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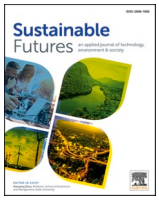

Climate concern, wood's perceived climate benefits, and attitudes as predictors of intention to live in multi-storey wooden buildings

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ABSTRACT

The built environment is a major contributor to global emissions, making the transition to low-carbon construction materials critical for climate mitigation. Multi-storey wooden buildings (MSWBs) have emerged as a sustainable alternative due to their carbon storage capacity and lower embodied emissions compared to conventional multi-storey buildings. However, consumer acceptability for MSWBs remains uncertain. This study draws on cognitive-motivational consumer models, expectancy-value theory, and Signalling Theory to examine the effect of climate beliefs and concern, belief on climate impact of wood construction, and MSWB attitudes on the intention to live in MSWBs. The relationships are tested using structural equation modelling applying survey data from 7053 respondents across seven European countries. The study finds that stronger climate beliefs and concern enhance perceptions of wood's climate benefits, which in turn influence both attitudes and housing intentions. However, attitudes toward multi-storey wooden buildings—particularly regarding comfort, health, and functionality—are stronger predictors of intention than beliefs alone, indicating a mediating role of attitudes. Cross-country differences highlight the role of cultural and regulatory contexts. The results suggest that policymakers and industry should emphasize and develop the climate benefits of MSWBs alongside improvements in perceived comfort and functionality. This study advances sustainable housing research by integrating environmental psychology and consumer behaviour perspectives.

1. Introduction

The Paris Agreement seeks to limit global warming to well below 2 °C above preindustrial levels, aiming for 1.5 °C by 2030, with a long-term goal of net-zero emissions by 2050 [1]. These targets have been incorporated into the European Green Deal [2], which sets the objective of climate neutrality within the European Union by 2050. Despite these measures, global temperatures continue to rise, with 2024 recording an average increase of 1.55 °C above pre-industrial levels, intensifying climate-related risks [3]. A major contributor to climate change is the construction sector, which consumes large quantities of raw materials and energy across the entire building lifecycle—from material extraction and production to construction, operation, and eventual demolition. This intensive resource consumption contributes significantly to greenhouse gas emissions, with the built environment estimated to account for roughly 37 % of global emissions [4]. Therefore, the adoption of low-carbon materials and resource-efficient practices is essential to achieving climate targets and reducing the sector's environmental burden [5]. Among alternative materials, wood generally exhibits substantially lower embodied carbon and energy demand compared to concrete and steel, making it a promising option for reducing the whole-life climate impact of buildings [5,6]. In line with this, the EU Policy Roadmap for Decarbonised Buildings emphasizes that achieving climate neutrality requires addressing whole-life carbon—not just operational emissions—and calls for regulatory interventions targeting material supply chains, design practices, and carbon accounting at EU and national levels [7].

Housing plays a pivotal role in broader sustainability transitions [4,8], which are multi-level processes involving material efficiency, life cycle thinking, and adoption of bio-based, low-carbon materials such as

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timber-based multi-storey buildings. Progress in construction is driven not only by technological innovation but also by social factors at different levels, including human behaviour and agency [9,10]. Empirical evidence from Northern and Central Europe indicates that public procurement, housing policy, and promotional efforts have supported the adoption of multi-storey wooden buildings [11–13]. These multi-level policy frameworks increasingly emphasize that sector growth depends not only on emissions reductions but also on well-being, liveability, and user preferences [14]. From an urban planning perspective, Churkina et al. [15] outline practical strategies for integrating wood into construction, including building code reforms, workforce development, and expanded bio-based manufacturing. Complementing these supply-side measures, understanding consumer perspectives on alternative materials is essential for scaling low-carbon housing innovations.

For wooden residential buildings to contribute meaningfully to emissions reductions, they must gain consumer acceptance [16]. Studies on European people's views toward multi-storey wooden buildings (MSWB) suggest that wood may be associated with attitudes and context [17]. Another finding is that the material is often seen as being natural or environmentally friendly, supporting comfort and well-being [16]. However, some consumers may, on the other hand, perceive it as lower quality than other materials or may express environmental concerns about the prevalent forest management practices [18–22]. The literature remains inconclusive on how these mixed perceptions influence the final purchasing decisions.

A key question for the construction sector is whether climate beliefs and concerns, and perceptions of the climate impact of building materials, influence housing choices. Such considerations extend beyond shelter, comfort, or affordability, reflecting broader concerns including ecological footprints, ethical sourcing, and climate responsibility—core elements of sustainable consumption [23]. They are particularly important for the construction sector, where long-term investments determine material use and associated climate impacts for decades [24]. In this context, wooden residential buildings offer a unique opportunity to align personal values with environmental goals, serving as both functional and symbolic representations of sustainability-oriented lifestyles. Consequently, material preferences are not only based on practical considerations but also reflect socially constructed meanings related to environmental identity, responsibility, and trust in green innovation [25].

The relationship between sustainability concerns and perceptions of wood is multifaceted. Roos et al. [20] found that heightened sustainability awareness can increase preference for wood, and similarly, Vehola et al. [26] report that strong climate concerns are associated with greater support for wood-based construction in Finland and Sweden. In contrast, Ruokamo et al. [27] observe that Finnish respondents may still have reservations about the environmental impacts of forest harvesting. Beyond the context of wood construction, factors such as green consumer identity and familiarity with certification systems influence interest in sustainability-certified housing [28]. Across sectors, studies consistently show that climate beliefs and environmental concerns shape purchasing behavior [29–32], although ego-defensive mechanisms can sometimes limit environmentally conscious choices [33]. Sustainability signals, including eco-labels, can affect perceived product quality through mechanisms such as the halo effect [34–37]. Moreover, sustainability-oriented practices can generate tangible business benefits, including innovation, operational efficiency, and enhanced competitiveness [38]. Accordingly, a sustainable business focus has the potential to influence consumer decision-making and improve business performance; however, if such claims are not supported by high production standards, they risk undermining credibility [39,40].

Despite growing interest in consumer attitudes toward wooden housing, few studies have examined how climate beliefs, perceptions of wood's climate-related role, and evaluations of comfort and functionality jointly shape housing preferences. Most prior research has considered these factors in isolation. To address this gap, the present study investigates the psychological mechanisms underlying sustainable housing preferences, focusing on multi-storey wooden buildings (MSWBs). In particular, it examines how climate beliefs and concern, perceptions of wood's climate impact, and perceived comfort and functionality influence intentions to live in MSWBs. By integrating insights from environmental psychology and sustainability transitions, this study offers a nuanced understanding of user-driven sustainability perceptions and provides implications for both research and practical strategies to promote low-carbon housing. The study emphasizes psychological mechanisms—climate beliefs, concern, and attitudes toward MSWBs—rather than socio-economic factors.

2. Theory

2.1. Theoretical underpinnings

Theoretically, this study builds on Fishbein's cognitive-motivational consumer model, which posits that consumer choice is guided by perceived product attributes and learned cognitions [41]. In addition, Fishbein and Ajzen's [42] Expectancy-Value Theory suggests that purchase intentions are shaped by the perceived value of a product. Another relevant framework is Signalling Theory [43], which explains how consumers infer product quality from observable attributes. This aligns with the concept of heuristics in belief formation, referring to mental shortcuts that simplify consumer decision-making [44]. Finally, this study also draws on Sörqvist et al. [34], who examined the green halo effect—a specific instance where products with environmental labels are perceived as having superior overall quality compared to conventional alternatives.

2.2. Conceptual framework

This analysis is guided by a conceptual framework that examines the relationships between climate beliefs and concern, perceptions of climate impact of wood construction, attitudes toward MSWB based on liveability, and individual choices—including mediated pathways. Fig. 1 presents this framework, which is further explained in the sections that follow.

"Climate Beliefs and Concern" (CCB in Fig. 1) represents an individual's awareness of and concern about climate change. Its manifest variables capture perceptions of the existence and severity of climate change, including beliefs about human causes and its role in recent extreme weather events.

WCB, "Belief in the Climate Impact of Wood Construction" captures whether the respondent believes that wooden construction materials have a comparatively low carbon footprint. The manifest variables emphasize beliefs about wood's climate impact and potential to reduce emissions and store carbon

MWA, "Attitude toward MSWB," reflects cognitive evaluations of liveability, comfort, and functionality. Its manifest variables assess whether MSWBs are seen as healthy, pleasant, and functional. In this study, we conceptualize attitude toward MSWBs specifically as a cognitive assessment.

Finally, MWI, "Intention to Live in an MSWB," represents an individual's willingness to reside in such buildings.

2.3. Hypotheses

2.3.1. Climate beliefs and concern, and beliefs about the climate impact of wood construction CCB→WCB

The influence of climate beliefs and concern on perceptions of the climate impact of wood construction remains understudied. Roos et al. [45] found that both the belief that climate change causes extreme weather events and the belief that it is human-induced positively shape perceptions of wood as a low-emission material. Evidence from other

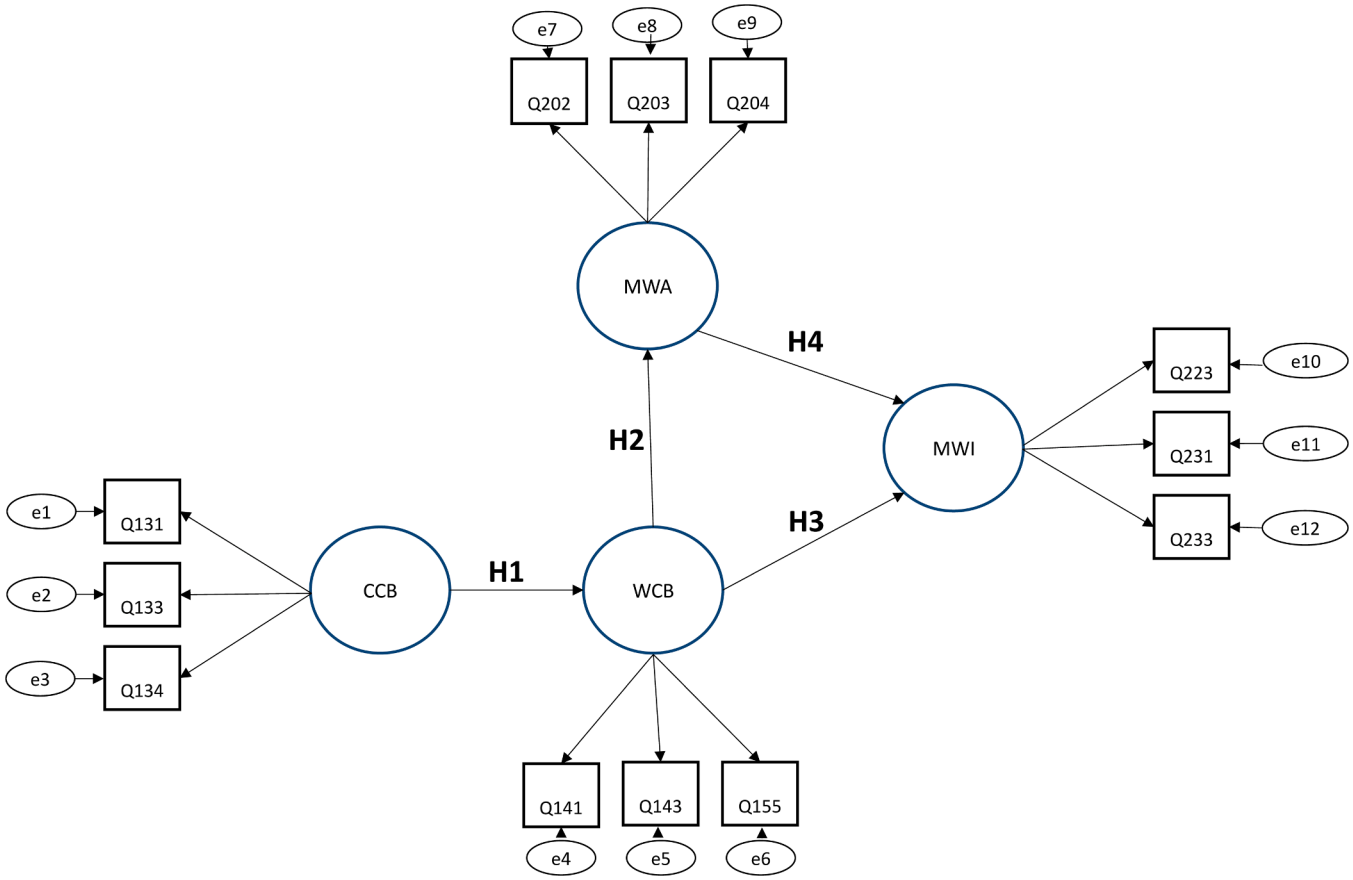

Fig. 1. Conceptual framework illustrating the hypothesized relationships among climate beliefs and concern, beliefs about the climate impact of wood construction, attitudes toward multi-story wooden buildings (MSWBs), and the intention to live in an MSWB.

sectors supports this pattern: Árnadóttir et al. [46] and Shen and Wang [47] show that climate concern directs consumer attention toward lower-emission alternatives, while Lorteau et al. [48] report that climate-related worries increase support for renewable energy sources such as solar and wind. Rondoni and Grasso [49] further confirm that sustainability concerns influence attitudes toward carbon footprint labels. Building on these insights, we hypothesize that climate awareness and concern enhance confidence in low-impact building materials such as wood.

H1. Climate beliefs and concern positively shape beliefs about the climate friendliness of wood construction.

2.3.2. Beliefs about the climate impact of wood construction and the attitude toward MSWB. WCB→MWA

Several studies across different product categories have documented a positive relationship between beliefs about a product's climate footprint and its perceived overall quality [34–36]. Loaiza-Ramírez et al. [37] also found that the impact of perceived sustainability performance of energy on consumers' adoption intention was mediated through perceived comfort.

Building on empirical data and theories of the halo effect and heuristics, we therefore hypothesize that consumers' beliefs about a product's sustainability performance – in this inquiry, carbon footprint – influence their perceptions of the overall experiential quality and well-being of living in MSWBs.

H2. Beliefs about the climate impact of wood construction influence the perceived comfort and satisfaction of residing in a wood building.

2.3.3. Beliefs about the climate impact of wood construction and intention to live in an MSWB, WCB→MWI

Studies indicate that consumer perceptions about climate performance, as indicated by carbon labels, can directly influence consumer choices towards food purchases [50] and willingness to pay a premium for energy [37]. For example, consumers in New Zealand and Japan have demonstrated strong demand for climate labels on products, reflecting a growing interest in carbon neutrality [51]. Similarly, Lohmann et al. [52] found that a higher carbon footprint negatively impacts food purchasing choices. It should be noted that the cited studies focus on purchasing behaviours other than housing decisions. We have not encountered studies that tested the relationship between perceived climate performance and intention to reside in wooden buildings. Nonetheless, research does appear to indicate that consumers who are aware that wooden construction materials have a low climate impact tend to prefer residing in a wood building (e.g., see: Viholainen et al. [21]).

H3. Beliefs about the climate impact of wood construction influence the intention to live in a wood building.

2.3.4. Attitude toward MSWB and intentions, MWA→MWI

Fishbein's model of consumer choice [41] and Expectancy-Value Theory [42] suggest that behavioral intentions—such as the intention to purchase or adopt—are shaped by an individual's attitude toward a product. This attitude, in turn, is determined by the individual's beliefs about the product's attributes and the subjective importance they assign to those attributes. In this study, it is hypothesized that high expectations regarding the well-being, comfort, and functionality of wood-based apartments contribute to a favourable (cognitive) attitude, which in turn influences the intention to live in such dwellings. This

view is supported by studies such as Petruch and Walcher [22] and Gold and Rubik [19], who find that willingness to live in wooden homes is often associated with the material's perceived positive effects on well-being.

H4. Favourable attitudes toward MSWB positively influence the intention to reside in one.

3. Method and data

3.1. Approach

The analyses applied confirmatory factor analysis (CFA) together with structural equation modeling (SEM) and used the statistical program R lavaan [53].

3.2. Data collection and sample

The study focuses on Finland, Norway, Sweden, Denmark, Austria, Germany, and the United Kingdom. Country selection followed the overarching objectives of the research project, which examines forest bioeconomy markets across the Nordic region and European countries with significant timber and sawnwood trade—particularly major exporters like Austria and Germany, and major importers like the United Kingdom.

Data were collected via an online consumer survey conducted by the market research company Syno International [54] among 7053 respondents in May and June 2021. Respondents were recruited to be representative of each country's demographics, considering factors such as building traditions, industrial background, and market size.

Online panel research has advanced in recent years and is widely used in marketing and social science research due to its advantages in speed, convenience, and cost-effectiveness [55]. Walter et al. [56] found that online panels yield psychometric outcomes comparable to those obtained through conventional data collection methods, demonstrating the approach's ability to produce valid and reliable data at a reasonable cost.

Although the questionnaire was administered in 2021, it remains valid and relevant because the survey captured public perceptions formed after several years of intense climate debate and policy development in Europe. The European Green Deal, adopted in 2020 and developed thereafter, had established climate neutrality as a binding EU goal, and discussions about the climate performance of construction materials—particularly timber versus concrete and steel—were already underway in both policy and industry circles. While shifts in public beliefs may occur over time, the 2021 data capture a period when European climate policies were being implemented, and public awareness of low-carbon construction was growing, providing a relevant context for examining consumer beliefs, attitudes, and intentions.

This study uses the same dataset as Kim et al. [17] but applies a different theoretical model to test new hypotheses. Whereas Kim et al. [17] examined Europeans' behavioural intentions to live in multi-storey wooden buildings using the Theory of Planned Behaviour, the present study focuses on the psychological mechanisms underlying sustainable housing preferences. Specifically, it links climate beliefs, climate concern, and perceptions of wood's climate impact to attitudes and intentions toward wooden housing, thereby integrating perspectives from environmental psychology and consumer behaviour and providing novel insights not previously explored.

The survey included questions on demographics, environmental attitudes, perceptions of wood use, living arrangements, employment in the forest or construction sectors, and factors influencing housing choices, with particular emphasis on perceptions of living in multi-storey wooden buildings (MSWBs). Most questions were formulated as statements that respondents evaluated in terms of agreement or attractiveness, along with rankings of factors influencing their preferences. The questionnaire was developed by a multinational team of researchers with forestry expertise, reviewed for cross-country differences, and finalized with input from Syno International experts [54]. A master questionnaire was prepared in English and translated into multiple languages; native speakers reviewed the translations to ensure the accuracy of specialized terminology. Supplement 1 contains the master questionnaire. Syno International distributed the survey to members of online panels in the selected countries, ensuring representative samples by age, gender, and region. A description of the respondents is presented in Table 1.

As requested from the panel data, Table 1 displays a relatively balanced gender distribution, with male and female respondents being nearly equal across all countries. Age distribution varies across the countries. Austria has a higher proportion of younger respondents under 30 (41 %), compared to other countries where this group ranges between 21 % and 23 %. Meanwhile, Germany has the highest proportion of middle-aged respondents (45–64 years old) at 43 %, while Austria and Denmark have the lowest in this category. The proportion of older respondents (65 and above) is high in Denmark (23 %), whereas Austria has a relatively younger sample, with only 8 % in this age group.

Denmark and Germany have the highest proportion of respondents with only primary education (18 % and 22 %, respectively), while Norway (7 %) and the UK (4 %) have the lowest. Secondary education is most common in Sweden (51 %) and the UK (54 %). University education is highest in Norway, with 34 % of respondents holding a bachelor's degree and 17 % a master's degree, suggesting a more highly educated sample in this country.

Regarding place of residence, Finland and UK stand out for their high proportions of respondents living in small or medium-sized cities (37 % in both countries). Germany and the UK have notably small rural population (only 8 % and 5 %, respectively), while Norway has the highest rural representation (19 %). The proportion of respondents living in metropolitan areas is highest in Austria (21 %) and Finland (20 %), whereas Norway has the lowest share (10 %).

Housing types also show variation across countries. Finland has the highest proportion of respondents living in apartments in multi-storey buildings (49 %), while the UK has the lowest (9 %). Detached houses are most common in Norway (46 %) and Denmark (43 %), whereas the UK and Germany have lower proportions of detached house dwellers (20 %, in both countries). The UK stands out with a much higher proportion of respondents living in semi-detached houses (36 %).

The variations in demographic, educational, and housing-related factors suggest meaningful cross-country differences that may influence perceptions of housing and environmental preferences.

3.3. Measurement variables and constructs

The variables in the analysis were measured as 9-point Likert bipolar scales from 1="strongly disagree" to 9="strongly agree". The latent constructs are presented in Table 2 and further described below.

Climate concern and beliefs (CCB) reflect beliefs about the existence, anthropogenic nature, and severity of climate change [47], which is partly similar as the definition of environmental concern [57,58]. Belief in the climate impact of wood construction (WCB) is based on previous studies on green trust [59,60], which reflect the perceived sustainability-related impacts of a product. In this study, the focus is specifically on impacts related to climate change.

Attitude toward MSWBs, based on well-being, health, and function (MWA) and the intention to live in an MSWB (MWI), are primarily rooted in the cognitive and, to some extent, behavioral dimensions of the Expectancy-Value Theory [42] and the Theory of Planned Behavior [61].

Table 1
Profile of Respondents by Country (Column Percentages).

Variable	Category	UK n = 1008	NOR n = 1007	FIN n = 1009	SWE n = 1008	GER n = 1006	AUT n = 1005	DEN n = 1010	All n = 1053
Gender	Female	52	50	51	50	51	48	50	50
	Male	48	50	49	50	49	51	50	49
Age Group	<30	22	22	21	23	23	41	23	25
	30–44	28	28	25	25	22	22	21	24
	45–64	37	34	39	37	43	29	32	36
	65-	14	16	15	14	12	8	23	15
Education	Primary education (up to 10 years)	4	7	9	9	22	14	18	12
	Secondary education (primary + 3 years)	54	38	46	51	41	43	38	44
	University degree, Bachelor (secondary + 3–4 years)	30	34	28	29	21	25	30	28
	University degree, Master (secondary + 5–6 years)	8	17	15	10	11	12	13	12
	University doctoral degree (Master + 3–4 years)	4	4	1	2	5	6	2	3
Place of residence	In a large city (100 000 – 1 000 000 inhabitants)	30	24	27	27	28	18	16	24
	In a small or medium sized city (10 000 – 100 000 inhabitants)	37	36	37	36	36	21	33	34
	In a village (< 10 000 inhabitants)	16	12	8	10	16	26	21	16
	In the countryside	5	19	8	9	7	14	13	11
	The capital region or a metropolitan area (> 1 million inhabitants)	12	10	20	18	12	21	17	16
Housing type	Apartment in a multi-storey building (at least 3 storeys)	9	22	49	38	36	39	22	31
	Apartment-building (1–2 storeys)	12	12	3	17	24	17	13	14
	Detached, single-family house	20	46	27	30	20	26	43	30
	Semi-detached house	36	8	3	4	8	7	4	10
	Townhouse/Row house	19	9	17	9	9	7	15	12
	Other	3	3	1	2	3	3	3	2

Note: All figures are column percentages. UK = United Kingdom, NOR = Norway, FIN = Finland, SWE = Sweden, GER = Germany, AUT = Austria, DEN = Denmark, All = All countries combined.

Table 2
Latent Constructs and Their Associated Manifest Variables.

Latent variable	Manifest variables
CCB. Climate Beliefs and Concern. "My opinions about climate change"	
	Human activities are causing climate change
	Climate change is a real and serious issue
	Recent extreme weather disasters are caused by climate change
WCB. Belief on climate impact of wood construction "My opinions about construction, climate and the environment"	
	Wood as a construction material keeps carbon stored, thus, can help reduce net emissions of global warming gases
	Building with wood is more climate-friendly than concrete or steel
	Carbon stored in wooden building materials will significantly increase attractiveness of using wood in construction
MWA. Attitude toward MSWB. "Please indicate your agreement to the following statements regarding multi-storey wood buildings (MSWBs)"	
	Life inside MSWBs is healthier than those constructed of other materials
	MSWBs are pleasant
	MSWBs are functional
MWI. Intention to live in an MSWB. "If I had the option to live in a multi-storey building… " (Dependent variable)	
	…. I would live in a MSWB
	….I would appreciate living in an apartment in a wooden building
	….I would choose an apartment in a multi-storey wooden building

4. Results

4.1. Measurement model

The Maximum Likelihood estimation method with Robust Standard Errors was used since it provides standard errors and test statistics that are robust to non-normality and potential heteroscedasticity [62]. The results of the Confirmatory Factor Analysis are shown in Table 3 and discussed thereafter.

Table 3 includes key model fit indices, standardized factor loadings, and reliability measures, providing insights into the validity and reliability of the measurement model. The Comparative Fit Index (CFI) that assesses how well the model fits compared to a baseline model obtained values ranging from 0.951 to 0.984 across countries, with the combined sample at 0.981. This indicates a good fit [63], p 140. Similarly, the Tucker-Lewis Index (TLI) that appraises model fit while penalizing complexity are well above acceptable thresholds. The combined sample achieves a TLI of 0.974, further supporting model adequacy [64] p 668.

The Root Mean Square Error of Approximation (RMSEA) of the discrepancy between the model and the population covariance matrix range from 0.042 to 0.075, with the combined model at 0.047, suggesting a strong overall fit. The Standardized Root Mean Square Residual (SRMR) measures the difference between observed and predicted correlations. This indicator yielded values below 0.05, with the combined model at 0.028, confirming minimal residual error and a strong fit [64] p 667–668.

Factor loadings indicate how well observed variables represent their latent constructs. Most loadings exceed 0.70, supporting strong construct validity. CCB shows consistently high loadings, demonstrating that its indicators effectively measure the construct across all samples. Attitudes Toward MSWB (MWA) and Intention to Live in an MSWB (MWI) also exhibit strong loadings, reinforcing the robustness of these constructs. Belief in the climate impact of wood construction (WCB) shows more variation, with lower loadings in Germany and Austria, which may suggest differences in perception across contexts.

Composite Reliability (CR) assesses the internal consistency of each construct. The obtained CR values are consistently above 0.70,

Table 3
CFA Results, Factor Loadings, Reliability, and Model Fit Indices.

Fit Indices/ Construct	UK	NOR	FIN	SWE	GER	AUT	DEN	All countries
CFI	0.970	0.951	0.982	0.977	0.984	0.982	0.970	0.981
TLI	0.959	0.932	0.976	0.969	0.978	0.975	0.959	0.974
RMSEA	0.061	0.075	0.051	0.055	0.042	0.044	0.058	0.047
SRMR	0.040	0.049	0.031	0.038	0.031	0.031	0.039	0.028
Factor loadings:								
CCB:								
Q131	0.818	0.885	0.852	0.867	0.818	0.833	0.849	0.847
Q133	0.924	0.929	0.900	0.919	0.884	0.857	0.891	0.905
Q134	0.823	0.830	0.797	0.800	0.787	0.814	0.797	0.804
WCB:								
Q141	0.761	0.764	0.720	0.740	0.694	0.630	0.742	0.719
Q143	0.671	0.684	0.666	0.721	0.643	0.661	0.708	0.682
Q155	0.701	0.624	0.761	0.649	0.536	0.479	0.627	0.625
MWA:								
Q202	0.757	0.679	0.753	0.734	0.722	0.723	0.703	0.729
Q203	0.859	0.837	0.885	0.893	0.845	0.841	0.839	0.860
Q204	0.718	0.791	0.876	0.869	0.816	0.842	0.855	0.819
MWI:								
Q223	0.759	0.654	0.810	0.592	0.730	0.700	0.618	0.698
Q231	0.832	0.621	0.845	0.880	0.843	0.807	0.832	0.818
Q233	0.868	0.733	0.909	0.858	0.818	0.853	0.858	0.850
Composite Reliability (CR)								
MWA	0.823	0.815	0.877	0.873	0.838	0.845	0.843	0.846
WCB	0.755	0.734	0.759	0.747	0.659	0.618	0.735	0.716
CCB	0.892	0.913	0.887	0.897	0.869	0.874	0.884	0.889
MWI	0.861	0.710	0.891	0.826	0.840	0.831	0.817	0.833
Average Variance Extracted (AVE):								
MWA	0.609	0.596	0.706	0.697	0.634	0.646	0.643	0.648
WCB	0.507	0.480	0.513	0.496	0.394	0.355	0.482	0.458
CCB	0.733	0.778	0.724	0.745	0.690	0.697	0.717	0.728
MWI	0.674	0.450	0.732	0.620	0.638	0.623	0.604	0.626
Cronbach's Alpha:								
MWA	0.817	0.806	0.872	0.866	0.835	0.943	0.837	0.841
WCB	0.749	0.725	0.757	0.743	0.653	0.615	0.731	0.713
CCB	0.889	0.912	0.884	0.895	0.868	0.873	0.882	0.887
MWI	0.857	0.700	0.888	0.810	0.839	0.827	0.804	0.827
Latent Variable Correlations	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85
HTMT Discriminant Validity	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85	All <0.85

indicating good reliability across most constructs and countries [64, p. 710]. Average Variance Extracted (AVE) reflects the proportion of variance captured by a construct relative to measurement error [64, p. 709]. AVE values indicate good convergent validity for most constructs, although lower WCB values below 0.5 were observed for Germany and Austria. To examine potential low-effort responding, cases showing identical ratings within each construct (i.e., straight-lining) were temporarily removed, while allowing variation between constructs [65]. However, this adjustment did not improve model fit or validity, so the full dataset was retained for analysis.

Cronbach's Alpha (α), which measures internal consistency, reflects strong reliability for CCB, MWA, and MWI. WCB presents slightly lower alpha values (<0.7), again for Germany and Austria, indicating potential variability in how this construct is interpreted [64].

Correlation coefficients between latent variables confirm that constructs are distinct, as all values remain below the critical threshold. The Heterotrait-Monotrait Ratio (HTMT) further supports discriminant validity, with all values indicating that the constructs are sufficiently independent from each other [66].

The confirmatory factor analysis (CFA) results indicate that the measurement model performs reasonably well across the seven countries. It generated good fit indices, robust factor loadings, and solid construct reliability. Some divergence in the WCB construct suggests possible undetected influences on how respondents interpret the climate-related benefits of wood. Given the reliability and validity metrics, the model is well-suited for use in subsequent structural equation modelling (SEM). The latent constructs seem to effectively reflect the underlying theoretical concepts in each national sample.

4.2. Structural equation models (SEM) results

Table 4 presents the results of the SEM applied to the mediated model across seven countries and the full sample. The results include estimates of direct, indirect, and total effects, along with model fit indices, offering a comprehensive assessment of the relationships among the latent variables. Covariances between constructs—such as between CCB and WCB—were not included, as they were not theoretically justified and only led to marginal improvements in model fit. Since the confirmatory factor analyses (CFA) and structural equation models (SEM) were conducted separately for each country, direct comparisons of model coefficients across countries should be interpreted with caution, as measurement invariance was not tested [63, p. 300].

The relationship between CCB and WCB is positive and significant across all countries, with coefficients ranging from 0.332 in Finland to 0.454 in Norway, and a value of 0.406 for the full sample. This indicates that higher levels of beliefs and concern about climate change are associated with increased belief in the beneficial climate impact of wood construction.

The effect of WCB on MWI varies across countries. While the relationship is significant in most cases, Finland (0.067) and Germany (0.118) do not show significant effects at the 5 % level. The full sample coefficient is 0.177, suggesting a modest but positive association overall.

MWA strongly predicts MWI, with coefficients ranging from 0.424 in Sweden to 0.742 in Finland. The full sample estimate is 0.569, indicating a robust and consistent effect across countries. This highlights the critical role of attitudes toward MSWBs in shaping behavioural intentions.

The effect of WCB on MWA is consistently strong across all countries, with coefficients ranging from 0.537 in Denmark to 0.733 in Sweden.

Table 4
Structural Equation Model Results: Direct, Indirect, and Total Effects.

Latent Variable	UK	NOR	FIN	SWE	GER	AUT	DEN	All
Direct Effects:								
CCB→WCB	0.364***	0.454***	0.332***	0.436***	0.424***	0.447***	0.387***	0.406***
WCB→MWI	0.203***	0.213***	0.067	0.275***	0.118	0.151*	0.243***	0.177***
MWA→MWI	0.534***	0.583***	0.742***	0.424***	0.658***	0.582***	0.433***	0.569***
WCB→MWA	0.652***	0.662***	0.643***	0.733***	0.665***	0.706***	0.537***	0.661***
IndirectEffects:								
WCB→MWA→MWI	0.348***	0.386***	0.477***	0.311***	0.437***	0.411***	0.232***	0.376***
TotalEffects[1]:								
WCB→MWI	0.551***	0.600***	0.545***	0.586***	0.556***	0.561***	0.476***	0.553***
Model Fit Indices								
RMSEA	0.061	0.077	0.050	0.054	0.044	0.043	0.059	0.048
SRMR	0.043	0.057	0.033	0.038	0.037	0.033	0.043	0.030
CFI	0.969	0.946	0.982	0.978	0.982	0.982	0.968	0.980
TLI	0.959	0.929	0.976	0.970	0.976	0.976	0.958	0.974

*** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$; [1]Total effects include both direct and indirect effects.

The full sample coefficient is 0.661, which points to an important role of belief in the climate impact of wood construction in fostering general positive attitudes toward living in MSWBs.

The mediated pathway from belief in the climate impact of wood construction (WCB) to intention to live in MSWBs (MWI) through attitude towards MSWBs (MWA) is positive and significant across all countries, with coefficients ranging from 0.232 in Denmark to 0.477 in Finland. The full sample indirect effect is 0.376, confirming that the influence of belief in the climate impact of wood construction on intention to live in MSWBs is partially channelled through attitudes toward MSWBs (MWA).

The total effect of belief in the climate impact of wood (WCB) on intention to live in MSWBs (MWI), which combines both direct and indirect pathways, remains consistently high across countries, ranging from 0.476 in Denmark to 0.600 in Norway, with a full sample estimate of 0.553. This further validates the strong role of belief in the climate impact of wood construction in shaping willingness, both directly and through attitudinal mediation.

The model fit indices indicate an overall good fit. RMSEA values range from 0.043 (Austria) to 0.077 (Norway), with a full sample value of 0.048, all within acceptable thresholds. SRMR values range from 0.030 (full sample) to 0.057 (Norway), further supporting model fit. The comparative fit index (CFI) and Tucker-Lewis index (TLI) exceed the commonly accepted 0.95 threshold in most cases, with the lowest values observed in Norway (CFI = 0.946, TLI = 0.929). These results indicate that the model adequately captures the relationships among the constructs.

4.3. Alternative specifications

The following alternative models were estimated:

CCB→WCB, WCB→MWI, MWA→MWI. Impact of beliefs about the climate impact of wood construction on attitude removed.
CCB→MCB, CCB→MWI, WCB→MWI, MWA→MWI. Impact of beliefs about the climate impact of wood construction on attitude removed. Direct impact of climate beliefs and concern on Intention to live in MSWBs added.

These models exhibited poorer fit based on the primary criteria, RMSEA and SRMR, and also reduced CFI and TLI values compared to the retained model.

5. Discussion

This study highlights the central role of climate beliefs and concern, beliefs about the climate impact of wood construction, and attitudes toward multi-storey wooden buildings (MSWBs) in shaping consumers' intentions to live in such dwellings. Individuals more concerned about climate change are more likely to view wood as a climate-friendly material. These beliefs, in turn, foster positive attitudes toward MSWBs—especially regarding their liveability, comfort, and well-being benefits. Among all predictors, attitudes toward MSWB emerged as the strongest determinant of housing intention.

Although beliefs about wood's climate benefits had only a modest direct effect on intention, the indirect effect—mediated through attitudes—was substantially stronger. This indicates that while beliefs on climate impact of wood construction are influential, they primarily operate through attitudes of wooden housing. In other words, perceived comfort and quality matter more to consumers than climate credentials alone.

Notably, in Finland and Germany, the direct link between beliefs about wood's climate impact and housing intention was not statistically significant. This may reflect national differences in housing policy, cultural familiarity with wood, or perceptions on materials. In Finland, for example, the symbolic and historical acceptance of wood may reduce the added influence of environmental beliefs on behaviour, even though these beliefs continue to shape attitudes indirectly.

These results align with previous studies indicating that attitudes are more immediate drivers of behaviour than general environmental concern, particularly in high-commitment decisions such as housing [20,26]. While Ruokamo et al. [27] found only a modest effect of climate concern on housing preferences, our findings demonstrate that concern influences intentions primarily through beliefs and attitudes.

This study also complements the work of Judge et al. [28], who emphasize the importance of sustainability identity in housing choices. Unlike consumer goods research, where environmental beliefs can more directly predict behaviour [29,32], housing decisions involve more complex trade-offs and rely more heavily on perceived liveability, identity alignment, and emotional engagement. Our findings are consistent with those of Sörqvist et al. [34], suggesting that a product's—in this case, a housing alternative—sustainability performance can influence cognitive attitudes.

Although this study used the same dataset as Kim et al. [17], the two studies adopt different theoretical lenses. Kim et al. focus on attitude, subjective norm and perceived behavioural control, whereas our analysis isolates the psychological mechanisms linking climate beliefs, material perceptions, and attitudes. A comparison of key model fit indices (RMSEA, SRMR, CFI, TLI) shows both models perform well, with the current model demonstrating slightly better fit. However, the difference is modest and may reflect sampling variation rather than substantive divergence.

Theoretically, this study contributes in several important ways. First, it validates and extends expectancy-value theory by demonstrating that climate beliefs and concern, along with beliefs about the environmental benefits of wood construction, shape attitudes that in turn strongly

predict behavioural intention. This reinforces a belief–attitude–intention pathway, where both rational evaluations and emotional responses—such as perceived well-being and comfort—guide decision-making. Second, the study applies Signalling Theory to show how sustainability cues, such as the carbon benefits of wood, influence consumer behaviour by shaping evaluations of liveability and design quality. This aligns with the concept of the green halo effect, where environmentally friendly features enhance overall product evaluations. Third, the findings expose a belief–attitude gap, challenging the assumption that values directly drive behaviour. While climate beliefs and concern, and belief on climate impact of wood construction are necessary precursors, they primarily influence intention when filtered through attitude toward MSWB.

This suggests that behavioural intention is mediated by evaluations of liveability, comfort and functionality. Overall, our findings refine prior models by demonstrating that the intention impact of climate beliefs and concern is largely channelled through intermediate beliefs and attitudes. This underscores the importance of psychological mediators in sustainable decision-making.

The findings offer valuable insights for promoting multi-storey wood buildings (MSWBs). The outcomes of the hypotheses and their practical implications are summarized in Table 5.

Overall, Table 5 highlights the interconnectedness between climate beliefs and concern, perceived climate performance of wood construction, attitudes toward liveability and comfort, and the intention to live in MSWBs. These findings underline the need for a communication strategy rooted in credible, science-based information, coupled with ongoing performance and sustainability innovations.

Since attitudes are the most influential predictor of intention, marketing – and product development – should focus on enhancing perceptions of comfort, well-being, and functionality. While environmental messaging remains relevant, it should be embedded within broader narratives of quality of life, health, and design appeal. A dual messaging strategy—emphasizing both sustainability credentials and lifestyle benefits—is likely to be most effective. This consumer-centric framing is also evident in national initiatives such as Finland's and Sweden's Wood Cities, Austria's Wood Solutions, and the US-based Think Wood campaign.

Table 5
Hypotheses: Outcomes, Interpretations, and Practical Implications.

Hypothesis	Outcome	Interpretation	Practical Implication
H1	Supported	Climate beliefs and concern positively influence perceptions of the climate impact of wood construction.	The industry and policymakers should base their communication efforts on climate change on scientifically grounded knowledge.
H2	Strongly Supported	Beliefs that the climate impact of wood construction positively affect attitudes toward the comfort and well-being benefits of MSWBs.	Both the industry and policymakers should highlight scientific evidence on MSWB's carbon footprint and prioritize innovation to further reduce it.
H3	Weakly supported, except in Finland and Germany	Beliefs about the climate impact of wood construction have a weak direct influence on the intention to live in MSWBs.	The industry and policymakers must provide scientifically validated data on MSWB's climate performance. Accurate, evidence-based communication is essential to strengthen this relationship. However, modest, this direct relationship should not be overseen.
H4	Strongly Supported	Positive attitudes toward the comfort and well-being benefits of MSWBs significantly influence the intention to live in them.	The industry should focus on enhancing these benefits. Innovations aimed at both reducing carbon footprint and improving liveability are essential to build trust and avoid perceptions of greenwashing.

From a policy perspective, the results support a more integrated approach to fostering MSWB adoption. Policymakers should consider updating building codes and standards to reflect not only technical performance but also comfort, liveability, and functionality, which strongly influence consumer intention. Investment in demonstration projects can showcase the co-benefits of sustainable and liveable housing, while standardized eco-labelling can clarify environmental performance and build public trust. These insights are particularly relevant in the context of EU initiatives such as the European Green Deal, the Energy Performance of Buildings Directive [67], and the REPowerEU plan [68], which aim to accelerate energy-efficient and low-carbon building practices. By highlighting the mediating role of attitudes and beliefs, our study provides novel evidence for designing communication and incentive strategies that encourage consumer adoption of sustainable housing. Importantly, the carbon benefits of MSWBs must be validated through independent assessments and communicated transparently to both consumers and decision-makers. Finally, the findings can inform broader strategies promoting circular construction, material reuse, and sustainable design, illustrating how psychological and contextual factors shape the uptake of environmentally friendly building practices.

This study has several limitations. First, although the data were collected via an online panel and are broadly representative, they may not fully capture the perspectives of all demographic groups. Second, because confirmatory factor analyses (CFAs) and structural equation models (SEMs) were estimated separately for each country, direct cross-country comparisons should be interpreted with caution. Third, while the model explains a substantial portion of the variance in the intention to live in multi-storey wood buildings (MSWBs), other factors—such as financial costs, cultural influences, and identity—may also play a crucial role. Fourth, translating the questionnaire into multiple languages may have introduced variations in interpretation, potentially affecting response reliability. Fifth, the stability of respondents' opinions over time cannot be assumed. In particular, their responses may have been influenced by evolving policies. For example, the EU Green Deal was adopted in 2019 but developed over the following years, while the EU Taxonomy Delegated Acts and other ongoing initiatives have aimed to promote environmentally low-impact and energy-efficient buildings. The findings thus capture public priorities at an early stage in the implementation of EU climate and housing policies, a period when perceptions and beliefs are likely to evolve gradually. Furthermore, attitudes and beliefs toward wood construction may shift over time, as is common in attitudinal research.

While we conceptualize the relationship between factual beliefs and attitudes as directional, based on cognitive-affective models, we recognize that our design does not allow us to fully disentangle causality from correlation. Future studies using experimental or longitudinal designs could further investigate the directionality of this relationship.

Future studies should explore additional factors influencing consumer choices for MSWBs. While this study focused on climate beliefs and concern and belief on climate impact of wood construction and attitude, economic considerations such as cost perceptions, government incentives, and long-term maintenance costs may be relevant elements in housing decisions. Additionally, personal identity and lifestyle alignment with wooden housing—such as emerging trends for minimalist or nature-connected living—could be examined as alternative drivers of MSWB adoption.

Longitudinal studies could examine whether attitudes and intentions

toward MSWBs change over time with increased exposure to wooden buildings. Experimental studies could investigate the effectiveness of different marketing messages in shaping consumer perceptions of MSWBs. Building on the global outlook for wood construction outlined by Churkina et al. [15], psychometric research could examine regional variations beyond the EU in the relationships among climate beliefs and concerns, perceptions of the climate impact of wood construction, and attitudes and intentions regarding MSWBs. Such studies should also account for cross-country measurement invariance to allow for more meaningful comparisons.

6. Conclusion

This study contributes to the literature on consumer preferences for sustainable housing by integrating psychological factors — including climate beliefs, climate concern, perceptions of wood's environmental impact, and attitudes toward MSWBs — with national context in a cross-national analysis. Unlike prior studies that often focus on single determinants or a single country, our approach demonstrates how individual beliefs and contextual factors jointly shape intentions to live in multi-story wood buildings (MSWBs). For the wood building sector, these results underscore the importance of promoting the environmental benefits of wood while ensuring that MSWBs meet consumer expectations for liveability, comfort, and functionality. These insights can assist developers and policymakers in designing housing strategies and marketing communications that align climate goals with consumer expectations, thereby promoting the wider adoption of sustainable housing.

CRediT authorship contribution statement

Anders Roos: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ritva Toivonen:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Florencia Franzini:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Cecilia Mark-Herbert:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Anne M K Toppinen:** Writing – review & editing, Investigation, Formal analysis, Conceptualization. **Camilla Widmark:** Writing – review & editing, Methodology, Investigation, Conceptualization. **Anders Qvale Nyrud:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Hans Fredrik Hoen:** Writing – review & editing, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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Data availability

Data will be made available on request.

References

[1] United Nations Framework Convention on Climate Change, The Paris Agreement. https://unfccc.int/sites/default/files/english_paris_agreement.pdf, 2015 [Accessed: 5 November 2025].
[2] European Commission, The European Green Deal. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en, 2019, 2019 [Accessed: 5 November 2025].
[3] World Meteorological Organization (WMO), WMO confirms 2024 as warmest year on record at about 1.55 °C above pre-industrial level. https://wmo.int/news/media-centre/wmo-confirms-2024-warmest-year-record-about-155degc-above-pre-industrial-level, 2025 [Accessed: 5 November 2025].
[4] United Nations Environment Programme (UNEP), Global Status Report for buildings and Construction 2024–2025. https://wedocs.unep.org/handle/20.500.11822/47214, 2023 [Accessed: 5 November 2025].
[5] R. Minunno, T. O'Grady, G.M. Morrison, R.L Gruner, Investigating the embodied energy and carbon of buildings: a systematic literature review and meta-analysis, Renew. Sustain. Energy Rev. 143 (2021) 110935, https://doi.org/10.1016/j.rser.2021.110935.
[6] J. Hart, B. D'Amico, F. Pomponi, Whole-life embodied carbon in multistory buildings: steel, concrete and timber structures, J. Ind. Ecol. 25 (2) (2021) 403–418, https://doi.org/10.1111/jiec.13139.
[7] European Commission /DG Environment. EU policy roadmap for decarbonised buildings: supporting the reduction of whole life carbon in the built environment (Final report, Publication No. KH-02-23-311-EN-N). 2023. https://doi.org/10.2779/634412.
[8] D. Gibbs, K. O'Neil, Building a green economy? Sustainability transitions in the UK building sector, Geoforum 59 (2015) 133–141, https://doi.org/10.1016/j.geoforum.2014.12.004Get, rights and content.
[9] F. Avelino, J.M. Wittmayer, Shifting power relations in sustainability transitions: a multi-actor perspective, J. Environ. Policy Plan. 18 (5) (2016) 628–649, https://doi.org/10.1080/1523908X.2015.1112259.
[10] S. Huttunen, M. Kaljonen, A. Lonkila, S. Rantala, A. Rekola, R. Paloniemi, Pluralising agency to understand behaviour change in sustainability transitions, Energy Res. Soc. Sci. 76 (2021) 102067, https://doi.org/10.1016/j.erss.2021.102067.
[11] R. Toivonen, H. Vihemäki, A. Toppinen, Policy narratives on wooden multi-storey construction and implications for technology innovation system governance, For. Policy Econ. 125 (2021) 102409, https://doi.org/10.1016/j.forpol.2021.102409.
[12] Toppinen A., Sauru M., Pätäri S., Lähtinen K., Tuppura A. Internal and external factors of competitiveness shaping the future of wooden multistory construction in Finland and Sweden. Construction management and economics. 2019;37(4), 201–216. https://doi.org/10.1080/01446193.2018.1513162.
[13] G. Ludwig, The role of law in transformative environmental policies—A case study of timber in buildings construction in Germany, Sustainability 11 (3) (2019) 842, https://doi.org/10.3390/su11030842.
[14] European Economic and Social Committee, Affordable sustainable housing in the EU (No. QE-01-24-005-EN-N). https://www.eesc.europa.eu/sites/default/files/2024-11/qe-01-24-005-en-n.pdf, 2024 [Accessed: 5 November 2025].
[15] G. Churkina, A. Organschi, C.P. Reyer, A. Ruff, K. Vinke, Z. Liu, B.K. Reck, T. K. Graedel, H.J. Schellnhuber, Buildings as a global carbon sink, Nat. Sustain. 3 (4) (2020) 269–276, https://doi.org/10.1038/s41893-019-0462-4.
[16] C. Harju, The perceived quality of wooden building materials—A systematic literature review and future research agenda, Int. J. Consum. Stud. 46 (1) (2022) 29–55, https://doi.org/10.1111/ijcs.12764.
[17] D.H. Kim, F. Franzini, B.J. Thorsen, S. Berghäll, F.X Aguilar, Greener homes: factors underpinning Europeans' intention to live in multi-storey wooden buildings, Sustain. Prod. Consum. 39 (2023) 373–381, https://doi.org/10.1016/j.spc.2023.05.030.
[18] O. Jonsson, S. Lindberg, A. Roos, M. Hugosson, M. Lindström, Consumer perceptions and preferences on solid wood, wood-based panels, and composites: a repertory grid study, Wood Fiber Sci. 4 (2008) 663–678.
[19] S. Gold, F. Rubik, Consumer attitudes towards timber as a construction material and towards timber frame houses, J. Clean. Prod. 17 (2) (2009) 303–309, https://doi.org/10.1016/j.jclepro.2008.07.001.
[20] A. Roos, H.F. Hoen, F.X. Aguilar, A. Haapala, E. Hurmekoski, J. Jussila, K. Lähtinen, C. Mark-Herbert, T. Nord, A. Toivonen R Toppinen, Impact of prospective residents' dwelling requirements on preferences for house construction materials, Wood. Mater. Sci. Eng. 18 (4) (2023) 1275–1284, https://doi.org/10.1080/17480272.2022.2126947.
[21] N. Viholainen, F. Franzini, K. Lähtinen, A.Q. Nyrud, C. Widmark, H.F. Hoen, A. Toppinen, Citizen views on wood as a construction material: results from seven European countries, Can. J. For. Res. 51 (5) (2021) 647–659, https://doi.org/10.1139/cjfr-2020-0274.
[22] M. Petruch, D. Walcher, Timber for future? Attitudes towards timber construction by young millennials in Austria, J. Clean. Prod. 294 (2021) 126324, https://doi.org/10.1016/j.jclepro.2021.126324.
[23] International Institute for Sustainable Development. (1995). Oslo Roundtable on sustainable production and consumption. Retrieved November 7, 2025, from http://www.iisd.ca/consume/oslo004.html.

[24] D. Ürge-Vorsatz, R. Khosla, R. Bernhardt, Y.C. Chan, D. Vérez, S. Hu, L.F Cabeza, Advances toward a net-zero global building sector, Annu. Rev. Environ. Resour. 45 (1) (2020) 227–269, https://doi.org/10.1146/annurev-environ-012420-045843.
[25] E. Heiskanen, K. Matschoss, S. Laakso, E.-L. Apajalahti, A critical review of energy behaviour change: the influence of context. Energy and Behaviour: Towards a Low Carbon Future, Academic Press, 2020, pp. 391–417, https://doi.org/10.1016/B978-0-12-818567-4.00015-6.
[26] A. Vehola, A. Malkamäki, A.-K. Kosenius, E. Hurmekoski, A. Toppinen, Citizen beliefs concerning wood as a construction material under extreme weather events, Can. J. For. Res. 52 (2022) 1266–1279, https://doi.org/10.1139/cjfr-2022-0108.
[27] E. Ruokamo, F. Franzini, K. Lähtinen, A. Toppinen, To renovate or build with wood? Results from Finnish citizen survey data, Constr. Manag. Econ. 42 (10) (2024) 886–901, https://doi.org/10.1080/01446193.2024.2358063.
[28] M. Judge, G. Warren-Myers, A. Paladino, Using the theory of planned behaviour to predict intentions to purchase sustainable housing, J. Clean. Prod. 215 (2019) 259–267, https://doi.org/10.1016/j.jclepro.2019.01.029.
[29] Y. Feucht, K. Zander, Consumers' preferences for carbon labels, J. Clean. Prod. 178 (2018) 740–748, https://doi.org/10.1016/j.jclepro.2018.01.172.
[30] M. Jakučionytė-Skodienė, G. Liobikienė, Climate change concern, personal responsibility and mitigation in EU, J. Clean. Prod. 281 (2021) 125189, https://doi.org/10.1016/j.jclepro.2020.125189.
[31] R. Habib, K. White, D.J. Hardisty, J. Zhao, Shifting consumer behavior to address climate change, Curr. Opin. Psychol. 42 (2021) 108–113, https://doi.org/10.1016/j.copsyc.2021.04.007.
[32] J. Zhang, M.S. Islam, M. Jambulingam, W.M. Lim, S. Kumar, Leveraging environmental corporate social responsibility to promote green purchases: the case of new energy vehicles in the era of sustainable development, J. Clean. Prod. 434 (2024) 139988, https://doi.org/10.1016/j.jclepro.2023.139988.
[33] N. Cocolas, G. Walters, L. Ruhanen, J. Higham, Consumer attitudes towards flying amidst growing climate concern, J. Sustain. Tour. 29 (6) (2020) 944–963, https://doi.org/10.1080/09669582.2020.1849234.
[34] P. Sörqvist, A. Haga, L. Langeborg, M. Holmgren, M. Wallinder, A. Nöstl, P. B. Seager, J.E Marsh, The green halo: mechanisms and limits of the eco-label effect, Food Qual. Prefer. 43 (2015) 1–9, https://doi.org/10.1016/j.foodqual.2015.02.001.
[35] V. Buettner, B. Gassler, R. Teuber, Does the Eco-Score lead to a halo effect? Influence of a sustainability label on product perceptions and purchase intention, Food Qual. Prefer. 121 (2024) 105246, https://doi.org/10.1016/j.foodqual.2024.105246.
[36] A. Chernev, S. Blair, When sustainability is not a liability: the halo effect of marketplace morality, J. Consum. Psychol. 31 (3) (2021) 551–569, https://doi.org/10.1002/jcpy.1195.
[37] J.P. Loaiza-Ramírez, T. Reimer, C.E Moreno-Mantilla, Who prefers renewable energy? A moderated mediation model including perceived comfort and consumers' protected values in green energy adoption and willingness to pay a premium, Energy Res. Soc. Sci. 91 (2022) 102753, https://doi.org/10.1016/j.erss.2022.102753.
[38] S. Ambec, M. .A. Cohen, S. Elgie, P. Lanoie, The Porter hypothesis at 20: can environmental regulation enhance innovation and competitiveness? Rev. Environ. Econ. Policy 7 (1) (2013) 2–22, https://doi.org/10.1093/reep/res016.
[39] K.U. Khan, F. Atlas, M.Z. Arshad, S. Akhtar, F. Khan, Signaling green: impact of green product attributes on consumers trust and the mediating role of green marketing, Front. Psychol. 13 (2022) 790272, https://doi.org/10.3389/fpsyg.2022.790272.
[40] M.N. Espineda, A.H. Banocnoc, I.B.B Bautista, A phenomenological study of consumer perceptions and industry challenges in the transition to sustainable packaging, Discov. Sustain. 6 (1) (2025) 762, https://doi.org/10.1007/s43621-025-01707-7.
[41] M. Fishbein, An investigation of the relationships between beliefs about an object and the attitude toward that object, Hum. Relat. 16 (3) (1963) 233–239, https://doi.org/10.1177/001872676301600302.
[42] M. Fishbein, Ajzen I. Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research, Addison-Wesley, Reading, MA, 1975.
[43] M. Spence, Job market signaling, Q. J. Econ. 87 (3) (1973) 355–374, https://doi.org/10.1016/B978-0-12-214850-7.50025-5.
[44] J.C. Santa, S. Drews, Heuristic processing of green advertising, Ecol. Econ. 206 (2023) 107760, https://doi.org/10.1016/j.ecolecon.2023.107760, 2023.
[45] A. Roos, E. Hurmekoski, L. Häyrinen, J. Jussila, K. Lähtinen, C. Mark-Herbert, E. Nagy, R. Toivonen, A. Toppinen, Beliefs on environmental impact of wood construction, Scand. J. Res. 38 (1–2) (2023) 49–57, https://doi.org/10.1080/02827581.2023.2168043.
[46] Á. Árnadóttir, T. Abdirova, S. Olson, J. Heinonen, M. Czepkiewicz, Does higher climate concern lead to a smaller carbon footprint? A study among the Nordic country residents, Resour. Conserv. Recycl. 205 (2024) 107543, https://doi.org/10.1016/j.resconrec.2024.107543.
[47] C. Shen, Y. Wang, How does public concern about climate change affect carbon emissions? J. Clean. Prod. 426 (2023) 139137 https://doi.org/10.1016/j.jclepro.2023.139137.
[48] S. Lorteau, P. Muzzerall, A.A. Deneault, E.H. Kennedy, R. Rocque, N. Racine, J. F Bureau, Do climate concerns and worries predict energy preferences? A meta-analysis, Energy Policy 190 (2024) 114149, https://doi.org/10.1016/j.enpol.2024.114149.
[49] A. Rondoni, S. Grasso, Consumers' behaviour towards carbon footprint labels, J. Clean. Prod. 301 (2021) 127031, https://doi.org/10.1016/j.jclepro.2021.127031.
[50] J. .A. Wolfson, A. .A. Musicus, C. .W. Leung, A. .N. Gearhardt, J. Falbe, Effect of climate change impact menu labels on fast food ordering choices among US adults: a randomized clinical trial, JAMa Netw. Open. 5 (12) (2022) e2248320, https://doi.org/10.1001/jamanetworkopen.2022.48320.
[51] M. Guenther, C. .M. Saunders, P. .R. Tait, Carbon labeling and consumer attitudes, Carbon. Manage 3 (5) (2012) 445–455, https://doi.org/10.4155/cmt.12.50.
[52] P. .M. Lohmann, E. Gsottbauer, A. Doherty, A. Kontoleon, Do carbon footprint labels promote climatarian diets? Evidence from a large-scale field experiment, J. Environ. Econ. Manag. 114 (2022) 102693, https://doi.org/10.1016/j.jeem.2022.102693.
[53] Y. Rosseel, lavaan: an R package for structural equation modeling, J. Stat. Softw. 48 (2012) 1–36, https://doi.org/10.18637/jss.v048.i02.
[54] Syno, Syno International: about us, Online at, https://www.synoint.com/about-us/, 2025 [Accessed: 5 November 2025].
[55] J. .R. Evans, A. Mathur, The value of online surveys, Internet Res. 28 (4) (2018) 854–887, https://doi.org/10.1108/IntR-05-2017-0181.
[56] Walter S L, Cole M S, Humphrey S E, A tale of two sample sources: do results vary for convenience and probability samples? J. Bus. Psychol. 34 (4) (2019) 425–452, https://doi.org/10.1007/s10869-018-9534-9.
[57] L. Zhang, L. Chen, Z. Wu, S. Zhang, H. Song, Investigating young consumers' purchasing intention of green housing in China, Sustainability 10 (4) (2018) 1044, https://doi.org/10.3390/su10041044.
[58] S. Drews, I. Savin, J.C. Van Den Bergh, S. Villamayor-Tomás, Climate concern and policy acceptance before and after COVID-19, Ecol. Econ. 199 (2022) 107507, https://doi.org/10.1016/j.ecolecon.2022.107507.
[59] Y.S. Chen, C.H Chang, Towards green trust: the influences of green perceived quality, green perceived risk, and green satisfaction, Manag. Decis. 51 (1) (2013) 63–82, https://doi.org/10.1108/00251741311291300.
[60] R. Shah, A. Modi, A. Muduli, J.D Patel, Purchase intention for energy-efficient equipment appliances: extending TPB with eco-labels, green trust, and environmental concern, Energy Effic. 16 (4) (2023) 31, https://doi.org/10.1007/s12053-023-10131-w.
[61] Ajzen I. The theory of planned behavior. Organizational behavior and Human decision processes. 1991;50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.
[62] K.H. Yuan, P.M Bentler, Three likelihood-based methods for mean and covariance structure analysis with nonnormal missing data, Sociol. Methodol. 30 (1) (2000) 165–200, https://doi.org/10.1111/0081-1750.00078.
[63] R. .B Kline, Principles and Practice of Structural Equation Modeling, 5th ed., Guilford Press, New York, 2005.
[64] J. .F. Hair Jr, W. .C. Black, B. .J. Babin, R. .E Anderson, Multivariate Data Analysis, 7th ed., Pearson Education, 2010.
[65] K. Reuning, E. Plutzer, Valid vs. invalid straightlining: the complex relationship between straightlining and data quality, Surv. Res. Methods 14 (5) (2020) 439–459, https://doi.org/10.18148/srm/2020.v14i5.7641 (September).
[66] J. Henseler, C. .M. Ringle, M. Sarstedt, A new criterion for assessing discriminant validity in variance-based structural equation modeling, J. Acad. Mark Sci. 43 (1) (2015) 115–135, https://doi.org/10.1007/s11747-014-0403-8.
[67] European Commission, Proposal for a directive of the European Parliament and of the Council on the energy performance of buildings (recast) (COM(2021) 802 final; 2021/0426(COD)). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0802, 2021 (December 15) [Accessed: 5 November 2025].
[68] European Commission. REPowerEU Plan: Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions (COM (2022) 230 final). Brussels: European Commission, (2022). Available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0230; 2022 (May 18) [Accessed: 5 November 2025].