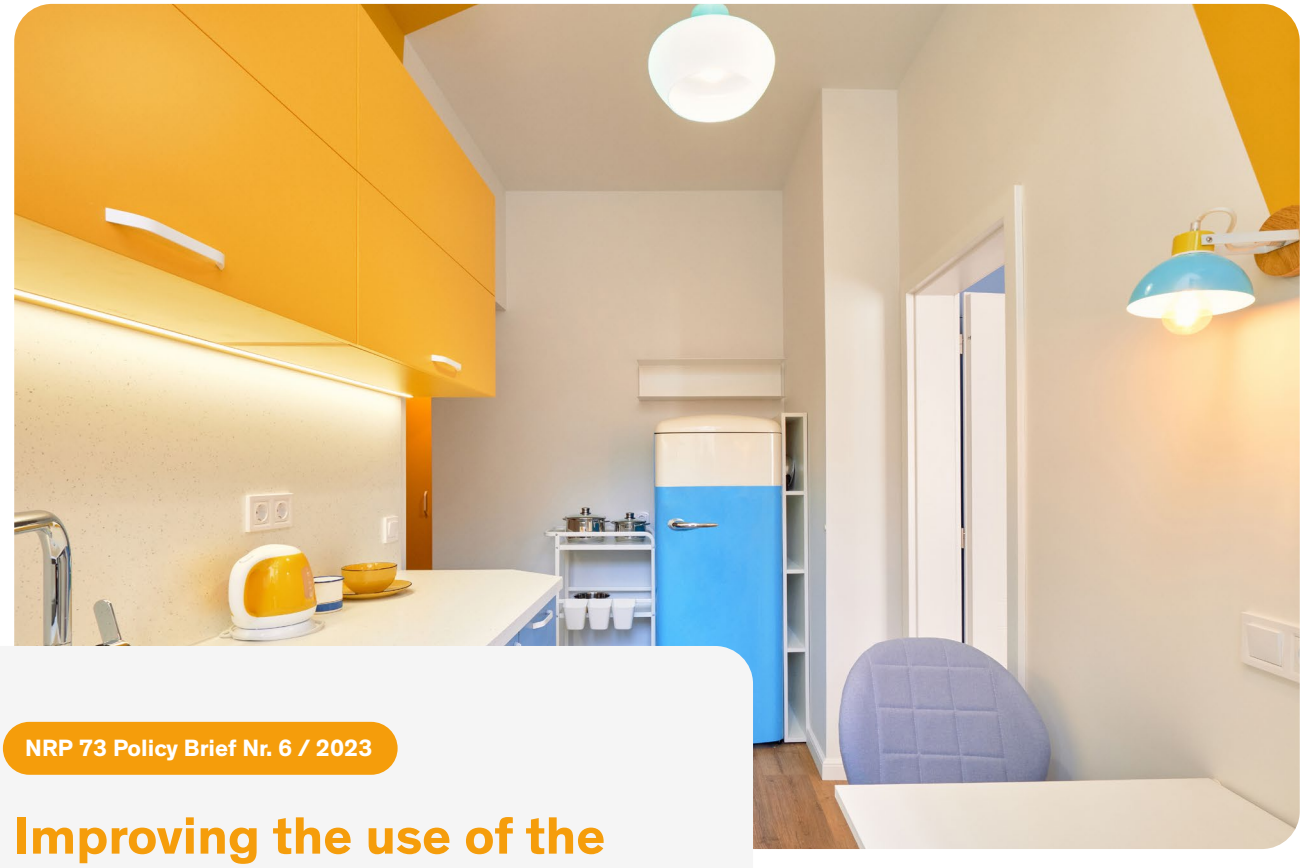

NRP 73 Policy Brief Nr. 6 / 2023

Improving the use of the housing stock to reduce its environmental impact

Importance for key players in the housing sector

1 In the future, the existing housing stock should be improved while less new dwellings are built.

2 This improvement will take the form of energy-efficient renovation as well as by encouraging cohabitation and reducing the amount of living space occupied per person.

3 Not only the key players in construction and property but also residents themselves will all have to alter their habits; the former by adapting their buildings for more efficient occupation and the latter by consenting to live in slightly smaller spaces.

Swiss National Science Foundation

Why residential floor space has been increasing since 1980

The total amount of residential floor space we use is the main determinant of our consumption of energy for heating, ventilation and lighting. The thermal qualities of homes naturally have a part to play, too, but these qualities increase the environmental impact of housing because of the additional materials required and the energy needed to produce and install them, as well as the extra waste generated. Furthermore, these impacts increase in line with the number and size of our dwellings and the surface area of the land occupied – land that is needed for natural and productive areas. It is therefore hardly surprising that reducing the per capita living space is considered one of the main levers for achieving more sustainable housing.[1]

This reduction is not happening yet, although the increase has slowed since the turn of the century. Table 1 presents the Federal Statistical Office (FSO) data describing this trend. Between 1980 and 2020, the total floor space of occupied housing units increased by 87 %, even though the population increased by only 37 %. The discrepancy can be explained by two factors: the greater fragmentation of the population and the increased size of new homes. Fragmentation of the population refers to the division of the population into groups of cohabitants – i.e. households. In 1980, 6.2 million residents occupied 2.4 million dwellings, giving an average of 2.6 people per home. Without this increased fragmentation, the 8.5 million residents we have in 2020 would occupy 3.3 million homes instead of the 3.9 million actually occupied. Paradoxically, the average floor space of housing units has risen by 15 % since 1980 even though they contain a smaller number of residents. Fewer people occupying larger homes accounts for the big increase in floor space per capita, from 34 m^2 in 1980 to 46 m^2 in 2020.[2]

Figure 1 illustrates which role these various factors play. As the base of each rectangle is equal to the number of residents and the height is equal to the m^2 per resident, the area of the rectangle is equal to the total floor space of occupied housing units in 1980, 2000 and 2020. It is clear that the floor space has increased mainly because of the increase in m^2 per resident between 1980 and 2000 and the increase in the population between 2000 and 2020.

Figure 2 presents a different illustration of the role of the different growth factors on total residential floor space. It shows the total floor space that would have been measured by the FSO in 2020, if the population, the floor space per resident, the fragmentation into households or the average floor space of housing units had remained the same as in 1980. Example: The 1980 population would have occupied 287 km^2 of residential space in 2020 under 2020 living conditions. In other words, the difference between the actual total floor space – 394 km^2 – and this hypothetical floor space – 287 km^2 – is attributable to demographic growth. This accounts for around half the increase in total occupied floor space, with the other half accounted for by the increase in floor space per resident. The latter is due in almost equal parts to the greater fragmentation of the population and the increase in the floor area of housing units.

The last column of Table 1 shows what the housing stock would look like in 2020, if the only growth factor affecting the number of housing units and their total floor space had been demographic growth. It also takes the estimated proportion of second homes in 1980 to be 14 %, rather than the actual figure of 19 % for second homes in 2020. In fact, the even higher growth seen in the number of second homes than in the number of occupied housing units reinforces the total increase in the floor space of housing units, and thus the environmental impacts of housing, even though statistics on this floor space are lacking.

The comparison of the figures for 1980, 2000 and 2020 in Table 1 shows that the fragmentation of the population and the increase in standards of comfort were most marked during the first two decades. Since then, the increase in the total residential floor space has been driven mainly by population growth. According to the FSO's demographic scenarios, the Swiss population will increase to between 9.5 and 11.4 million in 2050. 11.4 million people could be housed in the dwellings that already exist, provided that the average household size increased to 2.9 people, which would involve many new groupings. The average floor space per resident would go back down to 34.5 m^2, which is approximately the same level of comfort as in 1980.

The increase in standards of comfort as measured in terms of average floor space per resident clearly reflects the increase in our real incomes, because the proportion of income we spend on housing has hardly increased at all. Between 1980 and 2020, the proportion of household consumption expenditure devoted to housing, including energy, home improvements and maintenance, rose from 28 % to 31 %. This would be fine as far as comfort is concerned (there are significant distributive inequalities that are not discussed in this short text) – were it not for the environmental impacts, which increase in line with the m^2.

Table 1: Housing stock and population, 1980 – 2020

	1980	2000	2020	*1980 – 2020*	2020*
Total number of housing units (millions)	2.7	3.6	4.6	*+ 70 %*	3.7
Total number of occupied housing units (millions)	2.4	3.0	3.9	*+ 63 %*	3.3
Total floor space of occupied housing units (km^2)	211	302	394	*+ 87 %*	289
Average floor space per housing unit (m^2)	88	100	101	*+ 15 %*	88
Population (millions)	6.2	6.9	8.5	*+ 37 %*	8.5
Residents per housing unit occupied	2.6	2.3	2.2	*– 16 %*	2.6
Floor space per resident (m^2)	34	43.6	46.3	*+ 36 %*	34

FSO data except 2020* (see text).

[1] The International Resource Panel of the United Nations Environment Programme (UNEP) considers what it calls more intensive use of homes to be the measure with the greatest potential to reduce the greenhouse gas emissions associated with residential buildings. This could achieve a 70 % reduction by 2050 in the G7 countries, far ahead of improving recycling (14 – 18 %), designing buildings containing less material (8 – 10 %), and using timber (1 – 8 %) (IRP, 2020).

[2] The energy reference area, which includes not only living areas but also heated circulation and common areas, is estimated at 520 km^2 for private households in 2020: i.e. 61 m^2 per person (Wüest Partner, 2021).

What does the future hold?

The Swiss population will continue to grow, as we have seen, but that is not the only factor determining the total area used for housing; it will also depend on the types of housing units constructed over the next 30 years in response to demand for homes by the country's current and future residents – demand that will evolve, especially as the population ages.

We have attempted to represent the future trend with the help of decision rules based on observation of the past evolution of the housing portfolios of three major property owners – two cooperatives and an insurance company – which own 11 112 housing units throughout Switzerland between them. Accurate records of these property portfolios, interviews with their managers and a survey of residents enabled us to understand these decision rules and construct a model of how these property portfolios and their occupation have evolved since 1920 (Agriantoni, 2022).

What's gained in accuracy is lost in exhaustiveness: our model does not claim to represent the evolution of all housing in Switzerland; in particular it does not include owner-occupied homes and detached houses,[3] whose inhabitants occupy considerably more floor space per person (54.6 m^2) than the tenants of our three property owners (45.8 m^2). Nor does it include second homes. These sectors would need to be analysed individually.

If the trends and behaviours observed are extrapolated to 2050, the average floor space of housing units would increase by 6.3 % compared with 2020. Since household size is continuing to decrease, the floor space per resident would rise by 11.1 %. If it were to rise by this proportion for the entire population, the 10.4 million residents in 2050 according to the FSO's main scenario would occupy a total residential floor space of 537 km^2, which is 36 % more than at present.

How can residential floor space be reduced?

We have used our model to test the impact of the different measures proposed for slowing the increase in residential floor space: strict rules when allocating housing units to new tenants, a big decrease in owners' ability to construct new housing, and raising tenants' awareness of the environmental impact of buildings (Agriantoni and Thalmann, 2022). Even combined, these measures are not sufficient to reduce the average floor space per resident in the housing stock as a whole. They therefore cannot stem the growth in total residential floor space, and, consequently, the environmental impacts (materials, energy, waste).

To better understand the main drivers, it is useful to break down the impacts as follows:

$$\text{Impacts} = \text{Population} \times \frac{\text{Total area}}{\text{Population}} \times \frac{\text{Impacts}}{\text{Total area}}$$

That last fraction is decreasing thanks to energy efficiency measures (if the impacts are energy consumption), saving on materials, choosing less harmful materials, densification, etc. Great progress has been made in these respects, but it is being counteracted by the increase in the first two terms of the equation – population and floor space per resident.[4]

The results of the study are clear: it will be impossible to reduce the environmental impact of housing sufficiently if the population continues to grow without reducing the amount of living space per capita. Furthermore, achieving sufficiency (EEB, 2021) would benefit not only the environment but would also be financially beneficial. Our studies show that it will require effort by landlords as well as tenants, the construction sector as well as residents. This may be prompted by a better understanding of the environmental impacts, by the increased cost of each m^2, and by the increased cost of the environmental impacts (energy, materials, land, etc.) (Karlen, Pagani, Binder, 2021). It will be assisted by constructional and architectural solutions that make small dwellings and cohabitation more attractive, such as open-plan designs and the ability to transform housing units and communal areas (Pagani, 2022). This is bound to have consequences for the construction sector, which will have to concern itself less with constructing new buildings and more with working on existing buildings to turn them into enenergy-producing spaces while offering an agreeable living environment to a greater number of residents.[5]

Key Messages

Residential floor space is still increasing in Switzerland, and with it the environmental burden. Although the increase has slowed over the past 20 years, it will not be possible to turn the situation around without decreasing the average floor space per resident. Here we seek to understand the principal mechanisms of the trend – a rising population is fragmenting into smaller and smaller households occupying bigger and bigger homes, and there is the prospect of the total residential floor space increasing by more than a third by 2050 – and to consider how this process could be slowed through greater sufficiency while at the same time transforming the housing stock to encourage cohabitation.

What is meant by...

Sufficiency: This consists of freely choosing, without legal or economic compulsion, to consume a smaller quantity of certain goods, such as the living space one could and would like to consume.

[3] Lavagna et al. (2018) consider that the environmental impacts of the housing life cycle and the energy and materials used are 40 to 65 % higher for detached houses than for apartments, depending on the type of impact. This difference falls to a maximum of 5 to 18 % when the higher number of residents in detached houses is taken into account.

[4] Lavagna et al. (2018) show that the efficiency gains in housing, particularly as regards the energy performance of housing units between 1970 and 2000, have been cancelled out in the European Union by the increase in floor space per person. For Switzerland, Prognos (2021) estimates that the possible reduction in energy consumption in homes thanks to technology and policy (–66.0 PJ between 2000 and 2020) has been very nearly neutralised by the increase in floor space (+64.4 PJ).

[5] Following NRP 73, the SNSF set up the Co-Creation Lab for Sustainable Construction and Housing with the aim of bringing together key players in construction, property and housing to visualise a more sustainable future.

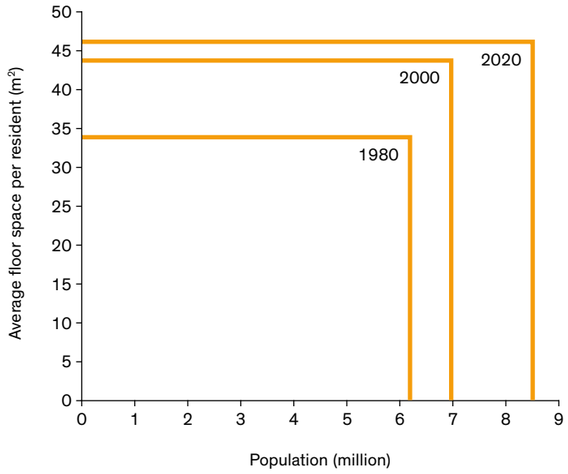

Figure 1:
The area of the rectangles represents the total floor space of occupied housing units

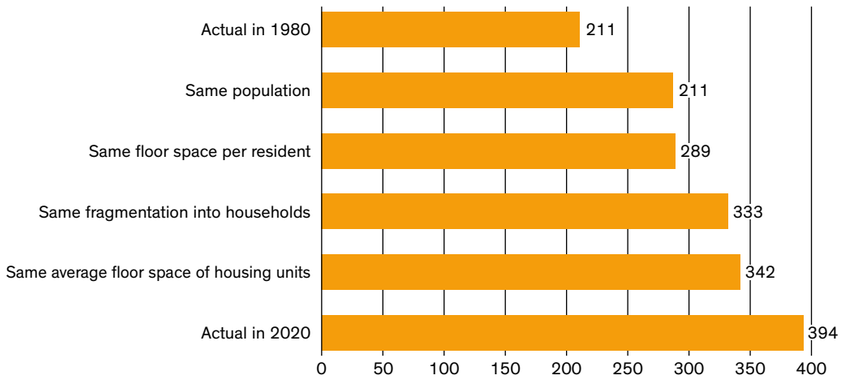

Figure 2:
Total floor space of occupied housing units in 2020 with the characteristics of 1980 (km²)

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About NRP 73

www.nrp73.ch

The National Research Programme “Sustainable Economy” (NRP 73) was launched by the federal council with a global budget of CHF 20 million for five years of research starting mid-2017. It funded 29 research projects in different thematic areas such as Circular Economy, Finance, Building & Construction, Cities & Mobility, Forestry, Agriculture & Food, Supply chain, Sustainable Behaviour and Governance. NRP 73 aims at generating scientific knowledge about a sustainable economy that uses natural resources sparingly, creates welfare and increases the competitiveness of the Swiss economy.

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