



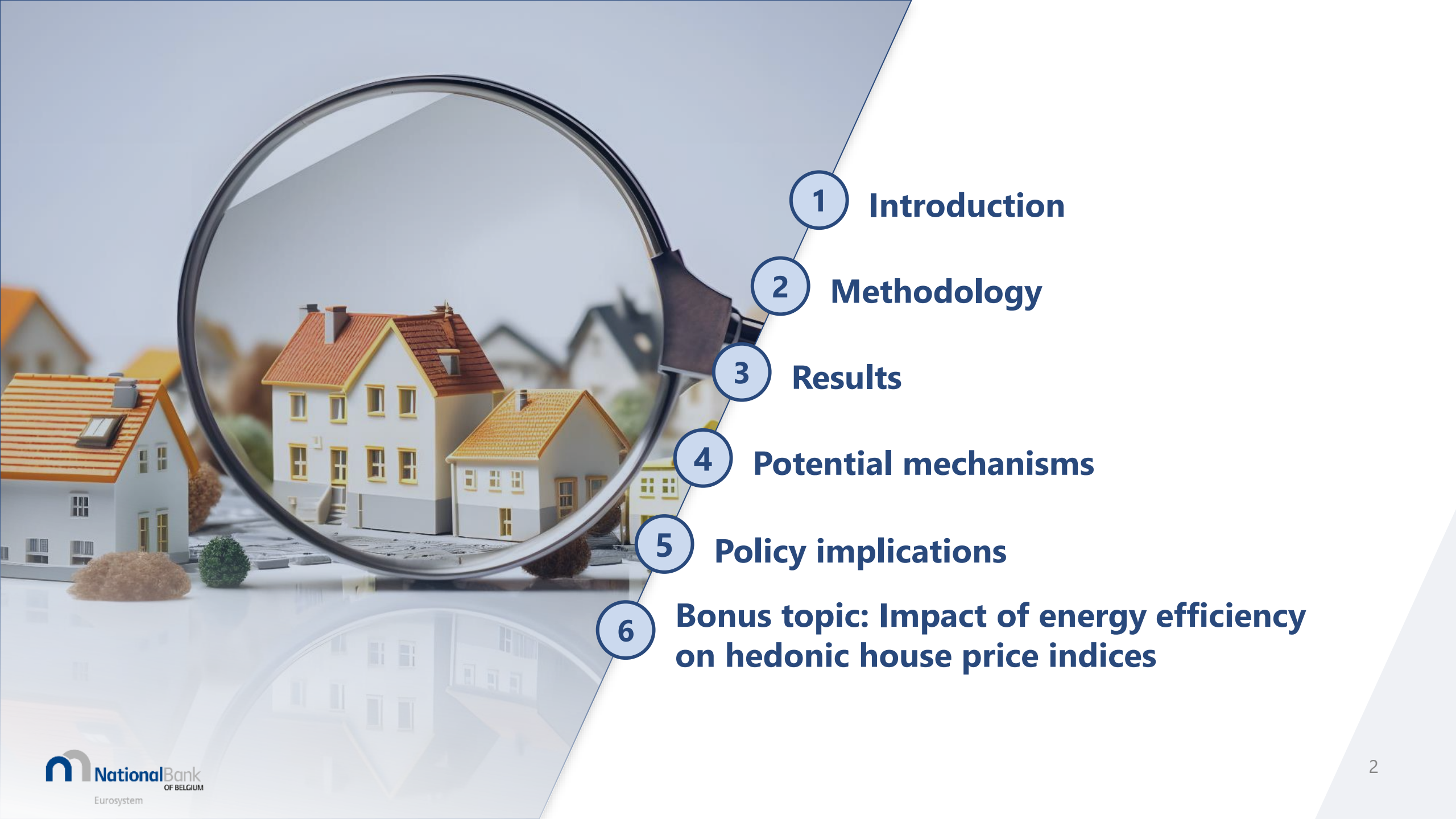
Impact of an energy renovation obligation for homebuyers on house prices

Peter Reusens¹

National Bank of Belgium

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

¹ in collaboration with Frank Vastmans (KU Leuven), Joren Vandenberghe (KU Leuven), Tijmen Van Kempen (University of Antwerp) and Sven Damen (University of Antwerp)



1 Introduction

2 Methodology

3 Results

4 Potential mechanisms

5 Policy implications

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

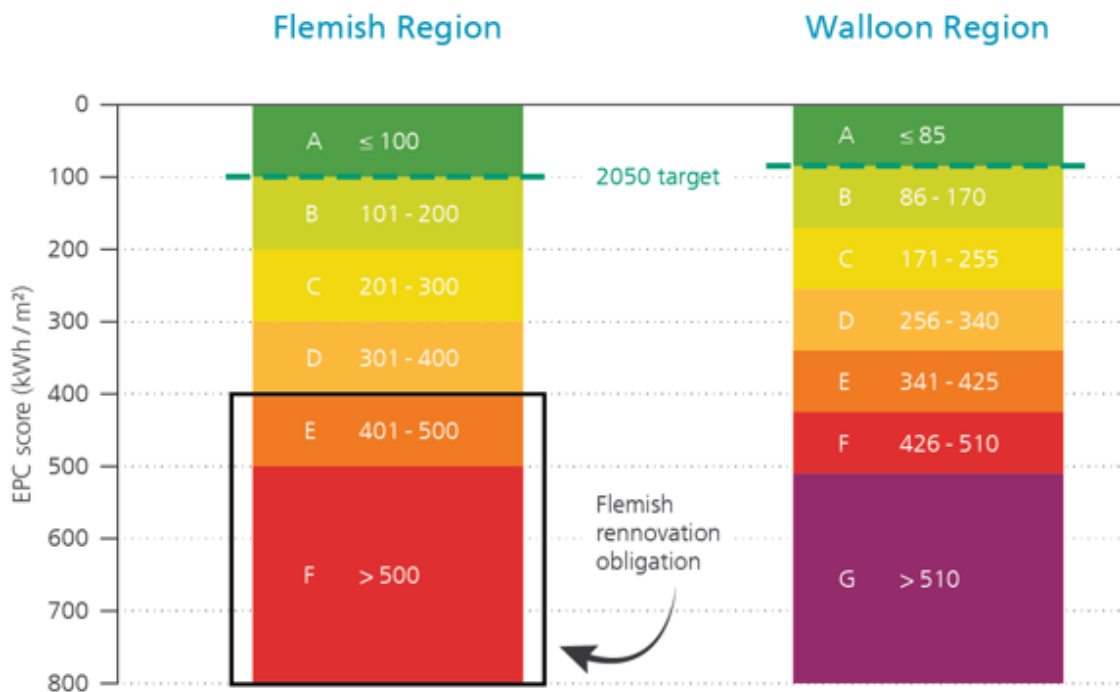


TE KOOP
A VENDRE

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 purposes¹



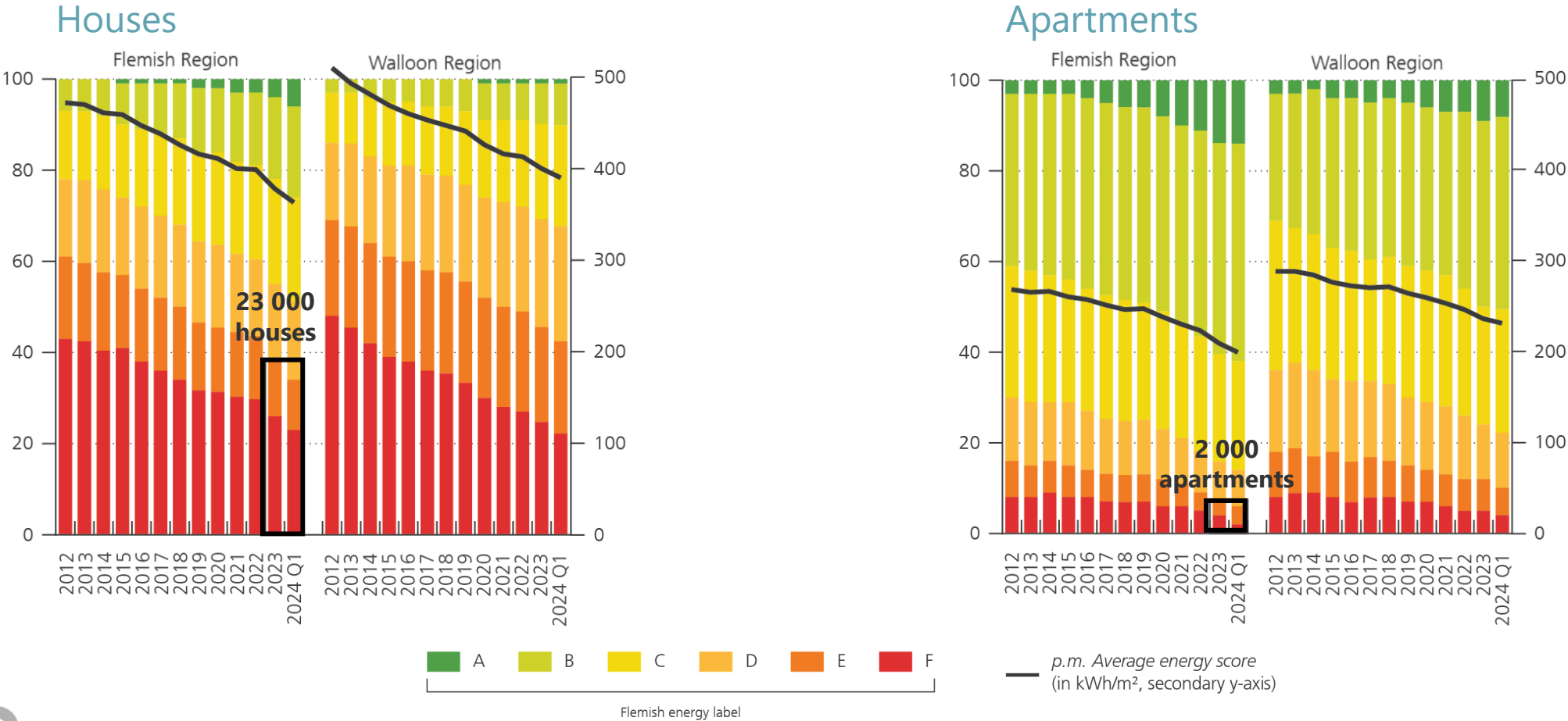
Belgium and its Regions



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

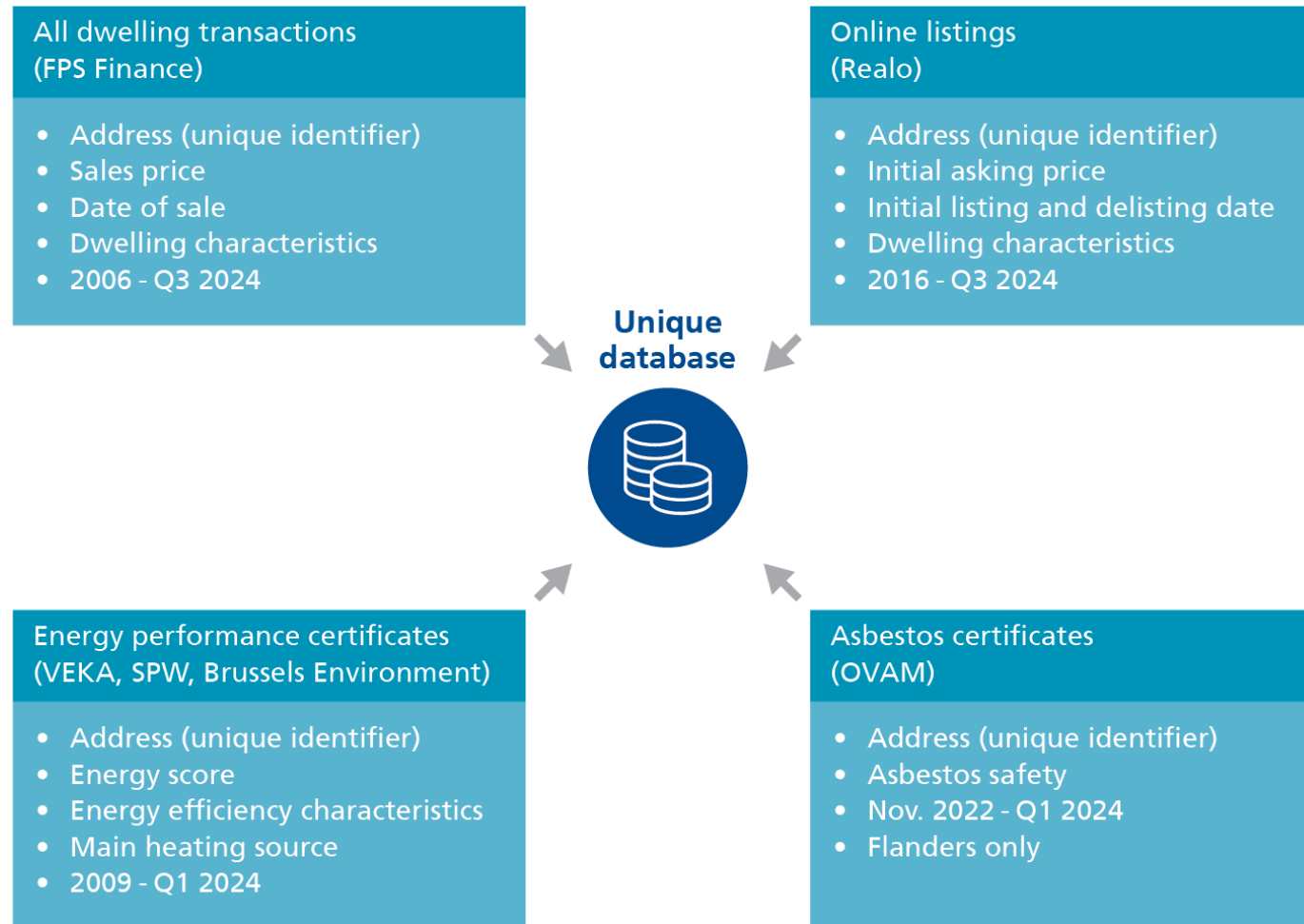
The energy efficiency of sold dwellings has improved over the past decade and the renovation obligation primarily affects houses rather than apartments

Energy efficiency EPC-score of the sold dwellings¹
(in % of houses sold (left axis); average EPC in kWh/m²y (right axis))



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



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](#))

The background of the slide features a close-up of a person's hand holding a small, stylized house icon. Overlaid on this is a semi-transparent blue rectangle containing a white line graph that trends upwards from left to right. A large white arrow points diagonally upwards from the right side of the blue rectangle. The text '2. Methodology' is centered within the blue rectangle.

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	<ul style="list-style-type: none">✓ 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	<ul style="list-style-type: none">○ 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	<ul style="list-style-type: none">✓ 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

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

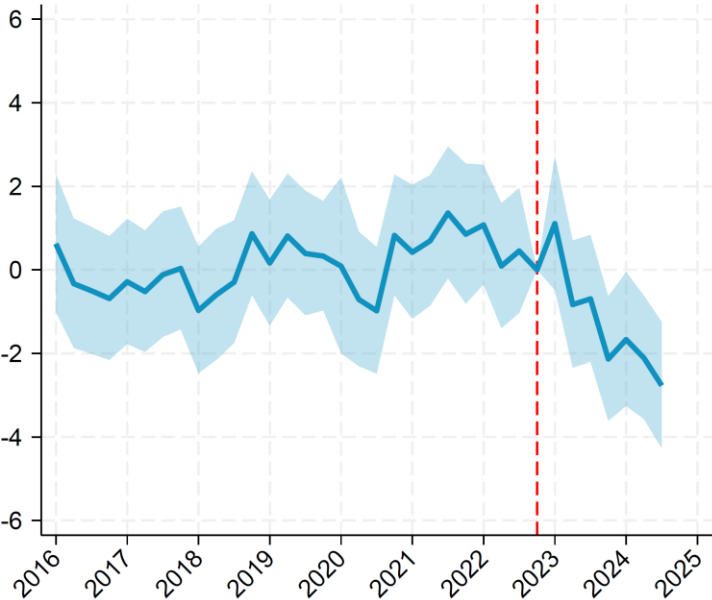


3. Results

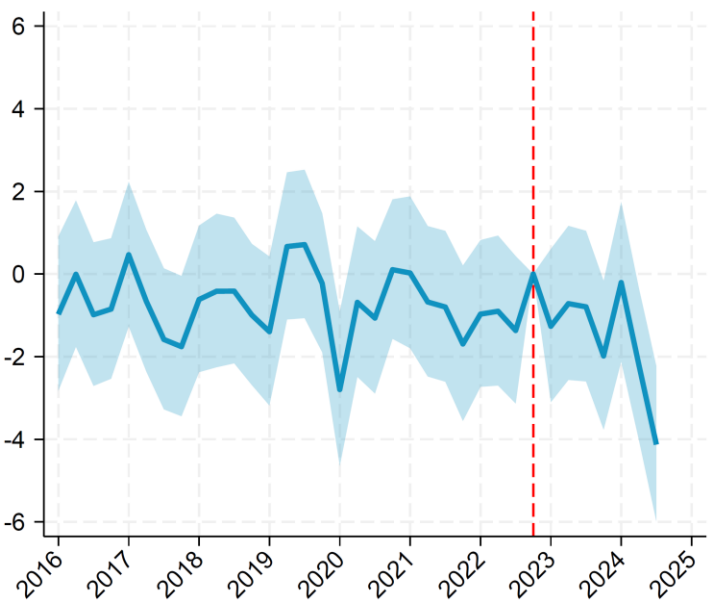
Price trends in the treatment and control groups were very similar prior to introduction of the renovation obligation

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

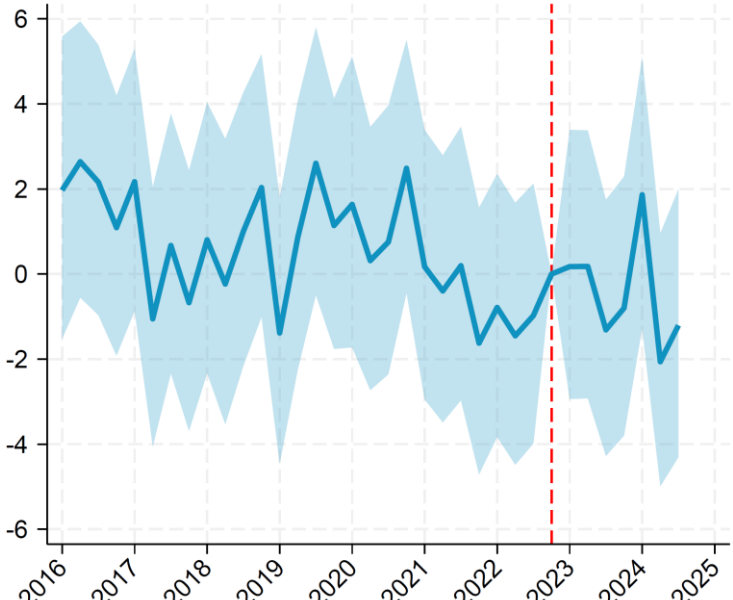
1. Flemish E+F vs D



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	

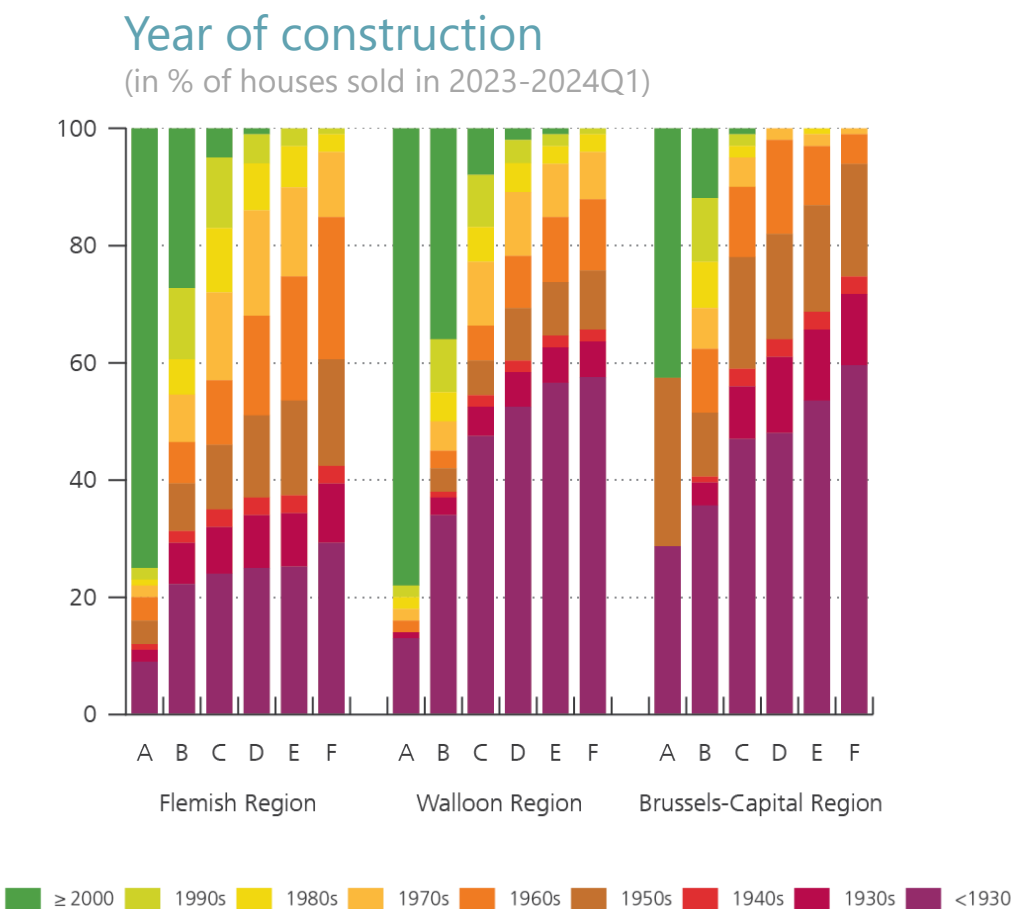
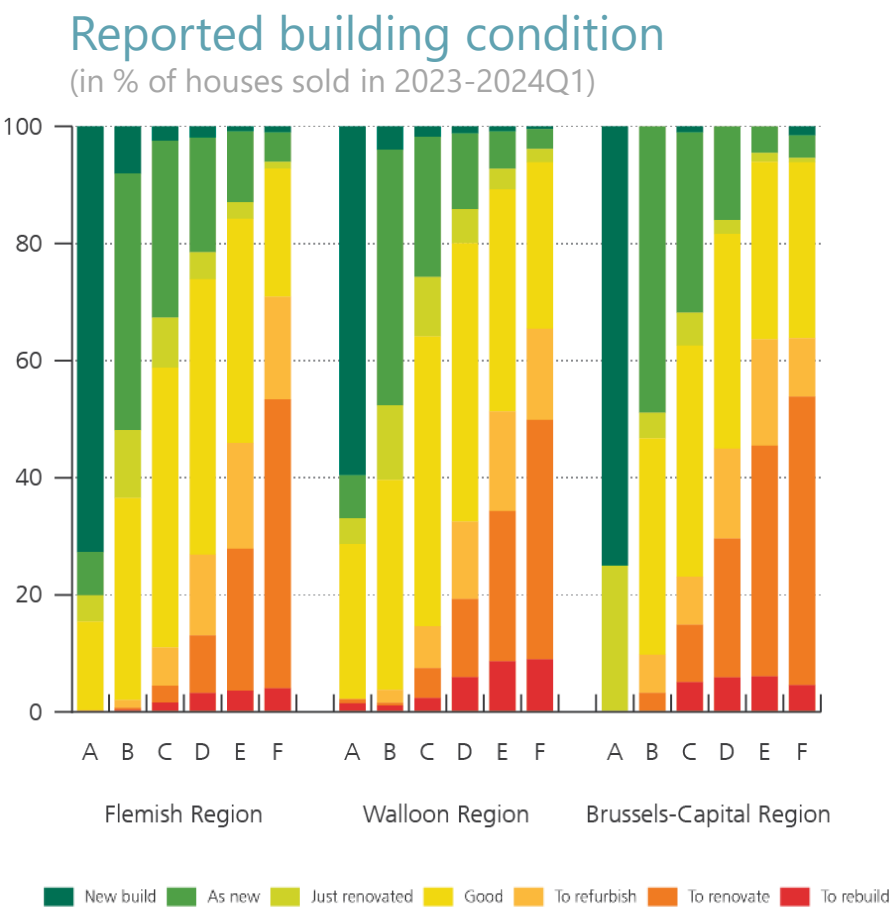


4. Potential mechanisms

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

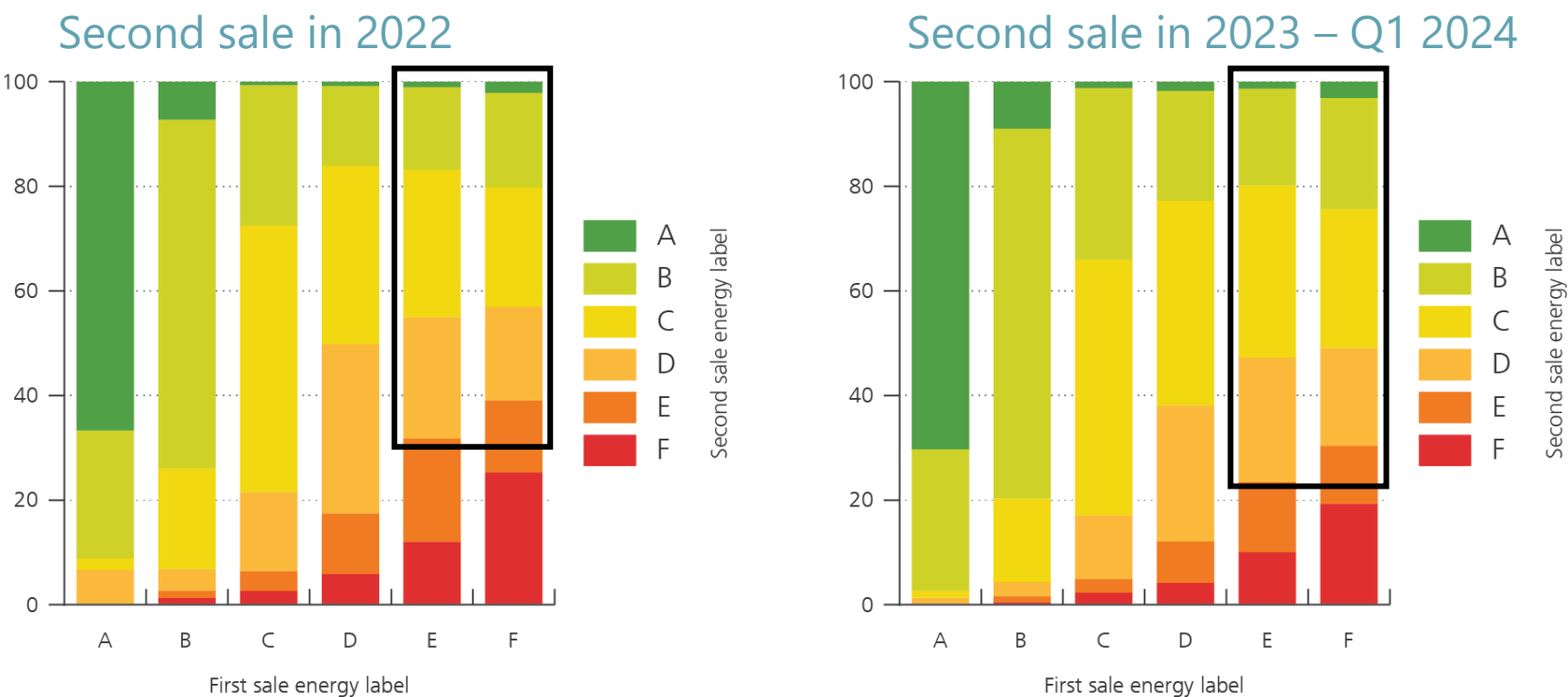
- 1. The credibility and enforcement mechanisms of the policy**
→ Big administrative fines for non-compliance, extensive media coverage, legal ad disclosures and information provision by banks reinforced buyer awareness and credibility of the Flemish renovation obligation
- 2. Whether the energy standard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



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 twice¹
(EPC distribution for the second sale, broken down by EPC for the first sale, as a %)



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

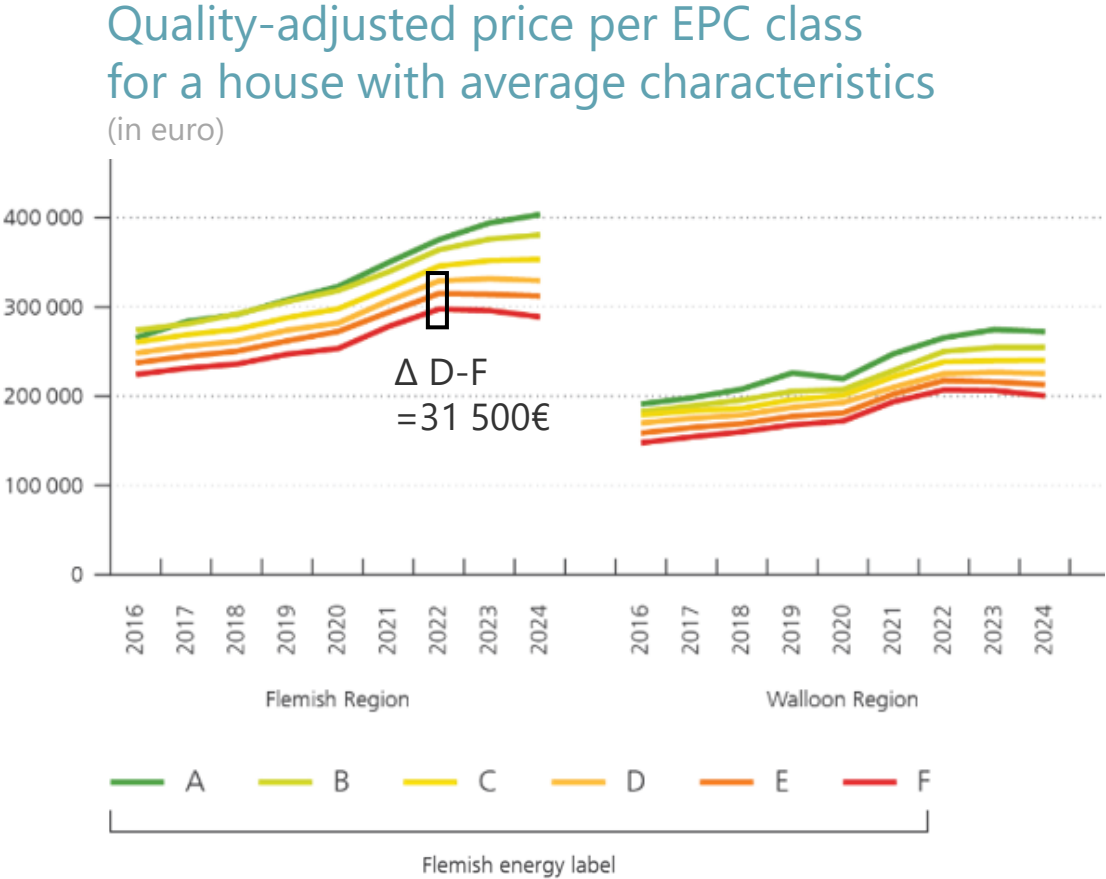
$$\log(p_{it}) = \delta_t + \sum_{z=1}^5 \alpha_t^z EPC_{it}^z + \sum_{k=1}^K \beta^k x_{it}^k + \varepsilon_{it}$$

- 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)

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

- 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)

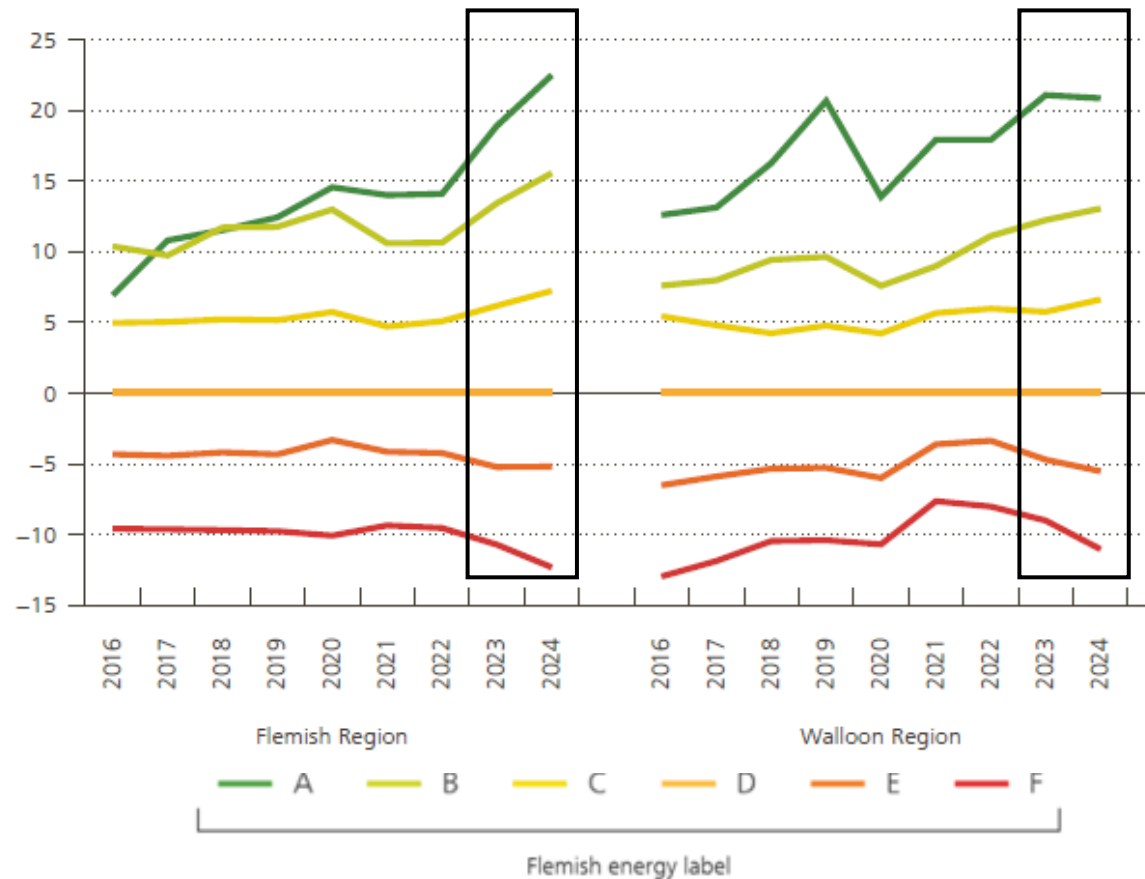
Price discount for houses with a class E/F EPC was already large prior to the renovation obligation and it largely corresponded to the renovation cost¹



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 EPC¹
(in %)

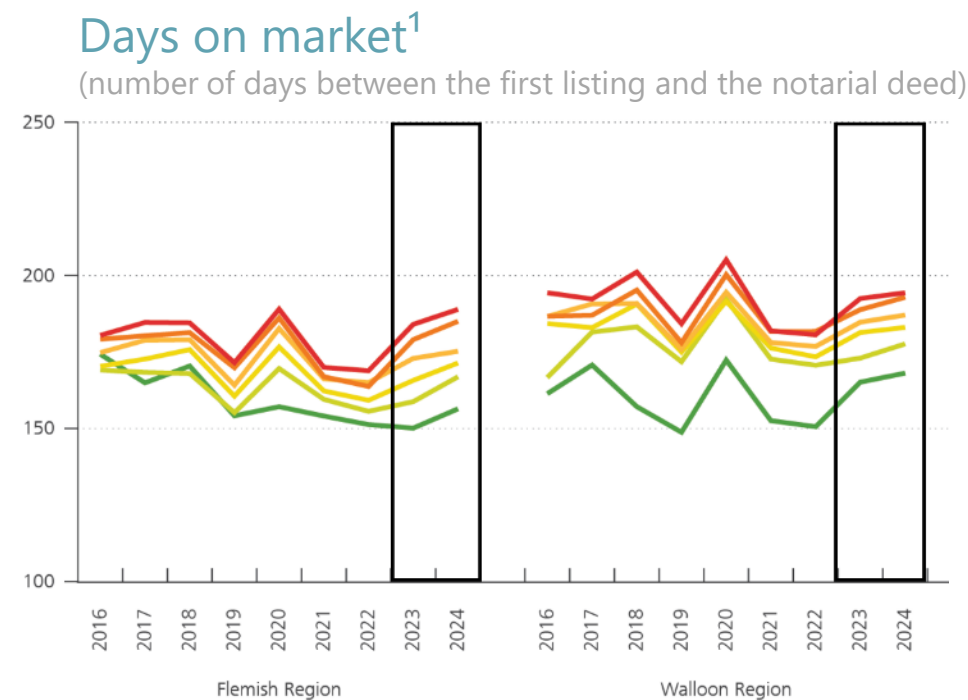
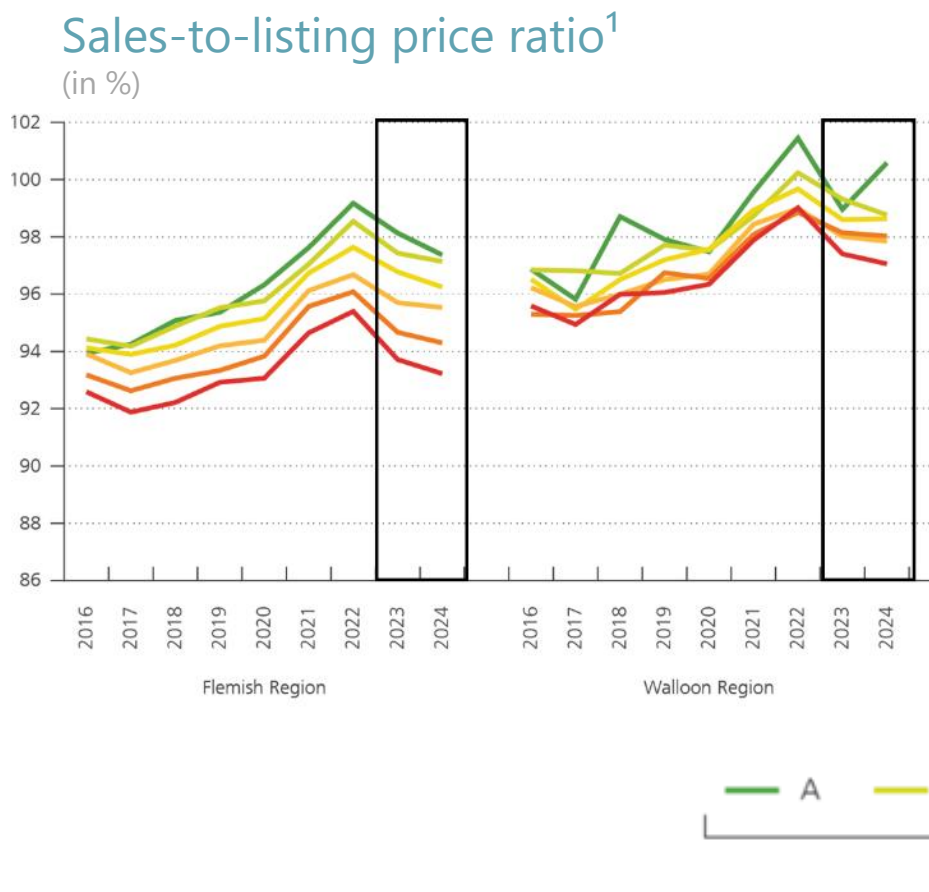


Factors behind the increased EPC price impact

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

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



A close-up photograph of a brass door handle. A key is inserted into the handle, and a keychain is attached to it. The keychain consists of a metal ring and a small, silver-colored metal house-shaped charm. The house charm has two square windows and a semi-circular door. The background is a blurred, warm-toned surface.

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 misreporting¹), 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 Region²
(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

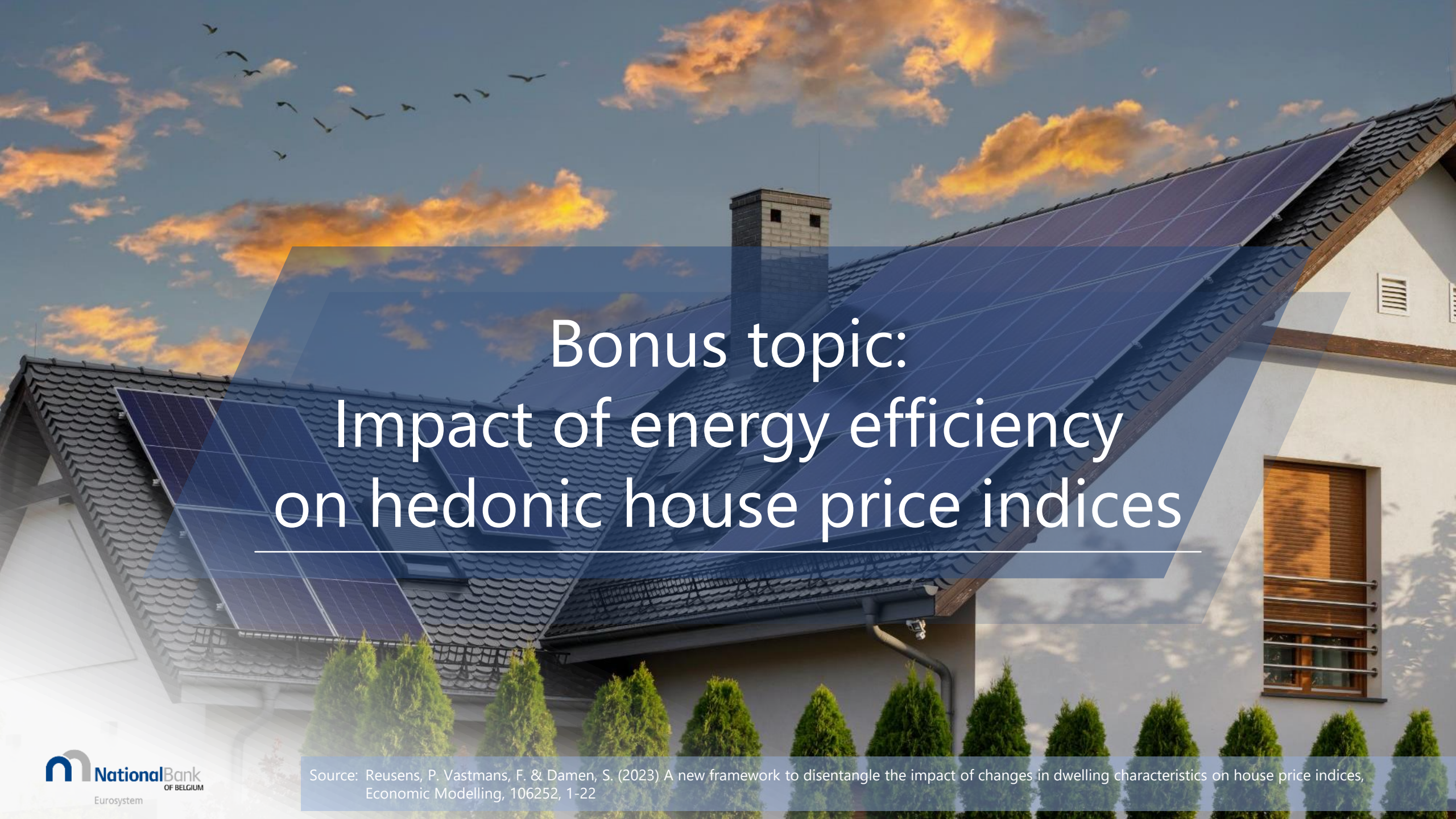
Conclusion

- 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, Vandenberghe, 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

A photograph of a modern house with a dark tiled roof. Several large, dark blue solar panels are installed on the roof. A chimney is visible in the center of the roof. The sky is blue with scattered white and orange-tinted clouds. Several birds are flying in the sky. The house has white walls and a window with wooden shutters. A row of small, green, conical evergreen trees is planted in front of the house.

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

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

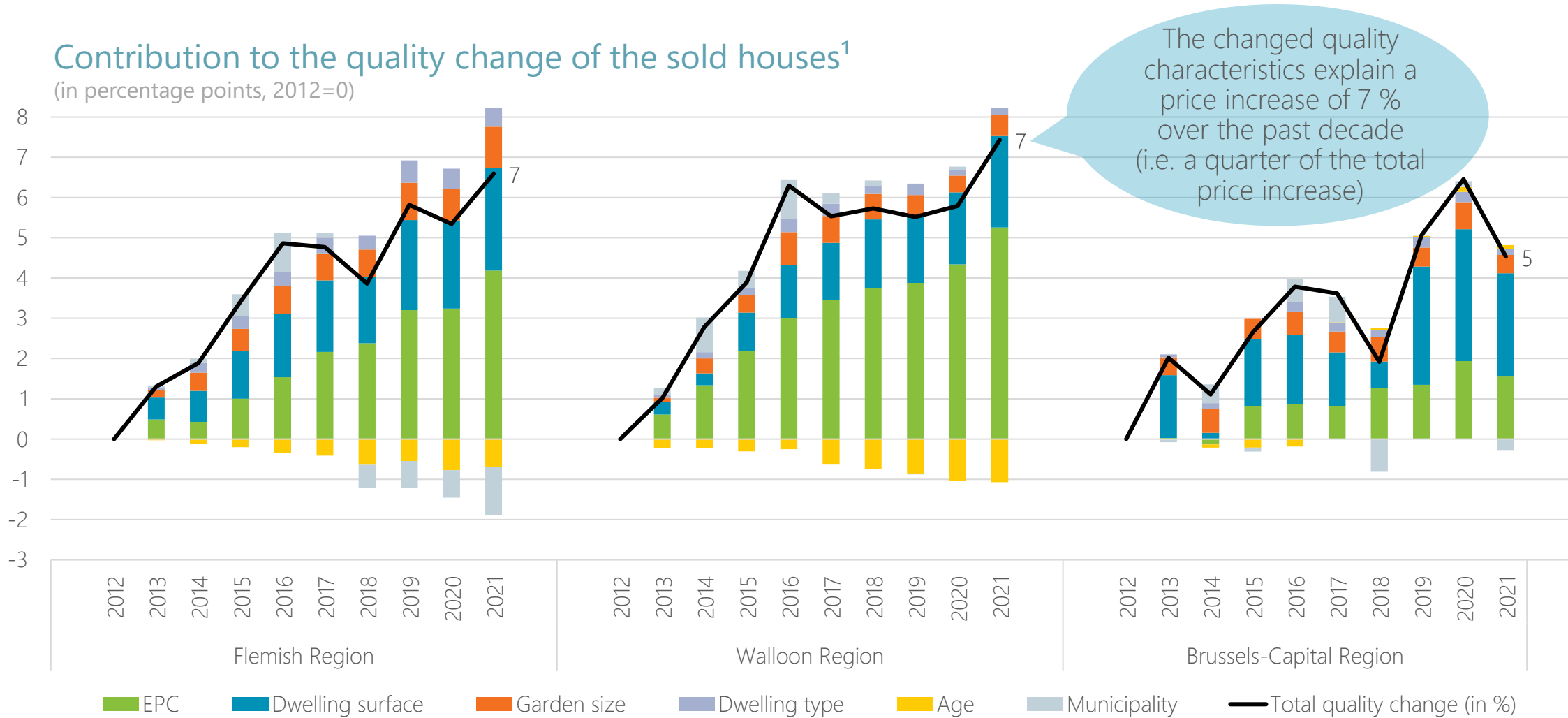
$$\log(p_{it}) = \delta_t + \sum_{k=1}^K \beta_t^k x_{it}^k + \varepsilon_{it} \quad \text{for } i = 1, \dots, N_t \text{ and } t = 0, \dots, T.$$

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

$$\underbrace{\frac{\prod_{i=1}^{N_t} p_{it}^{\frac{1}{N_t}}}{\prod_{i=1}^{N_0} p_{i0}^{\frac{1}{N_0}}}}_{\text{Geometric mean price index}} \approx \underbrace{I_t}_{\text{Hedonic price index}} \underbrace{\prod_{k=1}^K [1 + \hat{\beta}_{0t}^k (\bar{x}_t^k - \bar{x}_0^k)]}_{\text{Hedonic quality change}}$$

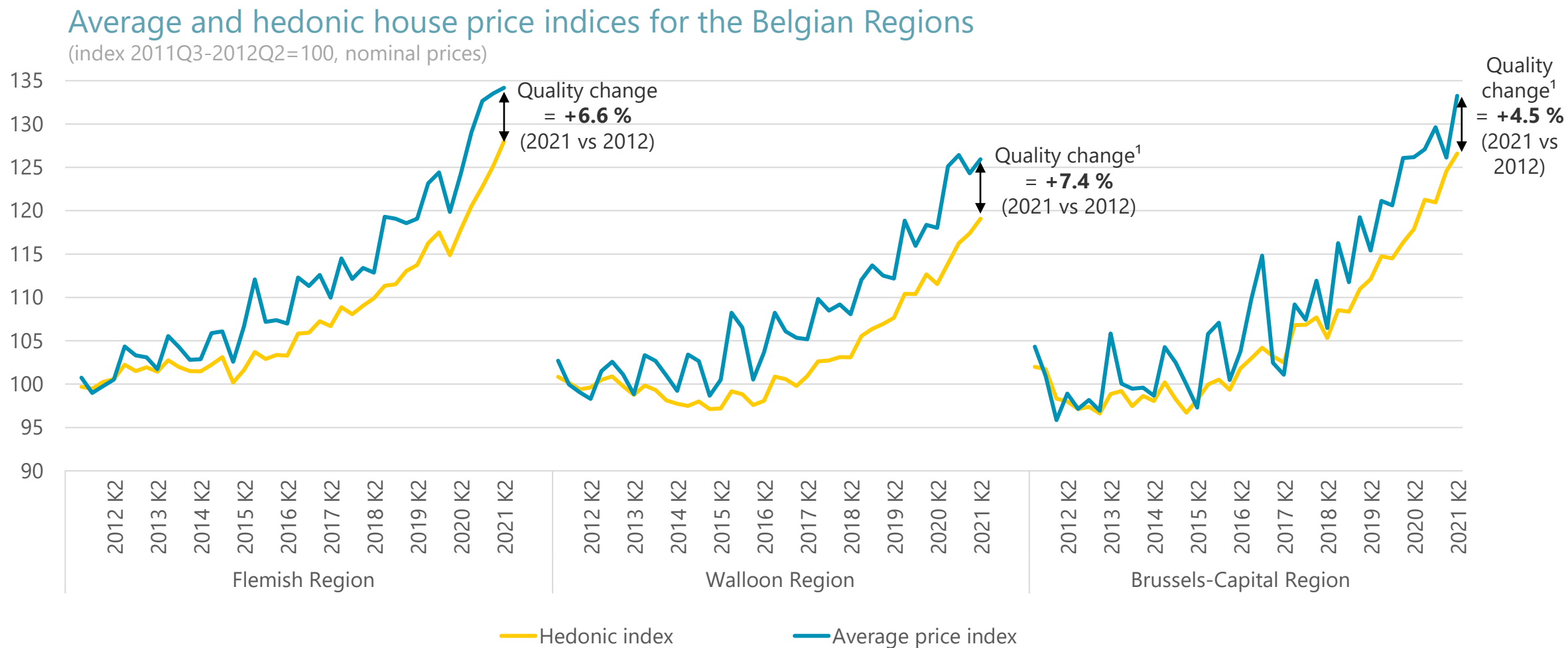
Contribution of variable k to the quality change

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

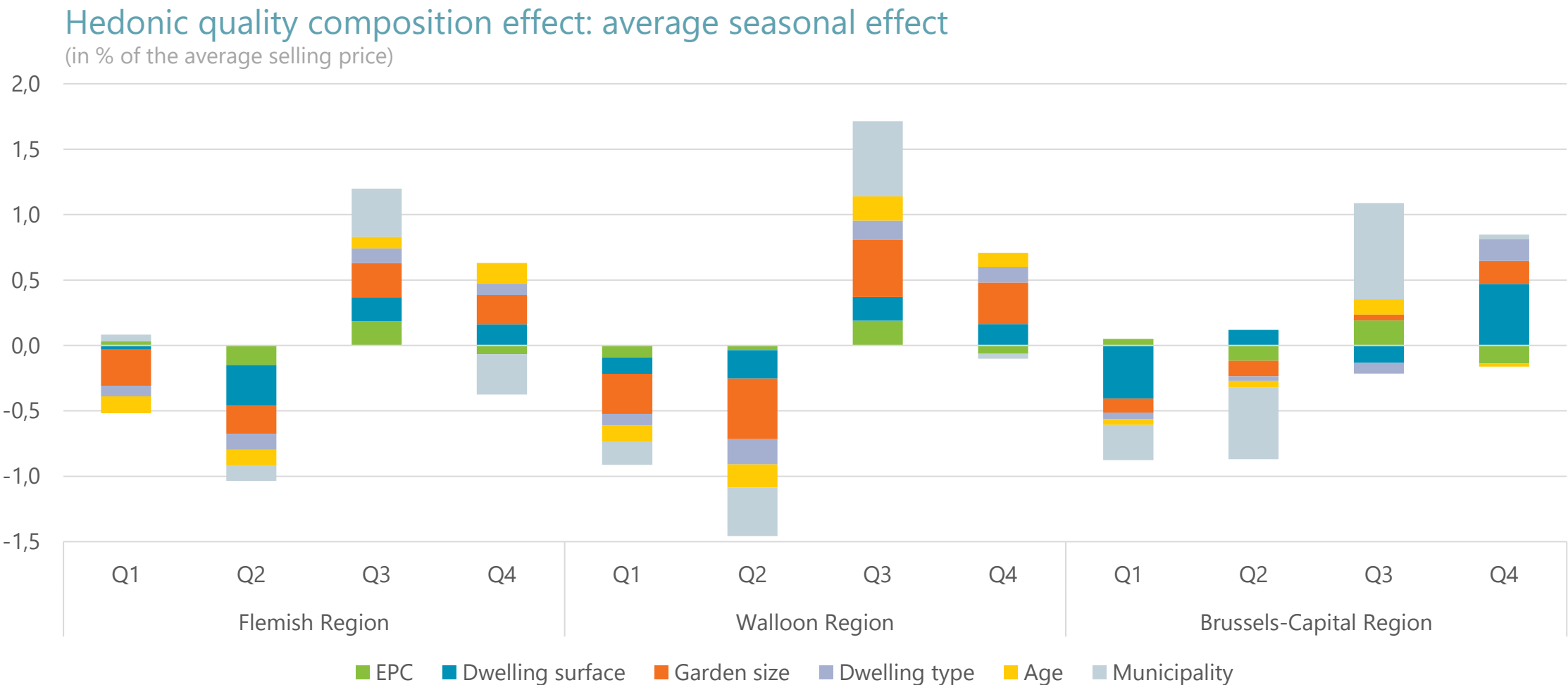


¹ The quality of the houses sold should be broadly interpreted as the value of their dwelling characteristics. Note also that apartments are excluded and that our years are shifted backwards by 2 quarters (e.g. our year "2021" corresponds to the period 2020Q3-2021Q2).

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



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

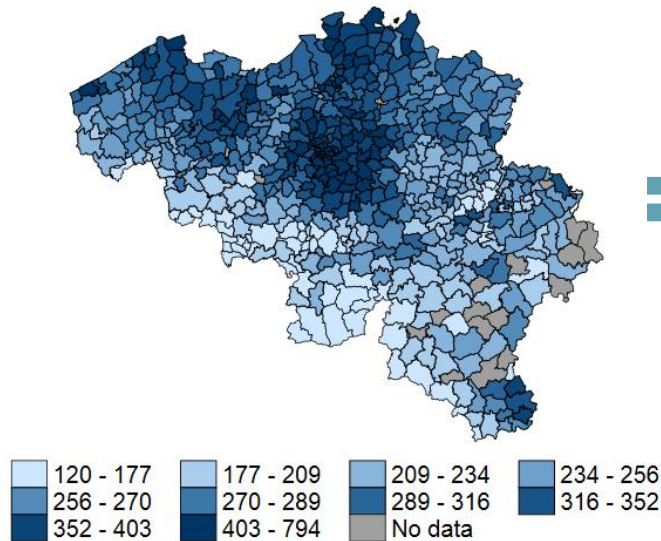


¹ As the notary deed take place about 3 months before the sales agreement, the actual sale of the houses takes place about one quarter earlier.

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)

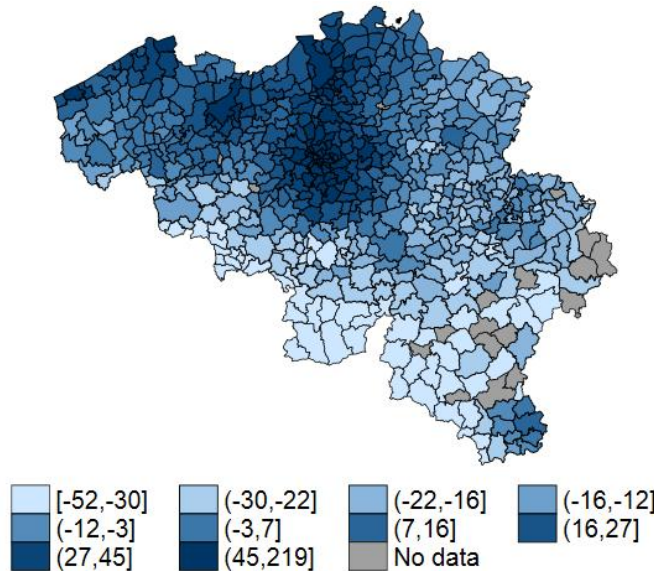
Average house price in 2021¹

(in '000 €)



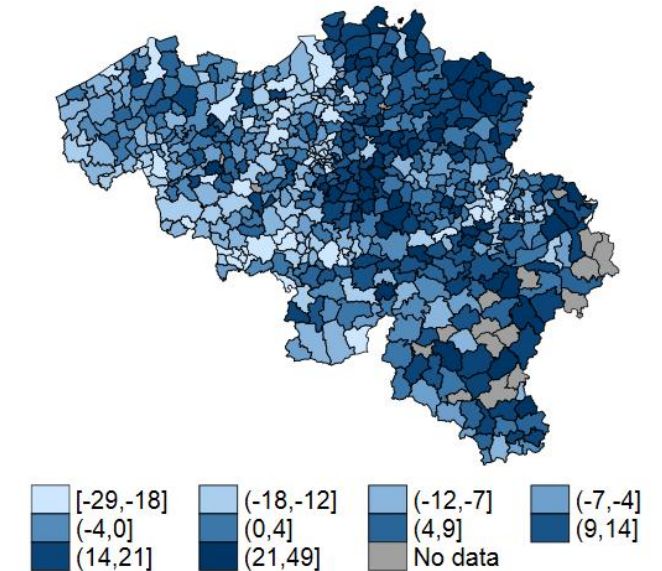
Price difference due to location

(% difference compared to the average municipality)



Price difference due to quality

(% difference compared to the average municipality)



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

