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Key Factors Influencing Consumer Choices in Wood-Based Recycled Products for Circular Construction Sector

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Abstract: This article explores the integration of wood recycling and reuse practices within construction and reconstruction processes, as highlighted in a wood products questionnaire. The aim of this study is to understand how the Romanian consumers perceive the circular economy in order to adopt responsible consumption models. The working instrument consisted of a questionnaire. The questionnaire was applied to 60.7% urban respondents and 39.3% rural ones and consisted of 23 items. The response rate was 68.5% for certain items (257 responses). In the first part, the integration of wood recycling and reuse practices within construction and reconstruction processes is examined. Emerging recycling techniques and demolition processes, particularly incorporating reused, reconditioned, and recycled wood in the construction industry, are evaluated. The economic and environmental implications of these practices are also examined, contributing to the discussion of eco-design policies, and construction waste management and standards. In the second part, insights are provided into how Romanian consumers' knowledge of CE principles, information about product characteristics, and attitudes influence the demand for recycled wood products. The study concludes with recommendations for better promotion strategies of wood-based recycled products, aiming to increase awareness of its long-term environmental and socio-economic benefits. Additionally, it suggests the need for providing more information on the environmental benefits of wood-based recycled products, and for a more active engagement of stakeholders in the transition to a circular economy. The results serve as a basis for a better understanding of Romanian consumers' adoption of sustainable consumption behavior in agreement with circular economy concepts and SDGs. While the majority of respondents generally shows openness to an eco-friendly product, mere promotion of these principles may not suffice to change entrenched behaviors and purchasing habits.

Keywords: wood recycling; construction and demolition waste; circular economy; construction; consumer behavior

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1. Introduction

Due to its specific physical and chemical attributes, wood is a versatile natural resource, suitable for various applications such as construction, furniture, packaging, and energy [1–6]. Since in its natural state wood possesses a more environmentally favorable profile compared to other common building materials, numerous studies advocate for wooden-framed structures over concrete and steel ones [7]. Wooden materials (natural or raw) offer a potential replacement for concrete, thereby contributing to reducing CO_2 emissions throughout all of a building's life cycle, in agreement with circular economy (CE)

objectives [8–13]. Although there is still a small number of publications on the topic of wood and its environmental benefits, the escalation in the number of published articles since 2017 indicates a growing interest in the subject of the CE and the benefits of its application in the built environment, and this upward trend is likely to continue [14].

Wood waste (WW) emerges as a valuable material, presenting opportunities for both recycling and energy recovery [15–17]. In Europe, WW is a significant source of secondary raw materials, with a substantial potential for being recycled or combusted. The diversity of types, applications, and sources of WW pose serious challenges to recycling practices [18–20]. WW quality is vital to all recycling applications, affecting the stability, longevity, and safety of the final products. Addressing material impurities, both physical and chemical, is crucial to ensure a clean and efficient recycling industry. The effective recycling of post-use WW into particleboard may face obstacles due to the presence of physical and chemical contaminants in the waste stream, underscoring the need to pay more attention to the quality of WW [21–23]. The Wood Recyclers Association in the UK categorizes wood waste into four main categories, delineating the sources, contamination levels, and disposal requirements for each category [7].

Historically, incineration has been the predominant end-of-life option for WW, due to its relatively high calorific value. However, WW holds a significant potential for other recycling options, ranging from direct reuse to subsequent recycling for applications with varying quality standards [24]. In recent years, particleboard has emerged as the primary recycling option for WW, with considerable production volumes in Europe. The share of recycled wood waste incorporated in particleboards varies regionally, being influenced by factors such as wood quality standards and company preferences [25–27].

Ghisellini et al. [28] and Hopkinson et al. [29] found recycling to be the most researched non-disposal method in the construction industry, highlighting the necessity to enhance research on waste reduction and reuse strategies in agreement with CE requests.

In a study from 2016, Ormondroyd et al. [7] promoted the philosophy of the cascading use of materials and waste reduction measures. They show the benefits of moving from the primary to the secondary use of wood. For example, particleboards can later be recycled, leading to a tertiary use of wood for energy recovery. This process can diminish landfill waste, contributing significantly to the improvement of resource efficiency and waste management practices in construction [30–33].

Construction and demolition waste (CDW) is a significant global waste stream, prompting concerns regarding resource depletion, environmental pollution, and energy consumption [34–36]. It also poses environmental and economic challenges, contributing to CO_2 emissions and global waste generation [37–39]. The perception that CDW is primarily generated during construction and demolition stages has led to significant efforts to reduce it on construction sites [37]. CDW is characterized as a mixture of various materials, including inert waste, non-inert non-hazardous waste, and hazardous waste, generated from construction, renovation, and demolition activities.

Benachio et al. [14] reviewed the literature on construction waste and focuses on material reuse within the built environment; they categorized CDW into three levels:

- At the micro-level, several studies focused on specific materials and methods for reuse, explored novel reuse techniques, and examined potential applications for material reuse, based on the existing literature [40–43];
- At the meso-level, research has focused on the broader application of the reuse of entire buildings rather than on specific materials or components. Manelius et al. [44] conducted a case study on buildings incorporating reused materials, while Pimentel-Rodrigues and Siva-Afonso [43] explored the potential for reuse during the operational phase of buildings. Additionally, Akanbi et al. [45] developed a method to assess the reusability of materials at the end of a building's life cycle.
- At the macro-level, studies concentrated on the overall reuse potential of materials within the construction industry. Geldermans [46] investigated the prerequisites for material reuse in the built environment, while Nubholz et al. [47] assessed the potential

benefits of reuse for reducing carbon emissions in the industry. Nordby [48] identified both barriers and opportunities for reuse specific to Norway.

Based on this classification, it can be considered that the built environment presents unique challenges to CE implementation due to the complexity and longevity of buildings, necessitating tailored strategies for material reuse and resource efficiency [49].

Zhang et al. [50] considered that the Waste Hierarchy and CE share similar principles, emphasizing resource efficiency and waste minimization through rethinking, redesigning, and repurposing products. According to the Ellen MacArthur Foundation and other authors, the CE is delineated as "restorative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles" [8,51–54]. The concept of the CE aims to create regenerative industrial systems by minimizing resource consumption and waste generation through reduce-reuse-recycle principles. Later, the application of the principles of recover, recycle, repurpose, remanufacture, refurbish, repair, and reuse aims to enhance the economic value of existing materials, aligning with CE goals (Figure 1).

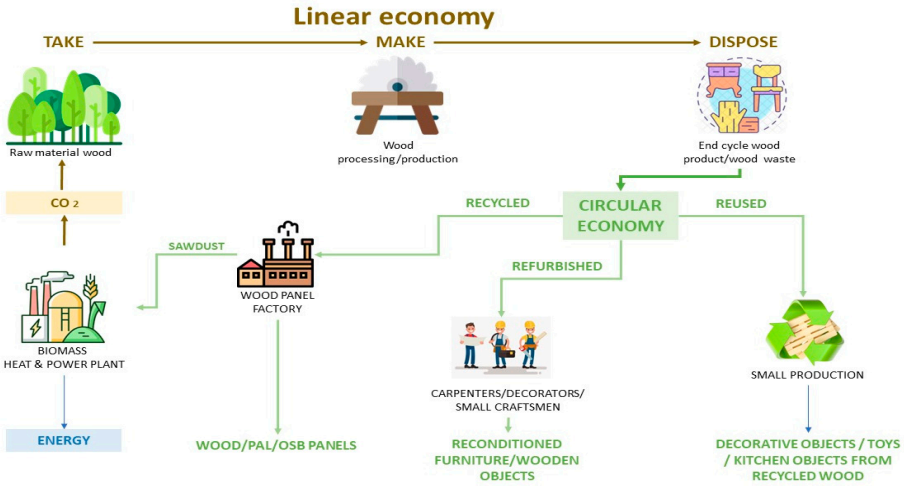

Figure 1. Linear economy versus circular economy.

The CE concept has been gaining traction in response to legislative demands and resource depletion concerns. However, further advancement in the knowledge and development of tools is necessary for broader application of this concept in industry, particularly within the construction industry [55]. Innovation in this sector often encounters delays in implementation, given the intricate nature of building projects, which are typically unique endeavors with complex supply chains [56,57]. Research on the CE in the contemporary built environment, particularly at the product and component level, is scarce, and practical applications on a large scale are lacking. Pomponi and Moncaster [58] conducted a literature review on CE definitions, identifying six dimensions crucial for CE implementation in the built environment: governmental, economic, environmental, behavioral, societal, and technological. They defined the CE for the construction industry as a holistic approach to buildings' design, construction, operation, maintenance, and deconstruction, consistent with CE principles. Starting from here, this study provides a baseline for future in depth research on how consumers incorporate environmental concerns in their purchasing decision of wood recycling and reuse practices within construction and reconstruction processes in line with the circular economy. This paper's structure includes an introduction, a literature review section, a methodology section, a results and discussions section, and a conclusions.

2. Successful Strategies, Models, Practices, and Challenges in Wood Waste Recycling

The simplest definition of the circular economy, given by Deutz, represents the transition from the linear economy, where one takes, makes, and disposes into the circular economy, where losses of materials are avoided [59].

The expression "circular economy" is rooted in natural ecosystems, which are cyclical, according to Birgovan et al. and Finamore and Otean-Dumbravă [60,61].

The gradual acknowledgment during the 1980s in North America and Europe that a consumer society was unsustainable without recycling prompted governments to implement various initiatives aimed at fostering recycling [62]. Consequently, there is now an infrastructure in place for collecting, sorting, and processing post-consumption wood products into raw materials for other industries. The primary end-uses for recovered wood include energy generation, particleboard manufacture, animal beddings, and landscape uses. However, these reuses typically offer relatively low value. Hence, there is an opportunity to reconsider wood recycling with the aim of increasing value and/or maximizing the lifespan of products made from recovered wood.

Globally, as the human population grows and income increases, the consumption of material resources continues to rise, potentially leading to scarcer and costlier resources in the future [63,64]. Despite this, business to business (B2B) schemes in Europe, particularly notably, have dramatically reduced waste generated at construction sites. For instance, the existence of a B2B deposit refund scheme is common for highly reusable packaging, such as pallets, construction packaging, and drums [65]. Some European countries have already achieved the objective of recycling 70% of CDW. Statistics indicate that the total mass flow of recovered waste accounts for more than 80% of total waste generation in member states such as the Netherlands, Germany, Denmark, or Italy [66–68].

In terms of environmental impact, this form of reuse extends the original material's (timber) lifespan into a second service life, thereby avoiding the need for an equivalent amount of virgin material and effectively locking away the carbon it contains for an extended period. This double benefit is achievable if procedures for reclaiming, sorting, and reprocessing are conducted with environmental considerations in mind. Among these steps, the reprocessing phase is particularly critical, as the removal of chemical contaminants like preservatives and resins is likely the most environmentally demanding aspect, especially if chemical or enzymatic cleaning methods are employed. There is still much to explore regarding the optimization of these processes and the environmental implications of various strategies in sorting, segregating, and purifying reclaimed wood to ensure its successful and environmentally responsible subsequent use [69].

Despite variations across regions, common barriers to CDW management include factors such as regulatory environment, lack of waste-processing facilities, poor communication and coordination among stakeholders, low awareness of environmental impacts of waste disposal, cultural resistance to CDW diversion, and inadequate project processes and activities [70]. The MATIERES initiative, is centered around the extraction of extremely valuable chemical substances, specifically nanocrystalline cellulose (NCC), from discarded medium density fiberboard (MDF) waste [71]. The CaReWood initiative is dedicated to producing laminated beams using reclaimed wood [72].

Industrial wood waste can be relatively well-defined and easier to recycle; household-generated wood waste collected through selective collection presents greater challenges [28]. Also, despite industry-wide awareness of the CE concept, clients, designers, and subcontractors often lack sufficient information, posing a key challenge to wider adoption. The absence of incentives to design products and buildings for disassembly and reuse at their end of life is a significant obstacle. To promote greater implementation of CE principles throughout the supply chain, a clear economic case supported by metrics, tools, and guidance is crucial. These aspects lack widespread adoption and are often applied in isolation, either within a specific sector or project, with little consideration of economic aspects across a building's life cycle. Key challenges identified include an unproven business case underpinned by viable business models, fragmented supply chains, short-term thinking, and the low value of many construction products at the end of life.

Several economic challenges, including the lack of market mechanisms to support increasing recovery and low product value at the end of life were deemed significant. The construction industry's fragmented supply chain structure and perceived lack of interest,

awareness, and knowledge and complexity of buildings were also viewed as significant challenges. According to the respondents, the most important challenge is the lack of incentive to design for end-of-life issues considering the construction products [30].

Some studies have explored the economic viability of recycling CDW, as stakeholders are primarily driven by the economic benefits of recycling [73–79]. They have found that recycling CDW is economically feasible and contributes to improved environmental management. However, recycling costs are influenced by factors such as transport distance, construction site conditions, and the volume of waste to be recycled. The unresolved issue of ownership within CBECE remains a challenge, particularly concerning who will be responsible for material circularity at the end of its life cycle [55].

3. Methodology

The choice of the type of survey is fundamental in the process [80]. Rotariu and Iluț consider many advantages of the indirect survey, such as the reduced cost, the objectivity of the results (because the respondents do not interfere with the researcher), the ability to reach more respondents within the survey, more time left to respond to the questions, etc. [81].

The research was conducted using an online survey (indirect) consisting of 23 items. The questionnaire's scope was to find more information about the Romanian consumers' general knowledge and understanding of the CE principles, as well as their behavior and preferences regarding recycled wood-based products, in the context of transitioning toward a green economy. The questionnaire was complemented by explanations regarding the importance of the research. It was also available online from 1 November 2023 to 13 December 2023. The total number of responses was 375. The sample population is not representative for the national level; however, the questionnaires were applied in accordance with the total population of each county. However, there were certain items that numbered only 257 responses (in the multiple-choice and open-end items), this meaning a total of 68.5% of responses. The results of the survey were limited by the number of answered items and the online medium used to apply it, taking into consideration that people are more likely to cooperate face-to-face. The study covered all of the main regions of the country, with the demographic distribution being presented in Table 1 below. Additionally, the table also presents other distribution criteria such as age, education level, occupational status, residency area, level of education, occupational status, and the income level of the participants in the survey. Educational level and occupational status are two demographic categories that could have altered the results, if changed significantly.

Table 1. Distribution of survey respondents by age, educational level, occupational status, monthly net income, region, gender, and residency.

Age	Frequency	Percentage (%)
18–24	133	51.8
25–34	53	20.6
35–44	37	14.4
45–54	23	8.9
55–64	9	3.5
65+	2	0.8
Educational level		
No school graduated	2	0.8
Primary school	1	0.4
Middle school	7	2.7
High school	96	37.4
University/college	125	48.6
Post-university studies	23	8.9
PhD	3	1.2

Table 1. *Cont.*

Occupational status		
Student	117	45.5
Employee	113	44.0
Unemployed	6	2.3
Entrepreneur	12	4.7
Housewife	4	1.6
Retired	5	1.9
Net monthly income (RON)		
<1000	61	23.7
1001–2000	37	14.4
2001–3000	36	14.0
3001–4000	43	16.7
4001–5000	25	9.7
5001–6000	28	10.9
Region		
Alba	43	16.7
Bistrița-Năsăud	55	21.4
Botoșani	1	0.4
Brașov	3	1.2
București	11	4.3
Buzău	1	0.4
Cluj	18	7.0
Constanța	1	0.4
Dîmbovița	2	0.8
Gorj	1	0.4
Hunedoara	1	0.4
Ilfov	5	1.9
Mureș	4	1.6
Olt	2	0.8
Prahova	1	0.4
Sălaj	31	12.1
Satu Mare	1	0.4
Sibiu	63	24.5
Suceava	1	0.4
Teleorman	2	0.8
Vâlcea	10	3.9
Gender		
Male	109	42.4
Female	143	55.6
Other	5	1.9

Table 1. *Cont.*

Residency		
Urban	156	60.7
Rural	101	39.3

Regarding the calculation of the Global Score, the individual scores for each practice are aggregated and weighted according to their importance, determined by the experts' opinion. Each practice was then assessed against several criteria, including environmental impact, economic viability, and scalability. Scores for each criterion were then combined to produce an overall score for each practice.

In addition to the above, a factor analysis was conducted to identify the underlying patterns and relationships between the different recycling and reuse practices. Thus, factor analysis allowed us to reduce the key data that explained multiple factors of response variation. This helped us to identify groups of practices that were most effective in stimulating circularity in wood recycling and reuse practice.

4. Results and Discussions

H1. *The awareness hypothesis: the vast majority of Romanian consumers have little or a moderate level of awareness regarding the benefits of using wood-based recycled products.*

➢ This hypothesis is confirmed by the three groups formed: (i) the first group that has little to no awareness about the concept of CE and quantifies a cumulated total of 45.5% (this group scoring the highest value); (ii) the second group that has a moderate level of awareness regarding the concept of CE, achieving a score of 40.9%; and (iii) the third group that is highly aware of the concept of CE, cumulating the smallest score: 13.6%.

H2. *The attitude hypothesis: the general attitude toward buying and using wood-based recycled products is positive among most Romanian consumers.*

➢ This hypothesis is also confirmed thanks to the significant cumulated total of 82.9% of the respondents who have a good opinion and take into consideration the origin of a product when buying.

H3. *Quality perception hypothesis: the perceived quality of wood-based recycled products influences the decision-making process of purchasing for the majority of Romanian consumers.*

➢ This hypothesis is confirmed thanks to the cumulative total of 81.7% of consumers who take into consideration the quality of the purchased product.

H4. *The price sensitivity hypothesis: the cost of wood-based recycled products is a significant factor that influences the decision to purchase a product by the majority of Romanian consumers.*

➢ This hypothesis is confirmed by the mean of 44.7% of the respondents who consider the price of a product important in decision making when buying.

H4.1. *Environmental concerns hypothesis: environmental concerns are a key factor for the majority of Romanian consumers when they choose to buy wood-based recycled materials.*

➢ This hypothesis is confirmed, as 63.4% of the respondents consider this factor very significant or significant.

H4.2. *Information accessibility hypothesis: the lack of information about or awareness of the availability and benefits of wood-based recycled products prevents their more widespread purchasing by most Romanian consumers.*

➢ This hypothesis is confirmed by the total of 40.9% of respondents who consider the lack of information one of the key factors of prevention.

To sum up, all of the above hypotheses are confirmed by the results of the study. With this said, despite the positive responses, the hypotheses regarding the level of awareness and the decision-making process present interesting responses and points of view when it comes to the decisive influencing factor that motivate the acquisition of a recycled wood-based product. One interesting aspect is the different levels of knowledge that people possess about the benefits of buying this type of product. As the results of the first hypothesis which links the small percentages regarding the price and the lack of information to being barriers against this type of behavior show, a cumulative total of 40% is relatively low and not significant enough on its own.

In the following section, the results of the survey will be presented in detail for a better understanding of the attitudes and behavior of the stakeholders. Firstly, the paper will present the process of acquisition of a wood product and what motivates *it* (Section A of the survey); secondly, the results regarding the level of familiarity with the CE concept and the stakeholders' perception of it will be analyzed (Section B of the survey); lastly, the third section will present the barriers regarding the application of CE principles, as perceived by the respondents (Section C of the survey). The results can be found below.

Point A. Acquisition of a wood product and what motivates it is represented by what type of wood-based recycled product the respondents buy, the perceived quality of that product, and what motivates them to buy recycled products.

(a) Acquisition of wood-based recycled products

Question 1-1. Have you purchased, at least once, a wood-based product (reused, refurbished, recycled)?

➢ The results show that the respondents tend to buy reused or refurbished products, these two categories scoring 65.1% and 65.6%, respectively. On the other hand, the recycled products gained a smaller percentage, 49.7%, this fact separating the respondents into two different categories, with two different perspectives.

Question 1-3. If yes, what type of product was it?

➢ The results presented above as percentages per category of recycled products show an inclination toward practical articles, rather than those that possess a main aesthetic use like furniture—80.2%; home accessories (frames, vases, etc.)—74.6%; decorations—73.8%; utensils—63.5; and toys—57.9%.

(b) The perceived quality of a wood-based product

Question 1-6. On a scale of 1 to 5, how do you evaluate the quality of the following types of wood-based products? (1 meaning "very unsatisfied" and 5 meaning "very satisfied"). This item measured the evaluation of each of the three types of products, as follows: reused, refurbished, recycled.

➢ Concerning the *reused* products, a cumulative total of 43.6% are satisfied or very satisfied with the product; 26.8% are neutral; and a cumulative total of 29.6% are not satisfied or very unsatisfied with the purchased product.
➢ Concerning the *refurbished* products, 49.8% of the respondents are satisfied or very satisfied with the product; 26.8% are neutral; and a cumulative total of 23.3% are not satisfied or are very unsatisfied with the purchased product.

➢ Concerning the *recycled* products, a cumulative total of 44.7% of the respondents are satisfied or very satisfied with the product; 29.2% are neutral; and 26.1% of the respondents are not satisfied or are very unsatisfied with the purchased product.

Based on the responses presented above, a mean of 46% of the respondents stated that they are satisfied with the purchased wood-based products, as the majority of the respondents were concentrated in the upper positive side of the scale.

Conceptualizing, in the paradigm of the linear economy novelty, was a dominant criterion, along with utility, in the case of the "3Rs" products; the criterion of utility becomes paramount, being upgraded in the new paradigm of environmental protection circularity.

Question 1-7. If yes, how would you describe your experience with the product and the level of satisfaction? This question was measured using the 5-step Likert scale, where {1} = very unsatisfied, {3} = indifferent, and {5} = very satisfied.

➢ The results show that a cumulative dominant total of 61% of the respondents were satisfied or very satisfied with the purchased product, considering that the recycled wood-based products they bought had a high standard quality.

The utilitarian criterion is confirmed by verification, clearly distinguishing the fact that, at the level of the user, there is no qualitative difference between a product obtained from a primary raw material in relation to the same product obtained from recycled materials. Under these conditions, it can be appreciated that the products purchased by the respondents correspond both from the perspective of utility and from the perspective of quality to their expectations in relation to the necessity of the object.

(c) What motivates them to buy recycled products?

Question 1-9. What would convince you to buy more wood-based products? For this item, the motivation of the respondents was measured for each of the three previously mentioned types of products based on the following aspects: durability, price, and quality. Since this was a multiple-answer item, the table below presents the frequency of each aspect of the recycled products scored. As shown in Figure 2, the most persuasive aspects regarding the purchasing of a wood-based recycled product are (i) the accessible price, (ii) its durability, and (iii) its high level of quality.

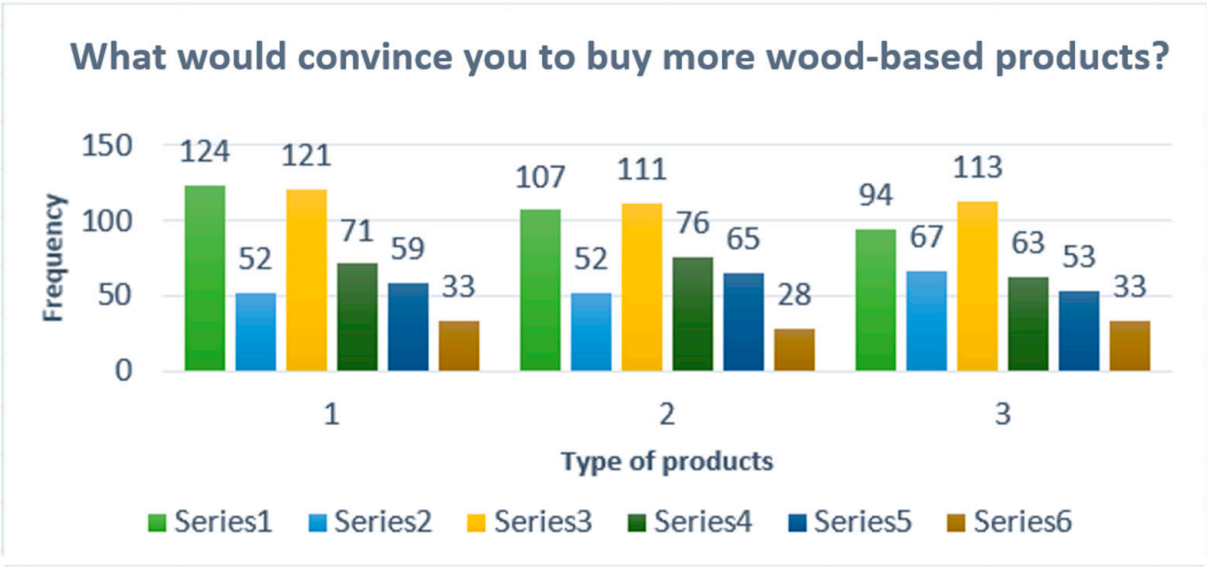

Figure 2. What would convince you to buy more wood-based products?

Question 1-11. From where do you prefer to purchase wood-based products?

➢ Concerning the *reused* products, 50.6% of the respondents prefer to shop from land-based stores, followed by fairs (20.2%) and online stores (13.2%).

- ➢ Concerning the *refurbished* products, 46.7% of the respondents prefer to shop from land-based stores, followed by online stores (20.6%) and fairs (17.5%).
- ➢ Concerning the *recycled* products, 49.4% of the respondents prefer to shop from land-based stores, followed by online stores (17.6%) and fairs (15.6%).

Based on the responses presented above, we can conclude that the behavior of the respondents still inclines toward physical shopping (land-based stores and fairs). This can lead us to the following assumptions: firstly, people are not yet accustomed to the online environment and have more trust in the well-known chains than in the local or smaller enterprises present at fairs. Secondly, the respondents prefer physical shopping due to the need to test or verify the quality of a product before purchasing it.

Cultural, design, and aesthetic differences, along with upcycled bargains, revalorized items, or the efforts to showcase them, highlight the need for creativity and added value. When the aesthetic function competes with the environmental protection function, which includes quality conditions and necessity, promoting the circularity of the aesthetic dimension of wood products subjected to reuse, refurbishment, or recycling (3R) facilitates acceptance of these principles. Online mechanisms are used to promote the aesthetic/environmental functions; the population is encouraged to validate these utility-related criteria through the physical acquisition of 3R products.

Point B. The level of familiarity with the CE concept (the 3Rs: reused, refurbished, recycled) and how it influences the consumers' purchasing behavior will also be analyzed across three dimensions: (i) the level of awareness of the respondents of CE principles, (ii) the importance of the environmental friendliness of the purchased products, and (iii) how the awareness of CE principles influences the buying process.

(d) The respondents' level of awareness of CE principles

Question 1-4. How familiar are you with the CE concept? This item was measured using the 5-step Likert scale, where {1} = not familiar at all, {3} = to some extent, and {5} = to a very large extent.

To analyze this item, we calculated the Global Score, classifying the responses into three groups. The dominant group was the second one, "the open-minded", which is moderately aware of CE principles, scoring a total of 66.9%. It was followed by the third group, "the followers", which is knowledgeable about CE principles, with a total of 17.5%. Lastly, the first group consisting of the respondents with little to no awareness regarding CE principles, "the unconvinced", scored the least significant total of 15.6%.

Question 1-5. How familiar are you with the concept of the 3Rs? This item also applied the 5-step Likert scale on all the three previously mentioned types of products (reused, refurbished, recycled).

- ➢ Concerning the *reused* products, a cumulative total of 42% are familiar or very familiar with the concept; 37.4% are familiar to some extent; and a cumulative total of 20.6% are not familiar or are very unfamiliar with the concept.
- ➢ Concerning the *refurbished* products, a cumulative total of 45.9% are familiar or very familiar with the concept; 36.2% are familiar to some extent; and a cumulative total of 17.9% are not familiar or are very unfamiliar with the concept.
- ➢ Concerning the *recycled* products, a cumulative total of 41.2% are familiar or very familiar with the concept; 36.6% are familiar to some extent; and a cumulative total of 22.1% are not familiar or are very unfamiliar with the concept.

To gain additional information, we analyzed these two items using the cluster method. In Figure 3, we can see the formation of three separate groups. The first one, forming between the Global Score of familiarity with the CE concept and the familiarity with the idea of reusing a product, means that most of the respondents connect these two concepts very closely, being more likely to use the same product multiple times and on multiple occasions ("the followers"). The second group formed is the one between the respondents familiar with the CE concept and the reuse concept, as well as with the refurbishing concept.

This can be interpreted as respondents' tendency to find different uses for the same product, but with small alterations to its initial form or stage ("the open-minded"). The last group formed is between the three concepts mentioned above and the concept of recycling. This can lead us to think that people tend to avoid the recycling stage as much as possible. This delimitation can be influenced by the degree of wear on a product that makes it impossible to reuse or refurbish it, the recycling principle implicating a new perspective of the respondents: the product reached its end-of-life stage and brings no improvement to their activity, as it can no longer be reused or refurbished. For this final stage, we can think of alternative usage so that it can be found in future products. ("The unconvinced").

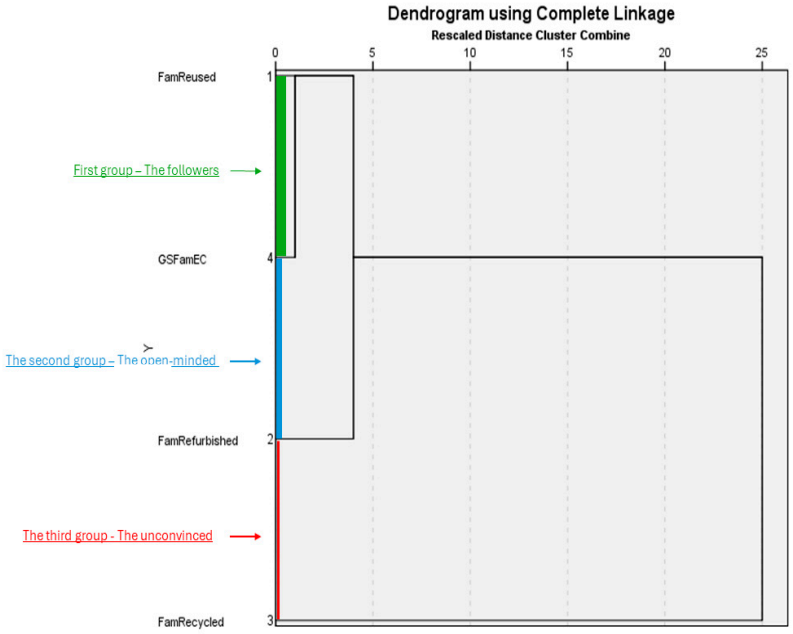

Figure 3. Cluster regarding the respondents' familiarity levels with the CE concept.

(e) Taking into account the environmental friendliness of the purchased products

Question 1-8. How important is it to you that a product is eco-friendly at the moment of purchase when making an acquisition decision? This item used the 5-step Likert scale measuring the importance given to the environmental factor, where {1} = very important, {3} = neutral, and {5} = not at all important.

A cumulative total of 63.4% of the respondents consider the environmental factor important or very important, 24.9% are neutral to this aspect, and a cumulative total of only 11.7% do not consider the possibility that a product is friendly to the environment and possibly recyclable important.

(f) How does the awareness of the CE principles influence the buying process?

Question 1-10. How much does the "wooden product…" label influences your purchase decision? We also applied to this item the 5-step Likert scale, measuring the influence as a decisive factor, as follows: {1} = very much, {3} = moderately, and {5} = not at all. This item analyzed the influence perceived per each category of product: reused, refurbished, recycled.

- Concerning the *reused* products, a cumulative total of 43.1% consider that the label influences their purchasing behavior; 36.2% are moderately influenced by it; and a cumulative total of 20.6% are not influenced by the existence of the label.
- Concerning the *refurbished* products, a cumulative total of 43.9% are influenced by the presence of the label; 37% are moderately influenced; and a cumulative total of 19% are not influenced by the label.

➢ Concerning the *recycled* products, a cumulative total of 38.1% are influenced by the presence of the label; 38.9% are moderately influenced; and a cumulative total of 22.9% are not influenced by the label.

Question 1-12. To what extent does your knowledge of CE principles influence the decision to buy products made from reused, refurbished, or recycled wood? This item was measured using a 5-step Likert scale, where {1} = significantly, {3} = moderately, and {5} = not at all.

A cumulative total of 44.7% of the respondents stated that they are highly influenced by the knowledge of CE principals in the purchase process, 32.3% are moderately influenced, and a cumulative total of only 23% are not influenced by this factor.

For a more detailed analysis, we used factor analysis to gain more information. This type of analysis helps to rank the correlations between variables from the most dominant to the least, using the Pearson correlation system at a step of accuracy of 0.092. As shown in Figure 4, the strongest correlations are between the influence of (i) the reused and refurbished items, scoring a 0.831 correlation; (ii) the recycled and refurbished items, this group scoring a 0.814 correlation; and (iii) the reused and recycled items, scoring a 0.737 correlation. This analysis gives us a deepened perspective: while a significant percentage of buyers are influenced by CE principles in their purchase process, wood-based reused, refurbished or recycled products are acquired independently from this awareness. Therefore, the decision to buy this type of product may not always be motivated or influenced by the awareness the buyer possesses, but rather by other factors as well, like its high standard of quality, an accessible price, or the fulfilment of the need of the buyer for the aesthetic, utility, or necessity factor.

Correlation Matrix[a]

Correlation	GSFamEC	Influence Reused	Influence Refurbished	Influence Recycled	GSEvEC
GSFamEC	1.000	0.276	0.237	0.234	0.089
InfluenceReused	0.276	1.000	0.831	0.737	0.009
InfluenceRefurbished	0.237	0.831	1.000	0.814	0.017
InfluenceRecycled	0.234	0.737	0.814	1.000	0.006
GSEvEC	0.089	0.009	0.017	0.006	1.000

a. Determinant= 0.92

Figure 4. Correlation matrix based on factorial analysis.

The correlation for 0.831, 0.737 and 0.814, these high values suggest that the variables related to reuse, refurbishment, and recycling have a strong relationship, which indicate that people who are influenced by one of these practices are likely to be influenced by the others as well.

Question 1-14. When considering the purchase of a wood product (new, refurbished, recycled, etc.), how important is it to know that the product can be recycled or refurbished at the end of its life? This item was measured using a 5-step Likert scale, where {1} = very important, {3} = neutral, {5} = not at all important.

A significant cumulative total of 59.6% consider the possibility of further recycling important or very important, 27.2% are neutral regarding this possibility, and only 13.2% do not take into consideration the importance of a new product being able to be recycled, reused, or refurbished later.

Section C. Barriers and future recommendations regarding the application of CE principles

Question 1-13. Which of the following aspects of CE do you think should be better promoted by manufacturers and sellers to stimulate the consumption of products made from recycled, refurbished, or reused wood?

As this item had a multiple-answer option, a better understanding is reached by presenting the frequency with which a certain principal should be better promoted. As presented above, the frequencies form two general groups: (i) the first group, which is more focused on the environmental benefits and the quality certification of a wood-based product that attests to the physical materialization of the theoretical principles, and (ii) the second group, which is more concerned about the information regarding a certain wood-based recycled product and its cost advantages. The two groups formed confirm the first hypothesis about the different levels of awareness of CE principles, as well as the cluster analysis and its groups' formation, as both the groups of "*the followers*" and "*the unconvinced*" are present in Figure 5.

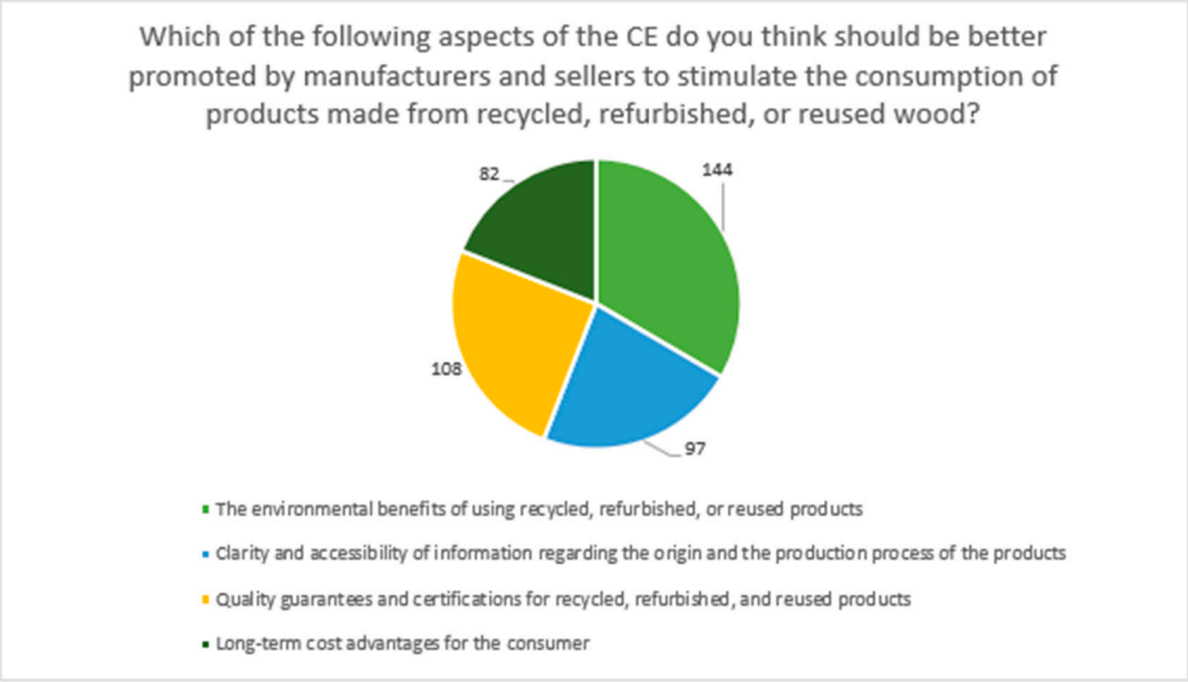

Figure 5. Perceived aspects for better-promoted CE principles.

Question 1-15. What barriers do you encounter or have you encountered in buying these products?

As this item also consisted of a multiple-answer option, we analyzed the frequency of the responses. From Figure 6, we can identify three main barriers perceived by the respondents. The main identified barrier is the *high prices* of the wood-based recycled products, which scored 119 responses. The second-ranking barrier is represented by the lack of sufficient information regarding this type of product, scoring 105 responses. Lastly, the limited availability of the "3Rs" products is regarded as a barrier, scoring 78 responses.

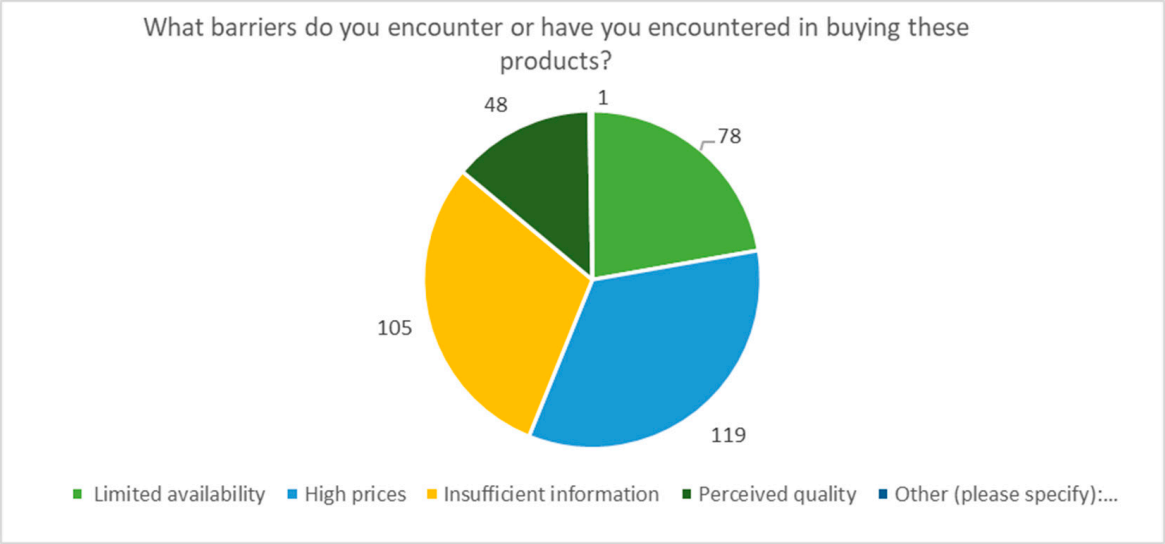

Figure 6. Barriers encountered in buying recycled products.

Question 1.16. What could manufacturers or sellers do to convince you to buy more products made from recycled, reused, or refurbished wood? (Open-ended question)

Closely connected with the previous question, the last item of the survey consists of an open-ended question regarding the perception of the respondents regarding what manufacturers and sellers could do to improve the impact of the wood-based recycled products in the social sphere. In order to analyze this item, we systemized the responses into four main groups. The results are presented in Figure 7.

Figure 7. What could manufacturers or sellers do to convince you to buy more products made from recycled, reused, or refurbished wood? (Open-ended question).

One interesting aspect is that this item reverses the perspective of the previous question. If the main barrier was a price that was too high for most people, in the open item, the decreasing of the price constitutes the second highest recommendation (31%). In opposition to these findings, Mastrobuoni et al. state that the price is considered a signal of quality and that the higher the quality of the products, the stronger the purchase intentions [82]. The main recommendation for future actions is the promotion of more information regarding the

benefits, origins, and characteristics of these products, so that they become more accessible for a wider range of people (56%). The cumulative total of 87% of the respondents who want more information about the products as well as a more accessibility to them confirms the first two groups of the study: "the followers" and "the open-minded", who are interested and want to contribute to the change toward a greener economy. The third group, "the unconvinced", is also present in the cumulative total of 13% of the respondents who either consider the products not durable enough or who do not know what to say about this matter, due to different reasons like indifference or the lack of information about this type of product or their benefits in the long-term environmental aspect.

Based on the results of the survey presented above regarding the attitude of the Romanian consumer toward the use of wood-based recycled products, we achieved a better understanding of the reality of the application of CE principles in the Romanian wood industry. The research also gave us an idea of the behavior patterns of the Romanian consumers, their motivations, and their interests regarding the transition toward a greener economy.

Point A. Acquisition of a wood product and what motivates it: what type of wood-based recycled product the respondents buy, the perceived quality of that product, and what motivates them to buy recycled products. The results are presented below:

- A total of 65.4% of the respondents stated that they have purchased a recycled wood-based product, displaying a predisposition toward practical items.
- A total of 61% of the respondents stated that they are satisfied or very satisfied with the quality of the purchased recycled wood-based product, as there is no perceived difference between the quality of a new product opposed to a recycled product.
- The decisive factors that motivate the purchase of a wood-based recycled product are its accessible price, its durability, and its high standard of quality.

To conclude the findings of point A, we can presume that there is a transition regarding the mindset of the buyers, from the focus on novelty to the focus on utility. This transition can also be influenced by aesthetic and added-value cultural needs of the consumers who can efficiently implement CE principles.

Point B. The level of familiarity with the CE concept (the 3Rs: reused, refurbished, recycled) and how it influences the consumers' purchasing behavior: the level of awareness of the respondents regarding CE principles, the importance of the purchased products being environmentally friendly, and how the awareness of CE principles influences the buying process.

- A total of 66.9% of the respondents are moderately or highly aware of CE principles (the 3Rs: *reuse, refurbish, recycle*)
- The respondents tend to avoid the recycling stage, resorting to it only when the product reaches its end-of-life phase by way of use.
- A total of 63.4% of the respondents consider it very important or important that the purchased product is eco-friendly.
- The decision to acquire a wood-based recycled product is not always influenced by the awareness of CE principles.
- A total of 59.6% of the respondents take into consideration the possibility that the product they want to purchase can be recycled later.

As a conclusion to Point B of the research, there is an evident dispersion of the respondents into three groups, each with different levels of understanding and willingness to adhere to and apply the principles of CE into their activity.

Point C. The barriers and future recommendations regarding the application of CE principles, is represented by the frequency of the responses regarding the limitations that the respondents encountered in the purchase process and what activities and initiatives they believe could ease this process.

- Despite the frequencies being relatively close in numbers, the respondents are more focused on the environmental benefits and the quality certification of a wood-based product that attests to the physical materialization of the theoretical principles than

the information regarding a certain wood-based recycled product, its manufacturing process, and its cost advantages.

- The two main identified barriers perceived by Romanian consumers are the high prices of the wood-based recycled products and the lack of sufficient information.
- The main recommendations found in the survey concentrate on the need for more information about the products, as well as more accessibility to them, resulting in a total of 87% of respondents who require more information or greater accessibility.

To conclude Point C, there is a clear inclination of Romanian consumers toward the application of CE principles in purchasing decisions, although small improvements are still needed.

Taking into consideration the conclusion of Points A, B, and C, we have a clearer "big picture" regarding the attitude of Romanian consumers toward CE principles and their application.

The consumers show a relatively large amount of interest toward the transition from a linear economy to a circular economy, although a wider understanding of the concept needs to be established.

While the respondents display a supportive attitude toward purchasing a wood-based recycled product, the purchase is not always influenced by the advocacy of or knowledge about CE principles, but by socio-economic factors. Although Romanian consumers exhibit significant environmental concern, this does not automatically translate into the adoption of eco-friendly consumption habits or practices.

5. Conclusions

The results of the study are an important starting point toward better understanding of how Romanian consumers perceive the CE and its principles in order to adopt responsible consumption models.

- The respondents have various levels of awareness and understanding of the principles of the CE. More than half of the respondents (66.9%) are moderately or highly aware of CE principles (the 3Rs: *reuse, refurbish, recycle*).
- Although most of the respondents showed an open attitude and willingness to adopt eco-friendly behavior (63.4% showed that a product being eco-friendly is important to them), simply introducing and promoting these principles might not be enough to change old purchasing habits. The study's findings also show that, based on the consumers' positive attitudes, there is an opportunity for manufacturers to consider wood recycling with the aim of increasing value and/or maximizing the lifespan of products. The motivation to buy wood recycled products, according to the respondents, is related to several criteria such as durability, a green label, an accessible price, a high standard of quality, an attractive design, and recommendations.

As the construction sector presents unique challenges related to CE implementation, tailored strategies for material reuse potential and resource efficiency need to be elaborated. To this purpose, the creation of market mechanisms to support increasing recovery and involvement of stakeholders from the construction industry's fragmented supply chain are viewed as significant challenges. There is also a need to make all stakeholders understand their precise roles, responsibilities, and the impact of their actions thoroughly. As far as consumers are concerned, the provision of clear information about (i) the opportunities and benefits of reuse for reducing the sector's overall environmental impact and (ii) the economic gains of applying the principles of recovering, recycling, repurposing, remanufacturing, refurbishing, repairing, and reusing buildings' design, construction, operation, maintenance, and deconstruction, in line with CE goals, turns out to be of high importance.

Taking into account the consumer's revealed environmental concerns, their awareness of CE principles, and their important role in purchasing decisions, positive attitude toward purchasing, and using wood-based recycled products, the provision of more information on their quality, utility, and other economic and environmental benefits gains high importance.

Based on the findings of the survey, the authors recommend better promotion strategies for wood-based recycled products to be adopted by local and national institutions and authorities, for raising awareness of the CE transition process and what is to be further achieved on the environmental as well as socio-economic level. Furthermore, alternative institutional projects and initiatives need to be conducted in order for stakeholders to understand their key precise role in the process of the transition to a greener, more circular economy.

Future research could provide more in-depth data about consumer behavior and could bring new information and insights about the standpoint of Romanian consumers and their attitudes toward the environmental concerns, as well as their behaviors and preferences regarding recycled wood-based products in the context of the CE transition.

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