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Impact on house prices of an energy renovation obligation for homebuyers[†]

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Abstract

This article analyses the impact of the Flemish energy renovation obligation on house prices. This policy, introduced in January 2023, obliges buyers of the most energy-inefficient homes to renovate within five years from purchasing the property in order to obtain at least a class D energy performance certificate (EPC). Applying a difference-in-differences technique and leveraging a unique dataset that merges sales data for all Belgian dwelling transactions with datasets on energy performance certificates, asbestos certificates and online real estate listings, we find that energy-inefficient houses in the Flemish Region became about 2% cheaper. This result holds true across multiple control groups: similar houses in the Walloon Region, houses with a class D energy certificate in Flanders, and a triple difference estimation comparing the price differential between EPC classes across both regions. The reasons for this relatively limited effect of the energy renovation obligation are, first, that a majority of buyers of energy-inefficient houses were already renovating their properties to at least a class D EPC prior to its introduction and, second, that the renovation cost was already largely factored into house prices beforehand. The slight increase in the price discount for energy-inefficient homes as a result of the renovation obligation creates some financial leeway for buyers to carry out an energy renovation. However, for those who were not planning to renovate, the renovation obligation results in a large compulsory investment, which could hamper the accessibility of homeownership for potential buyers without sufficient repayment capacity. As Flanders is the only region in the world to have introduced an energy renovation obligation for homebuyers, our findings may be of interest to the many other countries that are considering a similar policy.

Keywords: Climate policy, Energy efficiency, Energy performance certificates, Energy policy, House prices, Minimum energy performance standards

JEL classification: Q48, Q58, R31, R32, R38.

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Introduction

Enhancing the energy efficiency of homes is crucial to meet energy efficiency and climate neutrality objectives. In this article, we analyse the impact of the Flemish energy renovation obligation on house prices. Introduced in January 2023, the policy obliges buyers of the most energy-inefficient homes, i.e. those with a class E or F energy performance certificate (EPC), to renovate within five years from purchasing the property in order to obtain at least a class D level. This measure aligns with the European Union's Energy Performance of Buildings Directive (EPBD), which sets energy efficiency targets for the residential building stock of EU member states to be achieved by 2030 and 2035, prioritising renovation of the worst-performing dwellings and establishing minimum energy performance standards as a key potential lever (EC, 2024). The Flemish renovation obligation for homebuyers is an example of such minimum energy performance standards and is the first of its kind worldwide (OECD, 2024), making this study the first empirical evaluation of the impact of this type of measure.

We constructed a unique dataset by merging sales data for all Belgian residential real estate transactions with datasets on energy performance certificates (EPC), asbestos certificates and online real estate listings. This allows us to compare price developments between houses sold in the Flemish and Walloon Regions, the two main regions of Belgium. In addition, our dataset allows us to account for an extensive set of dwelling characteristics, including the energy score, the main heating source, the age of the property, the type of dwelling, the reported building condition, the size of the dwelling, the location and several other characteristics.

We use a difference-in-differences approach to estimate the impact of the Flemish renovation obligation on house prices. This method compares price developments for Flemish houses with a class E or F EPC (the treatment group) to those for similar houses sold in a comparable economic environment but not subject to the requirement (the control group), thereby allowing us to isolate the effect of the policy from other price determinants. We implement three specifications, each with a different control group. First, we use Flemish houses with a class D EPC – just above the renovation obligation threshold – as a control group. Second, we compare Flemish houses with a class E or F EPC to houses with a class E or F EPC in the Walloon Region, where the economic context is comparable but where there is no renovation obligation. Third, we estimate a triple difference (DDD) model to compare the change in the price difference between houses with a class E or F EPC and those with a class C or D EPC in both regions, thereby strengthening identification by controlling for common trends in the EPC-related price differential in both regions and for region-specific house price developments.

We find that the introduction of the Flemish renovation obligation led to a modest decline in the prices of houses with a class E or F EPC. Specifically, energy-inefficient properties became approximately 2% less expensive as a result of the policy change. This effect is consistently observed across all three difference-in-difference specifications and confirmed by multiple robustness checks. For an average house with a class E or F EPC in the year prior to the policy change, the estimated price effect corresponds to approximately €5,800. The price effect did not manifest itself immediately but rather accumulated gradually throughout 2023 and remained broadly stable over the first three quarters of 2024. It should be noted that this price effect comes on top of an already substantial pre-existing price discount for energy-inefficient homes compared to more efficient ones. Finally, our comparison with the Walloon Region suggests that the Flemish energy renovation obligation has not pushed up the prices of houses with better energy scores, as similar price increases were observed in both regions.

We uncovered two reasons for the limited effect of the Flemish energy renovation obligation on the prices of houses with a class E or F EPC. First, an analysis of houses sold twice reveals that a majority of buyers of houses with a class E or F EPC were already renovating their properties to at least a class D EPC prior to the introduction of the renovation obligation. As the overall quality of these houses is often

poor, renovation works – including energy efficiency improvements – are typically carried out. The renovation obligation therefore does not have much impact on these buyers. Second, the price discount for these houses was already substantial prior to introduction of the energy renovation obligation, with the cost of an energy renovation largely factored into the price. Estimating quality-adjusted house prices for each EPC class and region, we find that the energy score has been an important determinant of house prices for many years and that, prior to the policy's introduction, the price discount between the least energy-efficient houses and those with a class D EPC reflected already, to a large extent, the average cost of an energy renovation to a class D EPC.

This article is structured as follows. Section 1 discusses the Flemish renovation obligation as well as broader energy efficiency objectives in the two main regions of Belgium as well as in the EU. Section 2 presents the data. Section 3 examines the effect of the Flemish energy renovation obligation on house prices, while Section 4 explores the underlying factors driving this effect. Finally, Section 5 discusses the policy implications and Section 6 lays out our conclusion.

1. Flemish energy renovation obligation: context and policy framework

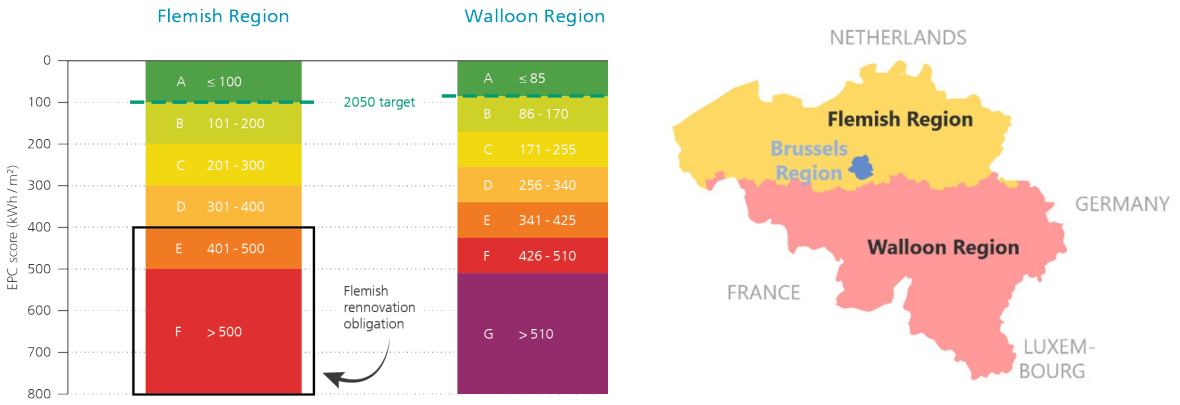
Heating accounts for a substantial portion of household energy consumption and greenhouse gas emissions in Belgium and the EU. In 2022, residential buildings represented 19.7% of total energy consumption in Belgium, with 71.3% of this amount attributable to heating and 14.2% to hot water (FPS Economy, 2024). The share of Belgian emissions from residential heating is 12.6% (Klimaat.be, 2024), which is higher than in the EU, partly due to the fact that Belgian homes are, on average, larger and older compared to the EU average (Eurostat, 2019, 2025).

Making homes energy-efficient and decarbonised is therefore an important part of the Belgian and EU 2050 energy efficiency and climate neutrality objectives. The Flemish and Walloon Regions have set the objective of achieving an energy-efficient housing stock by 2050, with an average energy score of 100 kWh/m^2 for Flanders and 85 kWh/m^2 for Wallonia. The recently revised Energy Performance of Buildings Directive (EPBD) requires EU member states to submit their draft National Building Renovation Plan by the end of 2025 and their final plan by 31 December 2026, outlining a trajectory to ensure that their residential and non-residential building stock becomes highly energy-efficient and decarbonised by 2050 (EC, 2024). In the medium term, the trajectory should substantially reduce the average primary energy demand of homes (i.e. by 16% by 2030 and by 20–22% by 2035), with at least 55% of this decrease derived from renovation of the worst-performing dwellings. Member states have the flexibility to decide which tools they wish to use to achieve these renovation targets, with minimum energy performance standards for existing dwellings – such as the Flemish energy renovation obligation – potentially serving as a key policy lever.

The energy efficiency of homes in the EU is documented by their energy performance certificate (EPC). This document is required when selling or renting a home and is prepared by a certified energy expert based on documentary evidence and visual inspection. The score indicates the theoretical amount of primary energy used by the building for heating and hot water over a year, expressed in kWh/m^2, and depends on the insulation of walls, the roof, floors, windows and doors, as well as on the heating installation, the existence of solar panels and characteristics such as the type of building (detached, semi-detached, terraced or apartment). While the energy score (in kWh/m^2) is calculated using very similar methodologies in the Flemish and Walloon Regions, the grouping of scores for energy class purposes varies greatly from region to region and results in different scales (see Figure 1). For the sake of comparability, we apply the Flemish EPC classification to all regions. This means, for instance, that class G houses in Wallonia are reclassified into class F in our analysis.

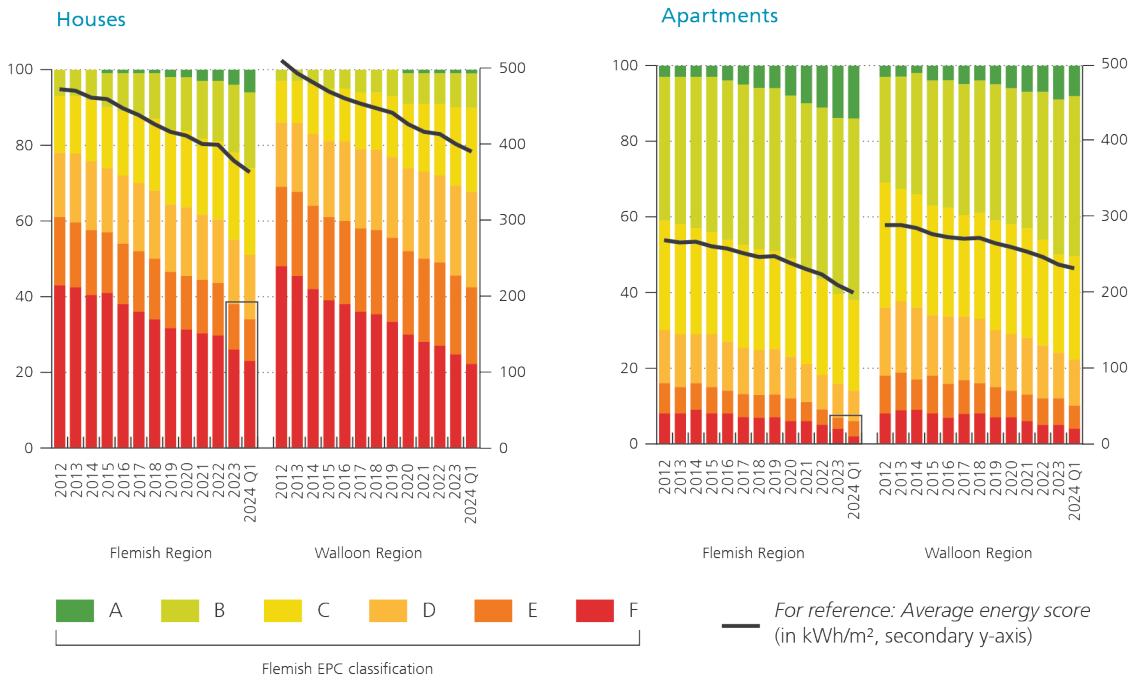
Grouping of energy scores by energy class and regional map of Belgium

Figure 1



Distribution of sold houses and apartments by EPC class[1]
(as a %)

Figure 2



[1] The share of dwellings subject to the Flemish renovation obligation is marked with a black rectangle.

In 2023, the Flemish Region introduced a renovation obligation for homebuyers, obliging purchasers of the most energy-inefficient homes, meaning those with a class E or F EPC, to renovate their dwelling within five years from purchasing the property so as to achieve at least a class D EPC (i.e. an energy score of maximum 400 kWh/m²). This first renovation obligation for homebuyers in the world – implemented with strong credibility and enforcement features (see Section 4) – has made Flanders a pioneering case internationally. At the same time, the EPC class D minimum target remains far from the long-term regional objectives for the building stock, and its adequacy has been debated in the public and policy arena, with views differing on ambition relative to longer-term goals versus feasibility and affordability for homebuyers.

This Flemish renovation obligation mainly affects single-family houses, as the prevalence of class E or F EPCs is much lower for apartments owing to the presence of fewer exterior walls compared to detached houses. Figure 2 shows the distribution of EPC classes and the average energy score for houses and apartments sold in different years and regions. It should be noted that Figure 2 is based on sold dwellings for which an EPC is observed at the time of transaction – the policy relevant population for a transaction triggered obligation – and that the resulting EPC distribution differs from that of the overall housing stock. In the period between 2023 and Q1 2024, about 35% of houses and 7% of apartments sold in the Flemish Region had a class E or F EPC and were thus subject to the renovation obligation. This amounts to 23,124 houses and 2,059 apartments. Finally, a limited number of households seem to have brought forward the purchase or sale of their dwelling with a class E or F EPC to the last quarter of 2022 so as to escape the renovation obligation. Indeed, the share of sold houses with a class E or F EPC jumped from 41% in the third quarter of 2022 to 47% in the last quarter of 2022 before falling to 37% in the first quarter of 2023 and then rising slightly to 39% in the second quarter of 2023.

Finally, Figure 2 also shows that the energy performance of sold dwellings has improved markedly over the past decade, but remains far from meeting the 2050 targets. In Flanders, the share of houses with an E or F EPC fell from 61% in 2012 to 34% in early 2024, while class A rose from virtually zero to 5.6%; for apartments, the share of dwellings with an E or F EPC declined from 16% to 6%, and class A increased from 3% to 14%. A similar improvement was observed in the Walloon Region, although average energy efficiency remains poorer than in Flanders. This improvement in energy efficiency in both regions reflects two main drivers: (i) a growing share of dwellings sold on the secondary market that were built under increasingly stringent new-build energy efficiency standards and (ii) energy renovations of existing homes (see also Section 4.1). In addition, the drop in the share of dwellings with an E or F EPC since 2023 in the Flemish Region is partly also due to the acceleration of sales involving E or F-rated dwellings in late 2022 (see previous paragraph) and possibly the postponement of some household moves to avoid the renovation obligation.

2. Data

We constructed our dataset by combining the universe of residential real estate transactions in Belgium with data on energy performance certificates, asbestos certificates and online real estate listings. Our dataset covers all dwellings sold in Belgium from 2006 to the third quarter of 2024, but our analysis focuses mainly on the period since 2016, for which all data sources (except asbestos certificates) are available.

The dwelling transactions database compiled by the Federal Public Service Finance (FPS Finance) records all sales of homes in Belgium, excluding new builds. It includes the sales price, the date of the notarial deed, the type of transaction (e.g., private sale, public sale or inheritance), a unique parcel identifier, and various dwelling characteristics such as the type of dwelling, the surface area, the age of the building, the number of years since the last officially recorded renovation, and the size of the garden. EPC data were obtained from the regional energy agencies, VEKA (Flemish Region) and SPW Énergie (Walloon Region). They include the energy score of the home, energy efficiency characteristics and the main heating source. We also incorporated asbestos certificate data from the Flemish Public Waste Agency (OVAM). An asbestos certificate has been required for homes sold in the Flemish Region since 23 November 2022. Finally, we used the property listings dataset compiled by Realo, which includes listings data from multiple online platforms and realtors, and thoroughly cleaned the data, to eliminate duplicate listings. This dataset contains, for each property, the initial asking price, the initial listing date and dwelling characteristics such as the energy score, main heating source and the reported building condition.

We merged the EPC, asbestos certificate and online listings databases with the transactions database using the address and the unique identifier (cadastral parcel key) of the property in Belgium. We linked each transaction to the most recent asbestos certificate and EPC prior to the date of sale, complemented by the energy score from the listings database for the small number of dwellings for which EPC matching was not possible. This approach allows excellent matching for houses (with the exception of a small number without a location identifier) but not for apartments as the postal box number for an apartment is defined differently across databases due to the lack of an official system for box numbers in Belgium. As a result, an apartment in the transactions database is often incorrectly associated with the EPC of another unit in the same building, which results in inaccurate matching at unit level given the wide range of energy scores within an apartment building depending on the location of the flat within the building.

We focus our analysis on single-family houses sold in the Flemish and Walloon Regions for several reasons. First and foremost, it is not possible to accurately retrieve the energy score of sold apartments from the available databases (see above). Second, the limited number of apartments with a class E or F EPC (see Section 1) results in a very small sample size. Third, while energy scores vary widely within an apartment building depending on the location of the flat within the building, all owners contribute to the energy renovation of common areas, which include outer walls, the roof, floors and the central heating system. Finally, we excluded the Brussels-Capital Region given the small sample size and the fact that apartments dominate its housing market.

We cleaned the data in several steps. We started with the set of all houses sold on the secondary market in the Flemish and Walloon Regions. This yielded a sample of around 483 000 and 243 000 houses, respectively, for the period from 2016 to Q3 2024. After removing public sales (about 3% in both regions) and transactions that could not be matched with an energy score (about 8% in the Flemish Region and 14% in the Walloon Region), we removed outliers, i.e. observations for which one of the characteristics was above the 99.95th percentile or below the 0.05th percentile and with studentised residuals beyond the range of [-2, 2], following Eurostat's guidelines for outlier removal (Eurostat, 2017). This sample, which is close to the universe of houses sold on the secondary market for the period up to Q1 2024, serves as the basis for our analysis in Figure 2 and Section 4.1. For the difference-in-differences and hedonic regression analyses in Sections 3 and 4.2, we performed several additional steps. We removed transactions that could not be matched with a listing (about 38% in the Flemish Region and 50% in the Walloon Region), as the listings dataset contains the important reported building condition characteristic. We also dropped observations from the transactions dataset with missing values for important dwelling characteristics. We ended up with a sample of around 252 000 and 87 000 houses for the Flemish and Walloon Regions, respectively. In our main analysis, we treat listings for which the building condition variable is missing as a separate category, but provide a robustness analysis in which we exclude these observations. Finally, we perform a robustness analysis for the larger sample, which includes observations that could not be matched with a listing.

3. Impact of the Flemish energy renovation obligation on house prices

This section analyses the impact of the introduction of the Flemish energy renovation obligation on house prices using three separate difference-in-differences specifications. Each specification compares the trend in the prices of Flemish houses with a class E or F EPC (the treatment group) – subject to the renovation obligation as from 2023 – with that of similar houses sold in a comparable economic environment but not subject to this requirement (the control group). This comparison allows us to isolate the impact of the renovation obligation from other house price determinants, so that we can attribute differences in price

trends to the renovation obligation. Each of the three analyses is based on a different specification with a distinct control group, allowing us to test the robustness of the estimated price effect.

In our first specification, we use houses sold in the Flemish Region with a class D EPC as our control group. The main advantage of this specification is that both the control and treatment groups are in the same region, allowing any developments specific to the Flemish housing market and economic environment to be differenced out. However, the price divergence between houses with a class E or F EPC and those with a class D EPC observed since 2023 may not be solely due to the Flemish renovation obligation. It may also partly reflect the increased importance of energy scores in housing markets more broadly – a trend we observe in both the Flemish and Walloon Regions, despite the absence of a renovation obligation in the latter – and which is likely driven by common factors such as higher and more uncertain heating bills since the European energy crisis (see Section 4.2). In addition, this specification does not reveal whether the price difference between Flemish houses with a class E or F EPC and those with a class D EPC is driven solely by a decline in the value of the former or also by an increase in the value of the latter. This upward price effect could result from a shift in demand for houses with a class E or F EPC to more energy-efficient homes, which, coupled with unchanged supply, would lead to a price increase for the latter group. We therefore interpret Specification 1 cautiously and complement it with the cross-region specification and the triple-difference specification.

In our second specification, we use a control group composed of houses with a class E or F EPC sold in the Walloon Region. The advantage of this specification is that it includes houses with exactly the same energy efficiency classes as in the Flemish treatment group, implying that they have been similarly affected by the growing importance of energy scores since 2023. In addition, although the Walloon Region is a distinct housing market with relatively limited interregional mobility due to linguistic and cultural differences and its own region-specific dynamics, developments in most key house price determinants are very similar to those observed in the Flemish Region. First, given that all major Belgian banks operate at the national level and set their credit policies accordingly, financing conditions and mortgage rates have evolved in a largely uniform way in the Flemish and Walloon Regions. Second, household income in both regions has grown at a similar pace due to the country's system of automatic wage indexation and interregional economic linkages, commuting flows and fiscal transfers via the federal government and social security. Third, demographic developments and the number of dwellings per household have evolved in a comparable way in both regions. Fourth, while house prices in the Flemish and Walloon Regions were affected differently by several region-specific changes in fiscal housing policy, the impact of these changes is taken into account in our model. Finally, another advantage of the second specification is that it can analyse the impact of the Flemish renovation obligation on the prices of houses with a class E or F EPC and on houses with a better EPC class separately. For the latter analysis, we use treatment and control groups composed of houses with a class C or D EPC sold in the Flemish and Walloon Regions and perform the same analysis for properties with class A or B EPC.

Our third specification integrates the two preceding specifications by estimating a triple difference (DDD) model, following the framework introduced by Gruber (1994) and formalised by Olden and Møen (2022). This specification compares the evolution of the price difference between dwellings with a class E or F EPC and those with class C or D EPC across the Flemish and Walloon Regions. While common trends in this EPC-related price difference in both regions are likely driven by shared factors – such as the European energy crisis – a more pronounced divergence in Flanders from 2023 onwards can plausibly be attributed to the introduction of the Flemish renovation obligation. Compared to the first specification, the DDD model thus offers a more robust identification strategy to estimate the impact of the Flemish renovation obligation, by controlling for common time-varying factors that have increased the importance of energy scores in both regions. Compared to the second specification, it accounts for region-specific developments, such as changes in fiscal housing policy, that may have affected housing prices in Flanders and Wallonia differently.

Table 1 presents the estimated price impact of the Flemish energy renovation obligation on the treatment group, based on the difference-in-differences analyses. Our findings for the entire post-treatment period indicate that Flemish houses with a class E or F EPC became approximately 1.1% cheaper on average due to the renovation obligation. The price decline of Flemish houses with a class E or F EPC is slightly more pronounced when compared to Flemish houses with a class D EPC (-1.4%) than when compared to Walloon houses with a class E or F EPC (-0.9%) or to the estimate from our triple-difference models (-1.1%). However, this first specification may overstate the policy's effect, as it does not fully account for the broader increase in the importance of energy scores in housing markets since 2023 (see above). All these negative effects are statistically significant across model specifications.

The price effect of the Flemish renovation obligation was, however, not immediate. Instead, our quarterly estimates show that the price effect accumulated gradually throughout 2023, stabilising at around -2% as from the fourth quarter of 2023. For an average house with a class E or F EPC in the year prior to the policy change, this estimated price effect corresponds to approximately €5,800. It should be noted that this price effect comes on top of an already substantial pre-existing price discount for energy-inefficient homes compared to more efficient ones (see Section 4.2). This magnitude is comparable to the findings of Ferentinos, Gibberd, and Guin (2023), who report that the introduction of a minimum energy performance standard for rental properties in England and Wales reduced the prices of the least efficient homes by £5,000–£9,000.

Finally, we find no evidence that the renovation obligation has pushed up the prices of Flemish houses with better EPC classes. Specifically, our comparison of Flemish houses with a class C or D EPC, as well as those with a class A or B EPC to the corresponding Walloon control group suggests that these segments were not substantially impacted by the policy. The estimated coefficients are close to zero and statistically insignificant, indicating that the renovation obligation had no measurable effect on the prices of houses with relatively good energy performance.

Estimated price effect of the Flemish renovation obligation for each difference-in-differences specification[1]

(as a %) Table 1

	1. Flemish Region	2. Flemish Region vs Walloon Region			3. Triple difference Flemish Region vs Walloon Region	
	E+F vs D	E+F	C+D	A+B	E+F vs C+D	E+F vs D
Entire period	-0.014***	-0.009**	0.000	-0.006	-0.011***	-0.011**
Q1 2023	0.010	-0.006	-0.009	-0.020	0.003	-0.004
Q2 2023	-0.010	-0.000	0.006	-0.026**	-0.007	-0.004
Q3 2023	-0.008	-0.001	0.006	-0.007	-0.009	-0.019*
Q4 2023	-0.023***	-0.013*	0.003	0.010	-0.019**	-0.014
Q1 2024	-0.018***	0.005	-0.007	-0.018	0.011	0.013
Q2 2024	-0.023***	-0.015**	0.009	0.013	-0.025***	-0.027**
Q3 2024	-0.029***	-0.035***	-0.007	-0.006	-0.030***	-0.018
Observations	154,403		338,807		219,414	288,373
R-squared	0.790		0.851		0.823	0.838

[1] The table shows the estimated coefficients of the difference-in-difference model, measuring the price impact of the energy renovation obligation on the treatment group for each difference-in-differences analysis. The first row reports the effect over the entire post-treatment period. Quarterly results are estimated using per-quarter variants of the model. The statistical significance of the coefficients is denoted by * (p<0.1), ** (p<0.05) and *** (p<0.01).

4. Potential mechanisms behind the price effect

This section discusses potential mechanisms behind the estimated price effect of the Flemish renovation obligation. We assess that, in general, the impact on house prices of an energy renovation obligation for homebuyers is closely linked to three factors, which can vary across countries and contexts: (i) the policy's credibility and enforcement mechanisms, (ii) whether the minimum energy performance standard is achieved by a large number of homebuyers even in the absence of the obligation, and (iii) the extent to which the renovation cost was already factored into house prices prior to the policy change. The first factor influences the extent to which households and banks take the policy into account in projected future renovation costs. The second factor reflects the binding nature of the energy renovation obligation, which depends on the typical renovation activity of buyers, the overall condition of the housing stock, and the stringency and scope of the renovation obligation – namely, the minimum EPC class to be achieved and the EPC classes subject to the obligation. The third factor determines the degree to which the EPC-related price discount of houses subject to the obligation should increase to reflect the cost of the mandatory energy renovation. Indeed, if homebuyers are required to improve their homes' energy performance, we expect buyers and banks to incorporate the full cost of complying with the obligation into their offers and mortgage conditions.

First, the strong credibility of and enforcement mechanisms for the Flemish renovation obligation explain why the policy has negatively affected the prices of houses with a class E or F EPC. Buyers are well aware that the obligation applies to them and is transferred to the next owner in case of resale, which reinforces its credibility and relevance at the time of purchase. Extensive press coverage has focused on both the obligation itself and the potential administrative fine of up to €200,000 for non-compliance. Moreover, by law, property advertisements must mention any renovation requirement, thereby ensuring transparency for prospective buyers. Banks provide further information to buyers on the renovation obligation during mortgage origination and factor the renovation cost into their credit assessments.

The relatively modest 2% impact of the Flemish renovation obligation on the prices of houses with a class E or F EPC could be attributed to the two other factors. First, the analysis of houses sold twice in Section 4.1 reveals that a majority of buyers of houses with a class E or F EPC were already renovating their properties to at least a class D EPC prior to the introduction of the renovation obligation. As the overall quality of these houses is often poor, renovation works – including energy efficiency improvements – are typically carried out regardless of an obligation and this behaviour is further encouraged by energy-efficiency policies such as mandatory energy efficiency disclosure for sales and rental dwellings, subsidies and renovation coaching (including one stop shops). The renovation obligation therefore does not have much effect on these buyers. Second, as Section 4.2 shows, the price discount for these houses was already substantial before the introduction of the renovation obligation, and the renovation cost appears to have been largely factored into the price.

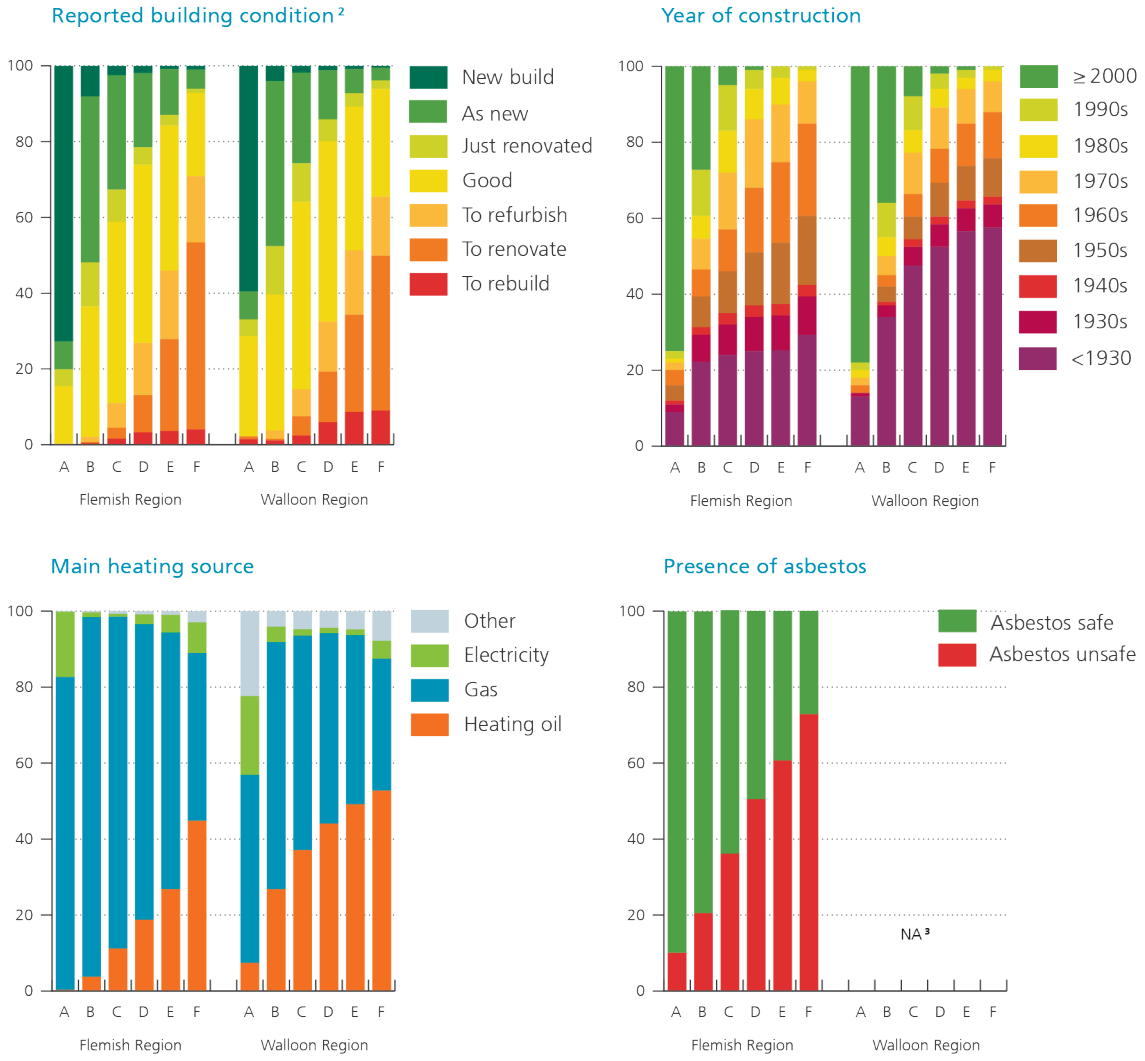
4.1. Pre-obligation energy renovation activity in Flanders

This section discusses energy renovation activity and dwelling characteristics for sold homes with a class E or F EPC and that were not yet subject to the Flemish renovation obligation. We limit our analysis to the period up to Q1 2024, for which our sample comes close to the universe of homes sold on the secondary market (see Section 2).

We first find that the overall quality and comfort of houses with a class E or F EPC is much worse than that of more energy-efficient houses. Figure 3 indeed shows that many houses with a class E or F EPC are in poor condition, old, considered unsafe due to the presence of asbestos and heated with oil.

Quality characteristics of houses sold in 2023 – Q1 2024 per EPC class[1]
(as a %)

Figure 3



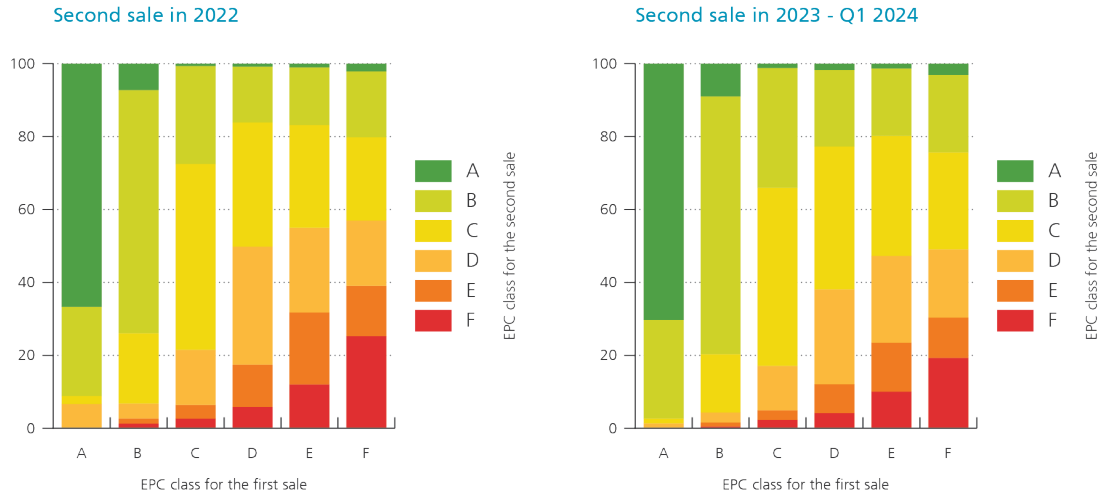
[1] The charts are based on a subsample that excludes observations with a missing value for the displayed variables.
[2] The reported building condition is a subjective assessment of the property by the seller included in the online listing. It should be noted that the share of houses to be rebuilt is underestimated, as most of these dwellings are advertised as a building plot and thus not included in the dataset of sold dwellings.
[3] There is no information on the presence of asbestos for houses in the Walloon Region.

Many buyers of houses with a class E or F EPC undertake renovations to improve energy efficiency and building quality, even without a formal energy renovation obligation. This behaviour is primarily driven by the poor energy performance and overall condition of these houses (see previous paragraph) and is further encouraged by policies such as the EPC certification and mandatory energy efficiency disclosure for sales and rental dwellings (providing energy performance details), renovation coaching (including one-stop shops), subsidies, and insulation and double-glazing standards. Figure 4 illustrates the change in EPC class for the approximately 26,000 Flemish houses that were sold twice, for the first time in the

period 2009–2019 and again in 2022 or 2023–Q1 2024, with at least a five-year interval between sales.[1] For second sales in 2022, we find that 60% of houses initially rated E or F improved to class D or better.[2] Although the timing of upgrades is unknown and some may reflect pre-sale renovations, most appear to be post-purchase. This interpretation is supported by findings in the literature that many buyers of energy-inefficient homes carry out an energy renovation relatively shortly after purchase (see following paragraph). Moreover, additional results (available upon request) show that EPC improvements for houses initially rated E or F often go hand in hand with upgrades in overall building condition, indicating that energy and non-energy renovations are typically integrated into a comprehensive renovation strategy. Finally, although the renovation obligation did not apply to sellers, pre-sale upgrades appear to have gained importance during 2023 and early 2024, as the share of houses initially rated EPC class E or F that improved to class D or better increased to 70%. This increase is likely partly driven by introduction of the Flemish renovation obligation and the increased impact of EPC ratings on house prices (see Section 4.2). However, it may also partly reflect EPC misreporting (see Appendix), and strategic timing of transactions, particularly the acceleration of sales involving E- or F-rated dwellings in late 2022 (see Section 1) as well as the possible postponement of some household moves to avoid the renovation obligation.

Change in the EPC class for Flemish houses sold twice[1]

(EPC distribution for the second sale, broken down by EPC for the first sale, as a %) Figure 4



[1] The charts illustrate the change in EPC class for Flemish houses with multiple recorded sales in the dataset, with at least a five-year interval between them. In particular, they show the distribution of EPC classes for the second sale (as a percentage) broken down by energy class for the first sale (x-axis). The left-hand chart displays houses for which the second sale occurred in 2022, while the right-hand chart depicts those sold for the second time in the period 2023 – Q1 2024. For a small share of repeat sales, the EPC class was lower at the second sale than at the first, likely due to home depreciation, variability among EPC certifiers, or changes in the EPC calculation software.

1 We could accurately analyse the change in energy efficiency only for Flemish houses sold for the second time since 2022. For this group alone, the EPC for the first sale could not be reused for the second sale, meaning the energy score had to be recalculated when the property was resold. Indeed, since January 2022, anyone selling a house in the Flemish Region must, by law, produce an EPC prepared as from 2019. In contrast, for repeat sales in the Flemish Region prior to 2022 and in the Walloon Region, a new EPC was often not produced for the second sale and the initial EPC from the first sale was used, even if renovations had taken place, hence resulting in underestimation of the actual change in energy efficiency.

2 It should be noted that we could only analyse the post-sale change in EPC class for the subset of houses sold twice, and renovation activity may differ for the full set of all sales. We acknowledge that repeat-sales analysis may involve some selection bias, as it covers homes resold within five to sixteen years, although a five-year minimum holding period was applied to limit short-term flips. In addition, the analysis excludes repeat sales of new builds following demolition and reconstruction works, for which data are unavailable and which inclusion would have increased the share of improved EPC ratings.

Our finding that many buyers of energy-inefficient homes carry out an energy renovation relatively shortly after purchase is in line with earlier evidence. First, according to the results of a large-scale housing survey in the Flemish Region, 50% of owner-occupiers made energy-saving improvements between 2002 and 2012, with a higher percentage for homes in poorer condition (Van den Broeck, 2019). The survey also revealed that major renovations are often at least partially completed by the buyer before they move in. Second, a more recent survey of Belgian homeowners conducted between 2018 and 2022 found that young households, which are the most frequent buyers of existing dwellings, are also more likely to perform an energy renovation. Specifically, 36% of homeowners aged 25 to 39 had carried out an energy renovation in the year prior to their participation in the survey, compared with 25% of those aged 40-54 and 20% of those aged 55-74 (Gepts et al., 2025). Furthermore, young homeowners tend to conduct more extensive energy renovations than older homeowners and are more likely to combine energy-efficiency improvements with structural and other renovation works. Finally, our findings on energy renovation activity align with Clara et al. (2026), who observed high renovation activity on the part of both homeowners and landlords for energy-inefficient homes in England and Wales and a further increase in such activity by the latter group as a result of the introduction of minimum energy performance standards for rented residential properties.

4.2. Capitalisation of energy renovation costs into house prices

In order to analyse the capitalisation of energy renovation costs into house prices, this section provides estimated quality-adjusted house prices for each EPC class and region, calculated as the estimated price for a house with average dwelling characteristics.[3] Since the quality-adjusted price for each EPC class is calculated for a house with the same characteristics (with the exception of the energy class), the predicted price difference between classes can be interpreted as the estimated added value of an energy class improvement, while price changes over time can be viewed as the actual change in price of an identical dwelling. However, caution is warranted for several reasons: the estimates are subject to estimation uncertainty; the price differences could still partly reflect differences in characteristics related to quality and comfort that are not controlled for in the dataset; and, finally, the price effect can be dwelling specific.

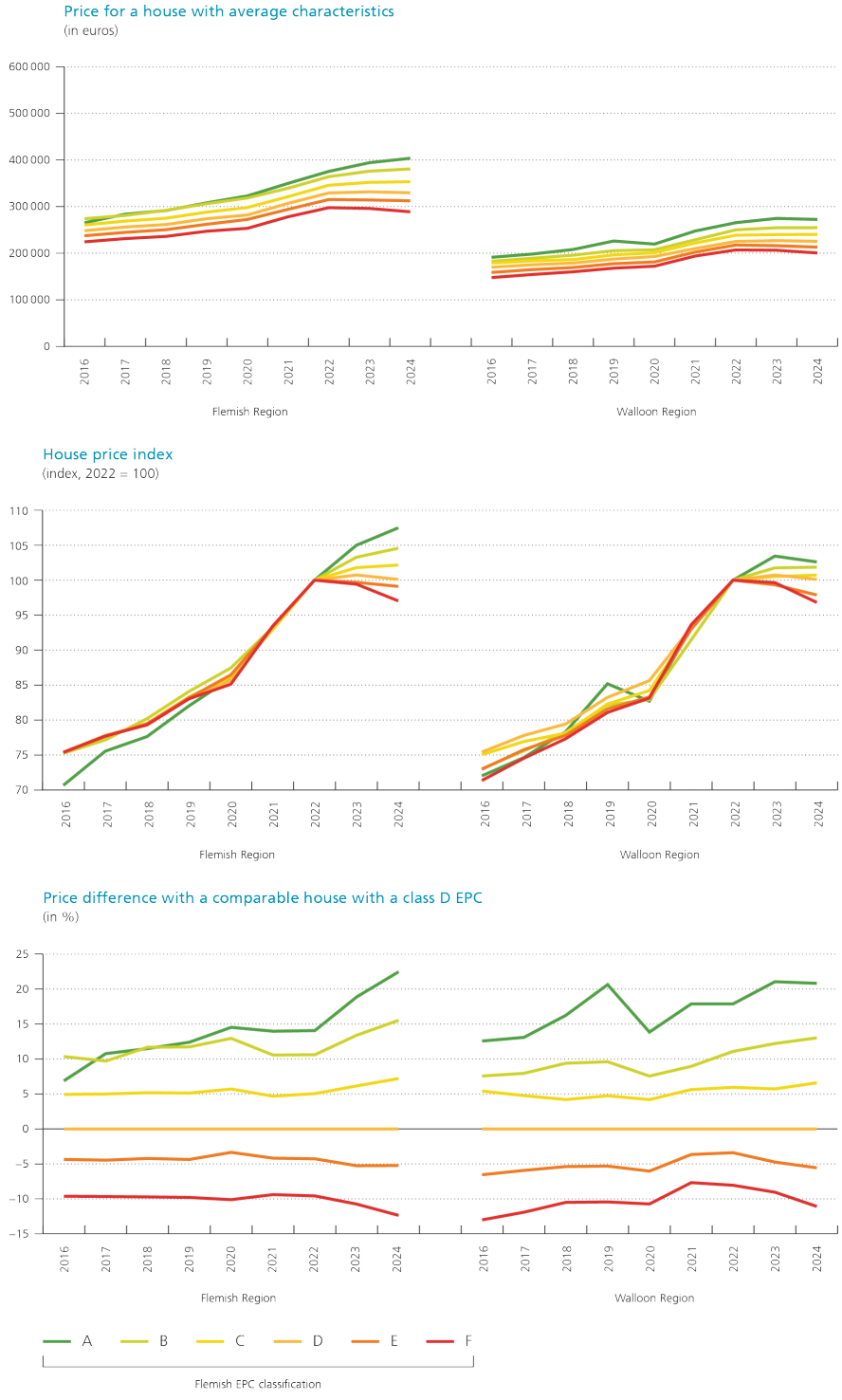
Figure 5 shows the quality-adjusted price (in euros) per EPC class for a house with average dwelling characteristics (top graph), as well as the corresponding price index (using 2022 as the reference year) (middle graph) and the relative price difference (in %) with a comparable house with a class D EPC (bottom graph).

First, our results show that the price discount for houses with a class E or F EPC was already large prior to introduction of the renovation obligation and that the renovation cost appears to have been largely factored into the price. In 2022, the price discount relative to a comparable house with a class D EPC was around 10% for houses with a class F EPC in the Flemish Region, which corresponds to a price difference of around €31 500 for an average Flemish house (see Figure 5, top graph). While accurate estimates of the cost of an energy renovation are lacking, an analysis of a small sample of invoices from recent Flemish energy renovations indicates that the price discount appears to reflect to a large extent the average cost of an energy renovation to a class D EPC. However, it should be noted that the renovation cost can vary widely depending on the dwelling's characteristics, regional and contractor-specific factors, and the technologies and materials used. Costs also depend on whether the energy renovation forms part of a broader refurbishment undertaken for structural or comfort-related reasons, whether the owner performs the work themselves, whether the renovation is part of a collective project, whether subsidies

[3] Unlike average house prices, quality-adjusted prices account for differences in property characteristics. For instance, energy-efficient houses are on average more expensive not only due to their greater energy efficiency but also because they tend to be newer and in better condition.

are taken into account and whether additional expenses are included, such as interior finishing, housing-specific adaptations, waste management and asbestos removal.

Quality-adjusted price per EPC class for a house with average characteristics
(in euros (top graph), as an index (middle graph) and relative price difference (bottom graph)) Figure 5



[1] Estimated for a house with dwelling characteristics equal to the regional average for 2016–2024.

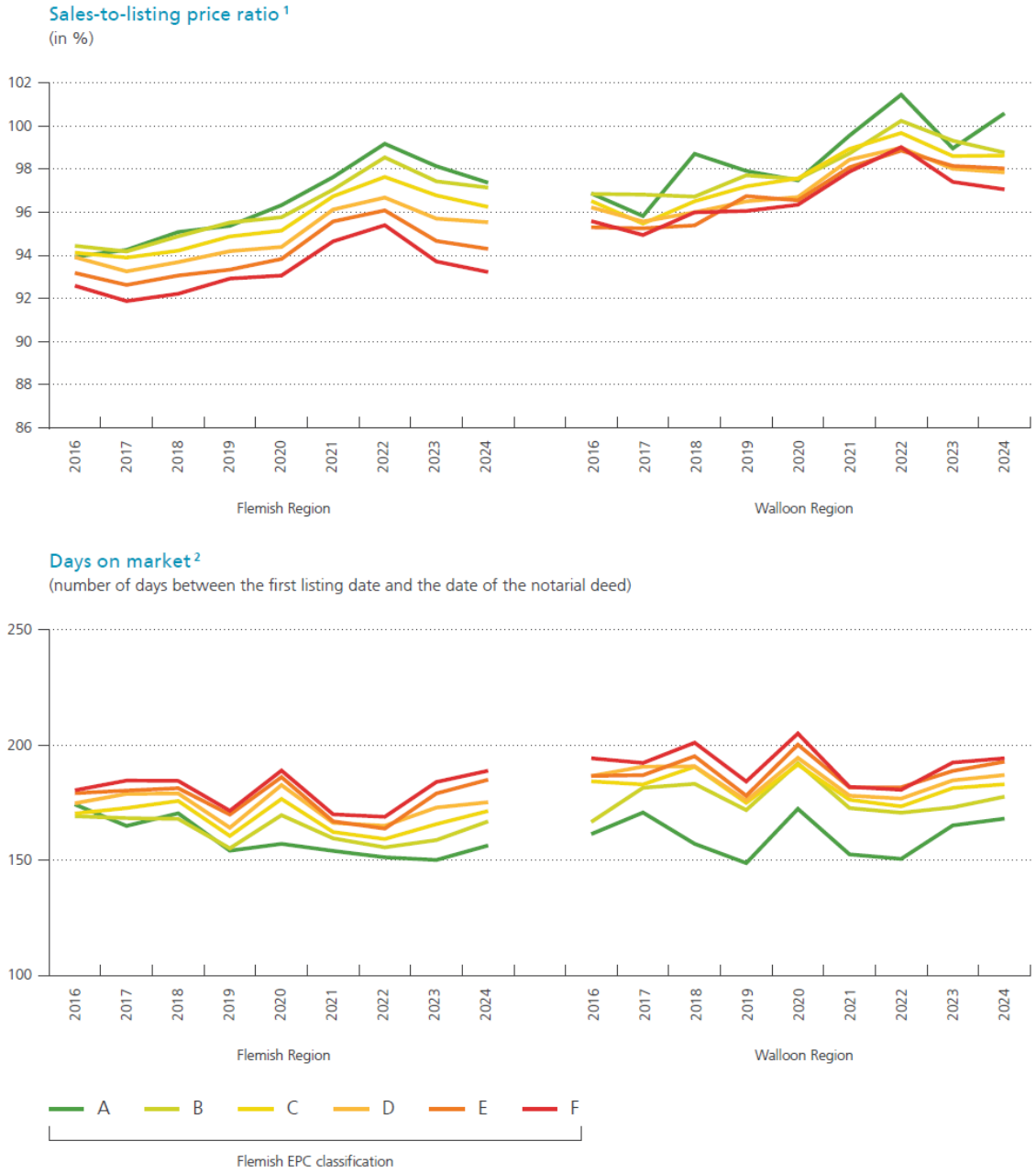
Second, while the energy score has long been an important determinant of house prices, its influence increased markedly in 2023 and the first three quarters of 2024 in the Flemish and Walloon Regions (see Figure 5, bottom graph). From 2016 to 2022, the estimated price premium for houses with a class A, B or C EPC, compared to those with a class D EPC, and the price discount for those with a class E or F EPC remained relatively stable at a sizeable level. On average, these premia and discounts amounted to, respectively, 13%, 11%, 5%, –4% and –10% in the Flemish Region and 16%, 9%, 5%, –5% and –10% in the Walloon Region. EPC-related price differences widened substantially in 2023 and in the first three quarters of 2024. Relative to the 2016–2022 average, the estimated price premium for houses with a class A EPC increased by 9.6 percentage points in the Flemish Region and by 4.8 percentage points in the Walloon Region. The increase in the price premium amounted to 4.4 and 4.1 percentage points for houses with a class B EPC (for the Flemish and Walloon Regions, respectively), 2.1 and 1.6 percentage points for those with a class C EPC, –1.1 and –0.4 percentage points for those with a class E EPC, and –2.7 and –0.7 percentage points for those with a class F EPC. The finding that the price discount for houses with a class E or F EPC increased by around one to two percentage points more in the Flemish Region than in the Walloon Region is in line with the results of our difference-in-differences analysis on the impact of the Flemish energy renovation obligation (see Section 3). The substantial widening of EPC-related price differences has resulted in strongly divergent house price index developments since 2023 (see Figure 5, middle graph). While prices in 2023 and 2024 were at the same level as in 2022 for houses with a class D EPC, they increased for those with a class C EPC, rose even more for those with a class A or B EPC and decreased for those with a class E or F EPC.

This divergence in price developments between EPCs observed since 2023 in the two regions is likely due to the fact that buyers and banks are increasingly taking the energy score into account in their purchase decisions and mortgage conditions. This shift can be attributed to several factors, including the introduction of the Flemish energy renovation obligation (see Section 3), the announcement of increasingly stringent energy renovation requirements in the two regions in the coming years, and higher and more uncertain heating bills since the European energy crisis. Other reasons include the announced future carbon price for heating fuels set by EU ETS2 as from 2027 and a sharp rise in the cost of labour and, especially, building materials, which has made energy renovations more expensive. Furthermore, regulatory developments have also played a role: the EU's Corporate Sustainability Reporting Directive (CSRD) and the EBA's Pillar 3 ESG disclosure requirements, both introduced in 2023, require banks to report on climate-related risks, financed emissions and the energy efficiency of real estate collateral, creating strong incentives for banks to integrate energy performance considerations into their lending and mortgage policies. This has been facilitated by improved data availability, with the share of new mortgage loans for which energy scores are recorded increasing from 39% in 2021 to 67% in 2022, 79% in 2023, and 82% in the first half of 2024 (NBB, 2024a). In practice, many banks now offer preferential mortgage rates for energy-efficient dwellings and incorporate anticipated renovation costs into credit assessments.

Finally, we find that, since 2023, the days on market and sales-to-listing price ratio have also diverged between EPC classes. Figure 6 shows the sales-to-listing price ratio and the days on market for a house with average dwelling characteristics, per EPC class and per region. Together with price data, these liquidity indicators are highly relevant for assessing the impact of climate transition policies on financial stability (ECB/ESRB, 2022; ECB/ESRB, 2023; Foerster et al., 2025). As can be seen, the sales-to-listing price is substantially lower for energy-intensive houses for the entire sample period, especially in the Flemish Region. In addition, the sales-to-listing price ratio is impacted by the housing cycle, with higher values in booming markets due to bidding wars in 2021 and 2022 and lower values since 2023 as a result of mortgage rate hikes and a general cooldown of the housing market. It has decreased more since 2023 for Flemish houses with a class E or F EPC, likely as a result of the energy renovation obligation. The latter two findings are also evidenced by the days on market indicator, which has increased since 2023, especially for Flemish houses with a class E or F EPC.

Sales-to-listing price ratio (top graph) and days on market (bottom graph) per EPC class for a house with average characteristics

Figure 6



[1] The sales-to-listing price ratio is the ratio between the final sales price and the initial listing price.

[2] The term "days on market" as used in this article refers to the period from the first listing date to the date of the notarial deed. This period also includes the time of, on average, about three months between signature of the preliminary sales agreement and the notarial instrument recording the sale.

5. Policy implications

To meet Belgian and EU 2050 energy efficiency and climate neutrality objectives, the vast majority of existing Belgian homes will need to undergo an energy renovation by 2050. This ambitious endeavour will require massive investment and face considerable challenges on both the demand and supply sides (NBB, 2024b). Deep energy renovations require substantial outlays, which many households are unable to finance, for example because they already have an existing loan to service. In addition, as energy-efficiency renovations are labour-intensive, a large increase in the demand for such renovations could be significantly hampered by labour shortages in the construction sector, which could exert upward pressure on prices and lead to higher renovation costs.

We argue that energy renovation obligations for homebuyers, such as the Flemish renovation obligation studied in this paper, can alleviate these challenges and accelerate renovations through four main mechanisms. First, they create financial leeway for buyers to carry out an energy renovation on newly purchased homes. Indeed, as set out in Sections 3 and 4, an energy renovation obligation for homebuyers lowers the prices of energy-inefficient homes, as buyers and banks incorporate the cost of complying with the obligation into their offers and credit assessments. Second, banks are well positioned to inform homebuyers about renovation requirements, as they are typically involved shortly before the sale and maintain a close financial relationship with their clients. This could enable buyers to better anticipate energy renovations, both in terms of cost and planning, and to integrate them into their purchase decisions. Third, a mandatory energy renovation for homebuyers implies that the renovation will take place relatively shortly after purchase of the property, which is a key renovation trigger point. Many buyers of energy-inefficient homes indeed undertake comprehensive upgrades to enhance both the overall quality and energy efficiency of their property, often soon after purchasing and before moving in (see also Section 4.1). Incorporating additional energy-efficiency improvements into a planned renovation can be more practical and cost-effective. For instance, installing floor insulation is more economical when it forms part of a necessary floor replacement and less disruptive when done before occupancy. Fourth, renovation obligations for homebuyers allow renovation deadlines to be spaced out over time based on the transaction date, unlike minimum energy performance standards which impose a uniform deadline on all homes. This phased approach can help alleviate the strain on labour supply in the construction sector.

However, an energy renovation obligation for homebuyers also has redistributive implications. The increase in the price discount of energy-intensive homes as a result of the renovation obligation implies a negative impact on the wealth of their owners. In addition, while it creates some financial leeway for buyers to carry out an energy renovation, the renovation obligation is still a large compulsory investment, on top of the purchase price, for those who were not planning to renovate. This could hamper the accessibility of homeownership for potential buyers without sufficient repayment capacity. This challenge is particularly relevant for lower income buyers, who often live in less energy-efficient homes for affordability reasons and are less likely to undertake renovation works compared to higher-income buyers (Van den Broeck, 2019). For these groups, complementary instruments – such as targeted subsidies, low interest renovation loans, or guarantee schemes – could be considered to help mitigate financing barriers, alongside supply-side policies that expand housing supply and improve housing affordability more generally.

A broader concern – related to minimum energy performance standards in general and the growing emphasis on energy classes – is the increased likelihood of deliberate misreporting of energy scores. In the Appendix, we show substantial bunching of energy scores just below the energy class thresholds in both the Flemish and Walloon Regions, which has strongly increased since 2023, especially for energy scores close to the Flemish renovation obligation threshold. We attribute this phenomenon partly to misreporting, as supported by Lu and Spaenjers (2025) for France. It should however be noted

that bunching primarily concerns energy scores just below the energy class threshold values, which make up a small percentage of total energy performance certificates. Still, while we did not investigate the existence of more generalised EPC misreporting, it seems clear that the growing importance of the energy score for homebuyers, banks and policymakers has increased the risk of misreporting. In particular, an increase in misreporting could be expected based on Goodhart's law, which states that when a particular measure becomes a (policy) target, it will become less effective as people start to game the system to meet the target.

Finally, renovation obligations for homebuyers are insufficient on their own to reach the 2050 climate and energy efficiency objectives. First, the minimum standard required under transaction triggered obligations – such as the EPC class D target in the Flemish case – may remain far below long term regional objectives for the building stock, implying that even dwellings covered by the obligation are not required to reach the long run target level. Second, many dwellings will not be subject to the obligation in the near term, which means that relying solely on transaction-triggered obligations would take many decades to achieve full coverage. Coverage will also expand unevenly across space, growing faster in high turnover market segments and areas than in low-turnover ones. Moreover, the policy may incentivise some households to postpone moving in order to avoid the obligation, potentially reducing household mobility and delaying energy-efficiency investments. Taken together, these considerations underscore the need for complementary measures beyond the transacted segment of the housing stock to accelerate renovations and ensure progress toward 2050 climate goals.

6. Conclusion

This article analyses the impact of the Flemish energy renovation obligation, introduced in January 2023, on house prices. This policy obliges buyers of the most energy-inefficient Flemish homes, i.e. those with a class E or F EPC, to renovate within five years from purchasing the property in order to obtain at least a class D EPC.

We find that the Flemish renovation obligation has had a modest negative impact on the prices of houses with a class E or F EPC. Energy-inefficient houses in the Flemish Region became about 2% cheaper relative to both similar houses in the Walloon Region and to those with a class D EPC in the Flemish Region. This result is consistent across multiple specifications, including a triple difference specification that compares price differentials between EPC classes across both regions. For an average house with a class E or F EPC in the year prior to the policy change, the estimated price effect corresponds to approximately €5,800. The price effect did not materialise immediately following the policy's introduction but instead accumulated gradually over the course of 2023 and remained broadly stable through the first three quarters of 2024.

The reasons for this relatively limited effect of the energy renovation obligation are, first, that a majority of buyers of houses with a class E or F EPC were already renovating their properties to at least a class D EPC prior to its introduction and, second, that the renovation cost was already largely factored into house prices beforehand. More generally, we assess that the impact on house prices of an energy renovation obligation for homebuyers is closely linked to three factors: (i) the credibility and enforcement mechanisms of the policy, (ii) whether the minimum energy performance standard is achieved by a large number of homebuyers even in the absence of the obligation, and (iii) the extent to which the cost of an energy renovation was already factored into house prices prior to the policy change. These factors can vary across countries and depend on the typical renovation activity of buyers, the overall condition of the housing stock, and the stringency and scope of the renovation obligation – namely, the minimum EPC class to be achieved and the EPC classes subject to the obligation.

Our finding that the Flemish energy renovation obligation has slightly lowered the prices of energy-inefficient houses has redistributive implications. First, it implies a modest negative impact on the wealth of the owners of energy-intensive houses. Second, the higher price discount creates a small amount of financial leeway for buyers to carry out an energy renovation, somewhat alleviating the financial burden of the energy and climate transition. However, for those who were not planning to renovate, the renovation obligation results in a large upfront compulsory investment, on top of the purchase price. This could hamper the accessibility of homeownership for potential buyers without sufficient repayment capacity.

Finally, as Flanders is the only region in the world to have introduced an energy renovation obligation for homebuyers, our findings may be of interest to the many other countries that are considering a similar policy. In particular, they are relevant for other EU member states, given that the recently revised Energy Performance of Buildings Directive sets energy efficiency targets for residential building stock to be met by 2030, with a focus on renovation of the worst-performing residential dwellings and the use of minimum energy performance standards as a key potential lever.

Bibliography

Civel, E., Creti, A., Fack, G., & Herrera-Araujo, D. (2025). Certification, manipulation and competition: Evidence from energy performance certificates (CEPR Discussion Paper No. DP19992). Centre for Economic Policy Research.

Clara, N., Cocco, J. F., Lakshmi Naaraayanan, S., & Sharma, V. (2026). Investments that make our homes greener: The role of regulation. Journal of Financial Economics, 177, 104236.

EC (2024), Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast).

ECB/ESRB. (2022). The macroprudential challenge of climate change. European Systemic Risk Board and European Central Bank, July 2022.

ECB/ESRB. (2023). Towards macroprudential frameworks for managing climate risk. European Systemic Risk Board and European Central Bank, December 2023.

Eurostat (2017), *Technical Manual on Owner-Occupied Housing and House Price Indices*, Eurostat.

Eurostat. (2019). *Average size of dwelling by household type and degree of urbanisation* [Data set]. Eurostat. https://doi.org/10.2908/ilc_hcmh02

Eurostat. (2025). *Conventional dwellings by occupancy status, period of construction and NUTS 3 region* [Data set]. Eurostat. https://doi.org/10.2908/CENS_21DWOP_R3

Ferentinos, K., Gibberd, A., & Guin, B. (2023). Stranded houses? The price effect of a minimum energy efficiency standard. Energy Economics. 120, 106555.

Foerster, K., Ryan, E. & Scheid, B. (2025). Pricing or panicking? Commercial real estate markets and climate change. ECB Working Paper Series No. 3059.

FPS Economy (2024), *Belgian energy data overview*, Summer 2024.

Gepts, B., E. Nuyts, G. Verbeeck (2025), "Where is the potential for deep (energy) renovations? A large-scale study of the renovation activities of Belgian households between 2018 and 2022", Energy & Buildings, 328, 1-9.

Gruber, J. (1994). The Incidence of Mandated Maternity Benefits. *The American Economic Review*, *84*(3), 622–641.

Klimaat.be (2024), https://klimaat.be/in-belgie/klimaat-en-uitstoot/uitstoot-van-broeikasgassen/uitstoot-per-sector.

Lu, X. & Spaenjers, C. (2025). Energy labels, misreporting, and heuristic hedonic models. Real Estate Economics, 1–23.

NBB (2024a), *Financial stability report 2024*, May 2024, 1-160, National Bank of Belgium.

NBB (2024b) Report 2023 - Economic and financial developments. Box 5: The importance of decarbonising residential heating, 181-183, National Bank of Belgium.

OECD (2024), *Global Monitoring of Policies for Decarbonising Buildings: A Multi-level Approach*, OECD Urban Studies, 1-106.

Olden, A. and Møen, J. (2022) The triple difference estimator, The Econometrics Journal 25, 531–553

Sejas-Portillo, R., Moro, M., Stowasser, T. (2025), "The simpler the better? Threshold effects of energy labels on property prices and energy-efficiency investments", *American Economic Journal: Applied Economics*.

Van den Broeck, K. (2019*), Drempels voor renovatie aan de vraagzijde*, Leuven, Steunpunt Wonen.

Appendix: Bunching of energy scores below the EPC class thresholds

In this section, we analyse the impact of the Flemish renovation obligation on the bunching of energy scores just below the energy class threshold values. Figure 7 shows the share of each EPC score interval with a width of 5 kWh/m^2 as a percentage of the total number of EPCs for houses sold in the Flemish and Walloon Regions. Like Lu and Spaenjers (2025), we limited our analysis to houses for which only one EPC was available prior to the sale so as to isolate bunching that is likely the result of misreporting. We excluded properties with more than one EPC because, for such properties, the homeowner may have carried out renovation works after having obtained a first EPC in order to move the property's energy score just to the left of the energy class threshold.[4]

We measure bunching by comparing the prevalence of the energy score interval just below the energy class threshold with that just above, which should be about equal in the absence of bunching. It should be noted, however, that a drop in the prevalence of energy scores just above the energy class threshold could in part also be the result of homes not being put up for sale or not being sold after having received an EPC on the wrong side of the threshold.

We observe a strong increase in bunching in the Flemish Region since 2023 and a comparable yet more moderate rise in the Walloon Region. First, given that the Flemish EPC classes were only introduced in 2019, there was no bunching at energy class thresholds in the period 2016–2018. The introduction of the EPC classes led to a small amount of bunching in the period 2019–2021 and in 2022, with 30 to 40% more houses sold with energy score intervals just below the threshold value than just above. Bunching increased strongly in the period 2023–Q1 2024, with energy score intervals just below the threshold two to almost four times more prevalent than those above the threshold. This was most noticeable at the Flemish renovation obligation threshold, between class D and E EPCs. As the EPC was introduced earlier in the Walloon Region, bunching was already present there during the period 2016-2018 and remained constant in 2019–2021 and 2022, with the prevalence of energy score intervals just below the threshold values being about 50% higher. Bunching also increased in the period 2023–Q1 2024, but to a lesser extent than in the Flemish Region.

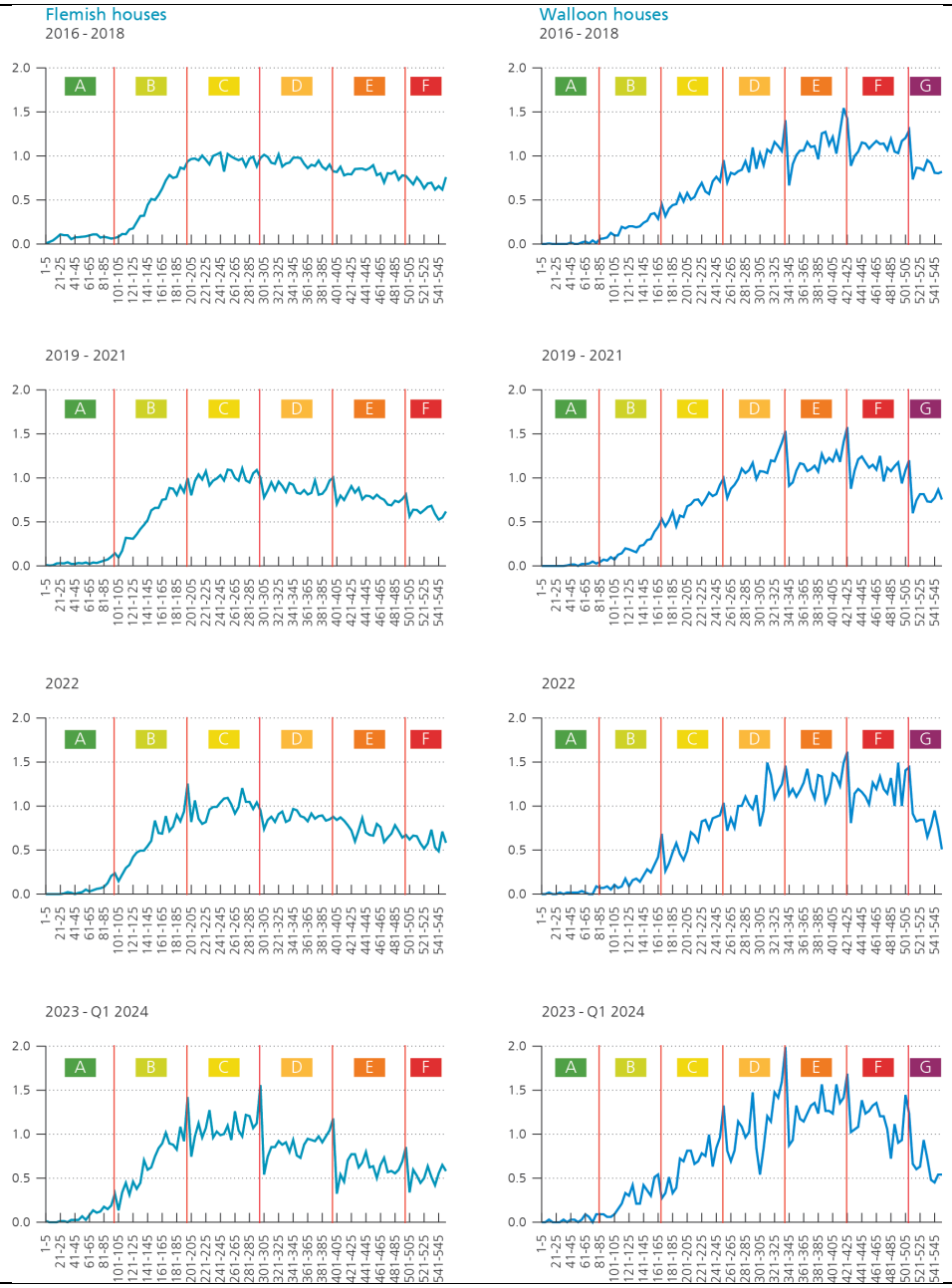
The increase in bunching observed since 2023 can most likely be attributed to the heightened importance of the EPC due to the introduction of the Flemish renovation obligation, the announcement of future renovation requirements in the two regions (see Section 1) and the increased salience of EPC scores in buyer decision-making, mortgage conditions, and broader market dynamics (see Section 4.2).

As we limited our analysis of bunching to houses for which only one EPC was available prior to the sale, this phenomenon likely results in part from misreporting. While bunching could also be the result of genuine renovation works (desirable from a climate-policy perspective) undertaken specifically to move the dwelling just across an energy-class threshold, this is not likely to be the main case for owners without prior knowledge of their property's energy score. However, we cannot rule out last-minute energy efficiency improvements stemming from an initial energy score estimate that was not documented in the EPC database, and Section 4.1 presents some evidence that pre-sale upgrades have become slightly more common since 2023. In addition, the bunching at the threshold between class D and E EPCs in 2023–Q1 2024 may also partly reflect the strategic timing of transactions, particularly the acceleration of sales involving class E or F dwellings in late 2022 (see Section 1) as well as the possible postponement of some household moves to avoid the renovation obligation. While disentangling the relative importance of these

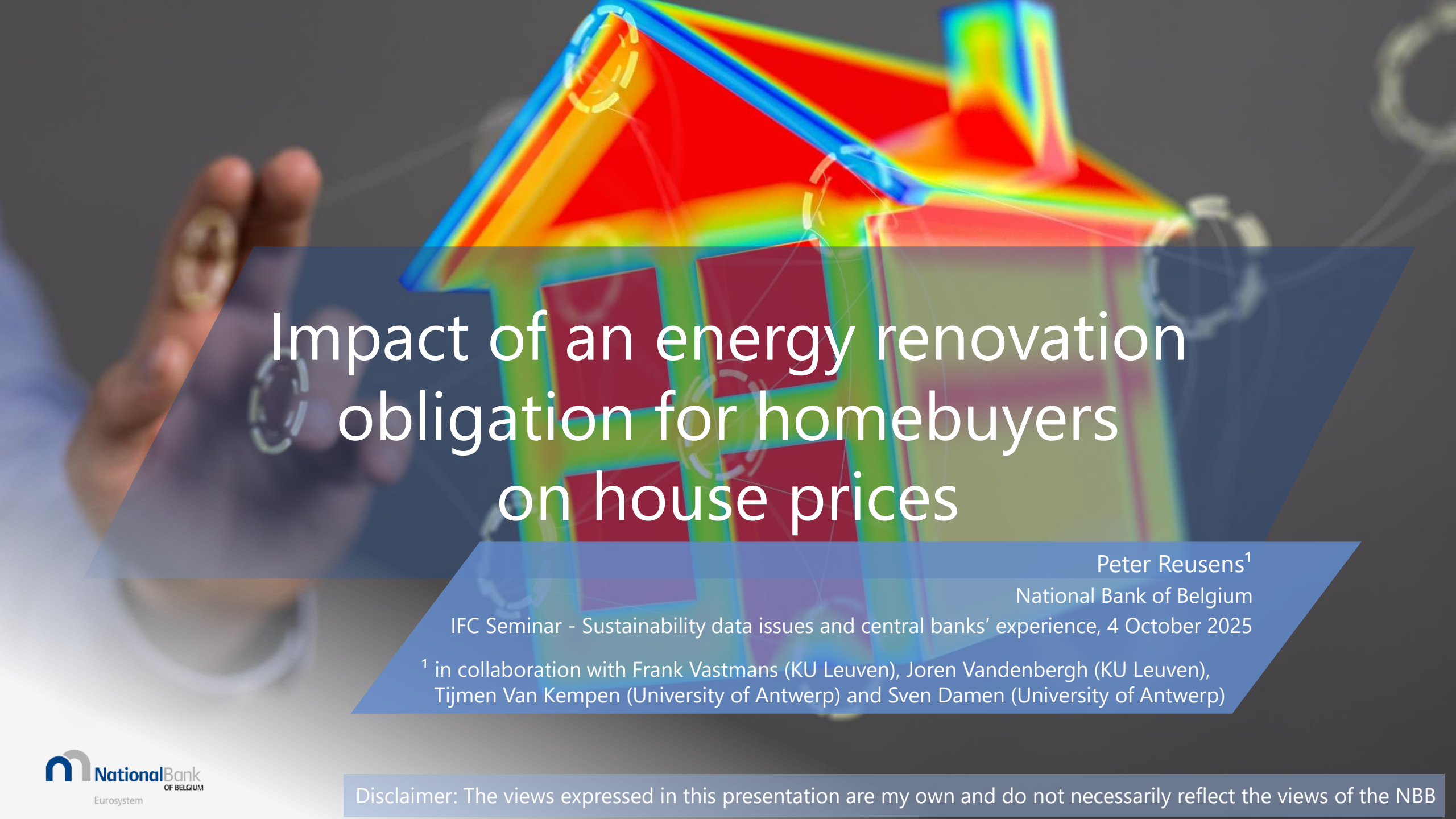
[4] Analysing properties in England and Wales for which more than one EPC had been requested before a sale, Sejas-Portillo, Moro and Stowasser (2025) found that sellers whose properties received an energy score just on the wrong side of the energy class threshold were more likely to improve their rating, which they attributed to last-minute energy efficiency improvements prior to listing the property.

reasons for bunching empirically is not possible with our dataset, our assessment that misreporting plays a role aligns with Lu and Spaenjers (2025) and Civel et al. (2025). Both studies document significant bunching in France and attribute it to misreporting, supported by evidence such as persistent assessor-specific tendencies, software-related variations, deliberate underreporting of dwelling size, and a higher prevalence of bunching in competitive certifier markets.

Prevalence of each energy score interval for houses sold, by EPC issuance year[1]
(as a percentage of the number of houses sold for which only one EPC was available prior to the sale) Figure 7



[1] The vertical lines indicate the energy class thresholds in the Flemish and Walloon Regions, based on the respective energy class definitions from Figure 1. The horizontal axis shows the energy scores, which are grouped in intervals of 5 kWh/m². We omitted very large energy scores (above 550 kWh/m²) from the graphs for the sake of readability.



Impact of an energy renovation obligation for homebuyers on house prices

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IFC Seminar - Sustainability data issues and central banks' experience, 4 October 2025

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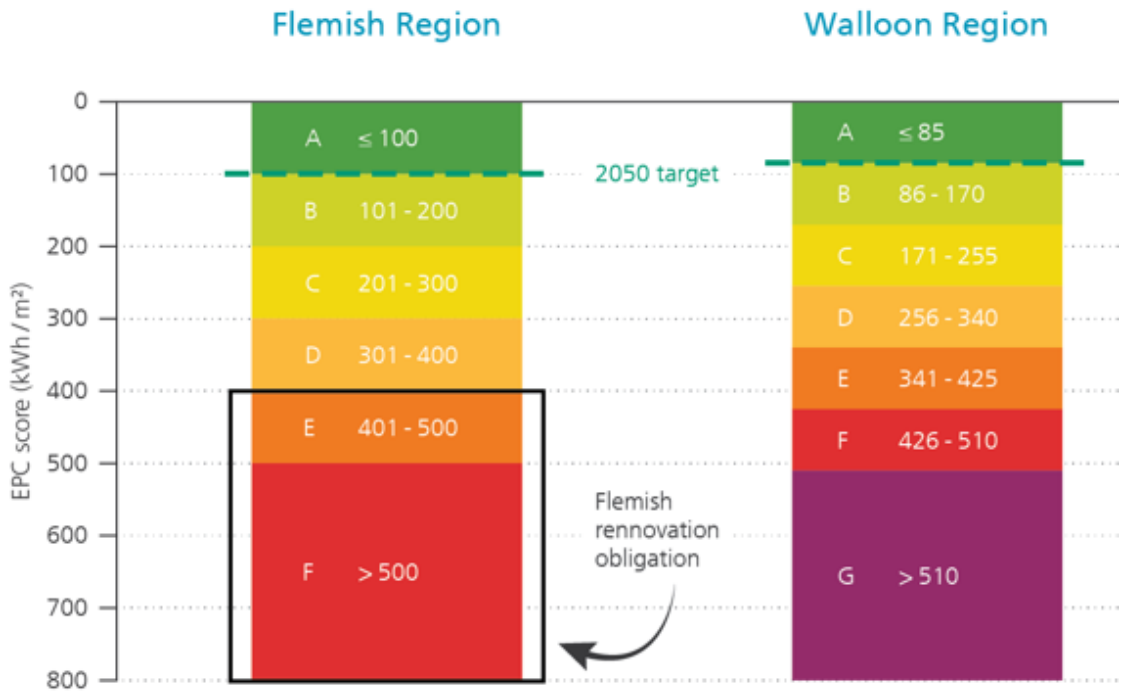
National Bank OF BELGIUM
Eurosystem

1. Introduction
2. Methodology
3. Results
4. Potential mechanisms
5. Policy implications
6. Bonus topic: Impact of energy efficiency on hedonic house price indices

1. Introduction

Since 2023, homebuyers of Flemish dwellings with a class E or F EPC are obliged to renovate their home to at least a class D level within 5 years

Grouping of energy scores for EPC class purposes[1]



Belgium and its Regions

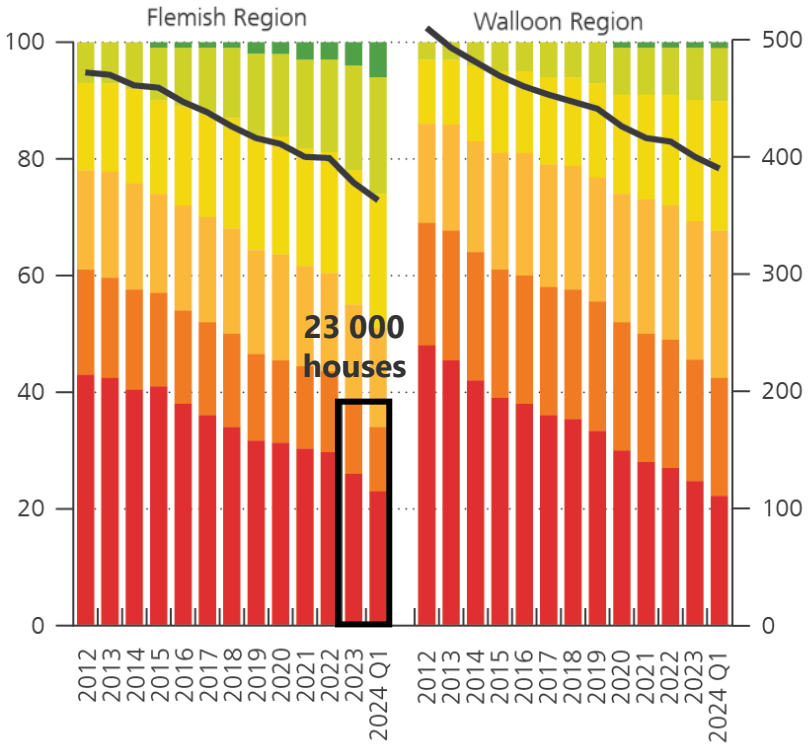
[1] This presentation uses the Flemish Energy Performance Certificate (EPC) classification for both regions for the sake of comparability.

The energy efficiency of sold dwellings has improved over the past decade and the renovation obligation primarily affects houses rather than apartments

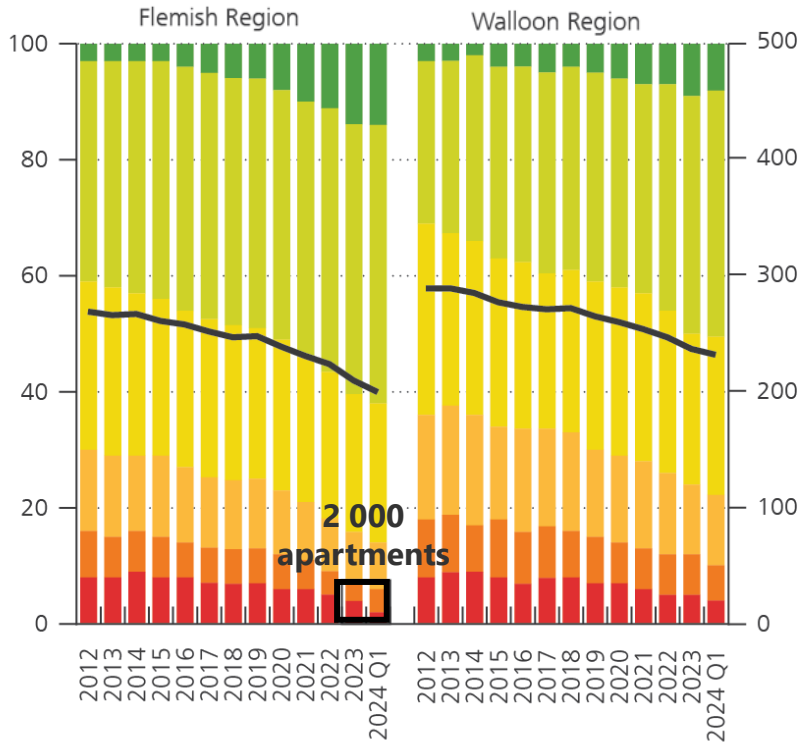
Energy efficiency EPC-score of the sold dwellings[1]

(in % of houses sold (left axis); average EPC in kWh/m²y (right axis))

Houses



Apartments



[1] Note that this energy performance distribution of the sold dwellings is worse than for the entire dwelling stock because (i) new constructions were not included, (ii) overrepresentation of energy-inefficient houses and (iii) the EPC certificate is issued before sale, not reflecting post-sale renovations.

We created a unique dataset, merging all Belgian dwelling transactions to the Energy Performance Certificates, asbestos certificates and online listings

All dwelling transactions (FPS Finance)

- Address (unique identifier)
- Sales price
- Date of sale
- Dwelling characteristics
- 2006 - Q3 2024

Online listings (Realo)

- Address (unique identifier)
- Initial asking price
- Initial listing and delisting date
- Dwelling characteristics
- 2016 - Q3 2024

Unique database

Energy performance certificates (VEKA, SPW, Brussels Environment)

- Address (unique identifier)
- Energy score
- Energy efficiency characteristics
- Main heating source
- 2009 - Q1 2024

Asbestos certificates (OVAM)

- Address (unique identifier)
- Asbestos safety
- Nov. 2022 - Q1 2024
- Flanders only

Main contributions

1. We are the first to examine the impact of a renovation obligation for homebuyers on house prices
   - This Flemish renovation obligation for homebuyers is the first of its kind in the world
   - Limited earlier evidence on minimum energy performance standards, but only for rental dwellings (Clara et al., 2024; Fuerst & Huang, 2023)

2. We provide more accurate estimates of the capitalisation of energy efficiency into house prices
   - Very wide range of estimated energy efficiency price premia in previous literature (see e.g. Copiello & Donati, 2021), due to differences in the time periods and countries analysed, EPC class definitions and omitted variable bias
   - We estimate quality-adjusted house prices for each EPC class, controlling for a large set of dwelling characteristics

3. We provide new insights on the energy efficiency and other characteristics of sold dwellings
   - Unique database merging Belgian dwelling transactions data, energy performance certificates, asbestos certificates and online listings data
   - Useful for the development of national databases on the energy performance of homes and the EU Building Stock Observatory (EC, 2024)

2. Methodology

We estimate the impact of the Flemish renovation obligation on house prices using difference-in-differences analyses

- We compare the trend in prices of Flemish houses with a class E or F EPC (the treatment group) with that of similar houses sold in a comparable economic environment but not subject to the renovation obligation

- We perform three separate analyses, each with a different control group

1. Flemish E+F vs D	✅ Same region 🟡 Similar EPC classes, but a general increased EPC importance may still confound results 🟡 Cannot isolate potential upward price effect of the policy on EPC D houses
2. Flemish E+F vs Walloon E+F	🟡 Similar economic context, but regional shocks may still confound results ✅ Same EPC class ✅ Can isolate policy impact on E+F, C+D, A+B EPC classes
3. Triple-Difference Flemish E+F vs C+D vs Walloon E+F vs C+D	✅ Controls for regional shocks ✅ Controls for common EPC-specific shocks 🟡 Cannot isolate potential upward price effect of the policy on Flemish EPC C+D houses

Difference-in-differences models

1. Flemish E+F vs D

$$\log(p_{it}) = \gamma R_{i,t}^{EF} + \delta_t + \delta_{EPC} + \sum_{k=1}^{K} \beta^k x_{it}^k + \epsilon_{it} \quad (1)$$

2. Flemish E+F vs Walloon E+F

$$\begin{aligned}\log(\tilde{p}_{it}) = {} & \gamma_{AB} R_{i,t}^{AB} + \delta_{t,AB} + \delta_{Flanders,AB} \\ & + \gamma_{CD} R_{i,t}^{CD} + \delta_{t,CD} + \delta_{Flanders,CD} \\ & + \gamma_{EF} R_{i,t}^{EF} + \delta_{t,EF} + \delta_{Flanders,EF} + \delta_{EPC} + \delta_{Fiscal} + \sum_{k=1}^{K} \beta^k x_{it}^k + \epsilon_{it}\end{aligned} \quad (2)$$

3. Triple-Difference

Flemish E+F vs C+D

vs

Walloon E+F vs C+D

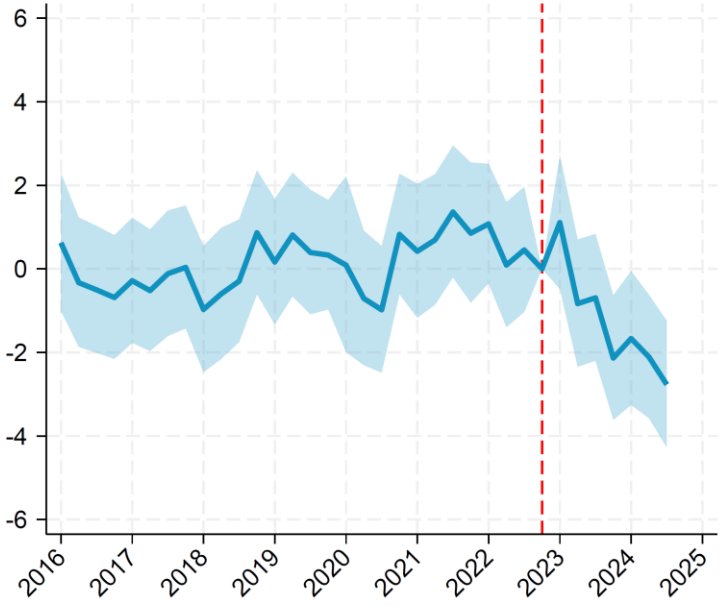
$$\log(p_{it}) = \gamma R_{i,t}^{EF} + \delta_{Flanders,EF} + \delta_{t,Flanders} + \delta_{t,EF} + \delta_t + \delta_{EPC} + \sum_{k=1}^{K} \beta^k x_{it}^k + \epsilon_{it} \quad (3)$$

3. Results

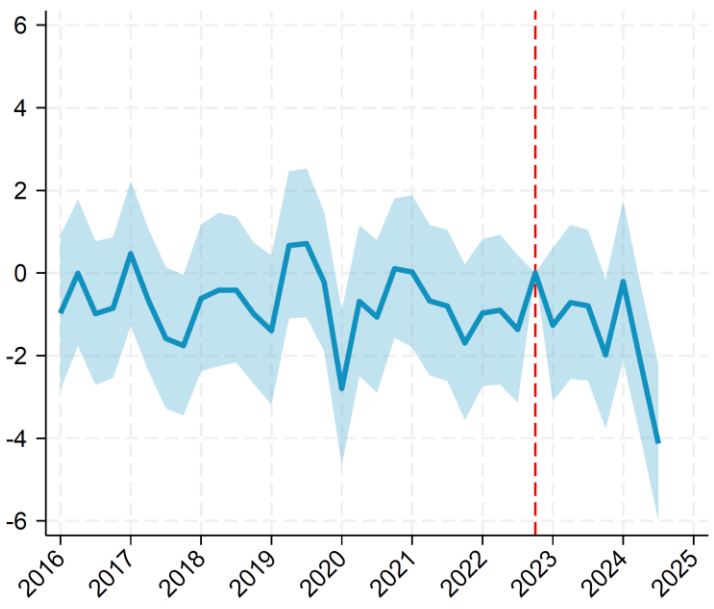
Price trends in the treatment and control groups were very similar prior to introduction of the renovation obligation

Difference in price trends (relative to Q4 2022) between the treatment group and the control group
(in percentage points)

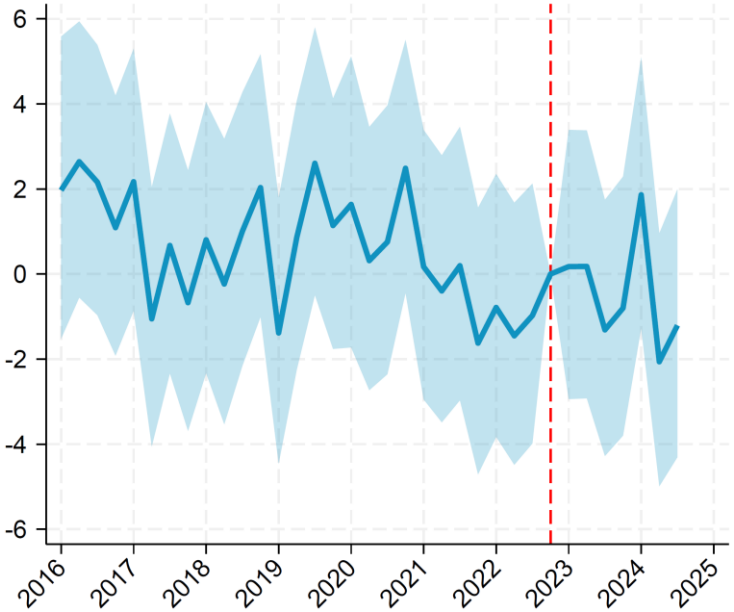
1. Flemish E+F vs D



2. Flemish E+F vs Walloon E+F



3. Triple-Difference



Flemish renovation obligation had a modest negative impact on prices of houses with a class E/F EPC and no price impact on the better energy scores

Estimated impact of the Flemish renovation obligation for each difference-in-differences analysis

	1. Flemish Region	2. Flemish Region vs Walloon Region			3. Triple difference
	E+F vs D	E+F	C+D	A+B	
Entire period	-0.014***	-0.009**	0.000	-0.006	-0.011***
	(0.003)	(0.004)	(0.003)	(0.005)	(0.004)
Q1 2023	0.001	-0.006	-0.009	-0.020	0.003
Q2 2023	-0.001	-0.000	0.006	-0.026**	-0.007
Q3 2023	-0.008	-0.001	0.006	-0.007	-0.009
Q4 2023	-0.023***	-0.013*	0.003	0.010	-0.019**
Q1 2024	-0.018***	0.005	-0.007	-0.018	0.011
Q2 2024	-0.023***	-0.015**	0.009	0.013	-0.025***
Q3 2024	-0.029***	-0.035***	-0.007	-0.006	-0.030***
Observations	*154 403*		*338 807*		*288 273*
R-squared	*0.790*		*0.851*		*0.838*

4. Potential mechanisms

We assess the house price impact of a renovation obligation for homebuyers to be closely linked to three factors, which can vary from case to case

1. **The credibility and enforcement mechanisms of the policy**
   → Big administrative fines for non-compliance, extensive media coverage, legal ad disclosures and information provision by banks reinforced buyer awareness and credibility of the Flemish renovation obligation

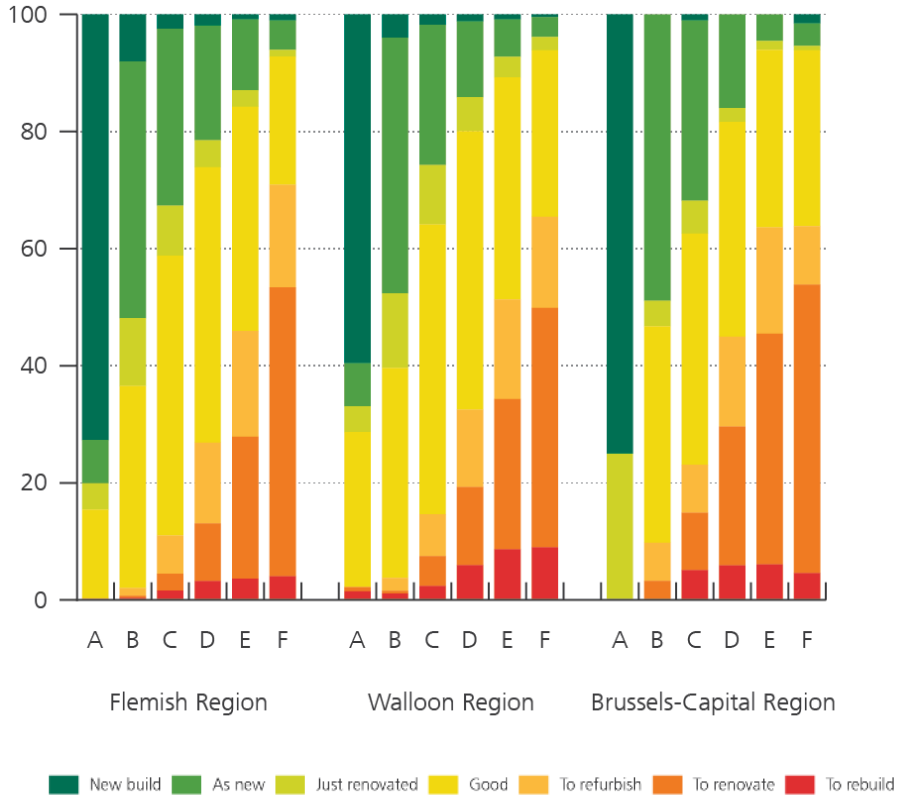
2. **Whether the energy standard is met by many homebuyers even without a mandate**
   → A majority of Flemish buyers of houses with a class E or F EPC were renovating their properties to at least a class D level in any case. The renovation obligation as such does not change much for these buyers

3. **Extent to which the energy renovation cost was factored into house prices before the policy change**
   → The price discount for Flemish E/F houses was large beforehand as the renovation cost seems to have been largely factored into the price

The overall quality and comfort of homes with a class E or F EPC are much worse than for more energy-efficient dwellings

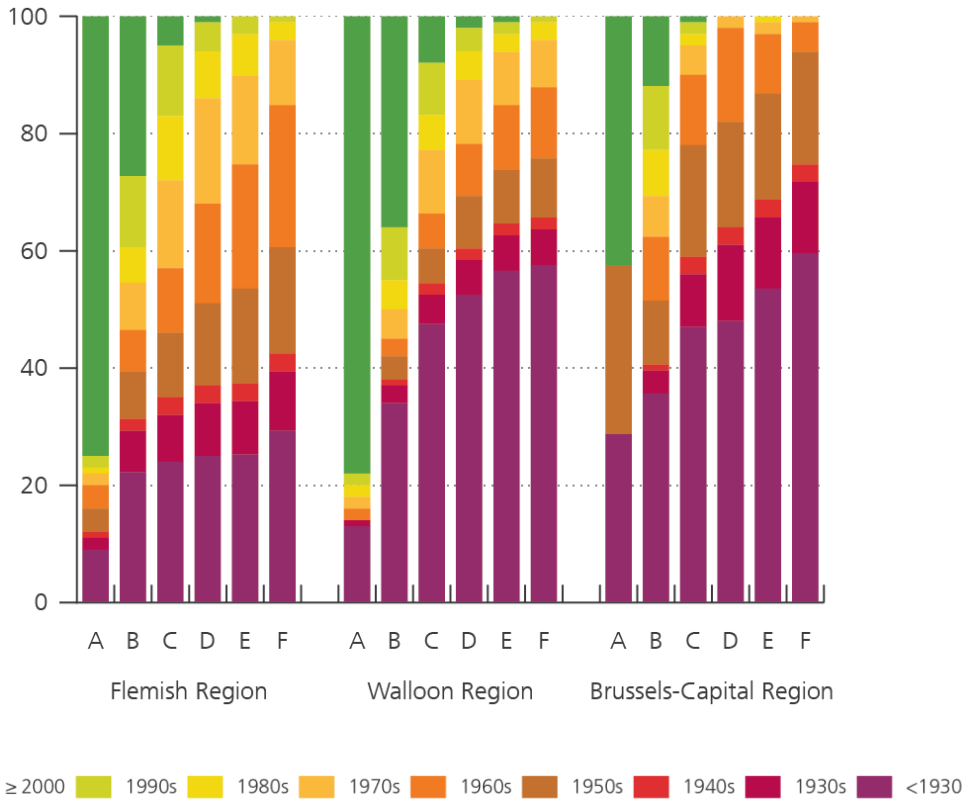
Reported building condition

(in % of houses sold in 2023-2024Q1)



Year of construction

(in % of houses sold in 2023-2024Q1)

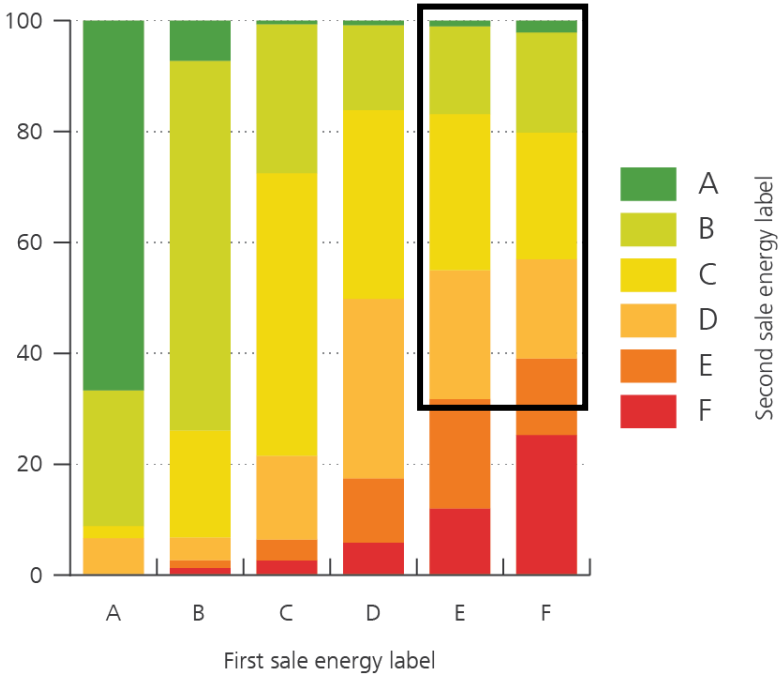


Due to their poor quality, a majority of buyers of houses with a class E or F EPC were renovating their homes to at least a class D level in any case

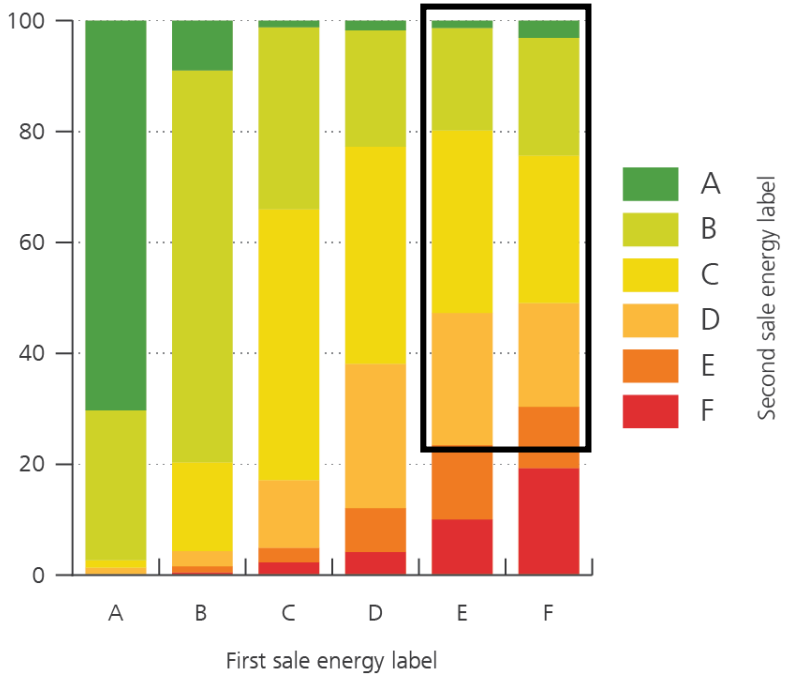
Change in the EPC class for Flemish houses sold twice[1]

(EPC distribution for the second sale, broken down by EPC for the first sale, as a %)

Second sale in 2022



Second sale in 2023 – Q1 2024



[1] The charts illustrate the change in the energy class for the Flemish houses with multiple recorded sales in the dataset, with at least a five-year interval between sales. We could accurately analyse the improvement in energy efficiency only for Flemish houses sold for the second time since 2022. For this group alone, the EPC for the first sale could not be reused for the second sale, meaning the energy score had to be recalculated when the property was resold.

Quality-adjusted house prices per EPC class: methodology

- Motivation for quality adjusted prices: energy-efficient houses are on average more expensive not only due to their greater energy efficiency but also because they tend to be newer and in better condition

- Hedonic regression model

$$\log(p_{it}) = \delta_t + \sum_{z=1}^{5} \alpha_t^z EPC_{it}^z + \sum_{k=1}^{K} \beta^k x_{it}^k + \varepsilon_{it}$$

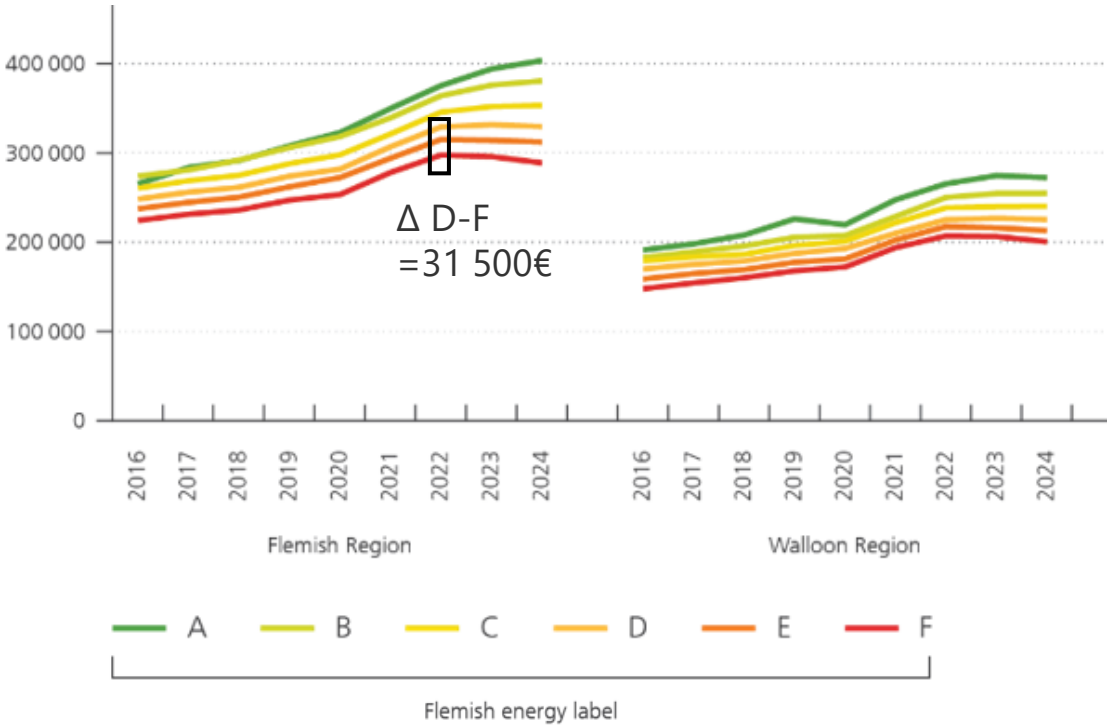
- Estimated quality adjusted price for a house with energy class *z* and average dwelling characteristics $\bar{x}^k$ (e.g. age, dwelling type, reported building condition, house size and location)

$$P_t^z = \mathrm{e}^{(\hat{\delta}_t + \hat{\alpha}_t^z + \sum_{k=1}^{K} \hat{\beta}^k \bar{x}^k)}$$

- Price difference between EPC classes can be interpreted as the estimated added value of a class improvement (but caution is advised due to estimation uncertainty, omitted variable bias and dwelling specific factors)

Price discount for houses with a class E/F EPC was already large prior to the renovation obligation and it largely corresponded to the renovation cost[1]

Quality-adjusted price per EPC class
for a house with average characteristics
(in euro)

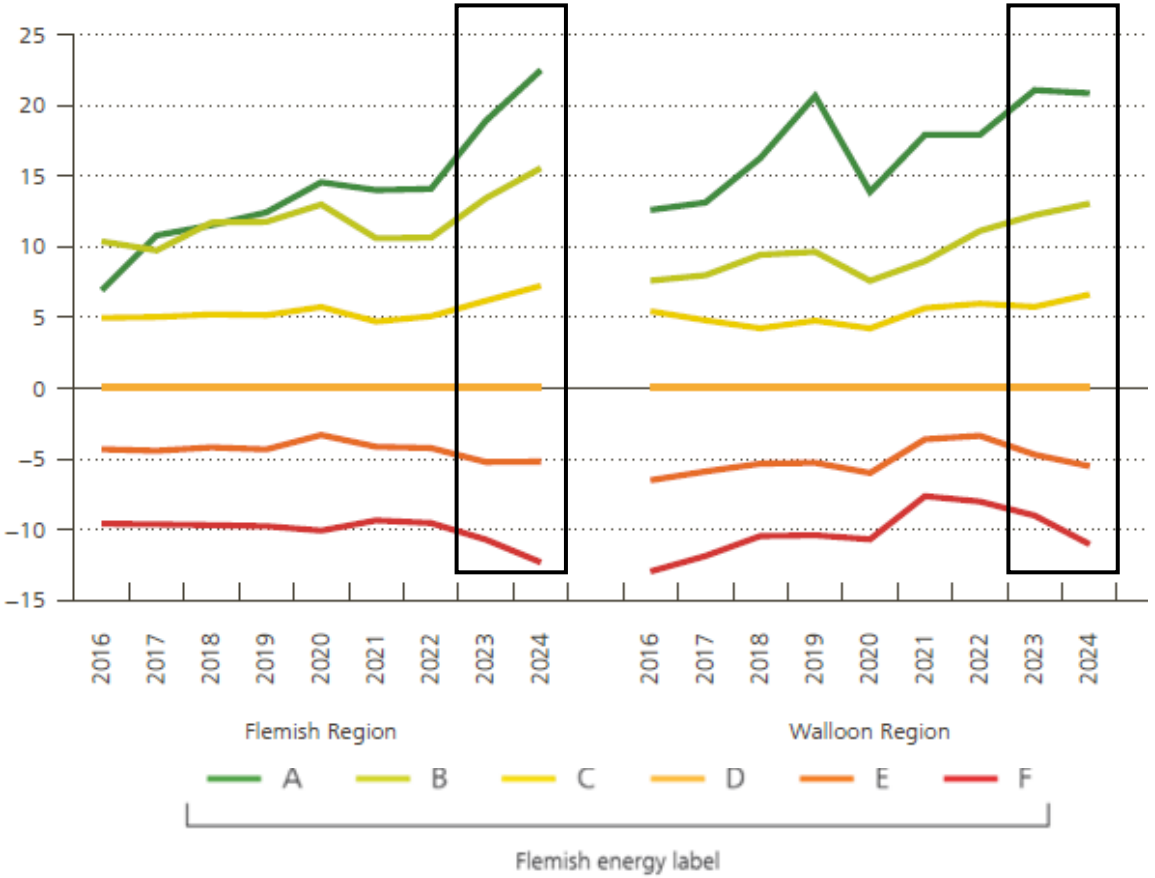


[1] While accurate estimates of the cost of an energy renovation are lacking, an analysis of a small sample of invoices from recent Flemish energy renovations indicates that the price discount appears to reflect to a large extent the average cost of an energy renovation to a class D level. However, it should be noted that the renovation cost can vary widely from dwelling to dwelling.

Beyond the Flemish renovation obligation, the energy score has gained importance in both regions since 2023 due to several additional factors

Price difference vs. comparable house with class D EPC[1]

(in %)



Factors behind the increased EPC price impact

Buyers and banks are increasingly taking the energy score into account in their purchase decisions and mortgage conditions as a result of:

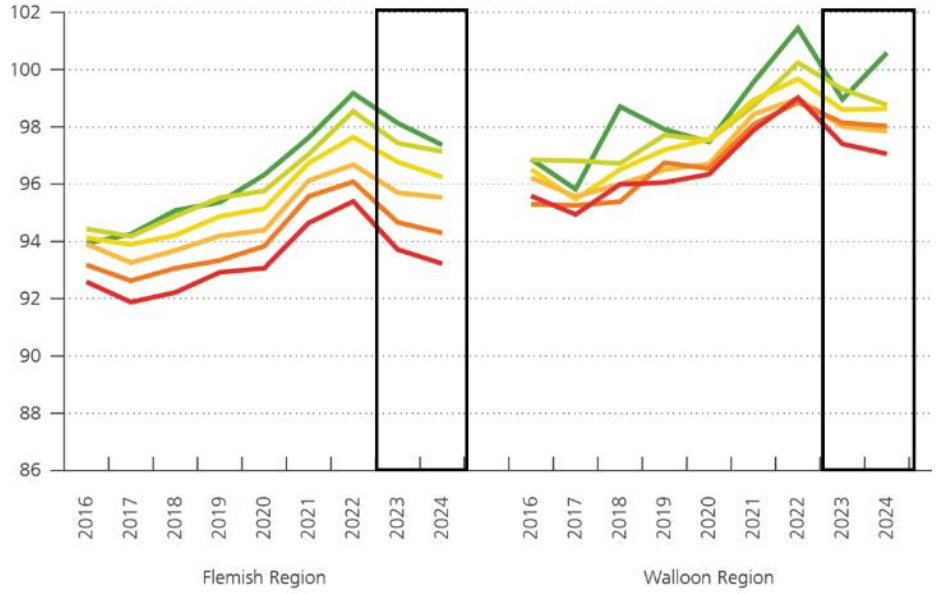
- Higher and more uncertain energy bills
- The future carbon price for heating fuels
- Higher renovation costs
- (Future) renovation obligations
- Better collection of energy scores by banks

[1] Our study estimates the price difference between homes with a different EPC class, while holding all other housing characteristics constant (e.g., age, condition of the home, size and location). Still, our results should be interpreted with caution as we could not control for quality characteristics that are not included in the dataset.

The sales-to-listing price ratio has decreased and houses are on sale for longer since 2023 (due to the rent increase) and the impact was largest for the energy inefficient houses

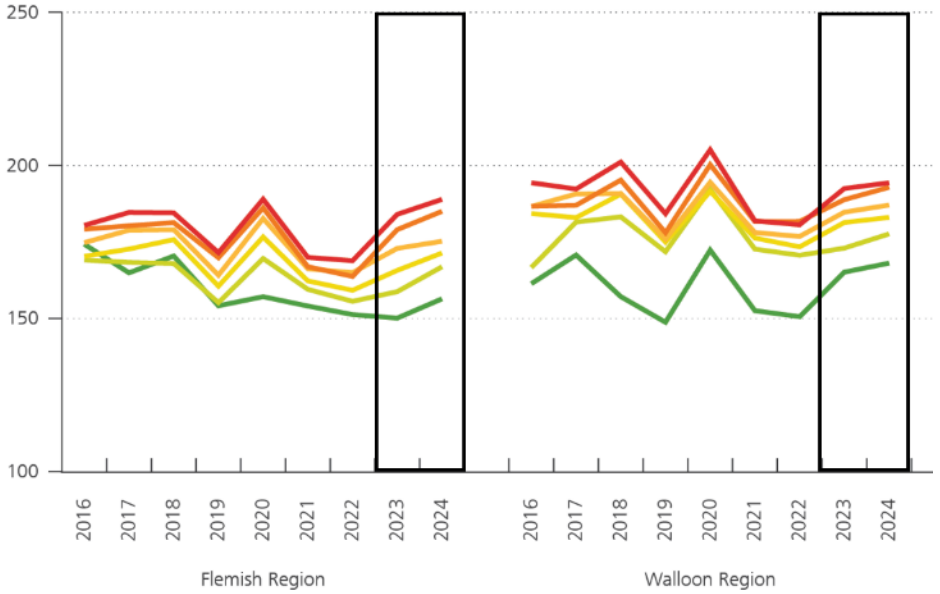
Sales-to-listing price ratio[1]

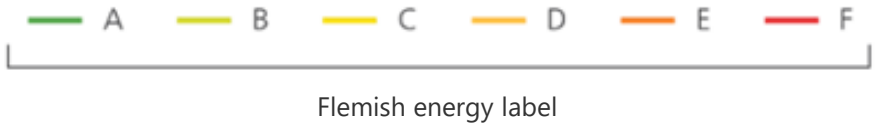
(in %)



Days on market[1]

(number of days between the first listing and the notarial deed)





[1] Estimated for a house with dwelling characteristics equal to the regional average for 2016–2024.

5. Policy implications

Energy renovation obligation for homebuyers: benefits and downsides

- Meeting EU 2050 energy efficiency and climate goals —requiring renovations of most existing homes— faces major hurdles: labour shortages, affordability issues, and limited homeowner interest

- An energy renovation obligation for homebuyers could somewhat alleviate these impediments in several ways
  - Slightly lowers purchase prices of inefficient homes, giving buyers financial room to invest in energy renovations
  - Leverages banks' role to inform buyers on renovation obligations
  - Aligns with natural renovation timing, as buyers often upgrade homes shortly after purchase
  - Ensures that energy renovations will take place (as it is mandatory)
  - Staggers renovation deadlines over time (vs. a uniform MEPS deadline), helping to alleviate labour shortages

- Potential downsides
  - Lowers property values for current owners of inefficient homes
  - The renovation obligation is a large compulsory investment for those who were not planning to renovate
    → This could hamper accessibility of home ownership for buyers without sufficient repayment capacity
  - The increased policy importance of EPC classes may exacerbate EPC-misreporting following Goodhart's law (next slide)

Increase in bunching just below energy class thresholds (partially due to misreporting[1]), which can be attributed to the increased importance of the EPC since 2023

Prevalence of each energy score interval of sold houses, by year of issuance of the EPC in the Flemish Region[2]

(as a percentage of the number of houses sold for which only one EPC was available prior to the sale)

Sources: FOD Financiën, VEKA, own calculations.

[1] Lu & Spaenjers (2025) observed significant bunching in France from 2013 to 2020 and attributed it to misreporting, supported by additional evidence.

[2] The horizontal axis shows the energy scores, which are grouped in intervals of 5 kWh/m². The vertical lines indicate the energy class thresholds.

Conclusion

National Bank OF BELGIUM
Eurosystem

Conclusion

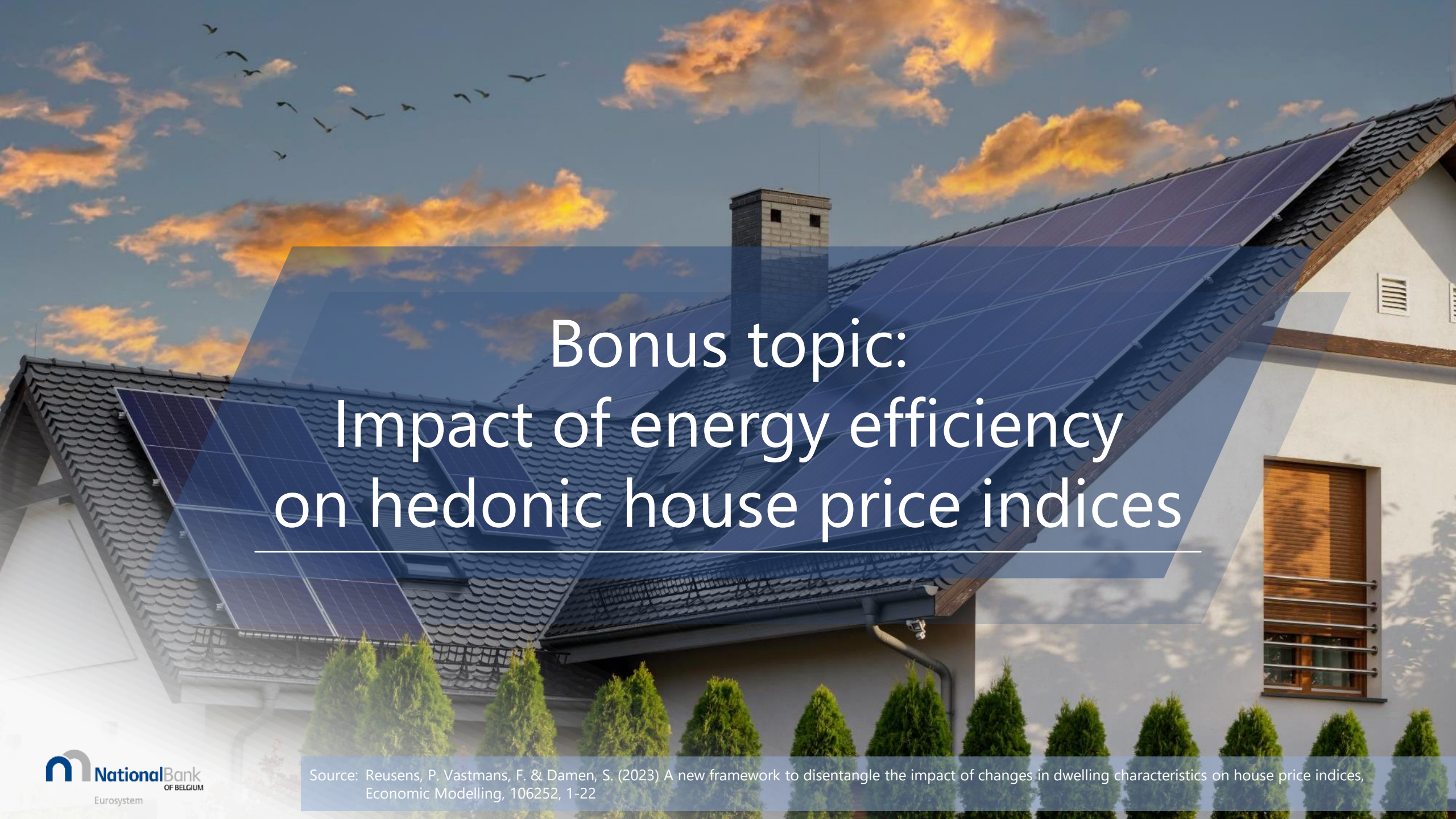
- We are the first to examine the impact of a renovation obligation for homebuyers on house prices
- We find that the Flemish renovation obligation has had a minor negative impact on the prices of E/F houses
- Reasons why the price impact was not larger
  - A majority of buyers of houses with a class E or F EPC were renovating their properties to at least a D level in any case
  - The price discount for these houses was large beforehand (renovation cost was already largely capitalised in the price)
- This slightly higher price discount of houses with class E and F EPC creates some financial leeway for buyers to carry out an energy renovation, but it also has redistributive implications
- As Flanders is currently the only region worldwide having introduced an effective renovation obligation for homebuyers, our findings are key for the many other countries that are contemplating similar policies

References

- Reusens, Vastmans, Vandenbergh, van Kempen and Damen (2025) Impact of the Flemish energy renovation obligation on house prices NBB Economic Review 2025 1

- Reusens, P. Vastmans, F. & Damen, S. (2023). A new framework to disentangle the impact of changes in dwelling characteristics on house price indices, *Economic Modelling*, 106252, 1-22

Contact: peter.reusens@nbb.be



Bonus topic: Impact of energy efficiency on hedonic house price indices

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Eurosystem

Source: Reusens, P. Vastmans, F. & Damen, S. (2023) A new framework to disentangle the impact of changes in dwelling characteristics on house price indices, Economic Modelling, 106252, 1-22

Unlike average house prices, hedonic house price indices correct for changes over time in the quality of the houses sold

Houses sold in Period 1 (illustrative example)

Houses sold in Period 2

Our paper proposes a new framework to disentangle and quantify the contribution of each individual dwelling characteristic to the quality change

- Standard log-linear hedonic regression model with changing coefficients

$$log(p_{it}) = \delta_t + \sum_{k=1}^{K} \beta_t^k x_{it}^k + \varepsilon_{it} \quad for\ i = 1, \ldots, N_t\ and\ t = 0, \ldots, T$$

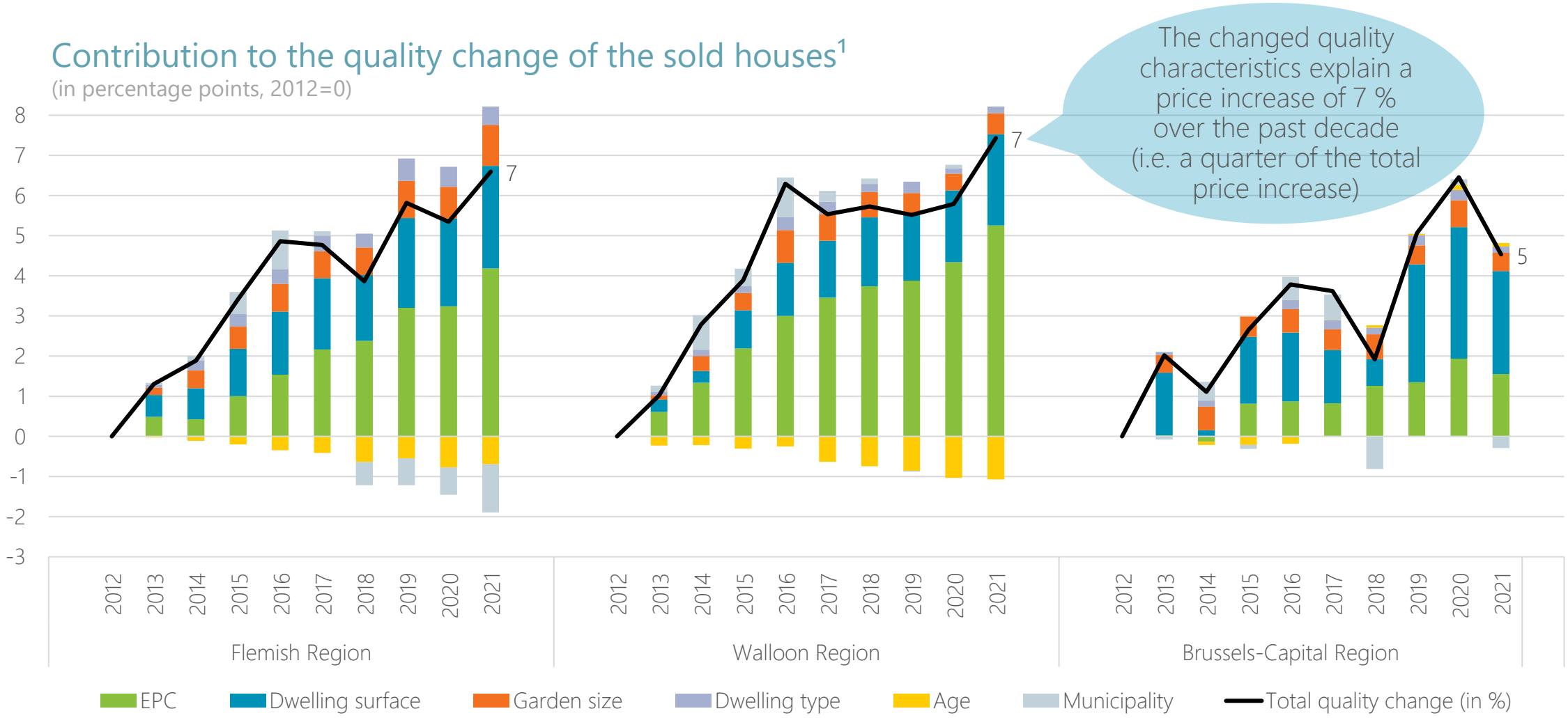
- Decomposition of the average price index as the product of the hedonic price index and the quality change

$$\frac{\prod_{i=1}^{N_t} p_{it}^{\frac{1}{N_t}}}{\prod_{i=1}^{N_0} p_{i0}^{\frac{1}{N_0}}} \approx I_t \prod_{k=1}^{K} [1 + \hat{\beta}_{0t}^k (\bar{x}_t^k - \bar{x}_0^k)]$$

Contribution of variable *k* to the quality change

Geometric mean price index | Hedonic price index | Hedonic quality change

The quality of the houses sold has improved over the previous decade, mostly driven by improved energy efficiency (as well as larger dwelling sizes)



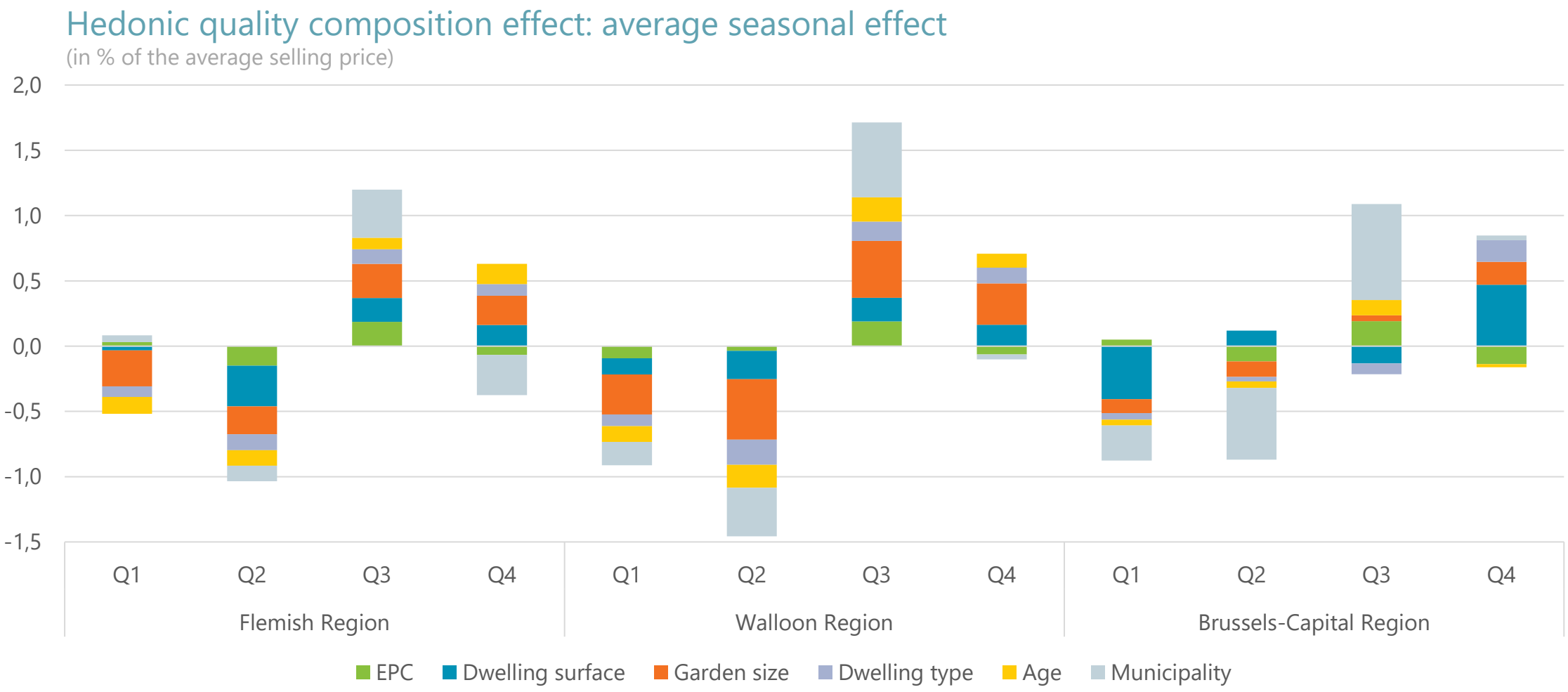
[1] The quality of the houses sold should be broadly interpreted as the value of their dwelling characteristics. Note also that apartments are excluded and that our years are shifted backwards by 2 quarters (e.g. our year "2021" corresponds to the period 2020Q3-2021Q2).

The hedonic house price index has risen 7% less over the past decade compared to average sales prices and it is less subject to (seasonal) fluctuations

Average and hedonic house price indices for the Belgian Regions

(index 2011Q3-2012Q2=100, nominal prices)

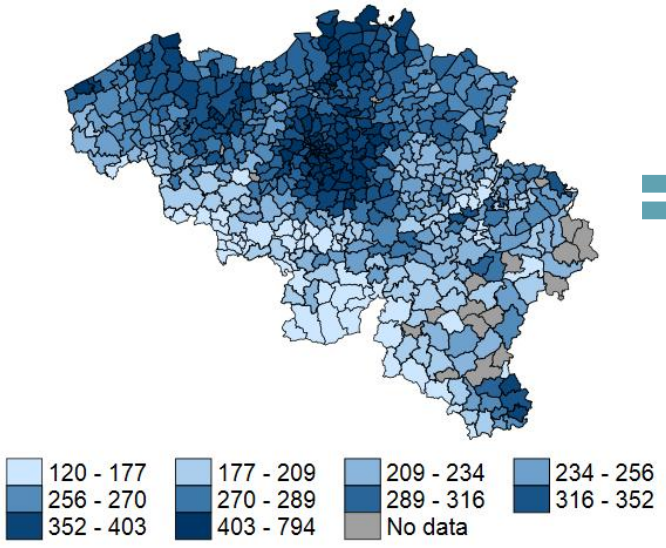
Seasonal pattern in hedonic quality change mainly reflects that dwelling and garden size is on average higher in Q3 and Q4 (sales of the Spring-Summer)[1]



[1] As the notary deed take place about 3 months before the sales agreement, the actual sale of the houses takes place about one quarter earlier.

Average house prices of municipalities differ mainly due to location effect but to a lesser extent also due to quality characteristics (e.g. city houses are smaller)

Average house price in 2021[1]
(in '000 €)



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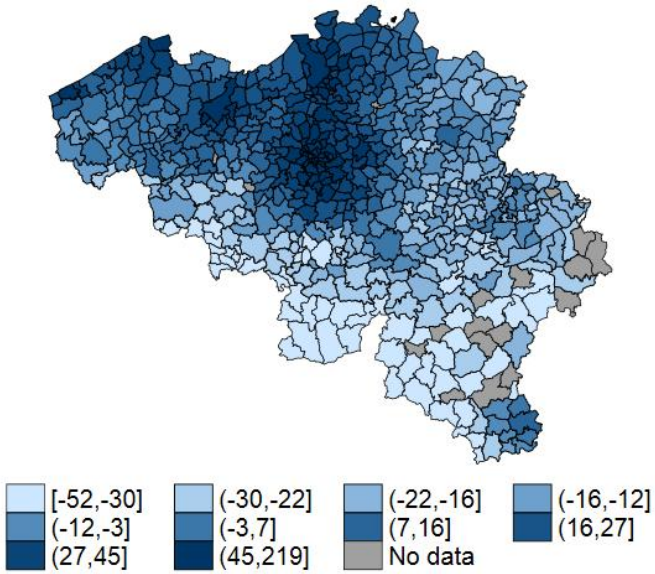
Price difference due to location
(% difference compared to the average municipality)



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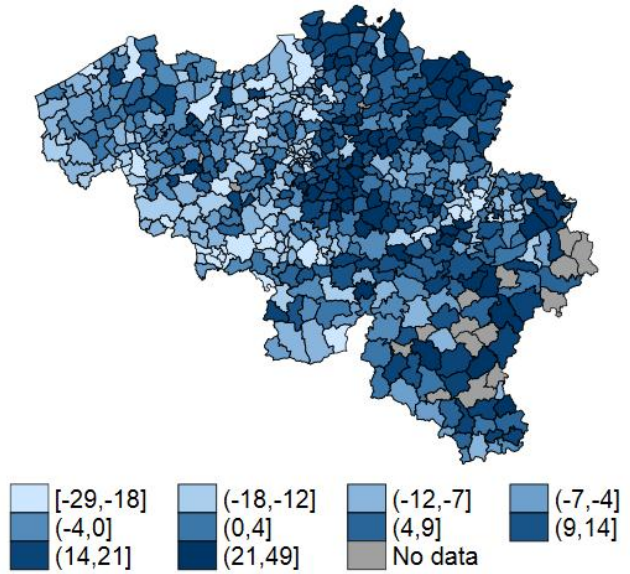
Price difference due to quality
(% difference compared to the average municipality)



Practical roadmap for the construction and interpretation of hedonic house price indices