and technical installation measures, and extensively documented. The key economic target variable is the Total Current Cost (TCC) or the life-cycle cost of the home over the actualisation period. This includes investment costs, energy costs, maintenance costs, reinvestment costs and disposal costs/residual value. To calculate the TCC over a 30-year period for a home/package of measures, account will be taken of:

- **Initial investment costs.**
- **Consumption costs.**

- **Total annual maintenance costs.**
- **Replacement costs.**
- **Residual value of investments.**
- **Subsidies.**
- **CO_2 emissions costs.**

A package of measures was then continually applied to this original home, which meant the home just complied with the definition of major energy renovations, in particular:

- **At least 75% of the separation structures to the outside environment are insulated (during or after) according to the 2015 requirements package (see Annex B: EPB requirements 2015).**
- **Ventilation system is provided.**
- **Heat production system is replaced.**
- **E90 must be achieved.**

The calculations were performed from both a macroeconomic (social) and microeconomic (private) perspective. In the optimisation process, these objectives were weighed against each other using the pareto optimisation method.

The macroeconomic optimum for the worker's house is in line with the average expected rise in energy prices at E48. Both the front and rear façades have a 12 cm thick outer insulation layer (U = 0.20W/m²K). The sloping roof is also renovated with a sarking insulation system that can bring the U-level to 0.16W/m²K. Insulation is applied to the floor above the basement up to the minimum U value of 0.10W/m²K. The windows (Uprof = 2.2W/m²K) are replaced on both facades including improved double glazing (Ug = 1.0W/m²K, g = 0.5). A new gas condensing boiler is connected to the existing radiators and a C3 ventilation system is selected, incorporating additional individual CO_2 sensors and actuators that improve the efficiency of the demand-side management of the extraction system. This total renovation (cost 47,055 euros) requires an additional investment of 11,000 euros compared with the benchmark renovation, but provides an additional primary energy savings of 45% which is enough to reduce the total current cost by approximately 3,000 euros.

The optimum for a large row house is achieved at E43. By way of illustration, for the type of large row house, the table with the detailed packages of measures indicates the cost-optimal approach, which can be found in the study for each of the types of housing.

Financiële parameters			Energetische parameters				
TAK	Totale Investering	TVT	E-peil	K-peil	NEB	PEV	Opmerkingen
€	€	jaar	-	-	kWh/m²j	kWh/m²j	
98075	50095	0	88	59	75	125	referentie : Uvoorgevel = 1.70, Uachtergevel = 0.24, Udak = 0.24, Vloer grond - kelder = 0.68-0.78, Uprofiel = 2.2, Uglas = 1.1, v50 = 6h^{-1}, ventilatiesysteem C1, Stookolieketel HR met HT radiatoren + mazoutboiler, 47% opengaande ramen
87726	49521	-1	87	59	70	123	(1) = referentie + gasketel + ventilatiesysteem C2 + geiser
85788	50453	1	79	59	70	112	(2) = (1) + gascondensatieketel
84447	51506	2	73	53	62	103	(3) = (2) + Uvloer kelder = 0.20
84261	52214	3	71	51	60	100	(4) = (3) + Uvloer kelder = 0.13 + Udak = 0.16
83916	53006	4	68	53	62	96	(5) = (3) + douchewarmteterugwinner
83628	53302	4	65	53	52	91	(6) = (3) + ventilatiesysteem C3
83469	54010	5	63	51	50	88	(7) = (4) + ventilatiesysteem C3
82273	55142	6	64	44	52	91	(8) = (2) + Uvoorgevel = 0.24 + Udak = 0.20
81995	55214	6	64	38	45	90	(9) = (8) + Uvloer kelder = 0.24 + Uglas = 1.0 maar gasketel
81021	56146	7	59	38	45	83	(10) = (9) + gascondensatieketel
80914	56777	7	57	36	43	80	(11) = (10) + Udak = 0.16 + Uvloer kelder = 0.13
80229	58573	8	49	36	33	69	(12) = (11) + ventilatiesysteem C3
79699	60073	9	44	36	33	62	(13) = (12) + douchewarmteterugwinner
79625	60788	9	43	35	32	60	(14) = (13) + Uvoorgevel = 0.13
79672	60966	10	43	35	32	60	(15) = (14) + Uvloer kelder = 0.10
79887	61654	10	41	33	30	58	(16) = (14) + Uprofiel = 1.40
80030	62444	11	40	32	29	56	(17) = (16) + Uvoorgevel = 0.10 + Udak = 0.13 + Uvloer kelder = 0.10
80413	62869	11	39	30	27	55	(18) = (16) + Uglas = 0.60
80423	68517	13	28	35	32	39	(19) = (16) + 2500Wp maar Uprof = 2.2
80828	70173	14	25	32	29	35	(20) = (17) + 2500Wp
81102	70845	14	24	31	28	34	(21) = (20) + Uachtergevel = 0.16
82043	73385	15	17	31	28	23	(22) = (21) + 3750Wp
82710	73557	14	13	35	32	17	(23) = (19) + 5000Wp
82660	74430	15	14	29	25	20	(24) = (22) + Ventilatiesysteem C4 maar Uvoorgevel = 0.16
82540	74600	15	15	28	25	20	(24) = (22) + Uglas = 0.60
83326	75885	15	9	31	28	12	(25) = (21) + 5000Wp
84998	78874	17	5	27	22	6	(26) = (25) + Uglas = 0.60 + Ventilatiesysteem C4
85534	79689	17	4	26	21	5	(27) = (26) + Uglas = 0.50
86232	81002	17	-2	31	28	-2	(28) = (21) + 7500Wp
87133	82720	18	-5	28	24	-6	(29) = (28) + Uglas = 0.60 + Ventilatiesysteem C4
88741	84954	18	-7	27	20	-10	(30) = (29) + Ventilatiesysteem D5
90263	86854	19	-10	27	17	-13	(31) = (30) + ventilatiesysteem Dwtw4
92145	88568	21	-13	27	20	-17	(32) = (30) + compactmodule
91591	89105	20	-12	24	15	-16	(33) = (31) + Uvoorgevel=0.13 + Uhellenddak=0.1 + Uglas = 0.5
94002	92068	23	-15	27	18	-20	(34) = (32) + ventilatiesysteem Dwtw3
94769	93231	24	-16	28	22	-22	(35) = (32) + zonneboiler
98256	97900	26	-20	24	16	-28	(36) = (34) + Uvoorgevel = 0.13 + Udak = 0.10 + Uglas = 0.50 + zonneboiler
99960	100230	27	-21	24	16	-29	(37) = (36) + zonneboiler-XL
99455	100691	27	-21	23	15	-29	(38) = (36) + Uvloer grond = 0.13 maar Udak = 0.13
101761	103879	28	-23	20	11	-32	(39) = (38) + ventilatiesysteem Dwtw4
109287	113157	32	-26	18	9	-37	(40) = (39) + Udak = 0.10 + Uvloergrond = 0.10 + Uprof = 0.90 + zonneboiler-XL + 30% extra opengaande ramen
114833	119031	35	-27	18	7	-38	(41) = (40) + v50 = 1,00
115928	121590	36	-27	19	10	-38	(42) = (40) + WP bodem-water COP4,4 Ltrad
124709	130986	40	-29	18	7	-40	(43) = (41) + WP bodem-water COP4,8 Ltrad
140168	147683	48	-29	18	7	-41	(44) = (43) + automatische zonnewering in het vlak van venster, maar slechts 20% extra opengaande ramen

Translation of image	
Source:	Translation:
Financiële parameters	Financial parameters
Energetische parameters	Energy parameters
TAK	TCC
Totale investering	Total investment
TVT	TVT
E-peil	E-level
K-peil	C-level

NEB	NZE building
PEV	PEV
Opmerkingen	Comments
jaar	year
kWh/m^{2}j	kWh/m^{2}y
kWh/m^{2}j	kWh/m^{2}y
referentie: Uvoorgevel = 1.70, Uachtergevel = 0.24, Udak = 0.24, Vloer grond – kelder = 0.68-0.78, Uprofiel = 2.2, Uglas = 1.1, v50 = 6h^{-1}, ventilatiesysteem C1, Stookolieketel HR met HT radiatoren + mazoutboiler, 47% opengaande ramen	reference: Ufront facade = 1.70, Urear facade = 0.24, Uroof = 0.24, Floor ground - basement = 0.68-0.78, Uprofile = 2.2, Uglass = 1.1, v50 = 6h^{-1}, ventilation system C1, Fuel oil boiler HE with HT radiators + heating oil boiler, 47% outward opening windows
(1) = referentie + gasketel + ventilatiesysteem C2 + geiser	(1) = reference + gas boiler + ventilation system C2 + geyser
(2) = (1) + gascondensatieketel	(2) = (1) + gas condensing boiler
(3) = (2) + Uvloer kelder = 0.20	(3) = (2) + Ufloor basement = 0.20
(4) = (3) + Uvloer kelder = 0.13 + Udak = 0.16	(4) = (3) + Ufloor basement = 0.13 + Uroof = 0.16
(5) = (3) + douchewarmteterugwinner	(5) = (3) + shower heat recovery system
(6) = (3) + ventilatiesysteem C3	(6) = (3) + ventilation system C3
(7) = (4) + ventilatiesysteem C3	(7) = (4) + ventilation system C3
(8) = (2) + Uvoorgevel = 0.24 + Udak = 0.20	(8) = (2) + Ufront facade = 0.24 + Uroof = 0.20
(9) = (8) + Uvloer kelder = 0.24 + Uglas = 1.0 maar gasketel	(9) = (8) + Ufloor basement = 0.24 + Uglass = 1.0 but gas boiler
(10) = (9) + gascondensatieketel	(10) = (9) + gas condensing boiler
(11) = (10) + Udak = 0.16 + Uvloer kelder = 0.13	(11) = (10) + Uroof = 0.16 + Ufloor basement = 0.13
(12) = (11) + ventilatiesysteem C3	(12) = (11) + ventilation system C3
(13) = (12) + douchewarmteterugwinner	(13) = (12) + shower heat recovery system
(14) = (13) + Uvoorgevel = 0.13	(14) = (13) + Ufront facade = 0.13
(15) = (14) + Uvloer kelder = 0.10	(15) = (14) + Ufloor basement = 0.10
(16) = (14) + Uprofiel = 1.40	(16) = (14) + Uprofile = 1.40
(17) = (16) + Uvoorgevel = 0.10 + Udak = 0.13 + Uvloer kelder = 0.10	(17) = (16) + Ufront facade = 0.10 + Uroof = 0.13 + Ufloor basement = 0.10
(18) = (16) + Uglas = 0.60	(18) = (16) + Uglass = 0.60
(19) = (16) + 2500Wp maar Uprof = 2.2	(19) = (16) + 2500Wp but Uprof = 2.2
(20) = (17) + 2500Wp	(20) = (17) + 2500Wp
(21) = (20) + Uachtergevel = 0.16	(21) = (20) + Urear facade = 0.16
(22) = (21) + 3750Wp	(22) = (21) + 3750Wp
(23) = (19) + 5000Wp	(23) = (19) + 5000Wp
(24) = (22) + Ventilatiesysteem C4 maar Uvoorgevel = 0.16	(24) = (22) + Ventilation system C4 but Ufront facade = 0.16
(24) = (22) + Uglas = 0.60	(24) = (22) + Uglass = 0.60
(25) = (21) + 5000Wp	(25) = (21) + 5000Wp
(26) = (25) + Uglas = 0.60 + ventilatiesysteem C4	(26) = (25) + Uglass = 0.60 + ventilation system C4
(27) = (26) + Uglas = 0.50	(27) = (26) + Uglass = 0.50
(28) = (21) + 7500Wp	(28) = (21) + 7500Wp
(29) = (28) + Uglas = 0.60 + Ventilatiesysteem C4	(29) = (28) + Uglass = 0.60 + Ventilation system C4
(30) = (29) + Ventilatiesysteem D5	(30) = (29) + Ventilation system D5
(31) = (30) + ventilatiesysteem Dwtw4	(31) = (30) + ventilation system Dwtw4
(32) = (30) + compactmodule	(32) = (30) + compact module
(33) = (31) + Uvoorgevel = 0.13 + Uhellenddak = 0.1 + Uglas = 0.5	(33) = (31) + Ufront facade = 0.13 + Usloping roof = 0.1 + Uglass = 0.5
(34) = (32) + ventilatiesysteem Dwtw3	(34) = (32) + ventilation system Dwtw3
(35) = (32) + zonneboiler	(35) = (32) + solar water heater
(36) = (34) +Uvoorgevel = 0.13 + Udak = 0.10 + Uglas = 0.50 + zonneboiler	(36) = (34) +Ufront facade = 0.13 + Uroof = 0.10 + Uglass = 0.50 + solar water heater
(37) = (36) + zonneboiler-XL	(37) = (36) + solar water heater-XL
(38) = (36) + Uvloer grond = 0.13 maar Udak =	(38) = (36) + U floor ground = 0.13 but Uroof =

0.13	0.13
(39) = (38) + ventilatiesysteem Dwtw4	(39) = (38) + ventilation system Dwtw4
(40) = (39) + Udak = 0.10 + Uvloergrond = 0.10 + Uprof = 0.90 + zonneboiler-XL + 30% extra opengaande ramen	(40) = (39) + Uroof = 0.10 + Ufloor ground = 0.10 + Uprof = 0.90 + solar water heater-XL + 30% extra outward opening windows
(41) = (40) + v50 = 1,00	(41) = (40) + v50 = 1.00
(42) = (40) + WP bodem-water COP4,4 Ltrad	(42) = (40) + WP soil-water COP4.4 Ltrad
(43) = (41) + WP bodem-water COP4,8 Ltrad	(43) = (41) + WP soil-water COP4.8 Ltrad
(44) = (43) + automatische zonnewering in het vlak van venster, maar slechts 20% extra opengaande ramen	(44) = (43) + automatic sun blinds on the plane of the window, but only 20% extra outward opening windows

Table 9: Packages of measures on the macroeconomic pareto front of the large row house

The house is well insulated, including interior insulation against the front wall, which makes it fairly inexpensive to install thicker insulation packages and, if space allows, the U value can drop to 0.13 W/m²K. The sloping roof is completely renewed and insulated to a U value of 0.16 W/m²K. The floor at the bottom is retained while the floor above the basement is insulated underneath (U = 0.13 W/m²K). In addition, the windows are replaced with better double glazing (U = 1.0 W/m²K) and profiles as adopted in the benchmark (U = 2.2 W/m²K). Moreover, due to this intensive renovation, the airtightness falls to v50 = 4.00 m³/m²h, and nodes on window anchors and, when connected to the wall-roof, are virtually free of thermal bridges. The central heating consists of a condensing gas combination boiler. This total renovation (cost: 60,788 euros) requires an additional investment of 10,700 euros compared to the benchmark renovation, but provides an additional primary energy savings of 5% which is enough to reduce the total current cost by approximately 18,450 euros.

The following table also includes the optimal E-levels for the other types of single-family homes and, for comparison, for the situations where E60 and E30 are achieved with the corresponding investment cost and total current cost.

Woning	arbeiders-woning	herenhuis	halfopen1	halfopen2	fermette	architecturale woning
Referentie	K55	K59	K62	K48	K60	K83
	E86	E88	E89	E87	E87	E89
	NEB85	NEB75	NEB95	NEB100	NEB85	NEB174
investering	36500	50000	31750	25500	48500	54500
TAK	68900	98000	74250	58000	109000	135000
Optimum	K39	K35	K41	K48	K60	K56
	E48	E43	E57	E80	E80	E73
	NEB41	NEB32	NEB50	NEB100	NEB82	NEB107
investering	47000	60750	47500	27000	47800	59500
TAK	65700	79650	73100	57500	93000	100500
E60	K52	K38	K43	K48	K60	K56
	E60	E59	E58	E60	E58	E59
	NEB59	NEB45	NEB51	NEB100	NEB82	NEB107
investering	40700	56000	47000	34800	60000	70000
TAK	66350	81000	73200	58000	95000	102500
E30	K39	K35	K43	K48	K38	K56
	E28	E28	E28	E30	E30	E30
	NEB41	NEB32	NEB51	NEB73	NEB48	NEB107
investering	54750	68500	60000	44000	86900	87000
TAK	66500	80400	76300	61000	99000	110000

Translation of image	
Source:	Translation:
Woning	Home
arbeiderswoning	worker's house
herenhuis	town house
halfopen1	semi-detached 1
halfopen2	semi-detached 2
fermette	farmhouse
architecturale woning	architectural home
Referentie	Reference
investering TAK	Investment TCC
Optimum	Optimum

Table 10: Optimum E-levels

This study material formed an important source of data in determining the long-term objective for the renovation of the Flemish housing stock (see also point 4, section on Renovation Pact).

2.2. NON-RESIDENTIAL BUILDINGS

In 2014, the Flemish Government established the tightening process for the E-level for offices and schools: E55 in 2016, E50 in 2018 and E45 in 2020. From 2021, every new office and school must at least meet the NZE requirements (nearly zero energy).

Offices and schools submitting permit applications or notifications from 2021 must respect the E40 level.

To guarantee that the pre-set requirements are feasible and affordable, a new study of the cost-optimal E-levels is conducted every two years. If necessary, this pre-set process with be adjusted.

The European Directive 2010/31/EU obliges the Member States to impose a requirement on every new building, with possible exceptions for certain industrial and agricultural buildings. In the context of interregional cooperation on the energy performance calculation method, the E-level calculation method was completed in 2015 for the other specific designated uses, such as hospitals, commercial buildings, catering, etc. The decision of the Flemish Government to introduce an E-level requirement for all non-residential designated uses for permits requested from 1/1/2017 received definitive approval on 18 December 2015.

Based on the assessment of the energy performance regulations in 2015 and the study conducted in that context, the Flemish Government has established a roadmap for all types of non-residential new construction and major energy renovation.

In the study of the cost optimum[2], several scenarios were calculated for 11 buildings with a total of 26 functions. The new EPN method (Energy Performance of Non-Residential Buildings) and the new benchmark were also used for offices and schools. An unambiguous comparison with the previous level of requirements and the previous 2013 study was therefore not possible. As a result, when assessing the tightening processes that were already established, only the results of the most recently conducted study (2015) were considered.

Since 2016, the requirement for offices and schools has been somewhat lower than the cost optimum. It was therefore decided not to maintain the stated tightening process for the E-level for the new construction of schools and offices. The reason for this may be the interplay of studying other buildings, the adjustment of the methodology, or an excessively limited evolution of the cost optimum through time, but this is not certain. Still, the tightening process for major energy renovations will be retained.

In establishing the EPN requirements for new construction in 2018 and 2021, the cost optimum will be the limit as an even more excessive tightening is not considered to be "rational". It has been decided to approximate the cost-optimal level for EPN functions from 2018 and, for the time being, not to seek further tightening in 2021. In 2021, only the requirement for offices ('office', 'technical spaces', and 'community' functions) will be tightened to E50 because a requirement of a maximum of E50 has been in place for public offices since 1/1/2016.

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[2] "Studie naar kostenoptimale niveaus van de minimumeisen inzake energieprestaties van niet-residentiële gebouwen" (Study on cost-optimal levels of the minimum requirements for energy performance of non-residential buildings) (VK engineering, KU Leuven (department of construction physics) and Royal Haskoning, October 2015)

For the comprehensive energy renovation, the cost-optimal level according to the study conducted will be approximated in 2021. For education, the calculated optimum is E93, for offices the cost-effective E-level ranges from E82 to E115. Prior to 2018, a choice was made for an interim tightening. The reason for this was to not unnecessarily increase the tension between new construction and major energy renovations for those functions.

The E-level requirement for major energy renovations was previously E90 (permit applications/notifications before 2017) for offices and schools. For permit applications or notifications after January 1, 2017, an E-level requirement applies for major energy renovations of all non-residential buildings which varies depending on the function of the EPN unit. An energy renovation is considered significant if all technologies (ventilation and heating) are completely replaced and at least 75% of existing and new partition structures that are adjacent to the outside environment (i.e. not the floors) are insulated. In addition to the existing minimum ventilation facilities (now extended to all non-residential functions), a minimum share of renewable energy (at least ≥ 10 kwh / m^2 per year) is now also applicable.

If the buildings consist of only one functional part, the requirements listed in the following table must be met, depending on the functional part.

$E_{eis,fct\ f}$	2017
Logeerfunctie	130
Kantoor	90
Onderwijs	90
Gezondheidszorg met verblijf	130
Gezondheidszorg zonder verblijf	130
Gezondheidszorg operatiezalen	105
Bijeenkomst hoge bezetting	130
Bijeenkomst lage bezetting	130
Bijeenkomst cafetaria/refter	120
Keuken	120
Handel	120
Sport: sporthal, sportzaal	115
Sport: fitness, dans	115
Sport: sauna, zwembad	115
Technische ruimten	90
Gemeenschappelijk	90
Andere	130
Onbekend	130

Translation of image	
Source:	Translation:

$E_{eis,\ fct\ f}$	$E_{requirement,\ fct\ f}$
Logeerfunctie	Accommodation function
Kantoor	Office
Onderwijs	Education
Gezondheidszorg met verblijf	Healthcare with accommodation
Gezondheidszorg zonder verblijf	Healthcare without accommodation
Gezondheidzzorg operatiezalen	Healthcare operating theatres
Bijeenkomst hoge bezetting	Meeting with high attendance
Bijeenkomst lage bezetting	Meeting with low attendance
Bijeenkomst cafetaria/refter	Meeting cafeteria/student restaurant
Keuken	Kitchen
Handel	Trade
Sport: sporthal, sportzaal	Sport: sports hall, gym
Sport: fitness, dans	Sport: fitness, dance
Sport: sauna, zwembad	Sport: sauna, swimming pool
Technische ruimten	Technical spaces
Gemeenschappelijk	Common
Andere	Other
Onbekend	Unknown

Table 11: E-level requirements for EPN units that undergo a major energy renovation

If the EPN unit contains different functional parts, the requirement for the EPN unit is determined as a weighting according to the useful floor areas of the existing functional parts.

TIn the context of the planned evaluation of the energy performance regulations in 2017, the FEA wishes to gain insight into the ratio of current and planned Flemish EPB requirements to the cost-optimal energy performance levels for new non-residential buildings and existing ones that have undergone a major energy renovation. This study is carried out in accordance with the method laid down in the Commission delegated Regulation No. 244/2012 of 16 January 2012.

The main objective of this task is to provide a detailed study of the total costs compared to the total primary energy consumption, calculated according to the method for non-residential buildings (EPN calculation method), of a number of energy saving measures and/or packages of measures that are applied to a set of benchmark buildings and building components. In this way, the cost-optimal and cost-efficient requirement levels can be determined for all types of non-residential buildings.

3. Information on the policy and measures to stimulate cost-effective extensive renovations of buildings, including extensive renovations in phases (EED Article 4(c)).

3.1 RESIDENTIAL BUILDINGS

The Flemish housing market is characterised by a large proportion of old homes and a low renovation rate (<1%). Despite the relative success of awareness-raising and

premium measures, citizens feel there are significant obstacles to undertaking extensive renovation of old energy-guzzling homes due to:

- **A lack of knowledge concerning energy saving measures.**
- **Uncertainty about the end result.**
- **Little experience with energy renovations, limited number of experienced advisors.**
- **Lack of financial resources.**
- **Split incentive/landlord-tenant problems.**
- **Co-ownership.**

Using an evolving set of interrelated measures, the Flemish Government is encouraging families to make a thorough valuation of the energy performance of their home.

Energy performance regulations

From 2015, major energy renovations of homes, apartments, offices and schools were required to comply with a global energy performance requirement E90 (Decision of the Flemish Government of 29 November 2013). A major energy renovation has been defined as a renovation in which the heating and/or cooling system is completely replaced and at least 75% of the existing and new partition structures that envelop the protected volume and that are adjacent to the outside environment are insulated, but are not a dismantling.

For dismantling of existing buildings with a protected volume exceeding 3000 m^3, an E-level requirement has already been applied since 2006. A dismantling is a conversion that maintains the support structure of the building, but whereby the systems for obtaining a specific indoor climate are replaced, along with at least 75% of the façades. The 'major renovation' is analogous to decommissioning but without the corresponding volume limit and with less extensive work on the envelopes.

From 2015, major renovations must not only meet the overall energy performance requirement, but also the requirements for thermal insulation of construction components (applied during or after the renovation) and the same ventilation requirements as new buildings. The thermal requirements for the construction components were tightened in 2016 and from the beginning of 2017 a requirement for a minimum share of renewable energy is in force (≥ 10 kwh/m^2 per year). A new strategy will also apply for non-residential buildings from 2017 (see further 3.2).

More information on the applicable requirements can be found on http://www.energiesparen.be/epb/welkeeisen.

Example projects and inventory of extensive renovations

As part of the reinforcement of the front runner policy for near-zero energy renovations, a study was carried out on behalf of the FEA to determine how an increase in the number of thorough energy housing renovations can be stimulated.

The intention was to gain insight into available and proven tools, methods and strategies for thorough energy renovations and the way in which the use and impact of these solutions can be increased in Flanders. Starting from an inventory of existing European and Belgian demonstration and research projects on 'thorough energy renovations,' an analysis of 180 promising solutions was conducted. Based on this analysis, four key guidelines for pooled action on thorough energy housing renovation were developed: 'innovation in the area of finance', 'support for technical innovation in housing renovation', 'anchoring quality renovation processes' and 'knowledge building and communication'. These key guidelines were translated into specific desired actions for different target groups such as interest groups, training centres, financial institutions, building materials producers, etc. See also section 3.1.4 Cohereno

<u>The "Home renovation: innovation in energy-efficient renovations" pilot</u>

On 22 November 2013, the Flemish Government decided to set up the home renovation pilot. This initiative is part of the front runner strategy and aims to stimulate scalable and reproducible renovation techniques to provide affordable solutions for key parts of the building stock. Extensive coordination of the actors in the building chain must lead to qualitative, integrated, but particularly also reproducible, scalable and affordable solutions. Research, development and demonstration activities are carried out in the pilot on the basis of real renovation projects.

A pilot is a structured testing environment in which companies or organisations can test innovative technologies, products, services and concepts using a representative group of individuals (or organisations), the test population, that are used as testers in their own living and working environment.

The "Residential renovation: innovation in energy-efficient renovation" pilot aims to contribute to improved market conditions for extensive renovations of homes by:

- **Developing scalable and reproducible renovation concepts.**
- **Stimulating cooperation between suppliers, developers and executors.**
- **Strengthening the demand side using a group approach and alternative forms of financing.**
- **Demonstrating the feasibility of cost-optimal energy performance levels.**

The home renovation pilot is comprised of an infrastructure of (groups of) housing units, representative of the Flemish residential building stock: e.g. a neighbourhood (parcelling, social housing, etc.), apartment buildings, street row houses, dispersed systems assembly homes, etc. Concrete renovation processes form the platforms on this infrastructure (with close involvement of owners and/or residents as a test population), on which the pilot projects are carried out. In addition to the different pilot projects, the pilot will also include an overarching coordinating and knowledge platform. This central coordination and knowledge platform will be responsible for the matching and follow-up of the projects, the quality assurance (including performance monitoring analysis) and knowledge management (collecting, bundling, disseminating). The pilot has an economic and/or social thrust. At the social level,

attention is paid to both the cost-effectiveness of energy-efficient renovations for owners and/or residents (maintaining home comfort and lifelong living) as well as taking the necessary steps in accordance with the climate policy (renovation rate of the housing stock).

On 22 November 2013, the Flemish Government decided to set up the 'housing renovation: innovation in energy-efficient renovation' pilot. On 7 February 2014, the Flemish Government then decided to reserve an additional 2 million euros from SALK funds (Strategic Action Programme Limburg Squared 2013-2019). As a result, the pilot projects have an available budget of 5 million euros. Support for the consortia for setting up the pilot platforms and implementing the projects is granted for a period of up to 4 years. In principle, the coordination and knowledge platform will receive support for a maximum of 5 years.

The Flemish Knowledge Platform Home Renovation has the overall objective of achieving 'Innovation in Renovation' and creating a positive innovation climate for the renovation of homes. As partners, this knowledge platform has the Belgian Building Research Institute BBRI, Pixii (formerly the Passive House Platform) and the following professional organisations: Flemish Construction Federation, the Bouwunie (Flemish federation for SMEs in the construction sector), NAV (Netwerk Architecten Vlaanderen or Flanders network of architects) as well as the following universities: KU Leuven, Ugent, Thomas More college and the Flemish Institute for Technological Research VITO. In 2014, a website was launched http://www.kennisplatform-renovatie.be/ that presents the individual pilot projects together with the results and lessons learned to all construction actors. Good practices at home and abroad are illustrated in a brief sheet for each initiative, focusing on the rollout possibilities for Flanders. Interaction with the various pilots takes place twice a year by means of a pilot project board consultation and close individual contacts are maintained with each pilot coordinator to capture the current state of affairs, possible barriers and innovative solutions developed.

In 2016, the knowledge platform identified a few priority knowledge dissemination themes that were supplemented by obstacles, concerns and solutions implicitly provided by the various pilots during the individual consultation. Interaction between the pilots themselves and discussion of these priority themes are facilitated by the organisation of workshops, among other things. Workshops were set up in 2016 on financing and business models, sustainable construction and lifelong living, LCA (life-cycle analysis) and prefab renovations. In addition, consultation between the clusters of pilots was organised on certain transversal themes and moderated by the knowledge platform. Within the project, various tools and methods were developed and tested to formulate renovation advice. The intention is to launch these on the market once they are finalised.

Various pilots are currently yielding their first results and have already developed solutions and tools, which the knowledge platform is currently collecting and analysing before their dissemination. For example, the NZE renovation of the *Drie Hofsteden* apartment block in Kortrijk was successfully tendered in consultation with the contractor, so via a construction team. They aimed for a six-month lead-time (due

in part to the use of prefabricated steel structures) and a minimum level of nuisance for residents during the implementation (starting in early 2017). Moreover, the pre-set NZE objective is feasible. For *RenBen*, a range of tools were developed to support the renovation supervisors. Their scorecard was developed into an app that systematically and automatically maps the various building components and suggests appropriate solutions. The result is then communicated to the landlord, together with renovation advice. A five-step methodology for this renovation advice was already set up. And the *Renoseec* pilot (Sint-Amandsberg) worked out a system of scanning homes and is therefore fully involved with the renovation advice. A set of other tools and accompanying tools was created within the *Werfgoed* pilot, in which a data management system clusters homes and residents to then provide appropriate renovation advice. The *duwolim+-* loan (rolling fund for housing renovation) is a financial tool that has already been widely acclaimed and was launched in the course of this pilot. The *De Schipjes* pilot focuses on energy renovation of heritage sites using innovation techniques, and its target group is assisted living. The study has been largely completed and the pilot is ready to be implemented. They are organising in-house workshops on the specific issues they face in their pilot: the tension between an energy renovation and the heritage site, and dealing with residents and their behaviour. A initial pilot prefab renovation was carried out in Limburg through the *Mutatie+* pilot. They captured the lessons learned from this initial pilot before starting a second home in early 2017. *Ecoren* is also focused on prefabrication as a means of fully renovating a home in just a few days.

The results from the 10 pilots are communicated using various focus themes, such as the customer, financing, business models, energy, costs and sustainable construction as well as lifelong living. A partner from the knowledge platform is responsible for each of these themes, depending on their expertise. For each theme, a data sheet was developed that is available on the website. The project is linked to the Renofase project where contractors, architects and material suppliers and producers are supported to realise efficient and high-quality renovation projects (www.renofase.be). The knowledge from the pilots and partners will be disseminated to the contractor and architect in a tailored way through the communication channels of the partners, workshops, conferences and seminars. New materials, products and systems are tested and validated; ideas and tools are developed and implemented through case studies. The housing renovation pilot is a beneficial area for this.

Energy performance certificate regulations for homes and for public buildings

Each home sold or rented has an energy performance certificate. At the end of 2016, 932,238 valid energy performance certificates had already been drawn up for existing residential buildings. The EPC ensures a basic awareness-raising among both owners and buyers as well as tenants, regarding the energy performance of the residence. In addition to an energy rating, the EPC mainly includes standard measures to improve the residence's energy performance. Currently, a project is being developed to extend the certification software with an advice section concerning the process involved to comply with the long-term objective (2050) for existing homes that was laid down under the Renovation Pact (see below).

Energy standards in the Flemish Housing Code

Since 1 January 2015, the roof insulation standard applies to all "independent" homes located in the Flemish Region. A lack of sufficient roof insulation will progressively weigh more heavily in the assessment of the quality of the housing, which means that from 2020, homes without adequate roof insulation will no longer comply with the applicable minimum standard framework in terms of quality, safety, health and energy performance. Moreover, on 15 July 2016, the Flemish Government decided to introduce an addition to the standard framework and will require double-glazing from 2020.

Premiums and subsidies for energy saving works

Efficient energy use among household and non-household customers is encouraged through the public service obligations concerning efficient energy use for the electricity distribution network operators. Under the Energy Decision of 19 November 2010, the operators are required to comply with a number of action commitments to encourage their end customers to save energy. The premium conditions and amounts have been the same throughout Flanders since 2012 and are periodically adjusted to avoid the implementation of suboptimal insulation works and the corresponding lock-in as well as to expand a stimulating framework for the combination of energy saving works.

In 2016, the Flemish Government implemented a number of changes (in force from 2017) in the framework of the efficient energy use/public service obligations for the existing buildings section:

As regards individual investments:

- **As of 2017, extensions/new building envelopers are also eligible for insulation and glazing premiums;**
- **A new premium will be introduced for insulation of interior walls;**
- **A number of premiums will gradually be phased out: roof insulation, cavity wall insulation, glazing, solar water heater (from 2019);**
- **For a number of premiums, the substantive conditions will be tightened: roof insulation, external wall insulation, floor insulation;**
- **For some measures, a link with a quality system will be provided (in time): internal wall insulation, external wall insulation, solar water heater and heat pump;**
- **Heat pumps will be switched to flat-rate premiums according to the type of heat pump, which will greatly increase the support for geothermal heat pumps in particular.**

From 2014, network operators have issued a combined premium for homes in which a simultaneous investment is made in wall insulation and the existing windows are replaced (Flemish Government Decision of 29 November 2013). This premium was scrapped and, from 2017, replaced by the more extensive Total renovation bonus for projects combining at 3 three different measures in a period of 5 years. In that case, in

addition the individual premiums, total renovation bonuses are awarded from the third investment.

following implementation of	flat-rate bonus per home	flat-rate bonus per apartment
the third investment	1250 euros	625 euros
the fourth investment	additional 500 euros	additional 250 euros
the fifth investment	additional 1000 euros	additional 500 euros
the sixth investment	additional 1000 euros	additional 500 euros
the seventh investment	additional 1000 euros	additional 500 euros

Table 12: Overview of total renovation bonuses

In addition to this stimulus for the phased implementation of renovation works, from 2017 efforts will be made to ease the associated burden and provide guidance by starting collective renovation projects (= at least 10 homes from the same neighbourhood that are investing in such works) under the supervision of project supervisors throughout the project. The project supervisor provides support for the citizen in the realisation of energy saving investments. To this end, the supervisor takes on as many of the citizen's tasks as possible, such as energy screening of the home, timing, advice on the energy renovation and action plan, drawing up measurement data, searching for contractors, site follow-up, administrative support for premium applications and financing, etc. The premium for collective renovation projects amounts to up to 400 euros per house or housing unit and is paid to the project supervisor responsible for assuming the complete burden of the owner of a house or apartment in the collective renovation project. The resident receives the regular premium.

For apartment buildings, the premium falls from the sixth housing unit to 100 euros per housing unit. The premium is capped at 5000 euros for the building.

And finally, the support for vulnerable target groups will be further expanded:

- **A substantial increase in the premium for an individual condensing boiler for protected customers (from 800 euros to 1800 euros);**
- **For protected customers, 50% higher premiums for exterior wall, inner wall, floor insulation and total renovation bonuses, 20% higher premiums for solar water heaters and heat pumps. The premium for glazing is fixed at 56 euros per m^2, for roof insulation at 10.5/5.25 euros per m^2 and for cavity wall insulation at 9 euros per m^2 (in contrast to the regular premiums, these will not be decreased over the coming years);**
- **The social roof insulation projects for vulnerable tenants on the private rental market are being expanded to include social cavity wall projects and social glazing projects. Vulnerable families are often forced to rent an energy-guzzling house on the private market. Although investing in roof insulation, cavity wall insulation or high efficiency glazing can lower the energy bill, it is not easy for the tenants to realise such investments. And the landlord himself often fails to**

invest because he has little vested interest as he does not pay the energy bill. The social energy efficiency projects help remedy this situation with tailored guidance and an extra high premium. The technical conditions to be met are identical to those that apply to the ordinary energy premiums of the network operators. The support is comprised of a flat-rate premium for the project promotor of 200 euros per work completed, supplemented by a maximum of 20 euros per m^2 of roof or attic insulation installed, a maximum of 12 euros per m^2 of cavity wall insulation installed or a maximum of 85 euros per m^2 of high-efficiency glazing installed.

Inexpensive to interest-free energy loans

A network of Energy Houses allocates energy loans financed with public funds for energy saving investments under the coordination of the FEA. Over 9,000 loans were granted since the beginning of 2015. Vulnerable families receive a 0% interest rate and intensive supervision during the process.

At the Flemish climate and energy summit on 1 December 2016, ING, BNP Paribas Fortis and BPost Bank committed themselves to offering cheap energy loans in 2017 at interest rates of less than 2 percent. By offering inexpensive energy loans, the banking sector is helping to create an energy efficient future. They are not only giving citizens the opportunity to invest in renewable energy in their homes, but to carry out energy saving renovations.

Premiums for renovation

A number of premiums, such as the renovation premium and the improvement and conversion premium, are provided from the Living policy area.

Through the renovation premium, the Flemish government supports owners who wish to renovate their home, which must be at least 30 years old, or who wish to transform an existing building into a home. The premium is calculated per category of work and equals 20% to 30% of the invoice amounts to be taken into account. Each category of work must involve an invoice amount of at least 2,500 euros (excluding VAT). The 30% calculation (with a premium capped at 3,333 euros per category of work) applies to:

- **owner-occupiers with an income of less than 30,060 euros (to be increased by 1,570 euros per person covered);**
- **those who rent the home to a social housing agency.**

All others receive a compensation of 20% (with a premium capped at 2,500 euros per category of work). The maximum amount of the premium for the two requests jointly is fixed at 10,000 euros for everyone. The works are divided into four categories.

- **Category 1: the structural elements of the home: works involving the foundation, the walls, the supporting floors and the stairs;**
- **Category 2: the roof: works involving trusses, roofing, gutters and drainage;**
- **Category 3: the external carpentry: works involving windows and exterior doors. Moreover, since 1 July 2016 they must comply with the ventilation provisions in the Energy Decision;**

- **Category 4: the technical installations: works involving the electrical system, the sanitary system in the bathroom and toilet as well as the central heating.**

In 2015, 13,665 people received renovation premiums, which amounted to a total amount of 81.6 million euros. The average renovation premium amounts to 5,970 euros.

The improvement and conversion premium (verbeterings- en aanpassingspremie or VAP) is a premium for improvements to homes of at least 25 years old for people with modest incomes as well as for conversions to make the home more suitable for senior citizens and the disabled. Depending on the building component, the premium varies between 500 and 1250 euros.

In 2015, 10,217 people received premium amounts, adding up to a total of 12.5 million euros. In 2015, the average premium award was 1,227 euros.

Both premiums can be cumulated with the energy premiums from the distribution network operators.
More information is available on the website https://www.wonenvlaanderen.be/verbouwen.

Social housing

The social housing patrimony in Flanders includes approximately 145,000 homes (52% houses, 48% apartments).

To support the Energy Renovation Programme 2020, the Flemish Government initially provided an overall budget of 28,525,000 euros for thorough energy renovations (at least 2 works) via the Flemish Government's decision of 10 January 2014 for the period 2012-2019. Through the Flemish Social Housing Company, the Social housing associations were able to obtain premiums for the replacement of single glazing by high-quality thermal window systems, the replacement of outdated heating devices by high efficiency devices, roof insulation, subsequent insulation of facades and floors, the installation of solar water heaters and heat pumps.

In 2016, the Flemish Government decided to reserve an additional 80 million euros from the Climate Fund for the renovation and/or replacement construction (demolition + reconstruction) of social housing, which accelerated efforts to bring the entire patrimony up to a proper level of energy efficiency by 2020 and enabled the government to take an exemplary role.

Information and labelling

See point 3.1 Horizontal measures from the Action Plan for the emphasis placed on the evolution towards more thorough total renovations.

Fiscal measures – 6% VAT for renovation

For homes that are older than 10 years, renovation works (conversion, renovation, rehabilitation, improvement, repair, maintenance) billed directly to the end user (owner or tenant) will be subject to a reduced VAT rate of 6% (instead of 21% for new construction).

Fiscal measures – property tax discount

From 1 October 2016, the discount property tax discount for energy efficient new construction, which has been in existence for years, was extended to major energy renovations of residential buildings for which a building permit application must be submitted:

- **if the E-level is a maximum of E90, the reduction is 50% of the property tax for 5 years;**
- **if the E-level is a maximum of E60, the reduction is 100% of the property tax for 5 years.**

The 'major energy renovation' is a renovation in which the technical installations are completely replaced and at least 75% of the existing and new envelope are (subsequently) insulated.

Fiscal measures – lower gift tax for energy renovation

On 1 July 2015, the Flemish Government reduced the gift taxes for property. Anyone who makes an energy saving renovation for a total amount of at least 10,000 euros (excluding VAT) within five years also enjoys an additional reduced rate.

Upon registration of the deed, the ordinary gift tax rate for real estate will be levied. Then, if the terms of the reduced rate are met, the difference between the previously levied normal rate and the reduced rate will be refunded.

Tranches (€) – rates from 1/7/2015	Direct line (grand)parents – (grand)children, between partners	Direct line – energy renovation	Non-direct line	Non-direct line – energy renovation
0-150,000	3%	3%	10%	9%
150,000.01 - 250,000	9%	6%	20%	17%
250,000.01 - 450,000	18%	12%	30%	24%
> 450,000	27%	18%	40%	31%

Table 13: Gift tax rates in Flanders

Fiscal measures – tax deduction for those who lend money for renovation agreements

Parties who lend money to a relative or acquaintance for renovation works on a property that is registered as vacant, neglected, uninhabitable or unfit can receive a tax deduction. The condition is that the borrower (or one of the borrowers) must live in the property for at least 8 years. The tax deduction amounts to a maximum of 625 euros per year, for the term of the loan and as long as the borrower uses the home as

his principal residence. For loans up to 25,000 euros, the tax reduction is 2.5% of the borrowed amount (calculated on the average of the amounts used on 1 January and 31 December, respectively, of the income year). The borrower receives an inexpensive loan at no additional cost.

Tax measures - Renovation discount

The tax base for the attribution of registration rights for the purchase of a vacant or uninhabitable property is reduced by 30,000 euros if the property is purchased with the aim of establishing a principal residence within the two years after the purchase. See http://belastingen.vlaanderen.be/renovatie-abattement

Future policy

See the information on the Renovation Pact under point 4.

3.2 NON-RESIDENTIAL BUILDINGS

The existing policy focuses on eliminating barriers that hinder investment in energy saving measures. From the previously mentioned Efika study, it appears that roughly three major barriers can be defined:

- **Lack of knowledge: the owner of the buildings does not know what the energy consumption is, what savings can be realised or the technical knowledge to implement the investments is lacking.**
- **Lack of time/priority: since energy is not the core task of companies or facilities and is only a small cost item, it receives little attention.**
- **Lack of profitability: the energy saving materials often have an excessively long payback period in a commercial environment, which prevents their implementation.**

Below is an overview of the existing policy measures followed by a summary of future policies that have been decided and planned.

Financial measures

- **Increased investment deduction (see also 3.4): companies can obtain a tax deduction on their taxable profit of 13.5% if they invest in an energy saving measure. See http://www.energiesparen.be/verhoogdeinvesteringsaftrek.**

- **Network operator premiums for efficient energy use (see also 3.4): the network operators (in Flanders, Eandis and Infrax) ensure support for energy saving measures by granting subsidies for certain measures. These measures are: external wall insulation, roof/attic insulation, floor/basement insulation, high-efficiency glass, heat pump, solar water heater and relighting. The expected savings are calculated in Table 7.**

- **Post-audit premium of the network operator (see also 3.4): in addition to the previous list of measures, the company can also receive a premium if it makes investments after carrying out an energy study or energy audit. However, these measures may not be included in the previous list and should also be implemented effectively.**

- **Ecology premium plus (see also 3.4): through the Flemish Agency for Innovation and Entrepreneurship VLAIO, companies can apply for support for innovative technologies that are included on an exhaustive list. This includes more than energy saving measures. See http://www.vlaio.be/themas/ecologiesteun.**

- **Reduction of property tax: the reduction can only be granted for new construction or reconstruction after complete demolition or building shell conversion (dismantling) or for major energy renovations. In the latter case, all technical installations are completely replaced and at least 75% of the existing and new envelope are (subsequently) insulated.**

  For major energy renovations with urban building permit application or notification from 1 October 2016 and, on 1 January of the fiscal year an E-level of:
  - **a maximum of E90, the reduction is 50% of the property tax;**
  - **a maximum of E60, the reduction is 100% of the property tax.**

  The reduction of the property tax is automatically granted based on the EPB declarations (EPB reporter) for buildings that are submitted to the FEA. See http://www.energiesparen.be/korting-onroerende-voorheffing.

Obligations

- **EPC Public**

An energy performance certificate (EPC) for public buildings is required for buildings where public organisations are located that provide government services to a large number of people. The implementation was systematically tightened. Initially, the EPC for public buildings was only mandatory for large public buildings with a useful floor area of 1000 m². Since 1 January 2015, the requirement applies to buildings larger than 250 m². This is more specifically about buildings of: the federal government, the Flemish Government, the provincial authorities, the municipal authorities, public companies, educational institutions, welfare and health services.

- **EPB (EPN)**

From 1 January 2017, there are additional EPB requirements for all non-residential designated uses, namely concerning the E-level and the minimum share of renewable energy, and these fall into the category EPN unit (Energy Performance of Non Residential Buildings). While there were previously only requirements for schools and offices in force, now they also apply to each space with another specific designated

use (andere specifieke bestemming or ASB). Also note that an E-level requirement is determined per space and not per building as a building may have multiple functions, with each function having specific characteristics. For the purpose of determining the E-level requirement for the building as a whole, a weighted average is taken based on the floor space used per space.

Other measures

In addition to financial support and commitments, the policy also aims to act as an awareness raising tool. To this end, the following have been developed:

- **Information brochure on catering**

The Flemish Agency for Innovation and Entrepreneurship (VLAIO) and Horeca Vlaanderen (Flemish catering sector) jointly publish a brochure in which they have bundled specific practical examples, available support measures and tips. The practical examples illustrate what measures have been taken and their financial return.

- **SME energie-wizjer.be**

On the website kmo-energiewijzer.be, SMEs can make their own estimate of where they stand by entering a number of basic details and then comparing them with a benchmark. This site was developed by ZES (Zero Emission Solutions) and NSZ (Neutral Trade Union for the Self-Employed) with a project subsidy from the Flemish government.

- **Information brochure on lighting**

An information brochure aimed at all companies that guides them in the choice of lighting, not only in terms of energy performance but also comfort. For SMEs, this is an essential factor as it concerns employees' well-being and their productivity at work.

Future policy

The Flemish Energy Company (VEB) is developing an information platform for semi-public entities. This project, called Terra, will enable entities to permanently view the most current energy-related data and compare them with other entities.

On 1 July 2016, the Flemish Government approved the energy efficiency action plan for the Flemish administration. As a starting point, all segments of the Flemish central Government have adopted the following binding objective from 2017: primary energy consumption (buildings and technical infrastructure) will decrease by at least 2.09% per year and per entity starting in 2017 up to 2020.

In addition to these decisive issues, an energy and climate pact was signed in the context of the Flemish Energy and Climate Summit of 1 December 2016, which set out further concrete measures. This pact is the most important document for the Flemish

Government's future energy and climate policy and energy efficiency is an indispensable element here. A summary of the relevant measures is given below:

The action plan for schools focuses on awareness raising as well as on actual investments in energy efficiency and a package of 10 measures was worked out for this purpose, whereby the following are relevant to energy efficiency:

- **Call for energy saving investments at colleges and universities.**
- **Adjustment of boilers.**
- **Efficient energy use investments for compulsory education.**
- **Energy management at schools.**
- **Energy performance contracts for schools.**

Concrete measures were also developed for the care sector to make care institutions more aware of the energy performance of the buildings:

- **Sustainability criteria for infrastructure projects (via the responsible VIPA agency).**
- **Energy performance diagnosis with possible progression to ESCO.**
- **Rolling fund for the care sector.**

The following measures will apply to the other sectors:

- **Investigate and, if necessary, introduce and finance an ESCO fund for investment in energy efficiency.**
- **Facilitate innovative energy efficiency techniques, at least through the EPB regulations.**

The FEA is also developing an action plan to stimulate and support investments in energy saving measures in non-residential buildings. As a basis, it is using the study paper that was prepared by Efika in 2016. As the non-residential building stock is very diverse and the bulk consumers are dealt with first, actions per sector will be developed, with a focus on trade and offices. The various actions proposed and developed in the context of the current transition projects, such as Rapid Acceleration, Vision 2050 (Stroomversnelling, Visie 2050) and Climate Vision 2050 (Klimaatvisie 2050) as well as the Flemish Parliament's resolution of 25 November 2016 on a strong Flemish climate policy will be embedded in the action plan.

4. Future-oriented perspective to steer investment decisions by individuals, the construction sector and financial institutions (EED Article 4(d)).

4.1. HOMES: THE FLEMISH RENOVATION PACT

Article 4 of the European Directive on energy efficiency (EED) 2012/27/EU requires Member States to establish a long-term strategy to commit to investments in the renovation of the national, public and private stock of residential and commercial buildings.

An initial version of the long-term strategy was required to be delivered to the European Commission by 30 April 2014. For Flanders, this strategy is included in the third Flemish energy efficiency action plan. As a basic strategy for housing, the Energy Renovation Programme 2020 was announced, backed up by the development of a front runner strategy (determining the objective as well as example projects and taking inventory of extensive renovations and pilot home renovation). The aim of this emergency programme was that by 2020

- **all roofs be insulated;**
- **all single glazing be replaced by insulating glass;**
- **outdated heating boilers be eliminated from Flemish homes.**

Although this strategy provided a good basis, it is not enough to meet the ambitious energy and climate objective.

Increasing the renovation rate of the Flemish housing stock and, at the same time, carrying out extensive renovations is not only crucial within the EED but also in the context of achieving the other European climate and energy objectives, particularly the greenhouse gas reduction target for non-ETS sectors and the renewable energy objective. Indeed, this objective is calculated as part of renewable energy in gross energy consumption. By reducing the denominator (gross final energy consumption) in 2020, realising the targeted share of renewable energy can be achieved more quickly.

There are significant challenges to be faced in moving towards a building stock with a significantly better energy performance. The government can facilitate and support this transformation, but other stakeholders, such as the construction sector, will have to join in the effort. We must work on this together through a mobilisation effort facilitated by an appealing "Renovation Pact", whereby investing in an improved energy performance of our housing stock becomes a matter of course. This requires an appropriate support framework, but also a broad-based positive message about the social importance of this transformation for our housing stock.

At the end of 2014, a project was launched to determine whether stakeholders could be prepared to shape a Renovation Pact with the objective of developing a coherent action plan that, from a short, medium and long-term perspective, leads to a strong increase in the renovation rate of our Flemish housing patrimony and optimises the energy performance of that patrimony to a near zero energy level.

Thirty-four partner organisations (construction sector, real estate, government, civil society, poverty reduction) have committed themselves actively and constructively cooperate in the development of a Renovation Pact. Under the coordination of the FEA, they consulted intensively during the first semester of 2015 on a strategic policy framework for a Renovation Pact and the selection of a number of leverage actions that will have a clear impact on the basic objective of the Renovation Pact, in particular a substantial increase in the renovation rate of the Flemish housing stock:

- **Long-term objective for the energy performance of existing homes.**
- **Good action examples.**
- **Integrated policy framework.**

- **Financing.**
- **Obligations.**
- **Communication.**

On 17 July 2015, the Flemish Government established the building blocks and recruitment efforts for the Renovation Pact. The FEA was tasked with launching a subsequent phase for the further development of the Renovation Pact and to make the leveraged actions described above more concrete. Once again, a multi-stakeholder approach was taken that gave further substance to the long-term objective. We provide a brief overview of the state of affairs.

<u>Long-term objective for renovation</u>

For the energy performance of existing homes, a long-term target for 2050 has been established, which consists of two equivalent tracks: a package of measures and an energy performance indicator. By 2050, the existing homes must reach the same or a comparable energy performance level as newly constructed residences for which permit applications were submitted in 2015.

The package of measures is composed as follows:
1° maximum U-values for the envelope:
- **roofs and ceilings: Umax= 0.24 W/m^2.K;**
- **walls: Umax= 0.24 W/m^2.K;**
- **windows (profiles and glazing): Umax= 1.5 W/m^2.K and Uglass = 1.1 W/m^2.K;**
- **doors and gates (including frame): Umax= 2.0 W/m^2.K;**
- **floor surfaces: Umax= 0.24 W/m^2.K.**

2° a heating system comprised of:
- **condensing boiler or;**
- **(micro) CHP or;**
- **heating system based on a renewable energy source (heat pump, etc.) or;**
- **decentralised heating appliances with a total maximum capacity of 15 W/m^2 or;**
- **connected to an efficient heating network;**

and functioning in accordance with the European, Belgian and Flemish regulations.

The communications must pay particular attention to ventilation, airtightness and sun protection.

For the alternate energy performance indicator track, the aim is an energy level equivalent to an energy rating (EPC figure) of 100 kWh/m^2 or E60. Initially, no minimum envelope indicator "S-level" will be established. The S-level will be stated for information purposes.

Knowing that the above long-term objective may not be sufficient to achieve the climate target, it is advisable to encourage the builder by means of communication and incentives to go beyond the above objective.

In order to track the evolution of the housing stock as it moves towards the long-term objective, a government contract was issued for the concrete implementation of the follow-up indicator. In the spring of 2017, Hasselt University will provide a final report with the follow-up indicator.

In order to track the evolution at housing level, a "housing ID" is being developed by a partnership including multiple government actors (FEA, Public Waste Agency of Flanders (OVAM), Flanders Space, the Flemish housing agency Wonen-Vlaanderen, LNE department). The housing ID is conceived as a unique integral digital file for each property, which can be consulted by the homeowner and his authorised representatives. It provides a means of following the evolution of each home towards the long-term goal. The housing ID is a tool that provides the user (owner/buyer/tenant) with insight into all relevant building aspects of his home, including energy aspects, the quality of the home and the evolution towards the long-term goal. The housing ID is a digital vault and personalised guideline for all past and future works. The housing ID is a portal for all building information, including energy. Through time, documents with information about the home can be added to the housing ID. The housing ID forms a single dynamic, modular whole, to which different modules (energy, housing quality, health, etc.) will be added over time.

With the 'Energy' module, the FEA wishes to offer citizens a tool that:

- **provides an overview of the current energy situation (energy performance as-is);**
- **provides an overview of the improvements that can be made (insight into potential and the different steps of the renovation advice);**
- **enables the evolution of the energy performance to be monitored and compared (benchmark);**
- **and supports those involved in this evolution by providing insight into the construction process and reporting on obligations, necessary certificates and obtaining financial compensation through a single central channel.**

The housing ID is being developed over a period of four to six years, but will first be applied in 2018.

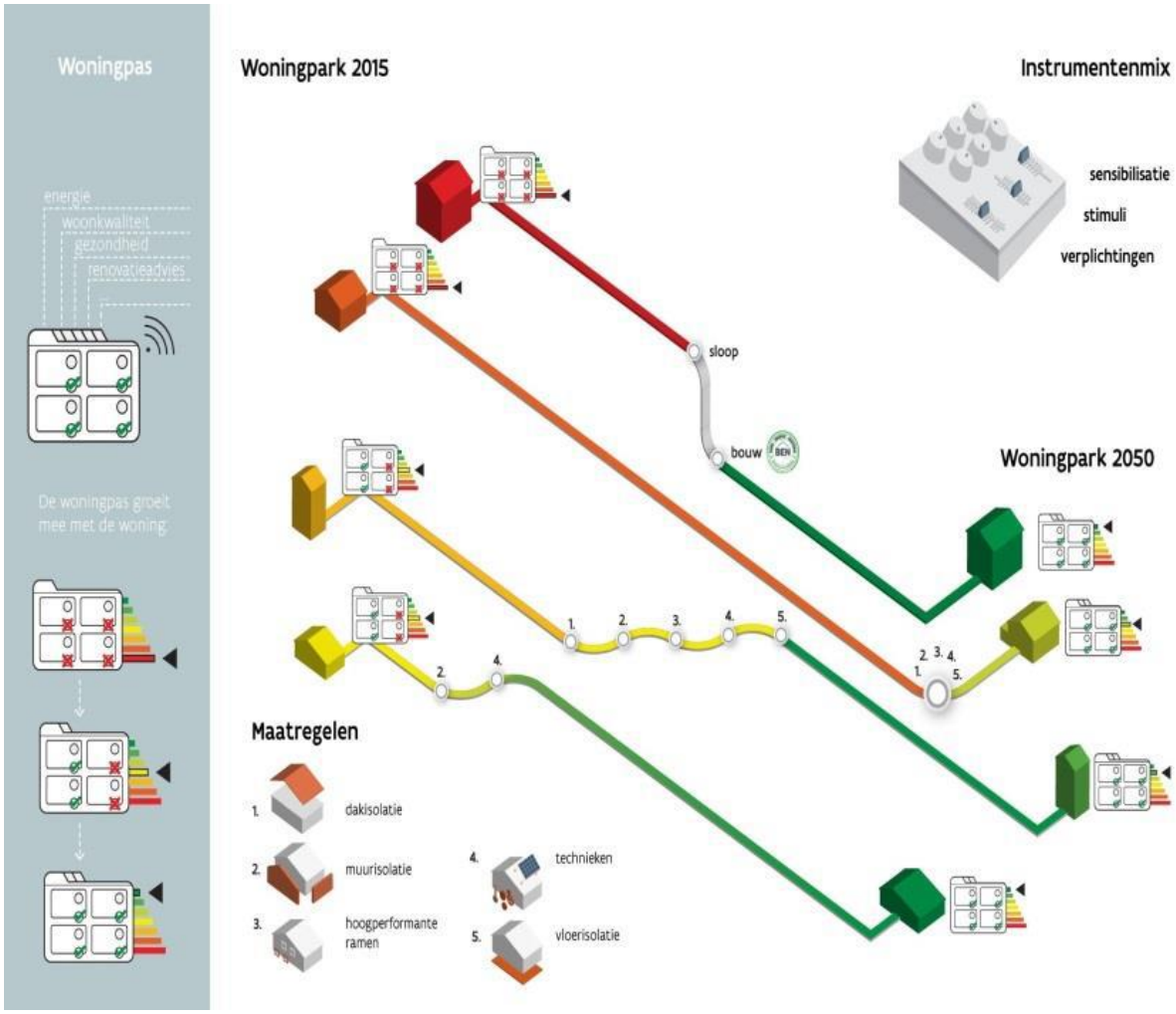
Translation of image	
Source:	Translation:
Woningpas Light	Housing ID Light
Woningpas Medium	Housing ID Medium
Woningpas Full	Housing ID Full
en verder ...	and further ...

The stakeholder consultation strongly emphasised the need for neutral and reliable renovation advice. The renovation advice that has been in development since mid-2016 describes the steps that need to be taken to bring the current energy performance of the home to the level of the long-term target. It also includes recommendations for a number of other major attention points involved in an

extensive renovation (airtightness, ventilation, considering whether demolition and reconstruction are preferable to renovation, etc.).

The EPC+, which is an upgrade of the current EPC, is a basic version of the renovation advice and will be prepared for sales or rentals. The standard recommendations from the current EPC are replaced in the EPC+ by a customised package for the specific home. The package of measures describes the works and the associated standard investment costs needed to renovate the home in accordance with the long-term target for 2050. Through the package of measures, EPC+ informs potential buyers and tenants about the broad strokes of the home's renovation process, moving towards the long-term objective.

The extensive renovation advice is intended for homeowners and provides the homeowner with a concrete roadmap for the long-term objective. The renovation advice gives the homeowner insight into the costs and the various possible renovation stages, thus helping the homeowner to make a well-considered, future-oriented planning of his renovation works. The renovation advice is analogous to EPC+ but goes more in-depth and is tailored to the owner in question.



Translation of image	
Source:	Translation:

Woningpas	Housing ID
energie	energy
woonkwaliteit	housing quality
gezondheid	health
renovatieadvies	renovation advice
De woningpas groeit mee met de woning	The housing ID evolves with the home
Woningpark 2015	Housing stock 2015
Instrumentenmix	Mix of instruments
sensibilitatie	awareness raising
stimuli	stimuli
verplichtingen	obligations
sloop	demolition
bouw	construction
Woningpark 2050	Housing stock 2050
Maatregelen	Measures
dakisolatie	roof insulation
muurisolatie	wall insulation
hoogperformante ramen	high-efficiency windows
technieken	technologies
vloerisolatie	floor insulation

Figure 18 Illustration of Renovation Pact (FEA)

The EPC+/renovation advice will be available in early 2019.

Although the short-term focus will be awareness-raising and support, it cannot be ruled out that imposing requirements will eventually be needed to achieve the long-term objective.

A system has been developed in the context of the Renovation Pact to identify good action examples and publish them on a web page (www.kennisplatform-renovatie.be/goede-praktijken).

With a view to the accelerated implementation of the long-term strategy, in April 2017 a project proposal will be submitted in the context of the LIFE Integrated Projects Climate Action programme by a partnership consisting of, among others, the Flemish and Walloon Region, the Belgian Building Research Institute (BBRI) and several Flemish and Walloon municipalities.

Because the long-term strategy covers all Flemish residences, steps have been taken to raise awareness and provide targeted support to vulnerable target groups so that their homes will eventually meet the long-term objective. In connection with this, the Flemish Government approved an Energy Poverty Programme on 4 March 2016. The paper contains 34 actions both for the protection against disconnection section and for the section concerning efficient energy use toolbox for target groups. In the implementation of the draft paper, processes were initiated to develop, implement and, where applicable, regulate the selected measures together with the implementing actors and report on these measures to the Flemish Government annually. From the beginning of 2017, the mechanism of the existing social roof insulation programmes (high support and integral guidance) will be extended for private rental homes to include cavity wall insulation and the placement of high-efficiency glass.

With a view to realising levers for renovation within other policy areas, an action plan was developed and validated by the Flemish Government on 10 June 2016, which provides solutions for bottlenecks in the area of spatial planning.

For more information on the Renovation Pact, we refer to http://www.energiesparen.be/renovatiepact.

The further development of the Renovation Pact was embedded in the various transition projects launched by the Flemish Government in 2016 and show a political will to work in the long term:

- **Vision 2050: a long-term vision for Flanders (draft paper of 25 March 2016), with the energy transition as one of the seven priorities.**
- **Climate Vision 2050 (Flemish Government draft paper of 22 April 2016), including a buildings working group.**
- **Rapid acceleration of development of energy vision and energy pact (Flemish Government draft paper of 19 February 2016).**

In the context of the Rapid Acceleration process, the energy efficiency working group proposed the following concrete measures for residential buildings:

- **Establish long-term energy performance targets, including clear interim targets for 2030 and 2040. Use transaction moments to match these with obligations.**
- **Quick development of a renovation advice, EPC+ and housing ID. Require renovation advice for obtaining (certain) premiums.**
- **Develop EPA with banks so that banks use the recalculator and in their lending policy, take account of their real energy profit after renovation.**
- **Tightening of the Flemish Housing Code in terms of energy performance (implement a maximum EPC figure or minimum requirement in the area of the envelope for homes with the worst energy performance).**
- **Make full use of Flemish fiscal instruments to encourage renovation, for example:**
  - **Adjust the home bonus to create a building and renovation bonus, where the level of the home bonus is linked to the energy performance of a home or of the energy-efficient investments carried out.**
  - **Expansion of the energy renovation benefit for gifts, so that the benefit is also advantageous for smaller donations.**
  - **Expansion of the renovation discount (the tax base for registration rights is currently reduced by 30,000 euros if the property is renovated within 2 years).**
  - **Reduction of property tax for renovations other than major energy renovations.**
  - **Tax reductions for families implementing energy-efficient investments with a focus on total renovation (tax reduction according to overall energy performance).**

- **Develop a faster procedure in the EPB regulations for recognising new technologies with significant market potential and a proven positive impact on the energy performance of the home.**
- **More strongly encourage conversion following demolition of old homes without heritage value and with poor energy performance based on a demolition assessment framework/rebuilding versus renovation.**
- **Tighter control of efficiency of old central heating systems using fuel oil and natural gas. Enter a replacement requirement for heating systems that do not achieve minimum efficiency.**
- **Scale up local unburdening measures and collective renovation projects that have already proven successful (IOK (waste management), Province of Limburg, Leiedal, etc.). Guide homeowners in the planning and execution of renovation works.**

In the Flemish Parliament, the majority parties and two opposition parties approved a so-called climate resolution in November 2016. In the resolution, parliamentarians ask the Flemish Government to phase out the use of fossil fuels, to create sustainable and near-zero energy-based prosperity, and to better protect the open spaces in Flanders. This resolution is an additional sign that the Flemish political arena wishes to make a transition to a low-carbon society.

4.2. NON-RESIDENTIAL BUILDINGS

Within the framework of the Flemish Energy and Climate Summit of 1 December 2016, strong efforts are being made to take concrete measures in non-residential buildings, especially in government buildings, schools and care institutions. With the long-term goals of 2050 in mind, the Flemish Government wants to draw up a plan of action in consultation with the various stakeholders (through round tables, project Rapid acceleration, etc.). This consultation should serve as a catalyst for developing partnerships and stimulating measures to achieve the goals. By involving the various stakeholders, the aim is to gain more commitment and involvement from stakeholders. See http://www.stroomversnelling.vlaanderen/.

A facilitating framework for ESCOs is being developed specifically for the education and care policy areas. In this way, the institutions are being encouraged to enter into energy performance contracts. In addition to this facilitation framework, pilot projects have also been launched to present the sectors with good examples. One of the services offered by the Flemish Energy Company to semi-public entities or local authorities is precisely the facilitation of these energy performance contracts.

In the context of the Rapid Acceleration process, the energy efficiency working group proposed the following concrete measures for non-residential buildings:

- **Establish long-term energy performance objectives, including clear interim objectives for 2030 and 2040. Use transaction moments to match these with obligations.**

- **Exemplary role of the government: for new construction, only build NZE buildings and set up a renovation process for existing buildings in order to extensively renovate at least 3% of government buildings annually.**
- **Benchmark real energy usage data of tertiary buildings by sector or sub-sector to stimulate demand for energy services.**
- **Introduce a mandatory audit for major tertiary buildings and measures to speed up implementation of identified measures.**
- **Development of a building ID (cf. housing ID for homes). For large non-residential buildings, building IDs must include a long-term planning. For relatively recent smaller non-residential buildings (construction year from 2000), building IDs must include a short-term planning for optimisation of technical installations. Indeed, many technical installations are currently not properly adjusted.**
- **The government must stimulate the ESCO market by dissemination information and implementing successful exemplary projects.**
- **Set up learning networks.**

5. An estimate of the expected energy savings and the benefits in a broader sense based on actual data *(EED Article 4(e))*.

The available estimates of energy savings are included in Table 2 of the action plan.

5.1. RESIDENTIAL BUILDINGS

The emissions of buildings account for about 30% of Flemish non-ETS emissions. The residential sector is responsible for approximately 75% of these emissions. In line with the European climate targets, a reduction of at least 80% of the greenhouse gas emissions is expected by 2050 (compared to 1990). Achieving the long-term target means, on average, a reduction of the EPC figure by 75%, which should lead to a decrease from the current 406 (for single-family homes and apartments) to 100.

5.2. NON-RESIDENTIAL BUILDINGS

The initial saving potential revealed by the Efika study indicates that optimisation and proper adjustment of existing installations already provide significant savings potentials, up to about 10%.

In addition, on the basis of two scenarios, it was estimated which savings could be realised. The first scenario is based on a renovation in the coming years of all buildings constructed prior to 1985 according to the average figures for 2006. This would allow an overall savings of around 20%:

		Verbruik vòòr renovatie	Verbruik na renovatie	Besparing
Andere gemeenschaps-, sociale en persoonlijke ..	Andere gemeenschaps-, sociale en ..	4%	2%	2%
	Total	**4%**	**2%**	**2%**
Gezondheidszorg en maatschappelijke dienstverlening	Gezondheidszog en maatschappelij..	1%	1%	1%
	Instellingen en tehuizen met huisv..	1%	1%	0%
	Ziekenhuizen	3%	2%	1%
	Total	**6%**	**4%**	**2%**
Handel	Detailhandel	7%	4%	3%
	Groothandel	1%	1%	1%
	Handel andere	1%	1%	0%
	Total	**9%**	**5%**	**4%**
Horeca	Drinkgelegenheden	1%	1%	1%
	Eetgelegenheden	5%	3%	2%
	Horeca overige	1%	0%	0%
	Hotels	1%	1%	0%
	Vakantiewoningen	1%	0%	0%
	Total	**9%**	**5%**	**4%**
Kantoren en administraties	Kantoren en administraties	12%	6%	6%
	Total	**12%**	**6%**	**6%**
Onderwijs	Beroeps en technisch onderwijs	0%	0%	0%
	Hoger onderwijs	1%	0%	0%
	Kleuteronderwijs	0%	0%	0%
	Lager onderwijs	1%	1%	0%
	Onderwijs overige	0%	0%	0%
	Secundair onderwijs	0%	0%	0%
	Total	**3%**	**1%**	**1%**
Totaal		**44%**	**24%**	**20%**

Translation of image	
Source:	Translation:
Verbruik vòòr renovatie	Consumption before renovation
Verbruik na renovatie	Consumption after renovation
Besparing	Savings
Andere gemeenschaps-, sociale en persoonlijke ..	Other community, social and personal ..
Andere gemeenschaps-, sociale en ..	Other community, social and ..
Total	Total
Gezondheidszorg en maatschappelijke dienstverlening	Healthcare and social services
Gezondheidszorg en maatschappelij..	Healthcare and social..
Instellingen en tehuizen met huisv..	Institutions and homes with accom..
Ziekenhuizen	Hospitals
Handel	Trade
Detailhandel	Retail
Groothandel	Wholesale
Handel andere	Trade other
Horeca	Catering service provider
Drinkgelegenheden	Beverage serving services
Eetgelegenheden	Food serving services
Horeca overige	Catering other
Hotels	Hotel services
Vakantiewoningen	Holiday homes
Kantoren en administraties	Offices and administrations
Onderwijs	Education
Beroeps en technisch onderwijs	Vocational and technical education
Hoger onderwijs	Higher education services
Kleuteronderwijs	Pre-primary education services
Lager onderwijs	Primary education
Onderwijs overige	Education other

Secundair onderwijs	Secondary education
Totaal	Total

Table 14: Savings potential (scenario 1)

The second scenario is more ambitious and sets the level of renovation on the figure of percentile 25 of each subsector. This would mean a primary energy savings of 36%, and creates the following picture for all subsectors:

		Verbruik vòòr renovatie	Verbruik na renovatie	Besparing
Andere gemeenschaps-, sociale en persoonlijke ..	Andere gemeenschaps-, sociale en ..	6%	3%	4%
	Total	**6%**	**3%**	**4%**
Gezondheidszorg en maatschappelijke dienstverlening	Gezondheidszog en maatschappelij..	2%	1%	1%
	Instellingen en tehuizen met huisv..	2%	1%	1%
	Ziekenhuizen	5%	2%	3%
	Total	**10%**	**4%**	**5%**
Handel	Detailhandel	10%	4%	6%
	Groothandel	2%	1%	1%
	Handel andere	1%	1%	1%
	Total	**13%**	**5%**	**8%**
Horeca	Drinkgelegenheden	2%	1%	1%
	Eetgelegenheden	8%	3%	5%
	Horeca overige	1%	1%	1%
	Hotels	1%	1%	1%
	Vakantiewoningen	1%	0%	1%
	Total	**14%**	**6%**	**8%**
Kantoren en administraties	Kantoren en administraties	16%	7%	9%
	Total	**16%**	**7%**	**9%**
Onderwijs	Beroeps en technisch onderwijs	0%	0%	0%
	Hoger onderwijs	1%	0%	0%
	Kleuteronderwijs	1%	0%	0%
	Lager onderwijs	2%	1%	1%
	Onderwijs overige	1%	0%	0%
	Secundair onderwijs	1%	0%	0%
	Total	**4%**	**2%**	**2%**
Totaal		**63%**	**27%**	**36%**

Translation of image	
Source:	Translation:
Verbruik vòòr renovatie	Consumption before renovation
Verbruik na renovatie	Consumption after renovation
Besparing	Savings
Andere gemeenschaps-, sociale en persoonlijke ..	Other community, social and personal ..
Andere gemeenschaps-, sociale en ..	Other community, social and ..
Total	Total
Gezondheidszorg en maatschappelijke dienstverlening	Healthcare and social services
Gezondheidszorg en maatschappelij..	Healthcare and social..
Instellingen en tehuizen met huisv..	Institutions and homes with accom..
Ziekenhuizen	Hospitals
Handel	Trade
Detailhandel	Retail
Groothandel	Wholesale
Handel andere	Trade other
Horeca	Catering service provider
Drinkgelegenheden	Beverage serving services
Eetgelegenheden	Food serving services

Horeca overige	Catering other
Hotels	Hotel services
Vakantiewoningen	Holiday homes
Kantoren en administraties	Offices and administrations
Onderwijs	Education
Beroeps en technisch onderwijs	Vocation and technical education
Hoger onderwijs	Higher education services
Kleuteronderwijs	Pre-primary education services
Lager onderwijs	Primary education
Onderwijs overige	Education other
Secundair onderwijs	Secondary education
Totaal	Total

Table 15: Savings potential (scenario 2)

5.3. BROADER BENEFITS

Construction, energy and environmental companies already account for approximately 25% of GDP and account for about 13% of the employment in Flanders. This business cluster has the ambition and the potential to form the engine of the Flemish economy.

In a survey on the public importance of renovation projects in the government budget (December 2014), KPMG used a concrete renovation project and investigated which funds flowed back to the government in the form of labour tax, property tax, corporation tax and VAT. About 34% of the total turnover from the project flowed back as government revenue. In addition, the renovated property has a positive impact on energy consumption (and CO2 emissions), as well as a beneficial effect on employment and thus an additional favourable effect for the government through lower unemployment costs.

To investigate the impact of the finalised long-term strategy on the economy and society in more detail, the University of Leuven is conducting research with a focus on the following:

- **The economic return on investments in energy saving measures in all buildings.**
- **Optimisation of (residential) fiscal matters and the existing subsidy policy. Focus on renovation/energy saving, less so on property acquisition.**
- **Macroeconomic consequences of the renovation stimulus, including the impact on employment in the construction sector.**

The study will be completed in the course of 2017.

The implementation of the long-term strategy for the renovation of buildings is also connected with the following social benefits:

- **Better cooperation between different Flemish Government policy areas.**
- **Trigger for innovation in the construction sector.**
- **Development of new business models in the implementation of renovation works.**
- **Mobilisation of dormant savings.**

- **Social inclusion and poverty reduction, provided that the homes of vulnerable families are also extensively renovated.**