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RESEARCH

Assessing the social acceptability of sufficiency measures in the residential sector

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Abstract
Efficiency measures are insufficient for achieving greenhouse gas neutrality in the residential sector. Additional efforts are needed, with the concept of sufficiency gaining increasing attention. Sufficiency targets demand side and behavioural change, while delivering wellbeing. Reducing living space per capita is a sufficiency measure often suggested for residential buildings. However, research dealing with social perceptions and attitudes towards sufficiency is limited. We conducted a survey of Berlin households to assess correlates of current living space, and examine satisfaction with current living space and willingness to downsize. A large proportion of the population is willing to reduce their living space, 43% of survey participants could envisage downsizing without compromising their personal wellbeing. Older people (aged 66–80) have the highest per capita consumption of living space of all age groups and are attracted to new living models, such as cluster apartments, as these models strengthen social interaction and promote autonomy. Empty-nesters also show high sufficiency potential, over half of this group indicate willingness to reduce living space. The paper highlights group-specific sufficiency potential and provides policymakers with suggestions for developing strategies that support downsizing while preserving or improving the wellbeing of residents.

Keywords Sufficiency · Housing · Sustainable consumption · Residential downsizing · Lifestyle · Urban planning

1 Introduction

The building sector is pivotal in the effort to mitigate climate change. Energy consumption and embodied emissions from construction of buildings are a major contributor to Greenhouse Gas (GHG) emissions. Emissions per-capita from buildings in Europe are around double the global average (Cabeza et al., 2022). A number of directives at the European level are targeting emission reductions, including the Energy Performance in Buildings Directive, Renewable Energy Directive, and Renovation Wave. Few of these target demand side solutions, with the emphasis placed rather on increased efficiency and reduced GHG intensity of energy supply.

A substantial body of research has been devoted to the investigation of cleaner energy and energy and material efficiency, with the aim of reducing both operational and embodied emissions (Thomas et al., 2019). Nevertheless, a focus on efficiency alone is insufficient to achieve the requisite reductions in environmental impact (Ellsworth-Krebs, 2020). Recently, the concept of sufficiency has emerged as a complementary strategy for addressing climate change (Bierwirth & Thomas, 2015; Samadi et al., 2017; Spangenberg & Lorek, 2019; Wiese et al., 2024; Zell-Ziegler et al., 2021). Sufficiency aims to reduce ecological footprints by limiting resource consumption, with less dependence on technological advancement, and is becoming more common in sustainability scenarios (Cabeza et al., 2022; Creutzig et al., 2022)).

The concept of sufficiency poses a fundamental question: how much is "enough"? (Von Winterfeld, 2007). As Saheb (2021) posits, sufficiency prioritises environmental compatibility through lower consumption, whereas efficiency

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provides more commodities to satisfy human wants. The defining feature of sufficiency, therefore, is a transformation in consumption patterns to reduce overall demand, while maintaining or attaining high levels of wellbeing (Saheb, 2021; Sugiyama et al., 2024). Wellbeing can be understood in many different ways. A recent review identifies five schools of thought for understanding wellbeing; subjective wellbeing, welfare economics, needs theories, capabilities, and ecological approaches (Jansen et al., 2024). While subjective wellbeing is most commonly measured through survey questions about life satisfaction, eudaemonic wellbeing is also highlighted as an important consideration attracting increasing attention in wellbeing debates (Brand-Correa & Steinberger, 2017; Lamb & Steinberger, 2017), and it is more associated with life fulfilment, purpose, and meaning (Jansen et al., 2024). This is distinct from hedonic wellbeing, which prioritises consumption and short-term happiness.

The concept of 'consumption corridors' establishes a framework to achieve high wellbeing with low resource demands within ecological limits, and it bears stronger relation to needs theories of wellbeing (Fuchs et al., 2021). It defines minimum and maximum consumption values for the corridor to create a consumption corridor that is both socially just and ecologically compatible. Within these corridors, individuals are free to shape their own lifestyles and have access to the resources they need for everyday life, enabling them to live with dignity without exceeding planetary boundaries. Pauliuk (2024) shows that a consumption corridor can be developed in which inequalities persist but remain within a level that is perceived as 'fair' by society.

In the residential sector, sufficiency can be observed in a number of ways, including the adjustment of expectations regarding thermal comfort with a view to reducing heating and cooling demands, or the limitation of the ownership of energy-intensive appliances (Rao & Min, 2018; Wiese et al., 2024; Zell-Ziegler et al., 2021). The most impactful sufficiency strategy identified for reducing resource use and emissions buildings is the reduction of per capita floor area (Cabeza et al., 2022; Pauliuk et al., 2024; Rao & Min, 2018). A reduction in the amount of per capita floor area will result in a decrease in energy consumption for heating, cooling, and lighting, while also reducing the quantity of materials and emissions generated when houses are constructed and maintained. The reduction in living space per capita not only supports environmental goals but also challenges the traditional notion of affluence, which often equates personal wellbeing with larger homes and greater material possessions (Bierwirth & Thomas, 2015). Cultural and economic drivers of household decisions in housing markets often conflict with sufficiency. For instance, housing may be perceived as a positional good symbolising wealth, or treated as an investment to increase value of assets or for use for future generations (Dewilde & Waitkus, 2023). For these reasons, and due to housing policies that favour larger dwellings in new constructions, households may be encouraged to live in larger homes. However, in the case of Berlin, a large majority of residents live in rental housing (Amt für Statistik Berlin-Brandenburg, 2024a), so these drivers may be weaker than in other locations with higher shares of owner-occupiers.

There are other structural conditions in Berlin that discourage reducing floor space among renters. Incentives to downsize by moving home are limited by a highly strained housing market, higher rents in new tenancy agreements (Mense et al., 2019), and the fact that suitable smaller properties are often unavailable in the same neighbourhood, meaning people would have to move to other districts and adapt to new social environments. Moving is also associated with stress and, in the short term at least, extra costs. This illustrates that sufficiency in the housing sector is not only a technical or economic issue, but also a social one. Ultimately, the success of sufficiency depends on households' and societies' willingness to accept changes, which requires a redefinition of notions such as prosperity, challenging the assumption that bigger is better, and changes to housing markets and policies which make downsizing easier. While such shifts are not historically unprecedented (Stengel, 2011), they take time. Changes in floor space must also be compatible with people's sense of personal well-being. At the same time, sufficiency can open up new opportunities. For example, it can foster housing concepts that better align with people's needs, such as collaborative living arrangements in later life (BBSR, 2020). This may be particularly relevant in ageing societies.

Although several studies demonstrate the potential of theoretically reducing living space in buildings, there is a lack of research on social perceptions and attitudes towards sufficiency. This theoretical potential can only be realised if people are willing to implement it. Research is therefore needed that analyses the willingness to implement sufficiency measures in everyday life considering housing situations and socioeconomic and demographic factors. Assessing people's openness to sufficiency measures alongside such factors can enable identification of population groups with high sufficiency potential.

This study addresses a gap in existing literature by examining the current housing situation and the social acceptance of sufficiency measures among Berlin's population. A research survey was conducted to answer the following two key questions: Firstly, what is the relationship between per capita floor area consumption and life-stage factors such as household size, age, and income? Secondly, to what extent are people willing to reduce their living space? The study provides new insights into the social dimension of sufficiency, highlighting population groups with particularly high sufficiency potential. The results aim to contribute to

a broader understanding of the sufficiency approach, from which a practicable strategy for reducing CO_2 emissions caused by the residential sector can be derived without reducing the population's personal wellbeing, from both subjective wellbeing and needs based perspectives. This can then inform new policy initiatives.

2 Material and methods

2.1 Research survey

We designed a research survey to collect quantitative and qualitative data to gain a deeper understanding of how the population perceives their current living space and the possibility of reducing individual living space per capita. The survey explored the extent to which a sufficiency lifestyle is conceivable and feasible for respondents, and to what extent their self-assessed wellbeing is influenced by the size of their living space. It also identified the factors influencing and hindering the implementation of sufficiency. We did not give a definition of wellbeing to the participants, but we deem that the self-assessment of living space as too small/appropriate/too large aligns closely with needs-based assessments of wellbeing, while questions on the relations of housing and living-space with wellbeing align with subjective wellbeing approaches measured through housing satisfaction or life satisfaction. 626 people from all parts of Berlin took part in the survey. The survey was distributed both online and in paper form and ran for a period of four weeks. The aim was to generate the most heterogeneous sample possible, particularly with regard to age, household size and income. To this end, the research survey was distributed mainly to universities, neighbourhood groups in all Berlin districts, senior citizens' representatives, and via direct distribution in the respective neighbourhoods. The survey focused on three main topics:

1. Current housing and household situation:

- Survey of participants' current housing and household situations
- Inclusion of participants' subjective perceptions
- Personal assessment of the appropriateness of the living space size
- Survey of changes in household size since moving and their impact on the housing situation

2. Importance of personal wellbeing:

- Influence of living space size on personal wellbeing
- Key factors influencing housing-related wellbeing
- Effects of a reduction in living space per capita

3. Willingness to downsize:

- Willingness to reduce living space, provided that wellbeing is not affected
- Reasons for and against reducing living space
- Willingness to move to a smaller dwelling, to experiment with co-housing or cluster[1] living models, or to share one's current residence with an additional person
- Openness of the population towards alternative housing forms aimed at reducing individual residential space consumption
- Barriers for downsizing

The survey data can be accessed in the associated Zenodo data repository (Arndt et al., 2026).

2.2 Statistical methods

Descriptive statistical methods were used to analyse the data to describe the current housing and household situation as well as the perception of and willingness to reduce living space. The study employed multiple regression analysis to examine the relationship between per capita living space consumption and various explanatory variables, and specified a binomial logistic regression to assess influences on willingness to downsize. Because some predictor categories exhibited sparse data patterns (e.g. no respondents for whom wellbeing is highly dependent on living space indicated willingness to downsize), we used Firth's bias-reduced penalized likelihood to mitigate separation and obtain finite, stable coefficient estimates (Firth, 1993). The selection of variables considered in these models is based on well-established findings from housing research literature. Numerous studies illustrate that socio-demographic, household-related and property-related characteristics are key determinants of housing-related variables such as living space, amenities and location. The work of Estiri and Zagheni, which identifies

[1] A cluster flat is a flat in which several small private living units are connected with shared rooms (Prytula et al., 2020). The difference to conventional shared flats is that all private living units have their own bathroom and optionally a kitchenette. The residential units are accessed via the communal area, which acts as a connecting element (STATTBAU Stadtentwicklungsgesellschaft, 2019). The communal area consists of a shared kitchen, a living room and other shared uses (e.g. utility rooms, additional sanitary facilities or flexible guest rooms).

variables such as household size, age, income, ownership status and location as being particularly influential on housing characteristics, also serves as a theoretical and empirical basis (Estiri & Zagheni, 2018; Estiri, 2014a, 2014b).

The following variables were incorporated into the regression model for per capita living space: age, household size, rent, equivalised income, and district of Berlin. Equivalised income was calculated as net (after-tax) household income divided by the square root of household size.[2] As the survey gathered household income ranges, each individual income range was represented by its arithmetic midpoint in the analysis. We specified the regression models for two groups, one for renters and one for homeowners, assuming that the two groups differ systematically in terms of the relevant influencing factors and housing conditions. Modelling the two groups separately allows differences in the influencing factors and their weighting to be assessed for each group, enabling more precise estimation and interpretation of the effects. Further, group-specific variables (such as rent) are prevented from distorting the respective non-applicable observations. This approach also allows specific statements and comparisons to be made for both segments of the housing market, enabling more relevant and targeted conclusions to be derived.

Equations (1) and (2) summarise the regressions for living space per capita.

Renters:

$$\begin{aligned}\text{living space per capita}_i \;=\; & \beta_0 + \beta_1 \text{household size}_i \\ & + \beta_2\ \text{rent}_i + \beta_3 \text{age}_i + \beta_4\ \text{district}_i \\ & + \beta_3 \text{equivalised income}_i + \varepsilon_i\end{aligned} \tag{1}$$

Homeowners:

$$\begin{aligned}\text{living space per capita}_i =& \beta_0 + \beta_1\ \text{household size}_i \\ & + \beta_2 \text{age}_i + \beta_3\ \text{district}_i \\ & + \beta_4 \text{equivalised income}_i + \varepsilon_i\end{aligned} \tag{2}$$

The binomial logistic regression of willingness to downsize W is modelled with the variables age, self-assessed dependence of wellbeing on living space, self-assessed sufficiency of current living space, and whether household size was reduced in recent years for different reasons (Eq. 3). Self-assessed dependence of wellbeing on living space and sufficiency of current living space are Likert variables which we model as categorical for better transparency of effects across different levels.

$$\begin{aligned}\log\left(\frac{\Pr(W_i=1)}{\Pr(W_i=0)}\right) =& \beta_0 + \beta_1 \text{age}_i + \beta_2 \text{wellbeing dependence}_i \\ & + \beta_3 \text{living space sufficiency}_i + \beta_4 \text{reduced HHS}_i\end{aligned} \tag{3}$$

2.3 Limitations

The study does not attempt to be representative and represents only a small part of the Berlin population (Table 1). Some demographic groups are underrepresented, such as male participants and the 81 + age group. The latter is not considered in the results due to the small number. The proportion of homeowners in the sample is disproportionately high and twice the Berlin average. The sufficiency potential analysed in this study therefore does not claim to be complete. However, the identified potential offers a good starting point for a further study to explore the sustainability contribution of sufficiency measures in the housing sector.

3 Results

3.1 Factors influencing the living space per capita

For the analysis of the sustainability contribution of housing sufficiency measures, it is necessary to first identify potential opportunities for savings. Accordingly, it is important to identify factors that influence the living space per capita and especially factors that lead to an above-average consumption of living space. The regression results (Table 2) indicate that the independent variables household size, age, equivalised income and the amount of rent including heating (for renters) all have a significant association with living space per capita. The models have quite high explanatory power, explaining 69% of variation in living space per capita for renters and 59% for homeowners. Household size is one of the most influential variables in the analysed models, with an increase of one person leading to a reduction in living space per capita by 11.5 m^2 for renters and by 8.5 m^2 for owner-occupied households.

For both renters and homeowners, no significant effects of age are observed for younger age groups. While living space appears to generally increase with age, significant and substantial correlations only emerge for renters aged 56 and over. Older renters have substantially more living space per person with age groups 66–70 and 71–80 having 16.5 m^2 and 18.2 m^2 more living space per person than the reference group (18–25), respectively. Among homeowners, only the oldest cohort shows a significant effect, with 23.0 m^2 more living space per person.

Higher equivalised income is positively associated with greater residential space per individual. An increase of 1,000

[2] The square root of household size is often used to show that additional needs increase less rapidly as household size increases. This results in a fair and comparable order of magnitude between households of different sizes (cf. OECD, 2025; Šedivý & Janský, 2025).

Table 1 Summary statistics of the survey responses and comparison with statistics for all of Berlin

Variable	Level	Survey (%)	Berlin (%)	Source (Berlin)
Age Group (Years)	18–25	7	10	Amt für Statistik Berlin-Brandenburg, (2024c)
	26–35	22	20	
	36–45	20	18	
	46–55	20	15	
	56–65	19	15	
	66–70	6	6	
	71–80	5	10	
	≥ 81	0	7	
Household size	1	26	27	Amt für Statistik Berlin-Brandenburg, (2025)
	2	41	31	
	3	18	16	
	4	11	16	
	≥ 5	4	9	
Tenure	Owner	30	15	Amt für Statistik Berlin-Brandenburg, (2024a)
	Renter	70	85	
Gender[a]	Male	28	49	Amt für Statistik Berlin-Brandenburg, (2024b)
	Female	72	51	
Net Household income (Euro/Month)	< 1.500	17	27	Amt für Statistik Berlin-Brandenburg, (2022)
	1,500–< 2,000	10	15	
	2,000–< 3,000	24	24	
	3,000–< 4,000	19	14	
	4,000–< 5,000	14	8	
	≥ 5,000	16	12	
Dwelling size (m^2)	< 40	4	8	Amt für Statistik Berlin-Brandenburg, (2024a)
	40–< 60	14	26	
	60–< 80	31	31	
	80–< 100	22	17	
	100–< 120	13	8	
	≥ 120	17	10	

[a]Of all participants, 0.46% identified as nonbinary; due to rounding, this proportion is not displayed in the table

€ in equivalised monthly income corresponds to an average increase in per capita living area of roughly 3.0 m^2 for renters and around 6.0 m^2 for homeowners. For renters, our analysis estimates that rent is positively associated with per capita living area, with an increase in 100 € gross rent corresponding to an additional 1.4 m^2 per capita.

3.2 Variation in floor area consumption by demographics and tenure

3.2.1 Overall variation

The mean living space per capita in the research survey is 45 m^2. The highest value of living space per person among the survey participants, 140 m^2, is ten times larger than the lowest (14 m^2). The range is comparatively large due to some outliers. The first quartile is 30 m^2, the third quartile 56 m^2. The median is 40.0 m^2, similar to the Berlin average of 38.3 m^2 (Investitionsbank Berlin, 2024). In the following, the paper considers the influence of life stage in form of household size, age and equivalised income on median living space per capita.

3.2.2 Household size

Living space per capita decreases with increasing household size Fig. 1). The median living space per capita of a person living alone (60 m^2) is three times as high as that of a six-person household (19 m^2). The effect of an additional householder is strongest between single- and two-person households; living space per capita single-person households is already 50% higher than in two-person households. This demonstrates that some household space is needed for essential services (kitchen, bathroom, etc.) which does not decrease much regardless of how small the household is, one factors contributing to the low efficiency of living space in

Table 2 Multiple regression analysis of living space per capita

	Renters		Homeowners	
Predictors	Estimates	p-value	Estimates	p-value
(Intercept)	44.330	<0.001***	51.578	<0.001***
Age groups				
26–35 years	2.327	0.346	8.830	0.356
36–45 years	2.543	0.351	5.067	0.552
46–55 years	4.558	0.113	4.468	0.613
56–65 years	9.695	0.001**	11.471	0.180
66–70 years	16.682	<0.001***	13.259	0.207
71–80 years	18.535	<0.001***	24.061	0.012 *
Household size	− 11.413	<0.001***	− 8.418	<0.001 **
Amount of rent including heating	0.014	<0.001***		
Equivalised income	0.003	<0.001***	0.006	<0.001 ***
District of Berlin	Y		Y	
Observations	273		114	
R^2/R^2 adjusted	0.687/0.661		0.590/0.502	

The reference group for the 'age' variable is the 18–25 age group

single-person households. The household size is a significant parameter regarding the environmental impacts caused by private households (Umweltbundesamt, 2022). Smaller households are usually associated with rising consumer spending, larger living spaces and an increased demand of energy per capita (Ivanova & Büchs, 2022). The continued decrease of household size thus risks increasing environmental burdens.

3.2.3 Age

Figure 2 shows that living space per capita tends to increase with age. The exception here is the category "36–45 years", for which the median is very slightly below the level of the previous age category, but the range (and maximum) is higher. Among respondents up to age 45, living space size per capita shows a similar value (median between 30 and 34 m^2). Above 45, the value rises sharply. From the age of 56 the value exceeds 50 m^2, and from age 71 the value exceeds the 70 m^2. Compared to the median value of 40 m^2, the values of the older age groups, especially 66 years and older, could be interpreted as overconsumption of floorspace. Accordingly, older age groups may have increased potential for reducing living space and can be a starting point for targeted sufficiency measures.

The age effect can be understood in relation to life stage and household dynamics. Starting a family is accompanied by an increasing need for space for parents and children while increasing wealth from accumulated savings makes larger dwellings more affordable with age. The wealth effect is also linked to the empty nest effect where parents can afford to stay in the same (large) dwelling after their grown-up children have moved out (Bierwirth & Thomas, 2015; Ellsworth-Krebs, 2020). Home ownership reinforces this effect, as it is associated with a higher barrier to changing residence. The empty nest effect is not restricted to parents

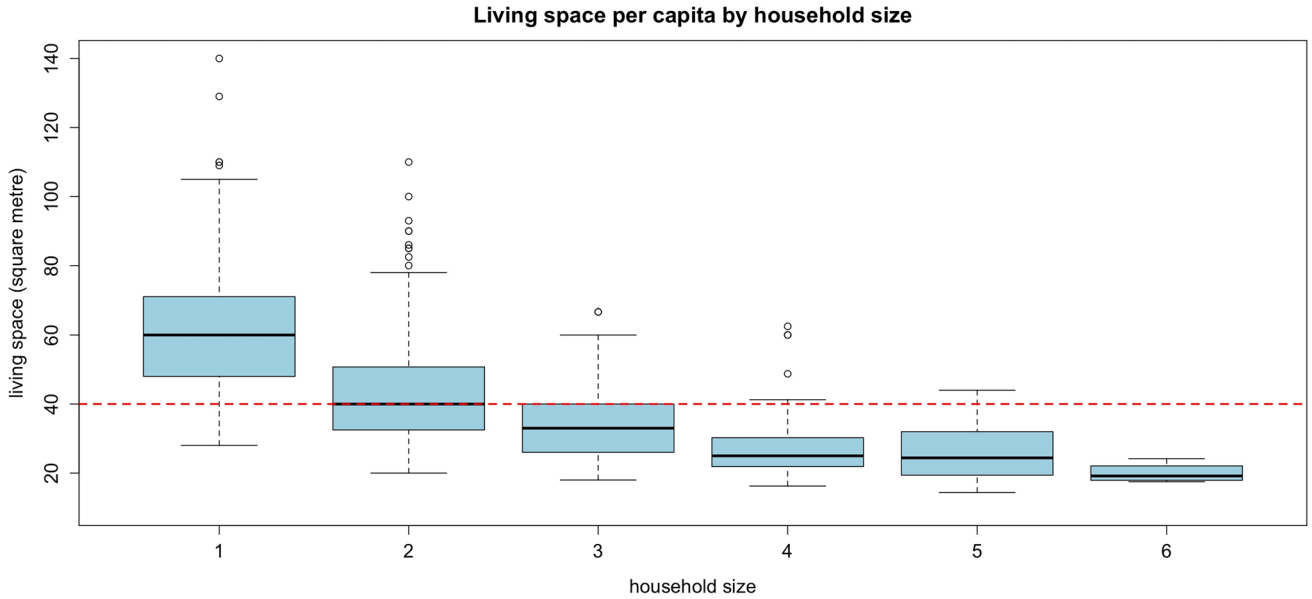

Fig. 1 Boxplot of the current living space per capita of the survey participants by household size (median in red). Underlying data are in the data repository (Arndt et al., 2026) https://doi.org/10.5281/zenodo.19738968

Fig. 2 Boxplot of the current living space per capita of the survey participants by age (median is shown in red). Underlying data are in the data repository (Arndt et al., 2026) https://doi.org/10.5281/zenodo.19738968

of adults, is also observed among widowed and separated people.

3.2.4 Ownership ratio

On average, homeowners have higher living spaces than renters. Among renters in our survey, the median living space per capita is 37 m^2, while homeowners have median per capita area of 50 m^2. Of the people surveyed, 70% rent and 30% own their homes. In Berlin, the ownership share was 15% in 2022 (Amt für Statistik Berlin-Brandenburg, 2024a). This is the lowest value compared to all other federal states, including the other city states of Bremen (32%) and Hamburg (20%) (Statistisches Bundesamt, 2024). Predictions assume an increase in the home ownership rate in the future (Bundesinstitut für Bau-, Stadt- und Raumforschung [BBSR], 2010).

3.3 Perceptions of living space adequacy and wellbeing

3.3.1 Assessment of own living space size

Almost three quarters (73%) of the respondents rate the size of their own living space as "appropriate" (Table 3). Just under one fifth (17%) consider it to be "too small" or "far too small". One tenth of the people regard their own living space as "too large". None of the survey participants rated it as "much too large". Of particular relevance for this research and the approach to sufficiency measures is the group of people who rate their own current living space as "too large". This group of people have median living space per capita of 60 m^2, 50% higher than the median of all survey participants (40 m^2). Only 4% of the survey group who rate their living space as too large live in a smaller living space per capita than 40 m^2.

It is mainly older generations who consider their living space to be too large (Table 3). While the proportion of respondents in the age groups up to 55 years assessing their living space as too large ranges from 4 to 7%, this increases with growing age, reaching 25% in the age group 66 to 70 years. The Federal Institute for Research on Building, Urban Affairs and Spatial Development comes to a similar conclusion, finding that one fifth of 60- to 85-year- olds rate their own home as too large (Bundesministerium für Verkehr, Bau und Stadtentwicklung [BMVBS], 2011). With increasing age, physical resilience decreases, and higher living space per capita can become a burden with advancing age and declining physical ability (BMVBS, 2011). This may help to explain why higher portions of elderly people perceive their living space as excessive.

There is a sizable group of people whose household size has decreased since they moved in because their children have left home; 26% of this group also feel that their current home is too big. The majority of these people are between 56 and 65 years old, implying that empty nesters have important potential for downsizing.

Table 3 Assessment of own living space according to age groups

Age group	far too small (%)	too small (%)	appropriate (%)	too large (%)
18–25 years	0	26	68	6
26–35 years	2	15	76	7
36–45 years	2	33	61	4
46–55 years	1	11	82	6
56–65 years	0	5	77	19
66–70 years	0	7	68	25
71–80 years	0	8	71	21
81 + years	0	0	100	0
Total	**1.1**	**15.7**	**72.7**	**10.4**
Per capita living space by response group	30 m^2 (median) 35 m^2 (mean)	28 m^2 (median) 31 m^2 (mean)	40 m^2 (median) 45 m^2 (mean)	60 m^2 (median) 65 m^2 (mean)

3.3.2 Importance of personal wellbeing

People's willingness to integrate sufficiency into their lifestyle is considerably dependent on its compatibility with their wellbeing. Lifestyle changes are only effective once supported by the population. Sufficiency is a demand-side sustainability approach. Policymakers can only provide a suitable framework for such change, but it is up to the people themselves to decide whether they want to adopt a sufficient lifestyle. Thus, it is important that sufficiency measures improve or at least maintain wellbeing levels. Wellbeing is therefore a key issue in the analysis of the potential of housing sufficiency. Survey participants rated the extent to which their wellbeing depends on the size of the living space – see Table S1 in the Supplementary Information SI1. The response scale ranges from 0 (not at all dependent) to 5 (very strongly dependent). Around one fifth (19%) show little dependence (categories 0 to 2). Categories 3 and 4 are strongly represented, with two-thirds of the respondents (69%) feeling a medium to strong dependence. For 11% of respondents, personal wellbeing is very strongly linked to the size of the living space. Respondents who rate living space as important for their wellbeing are, on average, likely to have higher living space per capita.

3.3.3 Does a reduction in living space per se compromise personal wellbeing?

The subjectively perceived impact of a reduction in living space on wellbeing is an important question for this research. Survey participants were asked whether a reduction in living space compared to their current living situation would mean an impairment of their personal wellbeing. A slight majority (56%) of the respondents answered “no”. The answers given by the participants appears to be independent of their current living space. The living space per capita of the respondents who answered "no" is on average 45.2m^2 (median 40 m^2). For those who answered "yes", it is 44.6 m^2 (median 40 m^2). This result can be interpreted in different ways. On the one hand, it can be seen as an indication of a transformation in the meaning of wellbeing among the participants (Stengel, 2011), in which a reduction in living space is not synonymous with regression or deterioration of wellbeing, while the qualitative dimension of living is at the centre. On the other hand, living space size is only one of many housing attributes. Wellbeing is therefore not solely dependent on the size of the dwelling, which may help explain why a reduction in living space is not automatically associated with reduced wellbeing.

The perception of negative effects on personal wellbeing associated with a reduction in living space can be attributed to several key factors, as survey responses indicate. One frequently cited reason for concern is the associated reduction in the number of rooms. Some of the survey participants fear losing functional separation within the home, which they believe would impair their quality of life. The threat of losing personal space by no longer having a separate room is particularly concerning. With the increased use of home offices, the importance of spatial separation between work and private life has grown. Working from home has become an integral part of many people's lives, and this has changed the demands placed on living space: In addition to recreation and social life, it now increasingly must allow for work. Participants fear impact on their wellbeing: “Mixing work and living by reducing space leads to a feeling of never being able to switch off” (survey participant). Another significant factor is the loss of storage space resulting from a reduction in floor space. This was often described as a practical and emotional challenge and was frequently associated with stress. Several participants expressed concern about not being able to keep all their personal belongings, and reported finding it emotionally difficult to part with items, especially given the general tendency towards increased consumption, which forces households to sell or discard possessions.

3.3.4 Age and perception of sufficiency

Next, we examine to what extent the different groups differ in their answers to the question about the impairment of personal wellbeing due to a reduction in living space. A large majority (87%) in the group of the youngest generation up to 25 years of age, while 63% of respondents aged 26 to 35 and 68% of those aged 66 to 70 do not perceive a reduction in living space as an impairment per se (cf. Figure S1 in Supplementary Information SI1). In the age groups 36 to 55 years and 71 to 80 years, over half of respondents see an implicit connection between a reduction in living space and an impairment of their wellbeing, regardless of other factors. This result is remarkable given the current average living space sizes per capita of the respective age groups (Fig. 2). Some of the age groups who already have smallest living space are least likely to feel a negative influence on their personal wellbeing due to a further reduction in the size of the flats.

3.4 Willingness to reduce living space

A reduction in the amount of living space per capita can be achieved by the following changes:

- Moving to a smaller home
- Increasing the size of the household in the existing dwelling by adding a new household member
- Changing the housing concept—the survey asked respondents about willingness to adopt the concept of a traditional communal dwelling[3] and that of a cluster dwelling. In both cases, it was assumed that this would involve an increase in the number of household members and thus a reduction in per capita living space.

The basic willingness to adopt one or more of the options described was measured in the research study (Table 4). 43% of all respondents in the research survey are generally willing to reduce their current living space per capita. Only one in ten of the survey participants feels that their own living space is too large, and around 80% rate their own wellbeing as moderately to strongly dependent on living space. With this in mind, a willingness of 43% can be classified as a high value. In the group of participants whose wellbeing is not at all or only slightly dependent on the size of the living space (category 0–2), the willingness is 63%.

[3] A communal dwelling is a form of housing in which several people share a flat without forming a family or partnership. Typically, each person has their own room, while the kitchen, bathroom and communal areas are shared.

Table 4 Willingness of participants to reduce their living space overall, as well as in relation to their assessment of current dwelling size, the perceived importance of living space for personal wellbeing, and the 'empty nest' effect

Population group	Willingness to reduce living space per capita (%)
Assessment of living space	
Far too small	0
Too small	13
Appropriate	44
Too large	85
Importance of living space for wellbeing	
0 no dependence	50
1	54
2	66
3	49
4	36
5 very strong dependence	18
Empty nest	
Children moved out	51
Total	43

To estimate the combined influences on declared willingness to downsize, we specified a binomial logistic regression using age and self-assessed importance of living space sufficiency and importance for wellbeing as covariates (Table 5). Age shows significant effects only for middle-aged (46–65) renters, who are substantially less willing to downsize than young (18–25) renters. Those who consider wellbeing to have moderate-to-strong dependence on living space (categories 2–4) are much more likely to indicate willingness to downsize than those in category 5 (very strong dependence). The model is more effective in estimating willingness to downsize for renters than for homeowners. Renters assessing their living space as too large or appropriate are much more likely to indicate willingness to downsize than those who assess their living space as (far) too small. For owners, a significant effect only exists for those who assess their living space as too large. Finally, renters who have experienced a household size reduction since moving in for various reasons (children moving out, separating from partner, partner deceased) are also much more likely to indicate willingness to downsize; this effect does not hold for homeowners. We considered additional regression model specifications for willingness to downsize, including socio-economic variables of income, rent, and household size. Beyond negligible effects of rent for renters, these socio-economics covariates showed no significant effects for owners or renters (cf. Table S2 in Supplementary Information SI1).

A differentiation according to age groups shows that willingness to reduce living space is highest among the two

Table 5 Binomial logistic regression of willingness to downsize

	Renters		Homeowners	
Predictors	Odds ratios	p-value	Odds ratios	p-value
Intercept	0.03	<0.001*	0.06	0.064
Age groups				
26–35 years	0.45	0.218	2.97	0.438
36–45 years	0.39	0.168	1.01	0.992
46–55 years	0.18	0.014*	1.49	0.739
56–65 years	0.23	0.041*	1.09	0.942
66–70 years	0.43	0.329	2.42	0.539
71–80 years	0.83	0.856	1.25	0.863
Living space importance for wellbeing				
0–1	3.96	0.128	2.14	0.567
2	16.69	<0.001***	6.74	0.048*
3	9.21	<0.001***	6.50	0.033*
4	3.72	0.03*	2.78	0.236
Self-assessed living space sufficiency				
Appropriate	11.13	<0.001***	2.27	0.336
Too large	533.35	<0.001***	15.11	0.015*
Household size reduction since moving in	2.38	0.019*	0.70	0.494
Observations	285		118	
R^2 Tjur	0.353		0.183	

Reference levels are 18–25 for age group, '5' for Living space importance, and 'Far too small/Too small' for Self-assessed living space sufficiency. Firth's bias-reduced logistic regression is used to reduce separation issues

youngest and oldest classes and drops significantly in the age groups in between (Fig. 3). The willingness among respondents 18–25 years old is twice as high (64%) as among those 36–45 years old (32%). Among the middle age groups, all of which show a low propensity to downsize, one group stands out. These are empty nesters whose children have moved out but who are still living in the same house. At 51%, a slight majority of them can imagine reducing their per capita living space (Table 4).

Although the lower physical resilience coming with a higher age combined with a big living space can lead to a physical overload, most older people do not want to relocate (Zheng et al., 2022). This is primarily due to a strong emotional attachment to one's home, not only to the physical living environment, but also the life journey associated with the place, personal memories, established social relationships, and familiar everyday routines (Scheibl et al., 2019). However, the recent past indicates that this trend is not immutable (Bierwirth, 2015). It seems increasingly attractive to more people to change their living environment in order to combine social inclusion with a self-determined life (BMVBS, 2011). Accordingly, the need for alternative housing options that enable independence in old age is increasing. Meanwhile, growth in demand for institutional care can be avoided with alternative housing options where older generations are less likely to live alone (BMVBS, 2011). Innovative housing projects are targeting specific age groups and lifestyles, opening up new perspectives on shared and resource-efficient living (BBSR, 2014).

One example of such an alternative form of housing is cluster housing, which combines small private apartments with spacious shared spaces. This concept is still relatively new and was first implemented in Switzerland in 2011 (BBSR, 2020). Since then, the model has attracted increasing attention in Germany and is increasingly being imitated. By 2018, at least 33 cluster housing projects had been

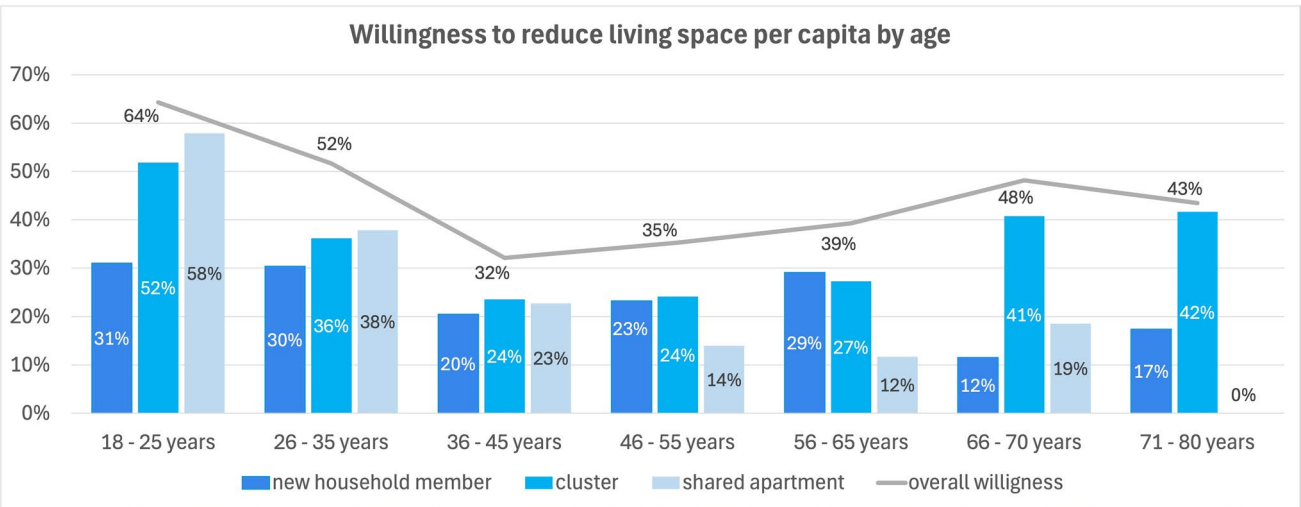

Fig. 3 General willingness (grey line) and willingness to accept an additional household member, to move into a shared flat and to live in a cluster flat by age group

identified in Switzerland, Germany and Austria, 12 of them in Germany (BBSR, 2020). Behind these projects are often young housing cooperatives that are experimenting with innovative forms of housing. Although the motivation for such housing projects is not primarily environmental, they often have a strong financial and social appeal (Bierwirth & Thomas, 2015). Our study has shown that these factors often influence the decision to change housing. This decision is often accompanied by a reduction in the amount of living space used by the individual (Bierwirth & Thomas, 2015).

4 Discussion and conclusions

The consumption of living space has a significant impact on the ecological footprint (Ivanova & Büchs, 2022). More space means higher energy and emissions, especially for heating (Ellsworth-Krebs, 2020), and more embodied emissions (Berrill & Hertwich, 2021). In Germany, two thirds of the energy consumed by private households is used for space heating (Umweltbundesamt, 2025), most of which is generated from fossil fuels. Despite improvements in energy efficiency, GHG emissions in the building sector are not declining enough to reach the sectoral target of the German Climate Protection Act (Agora Energiewende, 2025). In its review report 2025, the Expert Council for Climate Change highlights that the grand coalition agreement under the leadership of Friedrich Merz poses a risk to the achievement of the CO_2 reduction targets set out in the Federal Climate Action Act for 2030, as well as the overarching target of greenhouse gas neutrality by 2045 (Expertenrat für Klimafragen, 2025). The building sector has repeatedly failed to meet its sector-specific emission reduction targets. One of the reasons for this is the rising per capita consumption of living space, which offsets efficiency gains. This effect is most pronounced in rural areas, but the trend can also be observed in cities. In Berlin, the consumption of living space increased from 33.8 m^2 in 1991 to 38.3 m^2 in 2023 (Senatsverwaltung für Stadtentwicklung, 2002; Investitionsbank Berlin, 2024).

There are many reasons for the increases of living space in Berlin. Changes in the population structure and the behaviour of people in the population play a decisive role (Ellsworth-Krebs, 2020). In 2023, an average of 1.9 people live in a Berlin household (Amt für Statistik Berlin-Brandenburg, 2024b), with 50% living in single-person households. Lower fertility rates reduces the household size of people at a younger age (Bierwirth & Thomas, 2015). In Germany, Berlin is the federal state with the lowest birth rate (Statistisches Bundesamt, 2022). Fewer marriages and more divorces (Ivanova & Büchs, 2022) can increase in the number of single-person households and separated parents with children. Our static model shows a strong association between larger households and smaller living space per-capita (Table 2). While significant effects are confined mostly to older renting households, our regression model (Table 2) and descriptive statistics (Fig. 2) show increasing positive associations between age and per-capita living space, consistent with literature (Hein & Kuhnimhof, 2025). Changes in population age structure can have a continued impact in the future, due to the associations with age and household size. Increasing life expectancy also leads to more small households among older people (Bierwirth & Thomas, 2015; Umweltbundesamt, 2022). In addition to these demographic trends, the size of new housing has increased. In 1991 Berlin dwellings had an average living area of 67.5 m^2; by 2023 this had risen to 74.8 m^2 (Amt für Statistik Berlin-Brandenburg, 2024a).

Economic influences are also apparent from our static analysis, although weaker than demographic factors. We find that an increase of 1,000 € in equivalised monthly income corresponds to an increase in per capita living area of 3.0 m^2 for renters and 6.0 m^2 for homeowners (Table 2). Positive responses of floor area consumption to income are found in other studies, albeit with different model specification and metrics. Hein and Kuhnimhof (2025) find ~ 1% increases in household living space associated with a 1,000 € increase in monthly income in Germany, rising to 3–5% increases in a smaller sample where wealth was also reported. Increased wealth is also associated with increases in living space (Hein & Kuhnimhof, 2025). Regarding housing costs and living space, we find minor (an increase in 100 € gross rent corresponding to an additional 1.4 m^2 per capita) effects for renters, but were not able to capture costs effects for homeowners due to data unavailability. This association is more often examined the other way around – i.e. the influence of housing size on housing price, and it is usually positive (Bischoff & Maennig, 2011; Wittowsky et al., 2020). However, there are important caveats and distortions; age of rental contract makes a difference to rental price in Germany (contracts that started earlier tend to be cheaper) (Bischoff & Maennig, 2011). Further, walkability to amenities and access to transport networks, along with other location factors, can increase housing prices (Garcia & Raya, 2011; Wittowsky et al., 2020).

Turning the tide on residential floor space consumption requires a change of mindset. The sufficiency concept poses the question: How much living space is enough? A reduction in per capita living space can only be achieved if it is not accompanied by a loss of personal wellbeing. Reducing living space is a major change to everyday life, one that will require acceptance and support from the population to be successfully implemented. Literature on this question is mixed, but provides indications of how to support downsizing without reducing wellbeing. A UK panel study of the relationship between living space and subjective well-being

found a weak positive effect of increasing number of rooms on housing satisfaction and (for men) life satisfaction, while individuals who moved for larger accommodation reported higher housing satisfaction but not higher life satisfaction (Foye, 2017). A study of life satisfaction related to home-ownership and other variables including house size in Germany found almost no effect (odds ratio ≈ 1) of house size or number of rooms, but positive effects of ownership on life satisfaction (Zumbro, 2014).

In five European countries, Lehner et al. (2024) found reluctance but some potential acceptance of living space reductions. Citizen thinking labs considered acceptance for different low-carbon lifestyles options; giving up 'excess square metres' had an approval rating of 15% in Hungary, around 25% in Latvia and Germany, and around 40% in Spain and Sweden (Lehner et al., 2024). Notably, giving up excess living area and choosing shared housing were the least favoured among 18 housing-related behaviour changes. Low acceptance was linked to housing markets which incentivise home ownership, and the cost/difficulty of finding suitable smaller housing in urban areas. Conversely, participants who reduced living space reported positive effects including increased leisure time, more active transport, and better access to infrastructure and facilities (Lehner et al., 2024), corresponding to the different factors contributing to value of housing (Garcia & Raya, 2011). Still, even if only 25% of individuals were willing to reduce living space, that could still make a substantial difference to overall floor area.

Different stakeholder groups in society may take an interest in housing sufficiency policies. Interviewing different stakeholder groups (housing, social, and environmental groups), Bohnenberger (2021) found four distinct positions regarding sufficiency in housing policy with divergence over policy priorities. The suggest nonetheless that a coalition of housing organisations and some environmental groups could establish sufficiency as a policy paradigm in Germany and beyond. In order to change the status quo and bring about a shift towards greater climate compatibility in the housing sector, sufficiency measures are inevitable (Horn et al., 2025). Our study highlights this necessity and shows that a substantial proportion of the population is willing to reduce per capita living space, especially among the elderly.

Of all age groups, older households (66–80 years) have the most living space per capita and are most likely (23%) to self-assess as having too much space. This sentiment may be increasing. Hein and Kuhnimhof (2025) find that a steadily increasing share of older (61 +) individuals in West Germany self-report their living space as 'too large', from around 12% in 1984 to 25% in 2018. While self-assessing living space as too large is not the same as accepting floorspace reductions, it is probably a strong indication of higher acceptance. Priorities shift with increasing physical limitations in old age. Above all, aspects such as self-determination in everyday life and social interaction become more important (Ellsworth-Krebs, 2020). Innovative housing concepts that enable people to meet their needs with less living space are promising. Cluster housing is one example, with over 40% of those over 65 expressing a willingness to live in a community-based housing model as they age. Among empty nesters, results of the survey suggest that these households not only offer considerable potential for saving space (due to lower household size), but that there is also a higher than average (51% vs 43%) level of willingness to reduce living space.

The willingness of some survey respondents to reduce their per capita living space can support the practical feasibility of a consumption-related upper limit (Fuchs et al., 2021; Pauliuk, 2024). Such willingness (although not widespread) suggests that sufficiency measures are not merely theoretical concepts but also have social relevance and are open to negotiation. Political initiatives to encourage lower living space could therefore be accepted, provided basic comfort and needs are met and consideration is given to preserve individual wellbeing by facilitating easier downsizing for those interested and improving the non-quantity (i.e. quality and location) aspects of housing. In order to exploit the existing sufficiency potential, current barriers need to be addressed. Barriers can be found at different levels. Emotional attachment to one's current place of residence (especially for homeowners), concerns about a new living environment, or inertia about moving are individual-level barriers that can make it difficult for some people to convert 'willingness' into practice. But structural problems also exist, such as tight and inefficient housing markets. The low availability of housing raises the cost of relocating, even for downsizing. The incentive to downsize is reduced if existing rental contracts for larger apartments offer lower rents than those for smaller apartments that have been rented out more recently. In Germany, and particularly in Berlin, new rents tend to be much more closely aligned with current market levels than older rents (Mense et al., 2019), due to various measures such as rent caps, limits and indices, which primarily affect existing rents. This leads to a residency discount, whereby long-term tenancies are systematically cheaper than new contracts for similar properties (Bischoff & Maennig, 2011), creating lock-in effects where households remain in oversized flats because moving to a smaller flat with higher rent is unattractive.

It is not only the lack of housing to meeting demand, but also the attributes of the housing. Both the needs and the demographics of the population have changed. Deuster et al. (2023) see matching housing supply to demographics as key. The ageing society must be part of the housing strategy (Zheng et al., 2022). Too little attention is currently being paid to the implementation of new housing concepts that address these changing needs. Innovative housing projects are being built by young housing cooperatives in particular

(BBSR, 2020). In particular, age-appropriate housing needs to be reflected more strongly in the housing market. People are living longer, in smaller family units, and this trend will likely continue in the future. Household size reductions correlate with increased willingness to downsize. Housing policies are needed that prioritise issues such as social interaction, reducing loneliness and increasing the autonomy of physically impaired people in their homes. Policy makers need to recognise the need and potential for sufficiency and address barriers to create a framework that enables reduction in per capita living space while increasing wellbeing.

5 Summary

Supplementary Information SI1: This supporting information provides additional figures and tables depicting summary data from the survey described in the main article, and an additional regression results investigating associations between self-reported willingness to downsize and socio-economic and demographic attributes.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s44498-026-00103-2.

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Data availability The data used for this analysis is available at the following repository link https://doi.org/10.5281/zenodo.19738968

Declarations

Conflict of interest The authors declare no competing interests.

References

Agora Energiewende. (2025). Die Energiewende in Deutschland: Stand der Dinge 2024. Rückblick auf die wesentlichen Entwicklungen sowie Ausblick auf 2025. https://www.agora-energiewende.de/fileadmin/Projekte/2025/2024-18_DE_JAW24/A-EW_351_JAW24_WEB.pdf

Amt für Statistik Berlin-Brandenburg. (2022). Ergebnisse des Mikrozensus im Land Berlin 2020 (Endergebnisse): Bevölkerung, Erwerbstätigkeit, Privathaushalte, Familien, Lebensformen (Statistischer Bericht A I 10 / A I 11 / A VI 2 – j / 20). https://www.statistischebibliothek.de/mir/servlets/MCRFileNodeServlet/BBHeft_derivate_00026782/SB_A01-10-00_2020j01_BE.pdf

Amt für Statistik Berlin-Brandenburg. (2024). Bevölkerung in Berlin 2022: Bevölkerungsentwicklung, Bevölkerungsstand, Bevölkerungsfortschreibung auf Basis Zensus 2022(Statistischer Bericht A I 3 – j /22). https://www.statistischebibliothek.de/mir/servlets/MCRFileNodeServlet/BBHeft_derivate_00034827/SB_A01-03-00_2022j01_BEa.pdf

Amt für Statistik Berlin-Brandenburg. (2024). Ergebnisse des Mikrozensus im Land Berlin 2022 (Endergebnisse). Wohnsituation. https://download.statistik-berlin-brandenburg.de/701521a9dd8689d4/aea0f83295f7/SB_F01-02-00_2022j04_BE.pdf

Amt für Statistik Berlin-Brandenburg. (2024). Statistischer Bericht. Ergebnisse des Mikrozensus im Land Berlin 2023 (Erstergebnisse). https://download.statistik-berlin-brandenburg.de/800e3bae017521be/0b9bbd1d7030/SB_A01-10-00_2023j01_BE.pdf

Amt für Statistik Berlin-Brandenburg. (2025). Ergebnisse des Mikrozensus im Land Berlin 2024 (Erstergebnisse): Bevölkerung, Erwerbstätigkeit, Privathaushalte, Familien, Lebensformen. Bevölkerung im Land Berlin 2024 nach Beteiligung am Erwerbsleben (Statistischer Bericht A I 10 – j / 24; A I 11 – j / 24; A VI 2 – j / 24). https://download.statistik-berlin-brandenburg.de/e5a88f61949ce1dc/6541131bf63f/SB_A01-10-00_2024j01_BE.pdf

Arndt, K., Berrill, P., & Fuss, S. (2026). Supporting data for 'Assessing the social acceptability of sufficiency measures in the residential sector' (1.0) [Data set]. Zenodo. https://doi.org/10.5281/zenodo.19738968

Berrill, P., & Hertwich, E. G. (2021). Material flows and GHG emissions from housing stock evolution in US counties, 2020–60. *Buildings and Cities, 2*(1), 599–617. https://doi.org/10.5334/bc.131

Bierwirth, A. (2015). Strategische Entwicklung eines zukunftsfähigen Wohnraumangebots – ein Suffizienz-Szenario. *Uwf UmweltWirtschaftsForum, 23*(1), 49–58. https://doi.org/10.1007/s00550-015-0355-6

Bierwirth, A., & Thomas, S. (2015). Almost best friends: sufficiency and efficiency. Can sufficiency maximise efficiency gains in buildings? In A. G. Martins & J. Wade (Eds), *eceee 2015 Summer Study on energy efficiency: First fuel now Panel 1. Foundations of future energy policy* (pp. 71–82). https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2015/1-foundations-of-future-energy-policy/almost-best-friends-sufficiency-and-efficiency-can-sufficiency-maximise-efficiency-gains-in-buildings/

Bischoff, O., & Maennig, W. (2011). Rental housing market segmentation in Germany according to ownership. *Journal of Property Research, 28*(2), 133–149. https://doi.org/10.1080/09599916.2010.538477

Bohnenberger, K. (2021). Can "sufficiency" reconcile social and environmental goals? A Q-methodological analysis of German housing policy. *Journal of Housing and the Built Environment, 36*, 171–189. https://doi.org/10.1007/s10901-020-09762-4

Brand-Correa, L. I., & Steinberger, J. K. (2017). A framework for decoupling human neednsatisfaction from energy use. *Ecological Economics, 141*, 43–52. https://doi.org/10.1016/j.ecolecon.2017.05.019

Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR). (2010). Wohnungsmärkte im Wandel: Zentrale Ergebnisse der Wohnungsmarktprognose 2025. BBSR -Berichte kompakt: 2010/1

Bundesinstitut für Bau-, Stadt- und Raumforschung. (2014). *Neues Wohnen – Gemeinschaftliche Wohnformen bei Genossenschaften.* https://www.bbsr.bund.de/BBSR/DE/veroeffentlichungen/sonderveroeffentlichungen/2014/DL_NeuesWohnen.pdf;jsessionid=DC47FE5C215CAD3644E227D6FB2FB06A.live11314?__blob=publicationFile&v=1

Bundesinstitut für Bau-, Stadt- und Raumforschung. (2020). Clusterwohnungen. Eine neue Wohnungstypologie für eine anpasungsfähige Stadtentwicklung. https://www.bbsr.bund.de/BBSR/DE/veroeffentlichungen/zukunft-bauen-fp/2020/band-22-dl-korr.pdf;jsessionid=94443219C005D4DBB838B82879A2F3CB.live11294?__blob=publicationFile&v=2

Bundesministerium für Verkehr, Bau und Stadtentwicklung (BMVBS). (2011). Wohnen im Alter – Marktprozesse und wohnungspolitischer Handlungsbedarf (Forschungen, Heft 147). Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) im Bundesamt für Bauwesen und Raumordnung (BBR). https://www.bbsr.bund.de/BBSR/DE/veroeffentlichungen/ministerien/bmvbs/forschungen/2011/Heft147_DL.pdf

Cabeza, L. F., Bai, Q., Bertoldi, P., Kihila, J. M., Lucena, A. F. P., Mata, É., Mirasgedis, S., Novikova, A., & Saheb, Y. (2022). Buildings. In P. R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, & J. Malley (Eds.), *Climate Change 2022 Mitigation of Climate Change Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press. https://doi.org/10.1017/9781009157926.011

Creutzig, F., Roy, J., Devine-Wright, P., Díaz-José, J., Geels, F. W., Grubler, A., Maïzi, N., Masanet, E., Mulugetta, Y., Onyige, C. D., Perkins, P. E., Sanches-Pereira, A., & Weber, E. U. (2022). Demand, services and social aspects of mitigation. In P. R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, & J. Malley (Eds.), *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press. https://doi.org/10.1017/9781009157926.007

Deuster, C., Kajander, N., Muench, S., Natale, F., Nedee, A., Scapolo, F., Ueffing, P., & Vesnic Alujevic, L. (2023). Demography and climate change. *Publications Office of the European Union*. https://doi.org/10.2760/26411

Dewilde, C., & Waitkus, N. (2023). Inequality and housing. In K. F. Zimmermann (Ed.), *Handbook of labor, human resources and population economics* (pp. 1–29). Springer.

Ellsworth-Krebs, K. (2020). Implications of declining household sizes and expectations of home comfort for domestic energy demand. *Nature Energy, 5*, 20–25. https://doi.org/10.1038/s41560-019-0512-1

Estiri, H. (2014). Building and household X-factors and energy consumption at the residential sector: A structural equation model of energy consumption in the residential sector. *Energy Economics, 43*, 178–184. https://doi.org/10.1016/j.eneco.2014.02.013

Estiri, H. (2014). Energy planning in the big data era: A theme study of the residential sector. In Proceedings of the NSF Workshops on Big Data and Urban Informatics, University of Illinois at Chicago, August 11–12, 2014. University of Illinois at Chicago.https://dl.dropboxusercontent.com/u/35674979/CFP/proceedings/bduic2014_submission_33.pdf

Estiri, H., & Zagheni, E. (2018). Evaluating the age-energy consumption profile in residential buildings. SocArXiv. https://doi.org/10.31219/osf.io/yqkva

Expertenrat für Klimafragen (2025): Prüfbericht zur Berechnung der deutschen Treibhausgasemissionen für das Jahr 2024 und zu den Projektionsdaten 2025. Prüfung und Bewertung der Emissionsdaten sowie der Projektionsdaten gemäß § 12 Abs. 1 Bundes- Klimaschutzgesetz. https://www.expertenrat-klima.de.

Firth, D. (1993). Bias reduction of maximum likelihood estimates. *Biometrika, 80*(1), 27–38. https://doi.org/10.1093/biomet/80.1.27

Foye, C. (2017). The relationship between size of living space and subjective well-being. *Journal of Happiness Studies, 18*, 427–461. https://doi.org/10.1007/s10902-016-9732-2

Fuchs, D., Steinberger, J., Pirgmaier, E., Lamb, W., Brand-Correa, L., Mattioli, G., & Cullen, J. (2021). A corridors and power-oriented perspective on energy-service demand and needs satisfaction. *Sustainability Science Practice and Policy, 17*, 162–172. https://doi.org/10.1080/15487733.2021.1912907

Garcia, J., & Raya, J. M. (2011). Price and income elasticities of demand for housing characteristics in the city of Barcelona. *Regional Studies, 45*(5), 597–608. https://doi.org/10.1080/00343401003713381

Hein, S., & Kuhnimhof, T. (2025). Unravelling cohort effects in consumption of living space by German households. *Housing Studies*. https://doi.org/10.1080/02673037.2025.2473611

Horn, S., Gough, I., Rogers, C., & Tunstall, R. (2025). Meeting housing needs within planetary boundaries: A UK case study. *Ecological Economics, 230*, Article 108510. https://doi.org/10.1016/j.ecolecon.2024.108510

Investitionsbank Berlin. (2024). *IBB Wohnungsmarktbericht 2024*. https://www.ibb.de/media/dokumente/publikationen/berliner-wohnungsmarkt/wohnungsmarktbericht/2024/ibb-wohnungsmarktbericht-2024_barrierefrei.pdf

Ivanova, D., & Büchs, M. (2022). Implications of shrinking household sizes for meeting the 1.5 °C climate targets. *Ecological Economics*. https://doi.org/10.1016/j.ecolecon.2022.107590

Jansen, A., Wang, R., Behrens, P., & Hoekstra, R. (2024). Beyond GDP: A review and conceptual framework for measuring sustainable and inclusive wellbeing. *The Lancet Planetary Health, 8*(9), E695–E705. https://doi.org/10.1016/S2542-5196(24)00147-5

Lamb, W. F., & Steinberger, J. K. (2017). Human well-being and climate change mitigation. *Wires Climate Change, 8*, Article e485. https://doi.org/10.1002/wcc.485

Lehner, M., Richter, J. L., Kreinin, H., Mamut, P., Vadovics, E., Henman, J., Mont, O., & Fuchs, D. (2024). Living smaller: Acceptance, effects and structural factors in the EU. *Buildings and Cities, 5*(1), 215–230. https://doi.org/10.5334/bc.438.s1

Mense, A., Michelsen, C., & Kholodilin, K. A. (2019). Rent control, market segmentation, and misallocation: Causal evidence from a large-scale policy intervention (DIW Discussion Paper No. 1832). Deutsches Institut für Wirtschaftsforschung (DIW)

OECD. (2025). *To have and have not – How to bridge the gap in opportunities*. OECD Publishing. https://doi.org/10.1787/dec143ad-en

Pauliuk, S. (2024). Decent living standards, prosperity, and excessive consumption in the Lorenz curve. *Ecological Economics, 220*, Article Article 108161. https://doi.org/10.1016/j.ecolecon.2024.108161

Pauliuk, S., Carrer, F., Heeren, N., & Hertwich, E. G. (2024). Scenario analysis of supply- and demand-side solutions for circular economy and climate change mitigation in the global building sector. *Journal of Industrial Ecology, 28*, 1699–1715. https://doi.org/10.1111/jiec.13557

Prytula, M., Rexroth, S., Lutz, M., & May, F. (Eds.). (2020). *Schriftenreihe Zukunft Bauen: Band 22 . Cluster-Wohnungen: Eine neue Wohnungstypologie für eine anpassungsfähige Stadtentwicklung* (Stand: Februar 2020). Bundesinstitut für Bau- Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung. https://edocs.tib.eu/files/e01fn20/1735450804.pdf

Rao, N. D., & Min, J. (2018). Decent living standards: Material prerequisites for human wellbeing. *Social Indicators Research, 138*, 225–244.

Saheb, Y. (2021). *COP26: Sufficiency Should be First*. https://www.buildingsandcities.org/insights/commentaries/cop26-sufficiency.html

Samadi, S., Gröne, M.-C., Schneidewind, U., Luhmann, H.-J., Venjakob, J., & Best, B. (2017). Sufficiency in energy scenario studies: Taking the potential benefits of lifestyle changes into account. *Technological Forecasting and Social Change, 124*, 126–134. https://doi.org/10.1016/j.techfore.2016.09.013

Scheibl, F., Farquhar, M., Buck, J., Barclay, S., Brayne, C., & Fleming, J. (2019). When frail older people relocate in very old age, who makes the decision? *Innovation in Aging, 3*(4), 1–9. https://doi.org/10.1093/geroni/igz030

Šedivý, M., & Janský, P. (2025). How do regional price levels affect income inequality? Household-level evidence from countries worldwide. *The Annals of Regional Science*. https://doi.org/10.1007/s00168-024-01347-1

Senatsverwaltung für Stadtentwicklung. (2002). *Berliner Wohnungsmarktbericht (1991–2000)*. https://www.ibb.de/media/dokumente/publikationen/berliner-wohnungsmarkt/wohnungsmarktbericht/wohnungsmarktbericht_1991bis2000.pdf

Spangenberg, J. H., & Lorek, S. (2019). Sufficiency and consumer behaviour: From theory to policy. *Energy Policy, 129*, 1070–1079. https://doi.org/10.1016/j.enpol.2019.03.013

Statistisches Bundesamt. (2022). *Geburtenziffer 2021 erstmals seit 2017 gestiegen.* https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/08/PD22_326_12.html

Statistisches Bundesamt. (2024). *Wohnen. Eigentumsquote.* https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Wohnen/Tabellen/tabelle-eigentumsquote.html

STATTBAU Stadtentwicklungsgesellschaft (Ed). (2019). *Gemeinschaftliches Wohnen im Cluster: Ein praktischer Leitfaden zum Planen, Bauen und Wohnen.* Berlin. https://www.netzwerk-generationen.de/fileadmin/user_upload/PDF/Downloads_brosch%C3%BCren-dokumentationen/2019-12-13_Broschuere_Cluster_web.pdf

Stengel, O. (2011). *Suffizienz: Die Konsumgesellschaft in der ökologischen Krise*. *Wuppertaler Schriften zur Forschung für eine nachhaltige Entwicklung: v.1*. Oekom Verlag. https://ebookcentral.proquest.com/lib/kxp/detail.action?docID=6389108

Sugiyama, M., Wilson, C., Wiedenhofer, D., Boza-Kiss, B., Cao, T., Chatterjee, J. S., Chatterjee, S., Hara, T., Hayashi, A., Ju, Y., Krey, V., Godoy León, M. F., Martinez, L., Masanet, E., Mastrucci, A., Min, J., Niamir, L., Pelz, S., Roy, J., … Zimm, C. (2024). High with low: Harnessing the power of demand-side solutions for high wellbeing with low energy and material demand. *Joule, 8*(1), 1–6. https://doi.org/10.1016/j.joule.2023.12.014

Thomas, S., Thema, J., Brischke, L.-A., Leuser, L., Kopatz, M., & Spitzner, M. (2019). Energy sufficiency policy for residential electricity use and per-capita dwelling size. *Energy Efficiency, 12*(5), 1123–1149. https://doi.org/10.1007/s12053-018-9727-4

Umweltbundesamt. (2022). *Bevölkerungsentwicklung und Struktur privater Haushalte*. https://www.umweltbundesamt.de/daten/private-haushalte-konsum/strukturdaten-privater-haushalte/bevoelkerungsentwicklung-struktur-privater#832-millionen-menschen

Umweltbundesamt. (2025): Energieverbrauch privater Haushalte. https://www.umweltbundesamt.de/daten/private-haushalte-konsum/wohnen/energieverbrauch-privater-haushalte#endenergieverbrauch-der-privaten-haushalte

Von Winterfeld, U. (2007). Keine Nachhaltigkeit ohne Suffizienz: Fünf Thesen und Folgerungen. *Vorgänge (Berlin, Germany), 46*(3), 46–54.

Wiese, F., Taillard, N., Balembois, E., Best, B., Bourgeois, S., Campos, J., Cordroch, L., Djelali, M., Gabert, A., Jacob, A., Johnson, E., Meyer, S., Munkácsy, B., Pagliano, L., Quoilin, S., Roscetti, A., Thema, J., Thiran, P., Toledano, A., … Marignac, Y. (2024). The key role of sufficiency for low demand-based carbon neutrality and energy security across Europe. *Nature Communications, 15*, Article 9043. https://doi.org/10.1038/s41467-024-53393-0

Wittowsky, D., Hoekveld, J., Welsch, J., & Steier, M. (2020). Residential housing prices: Impact of housing characteristics, accessibility and neighbouring apartments – A case study of Dortmund, Germany. *Urban, Planning and Transport Research, 8*(1), 44–70. https://doi.org/10.1080/21650020.2019.1704429

Zell-Ziegler, C., Thema, J., Best, B., Wiese, F., Lage, J., Schmidt, A., Toulouse, E., & Stagl, S. (2021). Enough? The role of sufficiency in European energy and climate plans. *Energy Policy, 157*, Article 112483. https://doi.org/10.1016/j.enpol.2021.112483

Zheng, H., Long, Y., Wood, R., Moran, D., Zhang, Z., Meng, J., Feng, K., Hertwich, E., & Guan, D. (2022). Ageing society in developed countries challenges carbon mitigation. *Nature Climate Change, 12*, 241–248. https://doi.org/10.1038/s41558-022-01302-y

Zumbro, T. (2014). The relationship between homeownership and life satisfaction in Germany. *Housing Studies, 29*(3), 319–338. https://doi.org/10.1080/02673037.2013.773583