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Renovation activities by home-owners. Analysis of energy and non-energy renovation activities and possible connections.

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Abstract. In order to achieve a sustainable built environment by 2050, the European building stock needs to be retrofitted. Also in Belgium, with 75% of the residential buildings built before 1980, deep energy renovation is stimulated. The Flemish government premises long term goals for the energy performance of the existing building stock in the Renovation Pact (2014). To be able to monitor the progress and effectiveness of the Renovation Pact, knowledge of the actual renovation rate is indispensable. Since years, a renovation rate of 0.7% to 1% is communicated as an argument that renovation should be stimulated. However, there is little empirical evidence for this figure and how it reflects the actual energy renovation activity. Furthermore, non-energy renovation activities are considered as possible gate for home owners towards energy renovation, but little is known about these renovation activities. Since 2013, a yearly survey is done by Essencia Marketing, a marketing agency specialized in the construction sector, on the renovation activity of Belgian households. A representative sample of 1000 households indicates their renovation activity in the previous year through an online questionnaire on structural works (façade, wall, roof, etc.), technical works (HVAC, electricity, etc.) and energetic works (insulation, windows, etc.). For the period 2012-2018, the results show that each year almost 2,1% undertakes a deep energy renovation activity (excluding decorative works). To better estimate the energy renovation activity in Belgium, the paper will firstly discuss the different types of renovation works home-owners execute, and determine the share of energy related renovations. This will be confronted with official statistics on (energy) renovation. Then the non-energy renovation activity will be discussed to determine the share of renovations that could serve as a gate to promote deep energy renovation. This could inform policy makers on policy actions to stimulate combined renovations.

1. Introduction

In the context of achieving a sustainable built environment by 2050 the regional governments in Belgium spelled out measures and regulations to retrofit the existing building stock. To monitor the progress and to assess the need for adjustments of the policy actions for energy renovation, detailed information about the renovation activity is indispensable. Since years, a renovation rate for Flanders of 0,7 to 1% is communicated in the Renovation Pact [1] and used as an argument that renovation should be stimulated. However, the empirical basis for this figure is not clear and it is assumed that it only represents deep energy renovations with building permit. It is highly probable that the actual renovation rate is higher,



since many renovation measures in Belgium, especially energy-related such as roof insulation, replacement of windows or heating system, installation of solar panels, can be executed without building permit and are thus poorly documented.

Therefore, an in-depth analysis of the entire renovation activity is necessary. At first to clarify the mentioned 1% and in a next step to enhance the knowledge about the type of renovation and the combination of renovation works that take place. This could inform policy makers on the progress of their national action plans to meet up the Energy Performance of Buildings Directive (EPBD) [1] requirements, which urge member states to lower the CO₂ emissions of the new and existing building stock. The relation between energy related renovation works and CO₂ emission reduction is already provided in other literature [1].

2. Methods and means

In Belgium, where only deep renovations need a building permit, most renovation activity remains under the radar. As a marketing agency specialized in construction, Essencia Marketing explores yearly the renovation market by means of an online survey research among home-owners [4]. Since 2013 the renovation activities of a sample of the Belgian population, representative by age, region and education is examined. At the beginning of a year, respondents are invited to participate in an online survey. Besides general questions on their house, they are surveyed on eventual renovation activities they executed in the previous year. Tenants and owners of an apartment are screened out. Also the home-owners of a house built less than five years ago are left out. With a yearly sample between 500 and 1000 respondents since 2013, a database of 5449 respondents is obtained, considering the renovation activity between 2012 and 2018. Although through the years the questionnaire slightly changed, the methodology and used definitions remained unchanged. The analysis of the data is performed in JMP Pro 14.1 by means of consumer research method.

2.1. Characteristics of the Belgian home-owner

Most of the home-owners live in Flanders and 74% is older than 40. 47% owns a house which is built before 1970, so before the oil crises that induced the public attention for energy efficiency. 63% bought an existing house, whereas 37% was the first inhabitant of the (new built) house (Figure 1).

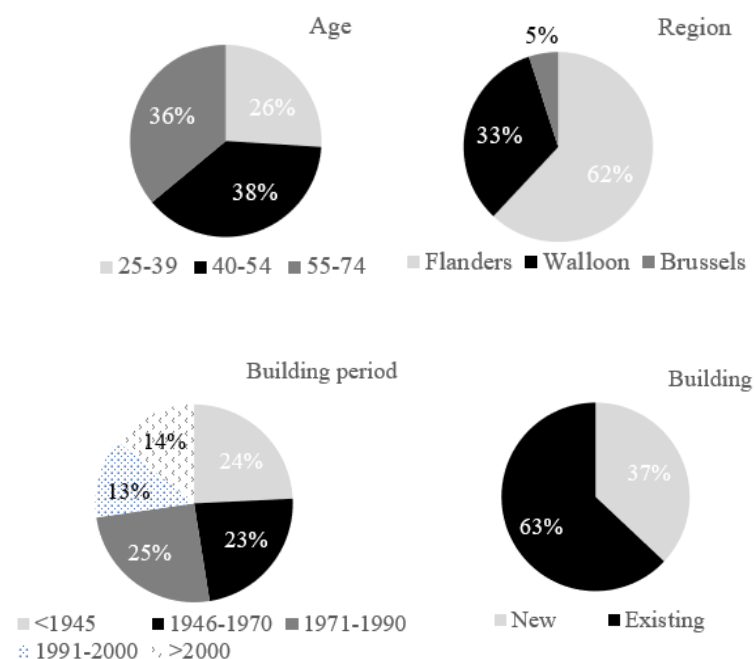


Figure 1. Characteristics of the Belgian home-owner.

2.2. Renovation activities considered

The considered type of renovation activity is limited to structural work (facades, walls, roofs, etc.), energy related work (insulation, heating, doors and windows, etc.) and other work (kitchen, bathroom, etc.). Decorative work (paint, furniture, carpeting, etc.) is not included. In this paper only the renovation activity of home-owners is under study. The activities of tenants or apartment owners are left out. An overview of the studied renovation work and their classification is given (Table 1).

Table 1. List of the renovation works and their classification.

Renovation work	Classification
Ventilation	Energy related
Heating elements (radiators)	Energy related
Doors, windows and glass	Energy related
Insulation (roof, wall and floor)	Energy related
Heating installation	Energy related
Heating pump	Energy related
Solar panels	Energy related
Solar water heater	Energy related
Roof covering	Structural
Wall (Exterior and interior)	Structural
Extension of the house	Structural
Porch	Structural
Garage	Structural
Garage door	Other
Works on electricity net (cables, switch,...)	Other
Roof window or dome	Other
Bathroom	Other
Kitchen	Other

3. Results

At first, the type of renovations and their evolution from 2012 until 2018 is presented. An analysis of their characteristics is discussed. A yearly renovation rate for the sample and its evolution is obtained. Secondly, an estimation of the overall renovation rate for Flanders is performed by relating the obtained results of the Belgian home-owners to the Flemish population including tenants, apartment owners and home-owners of whom the house is older than five years. Finally combinations of renovations are discussed.

3.1. General overview of renovation activity

Overall, the results of the online survey of Essencia marketing show that on average yearly 37% of home-owners executes at least one of the listed renovation works above, but with a tendency towards a decreasing percentage in the period 2012-2018. With an average of 2.4 renovation works that renovators perform in the same year, it is obvious that several renovation works are combined. Between renovation types, energy-related renovations are most popular followed by other types of work and structural work (Figure 2). Every year on average 24.6% of home-owners performs at least one energy-related renovation. Other works are performed yearly by 20.2% of the home-owners and structural works by 13%. A more detailed insight per year shows a declining trend in the energy related renovations for the

period 2012-2018, although still most popular. The number of structural renovators fluctuates in time, but shows a steady trend line. The other renovation works suffer from a decline, but not as severe as the energy related renovations.

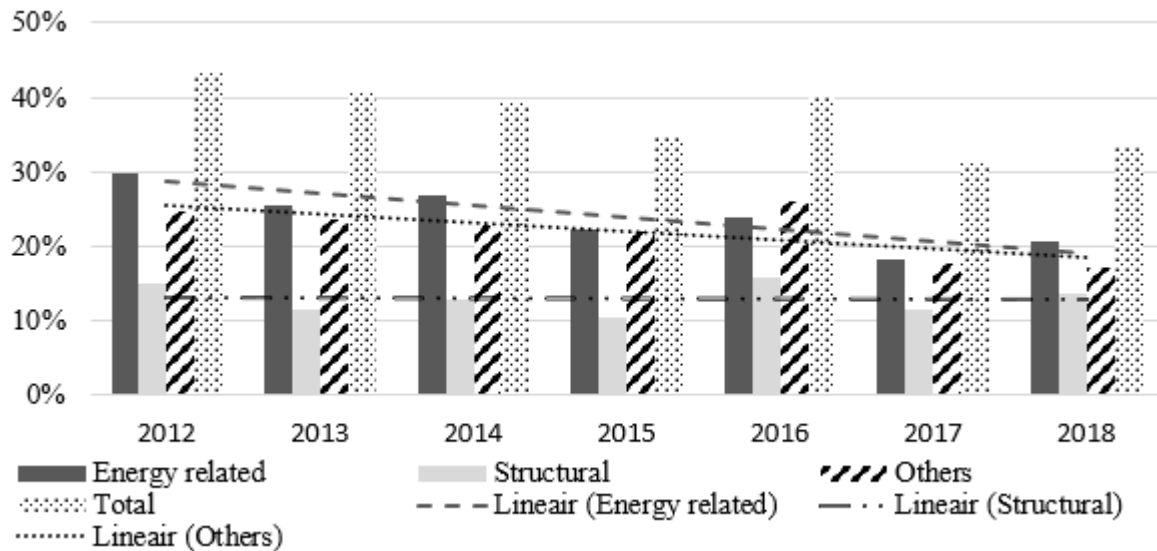


Figure 2. Overview of the renovation activity (in % of home-owners).

With regard to the presence of a building permit, yearly an average of 13.1% of all renovators applies for a building permit (period 2012-2018). Due to an adaptation of the questionnaire since 2016, a subdivision by type of work is only available until 2015. Before 2016, the application of a building permit was questioned for each renovation work separately, whereas since 2016 the application is questioned for the renovation in general. An average of 17.4% who performed an energy-related renovation received a permit. For structural works the percentage with building permit is expectedly higher (25.6%). While for other works the percentage with building permit remains low at an average of 9.9%.

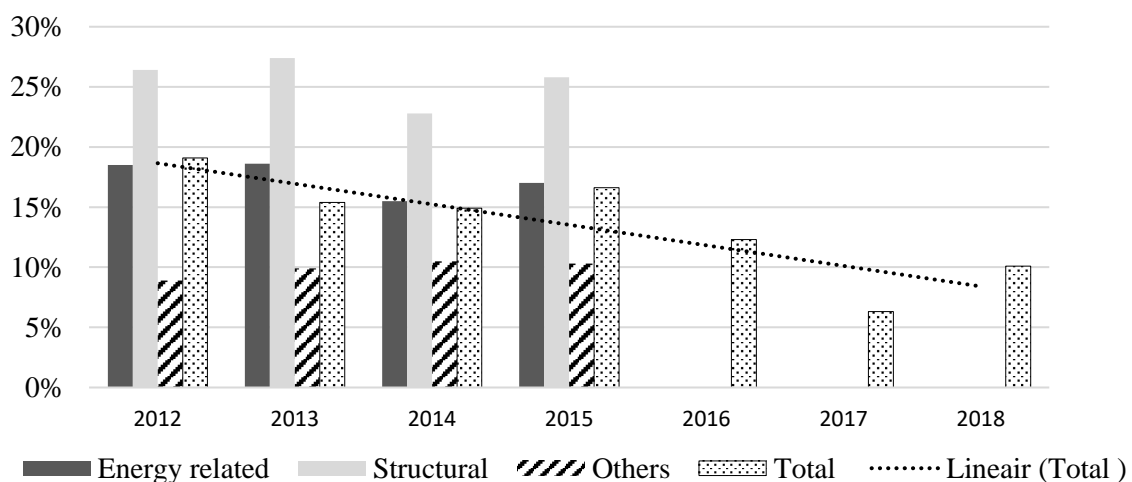


Figure 3. Overview of the application for a building permit (in % of renovators per type of renovation work).

Furthermore, an analysis of the renovation activity by building period shows more activity in houses built before 2000 (Figure 4). 40.5% of houses built before 1970 underwent a renovation activity compared with 27% of houses built after 2000. In addition, energy-related and structural works are performed more in houses built before 1990.

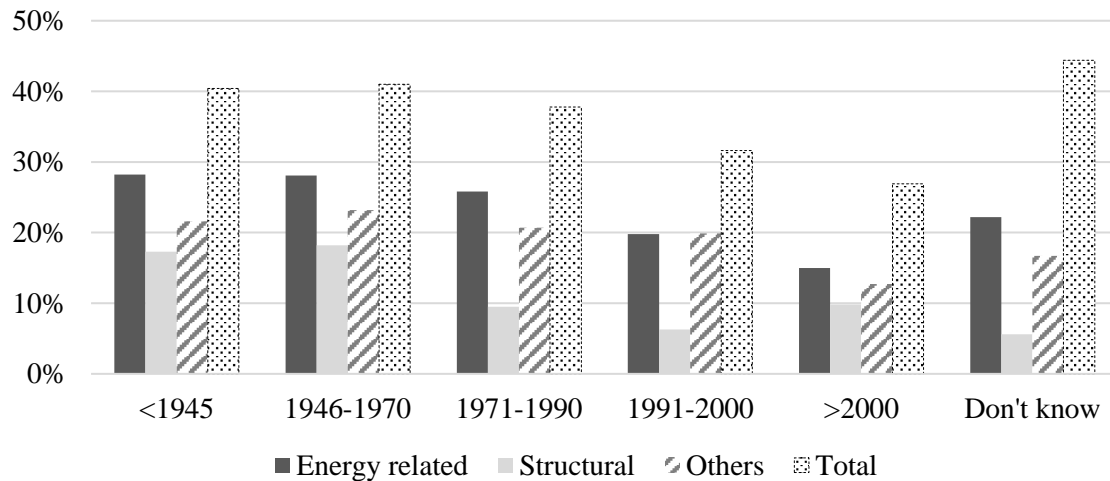


Figure 4. Overview of the renovation activity per type of renovation per building period (in % of renovators per building period).

3.2. Calculation of renovation rate

To compare the renovation rate of 37% of Belgian home-owners with the mentioned renovation rate in the Renovation Pact, further calculations are necessary. Firstly, to reconstruct the 1% renovation rate an analysis of the delivered building permits for renovation is performed. Secondly, a comparison is made with the Essencia Marketing survey. Finally, the reliability is explored by confronting the findings with other sources.

Statbel, the Belgian statistical office, reports on the delivered building permits for renovation [5]. In time, the regulation of building permits for renovation is severely adapted by making the application for a building permit no longer compulsory for small renovation works. Only deep renovation works (e.g. structural adjustments or expansion of the living area with more than 40m²) need to be accompanied by a permit. A comparison of the delivered building permits with the existing building stock shows an average renovation rate of 0.7% for buildings and 0.6% for living units in the period 2012-2018 in Flanders (Table 2).

Table 2. Overview of the building permits and building stock of Statbel for the period 2012-2018 (Flanders) [5].

	Building permits		Building stock		Renovation Rate		Building stock >5Y		Renovation Rate >5Y	
	Buildings	Dwellings	Buildings	Dwellings	Buildings	Dwellings	Buildings	Dwellings	Buildings	Dwellings
2012	15 846	17 593	2184 307	2836 293	0.7%	0.6%	2095 351	2653 482	0.8%	0.7%
2013	16 258	18 171	2197 301	2866 649	0.7%	0.6%	2110 203	2681 973	0.8%	0.7%
2014	16 435	18 487	2209 107	2894 414	0.7%	0.6%	2126 489	2712 703	0.8%	0.7%
2015	16 549	18 161	2220 608	2920 045	0.7%	0.6%	2142 761	2746 014	0.8%	0.7%
2016	15 760	17 856	2231 800	2944 668	0.7%	0.6%	2156 798	2775 682	0.7%	0.6%
2017	12 752	14 043	2244 288	2972 921	0.6%	0.5%	2170 299	2805 902	0.6%	0.5%
2018	16 526	16 526	2257 019	3006 601	0.7%	0.5%	2184 307	2836 293	0.8%	0.6%
Average	15 732	17 262	2220 633	2920 227	0.7%	0.6%	2140 887	2744 578	0.7%	0.6%

Until January 2018, a home-owner of a building older than five years could profit a reduced VAT rate of 6% instead of 21%. Therefore, also a calculation of the renovation rate is also made based on

building permits and buildings older than five years. However, still a renovation rate of 0.8% for buildings and 0.7% for dwellings is obtained.

When the renovation activity in the Essencia Marketing survey for the same period is analysed, a yearly rate of 37% of the Belgian home-owners is obtained (Figure 2). To compare the achieved renovation rate with the pronounced number of 0.7% to 1%, the Essencia Marketing survey need to be transposed from 1) Belgian home-owners to the Flemish population of owners and tenants, 2) home-owners to owners of dwellings, 3) houses older than five years to all houses and 4) all renovation to deep energy renovation.

1) Instructed by the Flemish government, a face-to-face survey among 10 000 households is performed in 2012-2013 about the living conditions and quality in Flanders, further referred to as GWO2013 [6]. 70% of the households owns their dwelling. However, the online survey of Essencia Marketing results in an owners rate of 83% probably caused by an underrepresentation of the social weaker households. Due to the larger sample and the higher degree of representativeness in GWO2013, the owners rate of 70% is used for conversion.

2) In addition, the type of dwelling needs to be added to transpose home-owners to dwelling owners. In the Essencia Marketing survey 14% of the owners were screened out because of their type of dwelling (apartment), so a correction factor of 86% is added. Hereby, the assumption of no energy-related renovation for owners of apartments is made, this could cause a small underestimation.

3). Based on the results of Table 2 a rounded average correction of 85% is necessary to expand from houses older than five years to the entire housing stock (comparison of renovation rates 0.7/0.8 (87.5%) - 0.6/0.7 (85.7%) or 0.5/0.6 (83.3%)).

4) Where the Essencia Marketing survey takes into account all renovation works, the mentioned renovation rate in the Renovation Pact is focused on deep energy renovation. Due to the absence of more specific information, it is assumed that renovations with building permit can be seen as deep (energy) renovation. Therefore, only renovators with building permit are withheld.

A recalculation of the obtained 37% home-owners renovators (Table 2) based on the explained assumptions for all renovation and for energy-related renovations is shown in table 3. The Essencia Marketing survey reports for the Flemish population a yearly rate of 2.5% for overall renovation activity and 2.1% for deep energy renovation. It is obvious that the detailed calculation of the Essencia Marketing survey surpasses the assumed 1%. Furthermore, the Essencia Marketing survey results in a yearly energy renovation rate of 13%, taken into account energy renovations with building permit as well energy renovations without building permit. This could give new insights on the need for adjustments of the policy actions for energy renovation.

To evaluate the reliability of these findings they need to be confronted with other sources, for example the Rational Use of Energy survey (RUE) [7]. Commissioned by the Flemish government, every two year a representative sample of Flemish households is surveyed considering their energy-related behaviour and energy-related investments. Specific attention is paid to the policy measures for energy renovations. Since, the RUE survey analyses the policy measure separately, the comparison will be performed on that level.

Table 3. Calculation of the correction factor for transposing Essencia Marketing results.

All renovations	Correction	Source	Assumption
Flemish population	100%		
Only owners	70%	70% GWO2013	Tenants don't perform deep renovations
Only home-owners	60%	86% Essencia	Apartment owners don't perform deep renovations
Only houses > 5 years	51%	85% StatBel	Correction is remained form buildings and dwellings
% of renovators	19%	37% Essencia	
With building permit	2.5%	13% Essencia	

Energy renovations	Correction	Source	Assumption
Flemish population	100%		
Only owners	70%	70% GWO2013	Tenants don't perform deep renovations
Only home-owners	60%	86% Essencia	Apartment owners don't perform deep renovations
Only houses > 5 years	51%	85% StatBel	Correction is remained form buildings and dwellings
% of renovators	13%	25% Essencia	
With building permit	2.1%	17% Essencia	

The RUE survey 2017 of the Flemish government indicates that 25% of a representative sample of the Flemish households installed roof insulation during the last ten years, of which 29% during the last two years. This means that on average 3.6% per year ($25\% * 29\%/2$) installed roof insulation during the last two years. Based on the Essencia marketing survey yearly an average of 5.5% of the Flemish home-owners installed roof insulation in the period 2016-2017. For a population with 60% home-owners this leads to an overall percentage of 3.3% ($5.5\% * 60\%$) of the Flemish population. Again, given the assumptions made to calculate the present estimation, both estimates are quite near one another, confirming the validation of our estimation.

Although further and more profound research is necessary to underpin the results of the survey through confrontation with other sources, it is clear that the 1% renovation rate of the Renovation Pact is rather a reflection of deep energy-related renovation with building permit than of the actual renovation rate. Furthermore, deep energy-related renovation with building permit is an underestimation of all energy-related renovation. The more detailed information about the yearly renovation activity provides more insights on the feasibility of the sustainability goals towards 2050.

3.3. Type and combination of renovation works

3.3.1. Type of renovation works. The top five of most pursued renovation activity is in order of appearance 1) works on the electricity net, 2) doors, windows and glass, 3) roof insulation, 4) bathroom and 5) the heating system. The highest rate for works on the electricity is not surprisingly since this work is often part of another renovation work (e.g. installation of solar panels mostly require extra electricity work, works on the interior wall are mostly combined with the installation of extra switches or sockets, ...). We notice that the top five contains three energy efficiency measures. Although along the years the shares of the works have changed, the composition of the top five remains mostly the same. In recent years roof insulation is sometimes replaced by works at the interior wall.

3.3.2. Combination of renovation works. Figure 5 shows the interrelational dependence of renovation types. 37% ($15\% + 8\% + 14\%$) of the renovators combines an energy-related renovation with structural or other works. However, 33% ($4\% + 21\% + 8\%$) renovates without any energy efficiency measures. For 12% ($4\% + 8\%$) it involves structural work, meaning renovating walls, roof or expanding the living space. Obviously, these types of work are most likely to be accompanied by energy related work. Further research will be necessary to determine if these structural renovation works could serve as a gate to promote deep energy renovation.

	Energy (1)	Structural (2)	Other (3)
1 + 2 + 3	15%		
1 + 2	8%		
1	29%		
2 + 3		4%	
3			21%
1 + 3	14%		
2		8%	
	100%		

Figure 5. Combination of renovation works

4. Conclusion and discussion

Based on a yearly online survey among a representative sample of Belgian households the renovation activity of Belgian home-owners is analyzed. Yearly, an average of 37% of home-owners renovates or rebuilds something in their house. Energy related renovation works are most executed. When the results are recalculated – as good as possible with the available data- to the population of Flanders, a renovation rate of 19% is obtained or 2.1% of deep energy related renovations. This result surpasses the 1% renovation rate, which is often referred to in the communication on the need for a higher renovation activity to achieve the European goals.

However, some limitations have to be mentioned. The Essencia marketing database indicates an underestimation of the lowest socio-economic households and it can be expected that due to budget limitations, renovation activities are lower among these households compared to higher income groups. Furthermore assumptions had to be made since the survey only questions home-owners, and excludes tenants and apartment owners. Also, the database under study was an online research among consumers. Although home-owners in general are aware of the type of renovation works executed, differences in interpretations cannot be avoided; e.g. a porch is seen as a structural work, although it can also be seen as replacing windows and doors which is an energy related measure. Finally, the size of the used database (5.449 respondents) permits a profound calculation of the evolution of the renovation activity. However, it makes it impossible to complement with results on energy use before and after the renovation. But as shown by [3], it can be expected that explication of energy efficient measures in general also lead to lower energy use.]

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