

Energy retrofitting of multi-family residential buildings

Assessment of current state and energy efficiency potential of the Geneva building stock based on case studies

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A better understanding of energy efficiency in the Swiss building stock, currently insufficient at the local level, is fundamental to achieve the goals of the Swiss energy strategy 2050. This study focuses on energy retrofitting of multi-family residential buildings in Geneva, integrating technical, economical, financial and environmental aspects, as well as preservation of cultural heritage.

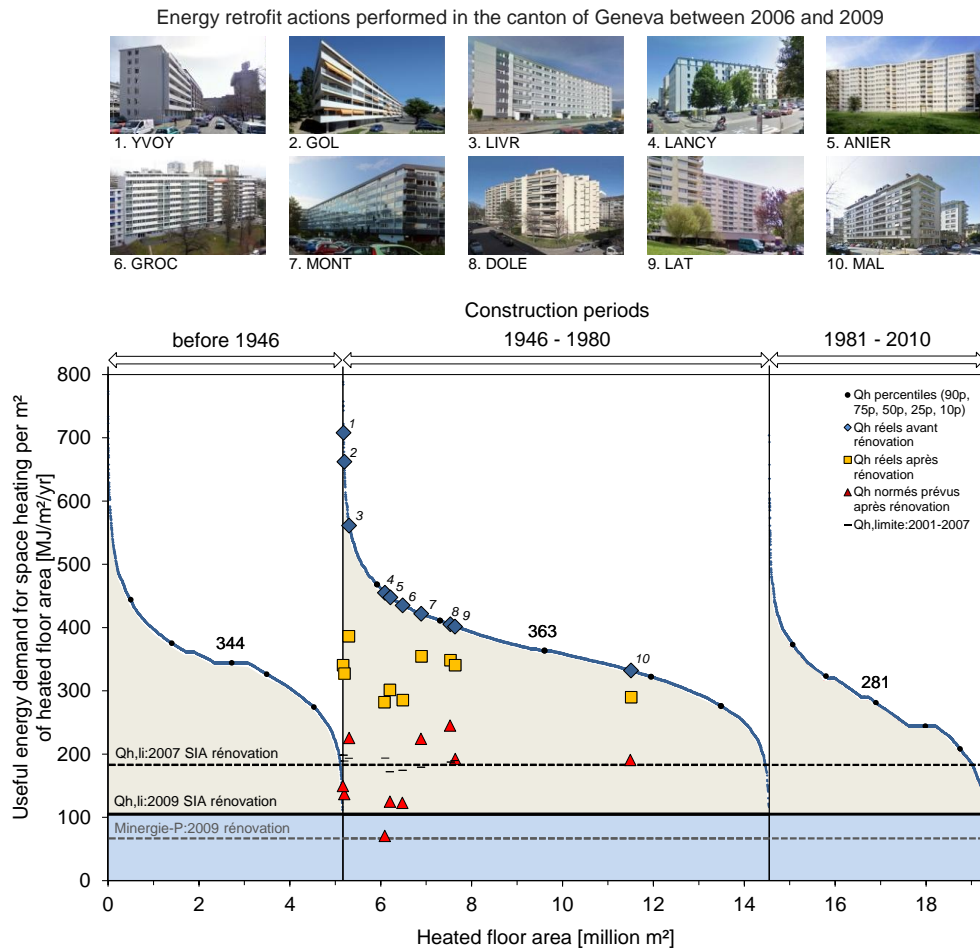
The current state of Geneva's building stock, presented in detail in the first part of this study, shows that multi-family residential buildings are responsible for almost half of the thermal energy consumption of the canton as well as half of the CO₂ emissions of the whole building stock. About half of this consumption and these emissions are caused by post-war multi-family dwellings built between 1946 and 1980, which are nowadays in need of retrofit and possess a strong energy saving potential and CO₂ emissions reduction. The analysis of retrofit dynamics registered between 2004 and 2012 in the canton of Geneva shows a significant increase of energy retrofitting of residential buildings since 2010 (increase in number and share of energy retrofit in total of energy and non-energy retrofit). The average annual energy retrofit rate of these buildings has quadrupled between 2004-2010 and 2011-2012, due to the retrofit boom of the post-war residential buildings and a tighter energy regulation.

The second part of this study deals with the real performance of retrofit actions with a focus on energy and economic aspects. The aim is to improve the actions undertaken and disseminate the best practices. The study is based on a monitoring campaign implemented in a multi-family building built in 1963 in Onex (GE) that was retrofitted according to the Minergie standard in 2008 and a benchmark study over 50 buildings (10 actions) retrofitted in Geneva between 2006 and 2009. The assessment of the energy performance of these actions shows that the real space heating demand of the retrofitted buildings is 43% to 142% higher than the expected calculated value, with one exception that has exceeded 310%. It also shows that the higher the predicted space heating saving potential is, the higher share of this potential will be reached in reality. On the basis of the observations made, the global retrofit cost (including energy related and non-related works) according to Minergie standard of the post-war multi-dwelling buildings in Geneva would be around 10 billion CHF before tax, which corresponds to around 300 million CHF per year until 2050 (without taking into account the extra cost related to heritage conservation). Therefore, achieving these goals will need a considerable financial effort from the owners, tenants and the State.

The last part of this study evaluates the theoretical energy saving potential for space heating in Geneva's multi-family building stock and provides concrete recommendations to mobilize efficiently this potential. The main conclusion is that the achievement of the ambitious goals set by the federal government, particularly those which aim to reduce by half the space heating demand by 2050, is hardly possible without an improvement of the current practices regarding the actors involved in building retrofit process (process that starts with the energy audit and ends with the use of the buildings by the occupants and energy managers). This also requires a global and coherent building retrofit strategy at cantonal level, as well as additional resources to ensure monitoring of the building stock energy performance.

A summary of the main results achieved may be found in the synthetic scheme below (Figure 0.1).

Figure 0.1. Synthetic scheme illustrating space heat use distribution of all multi-family residential buildings in the Canton of Geneva in 2010, according to the three major periods of construction. Also shown are effective and expected heating needs of the 10 retrofit actions (50 buildings) analysed, as well as the theoretical potential of energy saving for space heating by applying SIA 380/1:2009



Multi-dwelling buildings in Geneva		Period of construction			
		before 1946	1946-1980	1981-2010	TOTAL
Situation in 2010					
Number of buildings	[-]	3'831	5'240	3'531	12'602
Heated floor area	[mio m ²]	5.17	9.37	4.75	19.30
Total space heat use	[GWh/yr]	502 (27%)	945 (52%)	378 (21%)	1'825 (100%)
Theoretical energy savings potential (space heating)*	[GWh/yr]	354 (28%)	677 (53%)	241 (19%)	1'272 (100%)

*Hypothesis : Q_{h,li}:2009, compactness factor A_{th}/A_E=0.7

Keywords: energy retrofit, multi-family residential buildings, Geneva, current state, case studies, Minergie, performance, energy savings, energy efficiency potential, occupant behaviour, costs, financing, building stock, housing, Swiss energy strategy 2050