SUM4Re

Creating materials banks from digital urban mining

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Report with policy recommendations and proposals from a stakeholder point of view.

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EXECUTIVE SUMMARY

The aim of this report is to contribute to the Horizon Europe (HE) mission of fostering sustainable resource management by assessing both policy frameworks and public perceptions surrounding Construction and Demolition Waste (CDW) and recovery and reuse of secondary materials.

The document addresses two main topics:

1) Evaluation of the level of social awareness and attitudes towards the increased supply/use of secondary materials and upcycling of CDW within the construction industry key stakeholders.
2) Proposal of policy recommendations and measures that could support the social and economic impact of circularity for EU participants.

In chapter 2 there is the description of the social perception study that was carried out to assess the level of social awareness regarding sustainable material supply and CDW management, concerns and misconceptions.

In chapter 3 of the report a set of policy recommendations and guidelines are provided with the aim to enhance circularity's social and economic impacts. Recommendations emphasize problem-solving approaches, evidence-based guidance and clear policy options tailored to different governance levels.

In conclusion, advancing circularity in construction requires a dual approach: robust, harmonized policy frameworks coupled with strong social acceptance and trust. This report offers actionable recommendations that address both dimensions. By doing so, it seeks to unlock the full social and economic potential of circularity, reducing waste, lowering costs, creating jobs and strengthening public confidence in Europe's transition to a resource-efficient future.

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GLOSSARY

Terms, Abbreviations, and Acronyms

BIM	Building Information Modelling
CDW	Construction and Demolition Waste
CE	Circular Economy
CEAP	Circular Economy Action Plan
DAC	Development Assistance Committee
DPP	Digital Product Passport
ECOS	Environmental Coalition on Standards
EoW	End-of-Waste
EPR	Extended Producer Responsibility
ESPR	Eco-design for Sustainable Products Regulation
EU	European Union
EURIC	European Recycling Industries' Confederation
HE	Horizon Europe
MPs	Material Passports
NGO	Non-Governmental Organization
OECD	Organisation for Economic Co-operation and Development
SMEs	Small and Medium-sized Enterprises

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1. Introduction

This report presents the findings of a social perception study that shows how a specific sample of actors from the construction industry perceive sustainable material supply and CDW management. At the same time, this study focuses on evaluating how policies currently address sustainable material supply and CDW and bridge the gap with recommendations for awareness and regulatory improvements.

The construction sector is both a cornerstone of Europe's economy and one of its most resource-intensive industries. It consumes vast quantities of raw materials and generates significant amounts of waste, particularly through construction and demolition activities. CDW alone represents more than one third of all waste produced within the European Union, making it a critical priority for circular economy policies. Transitioning from a linear "take-make-dispose" model to a circular model, where materials are reused, recycled and given a second life, is essential to achieving EU sustainability and climate goals.

The European Green Deal and the Circular Economy Action Plan (CEAP) place strong emphasis on reducing material dependency, cutting waste, and lowering emissions. Yet, despite regulatory advances and ambitious targets, the uptake of secondary materials in the construction sector remains limited. Structural barriers such as fragmented regulations, insufficient market incentives, inconsistency between demand and supply and lack of harmonized standards continue to slow progress. At the same time, current buildings were not designed from the early stage to be dismantled, which complicates the task of exploiting products or materials Moreover, public perceptions and attitudes, ranging from limited awareness to misconceptions about quality and safety, play a decisive role in shaping demand for recycled materials and acceptance of circular construction practices.

Understanding the social dimension is especially important. Citizens, professionals, and local communities are not merely end-users of construction materials but also influential actors in shaping demand, supporting policy change and enabling innovation. However, widespread misconceptions, such as recycled materials being less durable or more expensive, undermine acceptance and uptake. Although numerous studies demonstrate that such materials can meet comparable technical and performance standards to their virgin counterparts, many stakeholders still perceive them as less reliable or more expensive (Geng et al., 2023; Tennakoon & Bouchlaghem, 2022). These perceptions are often rooted in limited market experience, inconsistent quality control, and a lack of visible large-scale applications (Shooshtarian et al., 2020). Furthermore, perceived higher costs, despite evidence that life-cycle analyses may show otherwise, remain a psychological and economic barrier to adoption (Karaca et al., 2024). Together, these misconceptions form a persistent social barrier that hampers progress towards a more circular construction economy. Addressing these concerns requires not only technical solutions but also clear communication, certification systems and demonstration projects like SUM4Re that make benefits tangible and visible. At the same time, the policy landscape must evolve to support a functioning market for secondary materials. Without effective collaboration across governance levels and sectors, circular ambitions risk being stalled by fragmentation and uneven implementation.

This report therefore sets out to provide a comprehensive assessment of perception and policy gaps in CDW management and sustainable material supply in order to identify where policies and stakeholder perceptions are misaligned, revealing areas where regulation, communication or incentives need strengthening to advance circular practices in the construction sector. This way, a set of actionable policy guidelines that are both ambitious and realistic, are developed, offering solutions that maximize the social and economic benefits of circularity. By doing so, it contributes directly to the EU Horizon mission of fostering climate neutrality, resource efficiency, and resilience through innovative, inclusive, and evidence-based approaches.

<u>Research objectives</u>:

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1) Evaluation of the level of social awareness and attitudes towards the increased supply/use of secondary materials and upcycling of CDW.

2) Proposal of policy recommendations and measures that could support the social and economic impact of circularity for EU participants.

Methodology:

A perception assessment through a questionnaire and a focus group to understand public awareness and attitudes, assessing knowledge, misconceptions, concerns and their environmental benefits. The key actors were also identified (citizens, contractors, architects, material suppliers, urban planners, policymakers, building and civil infrastructure asset managers from municipalities, waste managers, among others). At the same time policy and regulatory assessment was carried out by reviewing existing EU and regional level frameworks related to the recovery of construction products and materials for second life use and recycling.

Data collection was implemented through literature studies and online surveys:

Online Survey: a structured questionnaire was developed using Microsoft Forms and disseminated through the SUM4Re consortium network. The survey targeted construction professionals and relevant stakeholders from the construction industry in The Netherlands, Spain, Norway, Finland, Switzerland, France, Germany, Estonia and Norway aiming to capture perspectives on: 1) public awareness and attitudes, 2) misconceptions and 3) concerns regarding sustainable material supply and CDW management.

Focus Group: online discussion about sustainable material supply and CDW management with five participants from different countries and different areas of expertise within the construction industry. The discussion was guided with questions to engage participants and promote conversation towards the main research topics.

This report is organised in the following manner:

- Chapter 1: Introduction.
- Chapter 2: Social Perception Study.
- Chapter 3: Policy recommendations and guidelines to enhance social and economic impact of circularity.
- Chapter 4: Conclusion.
- Bibliography.

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2. Social Perception Study

Understanding societal perceptions is critical to advancing the circular economy in the construction sector. Policies and technical solutions can only achieve their intended impact if they are supported by public trust and stakeholder acceptance. To capture this dimension, the project conducted a social perception study focused on awareness, attitudes, knowledge, misconceptions and concerns related to CDW management and the use of secondary construction materials.

Methodology

A structured questionnaire with open-end and close questions, was designed and administered to capture broad insights from a diverse range of stakeholders, providing measurable data on attitudes, concerns and misconceptions.

To complement the survey results and obtain a deeper understanding of stakeholder perspectives, a focus group was conducted with selected participants, enabling a more interactive exploration of key themes, clarification of complex issues and validation of preliminary results. The session was guided by a semi-structured protocol consisting of open-ended questions, designed to stimulate discussion on challenges, opportunities, misconceptions and potential policy measures related to CDW management and circular material supply. The interactive format allowed participants to elaborate on their experiences and exchange viewpoints. The discussion was facilitated by an experienced moderator, ensuring balanced participation and focus on the key themes relevant to the project.

Objectives

1. Measure public awareness, knowledge and misconceptions of CDW and secondary/sustainable building materials.
2. Characterize attitudes and identify concerns (trust, perceived quality, willingness to use/pay, social norms).

Survey Scope and Sample Size

A total of 81 participants took part in the survey. This number provides a useful basis for exploratory analysis, though it is not sufficient to claim statistical representativeness of the wider population (e.g., EU citizens or the entire construction sector). At a 95% confidence level, a sample of 81 respondents yields a margin of error of approximately ±11%, which is higher than the conventional thresholds used in large-scale representative surveys. Therefore, the results should be interpreted as indicative rather than generalizable.

In summary, the survey of 81 participants is positioned as an initial step in the research process. It provides early indicative findings that enrich the project's understanding of stakeholder perceptions, while also underscoring the need for larger and more representative data collection efforts to validate and expand upon these results.

Despite its limited size, the survey offers valuable insights into perceptions and attitudes towards circular economy practices and CDW management. It serves as a pilot study, allowing the research team to test the questionnaire design, identify potential issues in data collection, and refine the methodology for future large-scale surveys. The findings also highlight preliminary trends that can inform the development of hypotheses, stakeholder engagement strategies and further research activities within the project.

The survey is best understood as an exploratory data collection step rather than a fully representative measure. While it cannot provide statistically robust subgroup comparisons, it does capture emerging themes and concerns within the target audience. In this way, the survey contributes to building an evidence base for the project and guiding future inquiries.

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To gain more insights on the matter, a focus group with five participants from different areas of expertise within the construction industry, provided richer insights into the assessment of public awareness related to sustainable material supply and CDW management.

Conclusion

Results reveal a low baseline of awareness among the general public: while most respondents were familiar with recycling in general, few recognized CDW as a distinct waste stream or understood its environmental significance. Misconceptions were frequent, particularly around the safety, durability, and cost of recycled construction materials. Concerns over resale value and lack of trust in certification were repeatedly cited by both citizens and professionals. These findings underscore the need to strengthen information flows, clarify regulations, and increase the visibility of successful circular practices.

At the same time, the study identified clear opportunities. When provided with information on environmental benefits and quality standards, participants showed significantly greater willingness to accept recycled materials and support related policies. Both citizens and professionals expressed openness to policy interventions, especially public procurement mandates, economic incentives, and certification schemes. This suggests that targeted communication and reliable assurance mechanisms can effectively shift perceptions and build demand.

Overall, the social perception study highlights that awareness alone is insufficient; perceptions are shaped by trust, visible proof of quality and the framing of economic and environmental benefits. Addressing misconceptions through education, certification and demonstration projects is therefore as critical as regulatory reform. Integrating these social insights with policy measures will be essential to unlocking the full potential of circularity in the construction sector.

2.1. Questionnaire

A survey was conducted through a questionnaire aiming towards SUM4Re's target audience that includes research institutions, public administrations, engineering companies, builders, engineers, architects, urban planners, construction companies, demolition companies, construction material suppliers and society in general.

It gathers the opinions and level of knowledge of the interviewees on various aspects related to the SUM4Re project. The aim is to understand the target audience in order to assess the perception related to CDW management and the use of secondary construction materials.

The questionnaire was completed online, in Spanish and English, and subsequently analysed using statistical processing software. A total of 81 responses were obtained from seven countries in the European Union.

The structure of the questionnaire is the following: 1) screening & demographics (profession and sector, age, gender, level of education, country, position within the company). 2) questions related to awareness and use of sustainable materials. 3) questions related to concerns and misconceptions and lastly 4) questions regarding environmental benefits.

The first group of questions, identified "**screening & demographics**" taking into account the gender, age group, expertise, educational level, position in the company and country of residence of each interviewee. This classification criteria are necessary for the analysis of each of the responses by population groups.

This information, always treated anonymously, is as follows:

- **Profession and sector**

This is an open-ended question, to which each interviewee could respond freely. It was subsequently closed in the following groups:

- Public administrations

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– Contractors
– Engineers
– Architects
– Construction companies
– Society in general

The distribution of the sample, according to this criterion, was as follows in Table 1.

Table 1. Questionnaire screening & demographics: profession and sector

Profession and sector	Frequency	Percentage
Public administrations	2	2,5%
Contractors	5	6,2%
Engineers	12	14,8%
Architects	8	9,9%
Construction companies	8	9,9%
General Society	46	56,8%
Total	**81**	**100%**

- **Educational level**

In this case, an open-ended response was also allowed, which has been closed in the following classification groups:

– Compulsory education
– Vocational training
– University studies
– Doctorate

The distribution of the sample, according to this criterion, is as follows in Table 2.

Table 2. Questionnaire screening & demographics: educational level

Educational level	Frequency	Percentage
Compulsory education	17	21%
Vocational training	8	9,9%
University studies	48	59,3%
Doctorate	8	9,9%
Total	**81**	**100%**

- **Position within the company**

This qualifying question aims to identify the interviewee's position within the company they work for, offering the following set of answers:

– Chief Executive Officer (CEO)
– Middle management
– Entry-level position

The distribution of the sample is as follows in Table 3.

Table 3. Questionnaire screening & demographics: position within the company

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Position within the company	Frequency	Percentage
Chief Executive Officer (CEO)	20	24,7%
Middle management	23	28,4%
Entry-level position	38	46,9%
Total	81	100%

- **Age**

This is another closed question, with the following possibilities:

- Between 18 and 25 years old
- Between 26 and 45 years old
- Between 46 and 67 years old
- Over 67 years old

The distribution of the sample has resulted in an almost equal distribution for the four groups as can be seen in Table 4.

Table 4. Questionnaire screening & demographics: age

Age	Frequency	Percentage
Between 18 and 25 years old	26	32,1%
Between 26 and 45 years old	25	30,9%
Between 46 and 67 years old	30	37%
Over 67 years old	0	0%
Total	81	100%

- **Gender**

The interviewees were offered the following set of possible answers:

- Male
- Female
- Non-binary
- I prefer not to answer

The results show that the majority are male, almost 70% as can be observed in Table 5.

Table 5. Questionnaire screening & demographics: gender

Gender	Frequency	Percentage
Male	55	67,9%
Female	24	29,6%
Non-binary	1	1,2%
I prefer not to answer	1	1,2%
Total	81	100%

- **Country**

Open-ended question based on the location where the interviewee's company operates. The number of answers can be seen in Table 6.

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The responses obtained are grouped into the following seven countries:

- Spain
- Belgium
- France
- Italy
- Netherlands
- Norway
- Sweden

Table 6. Questionnaire screening & demographics: country

Country	Frequency	Percentage
Spain	63	77,8%
Belgium	2	2,5%
France	2	2,5%
Italy	4	4,9%
The Netherlands	4	4,9%
Norway	5	6,2%
Sweden	1	1,2%
Total	**81**	**100%**

The second part of the questionnaire compiles questions related to **awareness and use of sustainable materials**. The first set of questions are related to the degree of awareness and actual use of secondary materials:

- Do you know what secondary materials are? (Table 7)
- Have you ever used secondary materials in your company? (Table 8)
- Do you know where you can get secondary materials in your area? If so, where? (Table 9)
- Do you consider secondary materials to be economically viable, or do you prefer to obtain materials elsewhere? Where? (Table 10)
- Would you be willing to use secondary materials in your job? If not, why not? (Table 11)

Table 7. Answers to "do you know what secondary materials are?"

Do you know what secondary materials are?	Frequency	Percentage
Yes	67	82,7%
No	14	17,3%
Total	**81**	**100%**

There is still 17% of the population interviewed who claim not to know what secondary materials are. The analysis by profession and sector reveals a surprising 25% of architects and engineers who claim not to know this.

By educational level, all those who have undergone vocational training and those with doctorates are familiar with these materials, while 23% of university graduates are not.

In terms of gender, the degree of ignorance reaches 22% among men, with only 8% among women.

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As for the classification by country, the only negative responses were collected in Spain, although we must say that in the other countries the number of interviews collected is less than 5 in all cases and does not allow us to obtain conclusive data.

The following range of possible answers was offered for the question “have you ever used secondary materials in your company?”

- Frequently
- Sometimes
- Rarely
- Never

Table 8. Answers to “have you ever used secondary materials in your company?”

Q: Have you ever used secondary materials in your company?	Frequency	Percentage
Frequently	6	7,4%
Sometimes	31	38,3%
Rarely	23	28,4%
Never	20	24,7%
Total	81	100%

As can be seen, only 7.4% of respondents use secondary materials “frequently” and just over a third “sometimes.” This shows a very low uptake of these materials in general.

Depending on the profession and sector of the interviewee, we found that contractors (40% of responses “frequently” and 60% ‘sometimes’) and construction companies (25% “sometimes”) are the most likely to use secondary materials.

Depending on the profession and sector of the respondent, we find that contractors (40% “frequently” and 60% “sometimes”) and construction companies (25% “frequently” and 38% “sometimes”) are the ones who use these materials the most. In these groups, there is no one who has ever used these materials.

In terms of educational level, the vocational training group clearly stands out from the rest due to the high implementation of the use of these materials (25% “frequently” and 63% “sometimes”).

Furthermore, none of the interviewees in this group stated that they do not use secondary materials. In the rest of the groups, the proportion is the opposite, with university graduates being the least likely to use them, at 32%. In the other groups, the proportion is reversed, with university students using them the least, at 32%.

As for the interviewee's position in the company, there are no comments of interest in this case. In relation to gender, no difference is apparent in each case.

With regard to age groups, there is a slightly higher use in the 26 to 45 age group, but without a significant difference from the rest.

Finally, in terms of countries, in Belgium and the Netherlands, 50% of responses were “no” (I have never used secondary materials), although the number of respondents in these countries is 2 and 4 respectively, so it is not appropriate to draw conclusions.

For the next question, “do you know where you can get secondary materials in your area? If so, where?”, the possible answers were:

- Yes
- No

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If yes, respondents were asked to indicate where to obtain these materials, for which they were given free rein to write their answers.

Table 9. Answers to "do you know where you can get secondary materials in your area? If so, where?

Q: Do you know where you can get secondary materials in your area? If so, where?	Frequency	Percentage
Yes	25	30,9%
No	56	69,1%
Total	**81**	**100%**

Only 31% of respondents say they know where to obtain secondary materials for their activity, which contrasts with the result obtained in the previous question, as more than 40% of respondents said they frequently or sometimes use secondary materials.

In terms of the profession and sector of the respondent, as in the previous case, contractors (60%) and construction companies (50%) have the highest level of knowledge in this regard.

In terms of educational level, the groups that respond "yes" in the majority are doctors (almost 90%) and those who have studied vocational training (63%).

With regard to the interviewee's position within the company, those in entry-level positions are almost entirely unaware of where to obtain these materials, with middle managers being the most knowledgeable (65%).

In terms of age groups, the level of knowledge increases in parallel with age, rising from 100% ignorance in the 18-25 age group 25 to 60% awareness in the over -45s.

The gender of the interviewee does not show any significant differences and, in terms of country of origin, the highest awareness rates are found in the Netherlands (100% of respondents), Norway, and Italy, although we should note that the number of interviews in these countries is too low to draw firm conclusions.

After asking this question, respondents who answered affirmatively (25 people) were asked to indicate where they acquired such materials. The responses are included in Appendix A of this document and are not included here due to their lack of statistical interest.

For the penultimate question regarding secondary materials, "do you consider secondary materials to be economically viable, or do you prefer to obtain materials elsewhere? Where?", the possible answers were:

- I consider them viable
- I prefer to obtain them elsewhere
- I don't know

If they responded that they preferred to obtain them elsewhere, respondents were asked to indicate where they could get them, for which they were given free rein to write their answer.

Table 10. Answers to "do you consider secondary materials to be economically viable, or do you prefer to obtain materials elsewhere? Where?"

Q: Do you consider secondary materials to be economically viable, or do you prefer to obtain materials elsewhere? Where?	Frequency	Percentage
I consider them viable	37	45,7%
I prefer to obtain them elsewhere	39	48,1%
I don't know	5	6,2%
Total	**81**	**100%**

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It is noteworthy that 48.1% of those interviewed do not know whether secondary materials can be viable. Even so, 45.7% consider them viable, compared to the low 6.2% who prefer to obtain them elsewhere.

In terms of the interviewee's profession and sector, architects (10.8%) and construction companies (16.2%) consider them to be the most viable, compared to 23.1% of engineers within the sector who do not know whether to consider them viable.

In terms of educational level, the group that considers them most viable are those with university studies (51.4%), compared to 25.6% of the compulsory education group who do not know about the viability of these materials.

With regard to the interviewee's position within the company, those in a middle management position prefer to obtain them elsewhere (60%), while 37.8% of the entry-level group consider secondary materials to be viable.

In terms of age groups, in the over-45 group we find both those who consider them viable (43.2%) and those who prefer to obtain them elsewhere (60%).

The gender of the interviewee shows differences, as 56.8% of the male group considers them viable, compared to 37.8% of the female group.

In terms of country of origin, the survey shows that in Spain, 70.3% consider them viable, while in Norway, despite being a very small sample for comparison, 40% say they prefer to obtain them elsewhere.

After asking this question, respondents who had answered that they prefer to obtain them elsewhere were asked to indicate where they acquire such material. The responses provided are included in the Appendix B of this document and are not included here.

For the last question regarding secondary materials, "would you be willing to use secondary materials in your job? If not, why not?" the possible answers were:

- Yes
- No

If not, interviewees were asked to indicate why they would not be willing to use secondary materials in their job, for which they were given a free-response box.

Table 11. Answers to "would you be willing to use secondary materials in your job? If not, why not?"

Q: Would you be willing to use secondary materials in your job? If not, why not?	Frequency	Percentage
Yes	80	98,8%
No	1	1,2%
Total	**81**	**100%**

Only 1.2% would not be willing to use secondary materials in their work, compared to the majority of respondents who would be willing to use them.

The negative response to this question is found in the construction sector (12.5%) and, in relation to educational level, we find it in the 13.5% of respondents with a university degree and the 12.5% with a secondary education.

With regard to the interviewee's position within the company, those in entry-level positions were the ones who responded negatively to the question (2.6%), while by age group, it was in the over-45 group that we found 3.3% responding negatively. By gender, it is the male group that would not be willing to use secondary materials in their work.

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These are very low percentages, as the majority of those surveyed said they would use them. The same is true for countries, where we only found negative responses in France, although we should remember that the number of interviews is too low to draw firm conclusions.

After asking this question, respondents who answered negatively were asked to indicate why. The answers provided were related to concerns about quality and regulatory compliance of the secondary materials.

Lastly, respondents were asked “what disadvantages do you think there may be to using secondary materials?” and the answers are gathered next:

- It depends on the type of material to obtain tests according to PG-3.
- Lack of places in the area to purchase it (3)
- I don't see any disadvantages (9)
- Lack of knowledge about its effectiveness (2)
- Cost (20)
- Uncertainty regarding warranty periods for the works
- Less resistance (9)
- Lack of long-term knowledge. Less control and knowledge of the materials incorporated in the mixture (2)
- Customer perception of quality
- Does not offer 100% quality (13)
- I don't know (7)
- They are not included in the specifications or in current regulations, which are very strict. Legal usage issues (8)
- Making you less competitive compared to other companies by increasing production costs.
- That you have to process them (3)
- Durability (8)
- In general, anything related to pollution (2) and that they may be sensitive to deterioration.
- The impact of their environmental footprint in addition to their production from non-renewable raw materials.
- They are not very attractive.
- A lot of logistics (2)
- Universal design, need for specific knowledge to disassemble and reassemble, very time-consuming.

The survey identified several perceived barriers or disadvantages to the use of secondary and alternative construction materials. The most frequently cited concerns related to technical performance (34 mentions), particularly durability, resistance, and long-term reliability. Economic issues (25 mentions), mainly higher costs and logistical challenges, were also highlighted as significant disadvantages. Perceptions of quality and acceptance (29 mentions) further emerged as a key barrier, with doubts about customer acceptance and lack of trust in the materials’ effectiveness. Additional obstacles included regulatory and legal constraints (9 mentions), as well as isolated references to environmental concerns (4 mentions) and processing challenges (3 mentions). Overall, the findings suggest that confidence in performance, cost competitiveness and stakeholder perceptions represent the most critical hurdles to wider adoption.

The third part of the questionnaire compiled questions regarding waste management and are gathered next:

1. Are you involved in waste management? The possible answers were yes/no and the detailed number of answers can be seen in Table 12.
2. With regard to “Waste management.”:
3. Preparation for reuse/recycling, improving collection and separation, and improving traceability.

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4. Increase circular value recovery: recover secondary materials. Increase, improve, and promote reuse.
5. Reduce the impacts associated with poor waste management.

Table 12. Answers to "are you involved in waste management?"

Q: Are you involved in waste management?	Frequency	Percentage
Yes	31	38,3%
No	50	61,7%
Total	**81**	**100%**

The answer to this question can be related to all of the above, taking into account involvement in recycling. Hence, the majority of respondents (61.7%) do not consider themselves involved in waste management.

In relation to profession and sector, in the contractor and architect groups, we find that they do see themselves as involved, but in the rest of the groups, those who do not see themselves as involved exceed 50%. 50% do not see themselves as involved.

In relation to educational level, the vocational training group is divided 50/50 in its responses, while in the rest of the groups the negative response reaches the highest percentage, reaching 82.4% in the compulsory education group.

In terms of the interviewee's position within the company, the CEO group and middle management are the most involved in waste management, compared to 86.8% of the rank-and-file group who are not. By age group, in all groups, the majority of respondents considered that they were not involved.

And the group with the highest percentage of the group with the highest percentage of involvement is those over 45. By gender, we also find that most of those surveyed do not consider themselves involved.

By country, and excluding Spain, the Netherlands is the only country where we find 100% involvement in waste management.

With regard to "Waste management." Preparation for reuse/recycling, improving collection and separation, and improving traceability, the possible answers were:

- Very often
- Often
- Sometimes
- Rarely

The highest percentage of this question is found in "very often," which shows that there is some involvement in waste management, at least in terms of recycling and reuse, reaching a low 1.2%.

In terms of profession and sector, it is in the contractor's group where we find the highest percentage of "very often," while in the general society group and in the architect's group we find the highest percentage of "rarely" with 18.8% and 16.7% respectively.

In relation to educational level, the response "very often" has very similar percentages in all groups, which is in line with the general responses.

In terms of the interviewee's position within the company, the CEO and middle management groups have the highest percentage of "very often" responses, with the entry-level group reaching 50% in the "rarely" response.

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By age group, the 18-25 age group has the highest percentage of “rarely,” with the lowest percentages of “very often” and “often.” By age group, the 18-25 age group has the highest percentage of “rarely” responses, with the lowest percentages for “very often” and “often.” By gender, we find a similar percentage for the “often” response, with 50% in both groups.

By country, and excluding Spain, we only find one response of “rarely” in the Netherlands. In the rest of the countries, the percentages are distributed among the other responses.

With regard to “Waste management.” Increase circular value recovery: recover secondary materials. Increase, improve, and promote reuse, the possible answers were:

- Very often
- Often
- Sometimes
- Rarely

The highest percentage of this question is found in “sometimes,” followed by the response “very often” and, with a lower percentage, “rarely,” which shows some interest in increasing, improving, and promoting reuse.

In terms of profession and sector, it is in the group of contractors and construction companies where we find the highest percentage of “very often” responses, while, as in the previous question, in the group of society in general and in that of architects, we find the highest percentage of “rarely” responses, with 25% and 16.7% respectively.

In relation to educational level, the response “sometimes” has the highest percentages in the compulsory education and university studies groups, but not so in the vocational training and doctorate groups, where the highest percentage is found in "very often."

As for the interviewee's position within the company, the responses are similar to the general ones. By age group, the groups have responses with different percentages; the 18-25 age group has the highest percentage of “sometimes,” while the 26-45 age group has the highest percentage of “often” and those over 45 have “very often” and “sometimes.” By gender, in the male group, “very often” is the most chosen response, while in the female group it is “often.”

By country, and without taking Spain into account, we only find one response of “rarely” in the Netherlands. In the rest of the countries, all reach the highest percentage in “very often.”

With regard to “Waste Management.” Reduce the impacts associated with poor waste management, the possible answers were:

- Very often
- Often
- Sometimes
- Rarely

This question follows the same line as the previous ones, with the highest percentage in terms of reducing the impacts associated with poor waste management being the response “often” (12.3%), but closely followed by “very often” with 11.1%.

In relation to profession and sector, and as in the previous question, the result is In relation to profession and sector, and as in the previous question, the result is similar to the overall percentages, with practically all groups having the highest percentage in the “often” response, except for society in general, which has higher percentages in the “sometimes” and "very often“ responses, and contractors, who divide their responses between ”very often" and “rarely.”

In relation to educational level, the groups distribute most of their responses differently: compulsory education “often,” vocational training “very often,” university studies “sometimes,” and doctorate “very often.”

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In terms of the interviewee's position within the company, the entry-level group has the majority of its responses as “sometimes,” while those of the CEO and middle management groups are both “often.” By age group, the majority of responses are also distributed: 18 to 25, “sometimes”; 26 to 45 “often” and over 45 “very often.” By gender, we find a higher percentage of “sometimes” in the male group, since in the female group the highest percentage is for the answer “often.”

Lastly, the fourth part of the questionnaire is to determine the degree of social awareness regarding the use of secondary materials and CDW:

1) What consideration does recycling waste deserve in your company? The possible answers were:
    a. It is a waste of time and resources
    b. It does not affect the activity
    c. It is necessary but not practiced
    d. They try to do basic recycling
    e. They are systematic about it
    f. It is part of the company's philosophy

The detailed answers to this question can be seen in Figure 1.

Figure 1. What consideration does recycling waste deserve in your company?

The highest percentage in this question is related to the previous answers regarding recycling and is “basic recycling is attempted,” although we can also highlight that more and more companies are involved in this, since the next highest percentage corresponds to the answer “it is part of the company's philosophy” and the lowest percentage is found in “they are systematic in this regard.”

In relation to educational level, the groups distribute most of their responses between the two with the most responses in the general question, with the exception of the compulsory education group, whose majority responses include “it is necessary but not practiced.”

As for the interviewee's position within the company, the entry-level group also distributed its majority responses between “basic retraining is attempted” and “it is necessary but not practiced.” By age group, the majority of responses were also distributed along the same general lines as by gender.

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2) What materials procurement policy does your company follow? The possible answers were:
   a. We acquire materials from secondary uses
   b. We prioritize the acquisition of recycled products
   c. We acquire raw material

The detailed answers and percentages obtained can be seen in Figure 2.

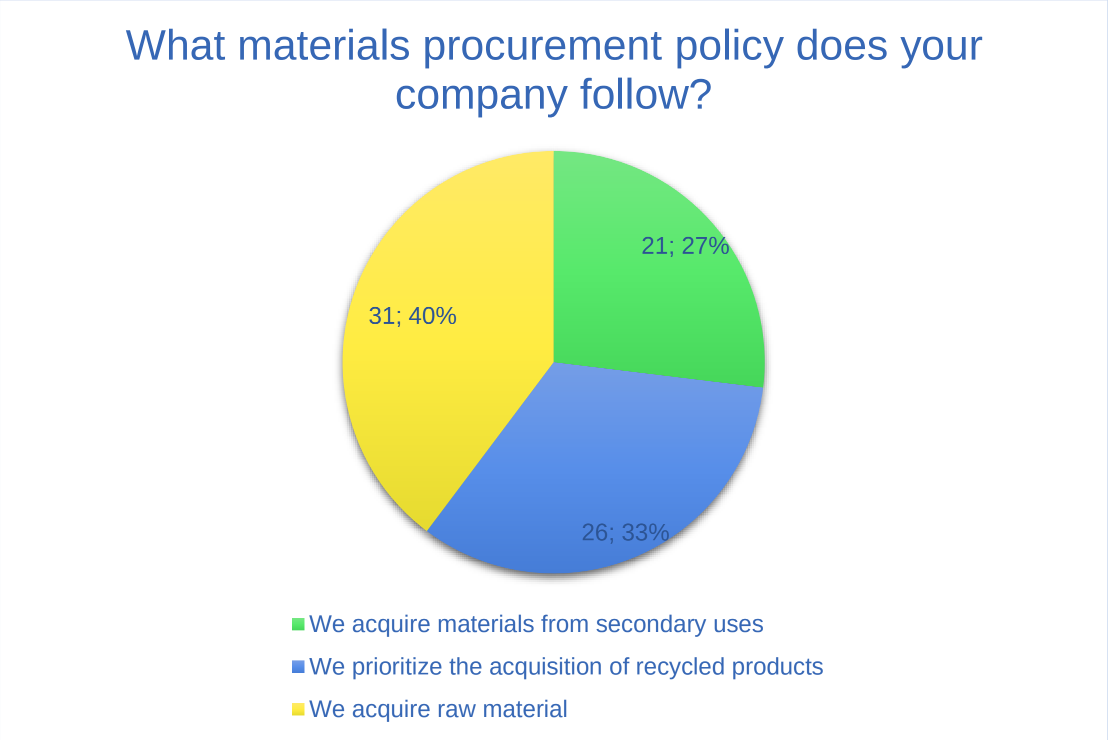

Figure 2. What materials procurement policy does your company follow?

The results for this question are fairly balanced across the three possible answers, although a higher percentage is found in “they acquire raw materials.” This leads us to believe, as we mentioned earlier, that there is increasing involvement in recycling activities.

In relation to profession and sector, the result is similar to the overall percentages, except for the group of contractors, where we found no responses “purchase materials for secondary use”; the percentages are distributed between the two remaining responses.

In relation to educational level, the groups distribute most of their responses between the two with the highest percentages in the general question. In terms of the interviewee's position within the company, the middle management group differs from the other two groups in that its second most popular response is “they purchase materials for secondary use,” the response that has the lowest percentage overall. The same is true for age groups, with those between 18 and 25 also giving the highest percentage to "they purchase materials for secondary use." By gender, the majority of responses are distributed along the same general lines.

3) Are you concerned that your company does not use secondary materials or upcycling? The possible answers were:
   a. Yes, a lot
   b. Slightly
   c. No, not at all

The distribution of answers can be seen in Figure 3.

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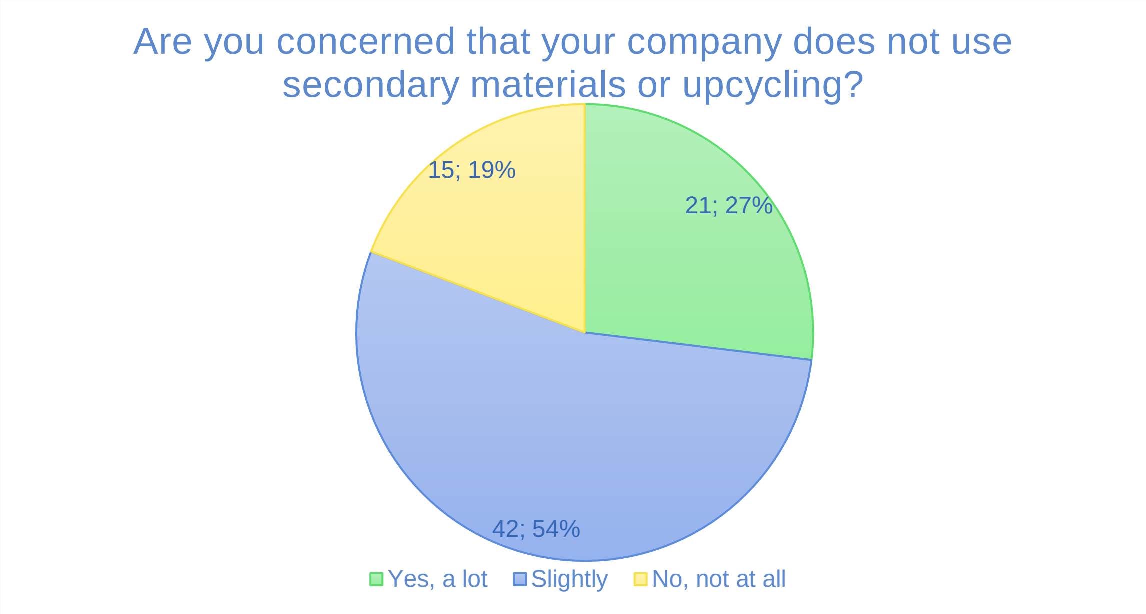

Figure 3. Are you concerned that your company does not use secondary materials or upcycling?

Looking at the results of this question, we can see a certain concern on the part of the respondents about the lack of interest shown by companies in the use of secondary materials, since the highest percentages are found in "slightly" and "yes, a lot."

In relation to profession and sector, the result is similar to the overall percentages, and they consider it a concern that their company does not use supra recycling. Even so, there is also a certain percentage in the "no, not at all" response, which in groups such as architects and construction companies reaches 25%.

In relation to educational level, the groups distribute most of their responses between the two with the highest percentages in the general question, with the exception of the doctorate group, which has a high 37.5% in the "no, not at all" response and a low 12.5% in the "yes, a lot" response.

In terms of the position of the interviewee, we find that in the CEO group, the highest percentages are in "slightly" (60%) and "no, not at all" (25%), while the other two groups maintain the general trend.

By age group, something similar happens in the over-45 group, where the highest percentages are "slightly" (51.7%) and "no, not at all" (27.6%). By gender, the responses with the highest percentages in both groups are similar to the general response.

By country, and without taking Spain into account due to the difference in sample size, it is surprising that the Netherlands is the country where we find the highest percentage in "no, not at all," since in the rest of the questions the Netherlands is the country with the highest percentage in "yes, a lot."

4) Are you aware of the impact of construction and demolition waste? The possible answers were:
    a. Yes
    b. No
    c. To some extent

The number of answers can be seen in Figure 4.

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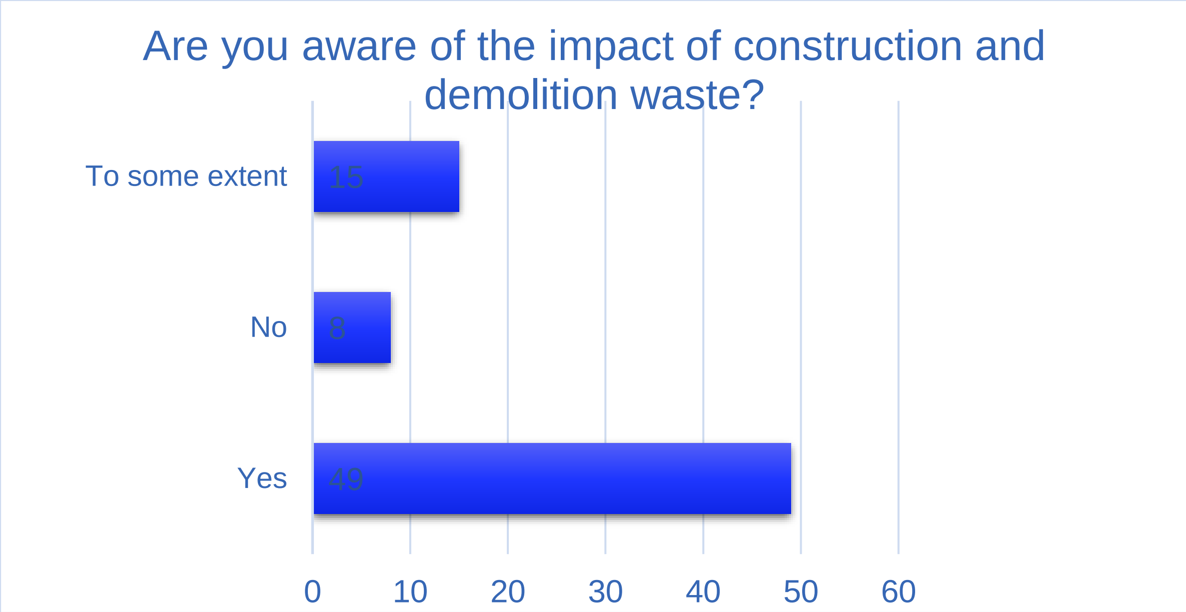

Figure 4. Are you aware of the impact of construction and demolition waste?

The answers to this question show awareness of the impact that construction and demolition waste can have on the environment, with a high 60.5% answering affirmatively and a low 9.9% answering negatively.

In relation to profession and sector, the result is similar, as expected, to the overall percentages, with no negative responses in many of the groups.

In relation to educational level, something similar occurs, although in the vocational training group we find a higher percentage in the “to some extent” response, 50%, than in the affirmative, 37.5%.

As for the position of the interviewee, it is also equal to the overall average, something that also occurs by age group, although in this case in the over-45 group we find no negative responses; everyone is aware of the impact of climate change on their profession.

In relation to the position of the interviewee, it is also equal to the overall average, something that also occurs by age group, although in this case in the over-45 group we find no negative responses; everyone is aware of the impact of climate change on In terms of the position of the interviewee, it is also equal to the overall average, which also occurs by age group, although in this case, in the over-45 group, we did not find any negative responses; everyone is aware of the impact of waste, even if only to a certain extent. By gender, we find that in the female group, the highest percentage is in the “to a certain extent” response, 50%, thus exceeding the 37.5% of affirmative responses.

5) Do you consider reused materials to be safe? The possible answers were:
   a. Yes
   b. No
   c. I don’t know

Results can be seen in Figure 5.

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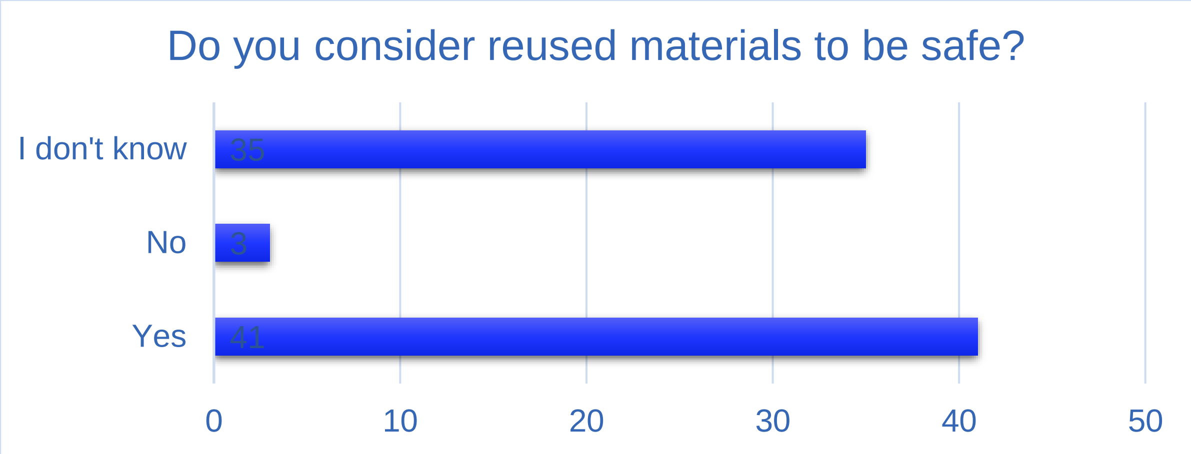

Figure 5. Do you consider reused materials to be safe?

The answers to this question reveal a certain lack of knowledge about reused materials, since although the majority of respondents answered affirmatively (50.6%), 43.2% answered “I don't know,” confirming this lack of knowledge.

In relation to profession and sector, the result is similar to the overall percentages, with a higher percentage of positive responses but also a high percentage of “I don't know” responses. In some groups, there were no negative responses, such as contractors and engineers, but 12.5% of architects and construction companies considered that reused materials are not safe.

In relation to educational level, the compulsory education group shows the most lack of knowledge, with a higher percentage of this response than the affirmative one. The rest of the groups show responses similar to the overall average.

In terms of the position of the interviewee, the group that considers reused materials to be the safest and has the most knowledge is middle management, as there are no negative responses either.

By age, it is also the same as the overall average, although the greatest lack of knowledge is found in the 18-25 age group, with a high 68% responding “I don't know.” By gender, the responses follow the overall average, with no negative responses in the female group.

By country, and without taking Spain into account due to the difference in sample size, we find that there are no negative responses, although only in Belgium do we find 100% positive responses. In the rest of the countries, there is a certain lack of knowledge, similar to the average we have been analysing.

After asking this question, respondents who answered affirmatively (41 people) were asked to indicate which materials they considered safe and which they had little confidence in. The responses are included in the appendix to this document and are not included here due to their lack of statistical interest but it can be found on Appendix C.

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2.2. Focus Group

Date: 9th of September 2025

Moderation team:

- *Moderator:* Spyros Mathioudakis, EBC Senior Policy Officer.
- *Support:* Giorgia Signoretto, EBC Projects Officer.
- *Support:* Carla Rois, Training Specialist, Estudios Rafer.

Participants:

The areas of expertise from the five participants are:

- A Circular Economy facilitator, supports companies, cities and municipalities, and other organizations in the Green Deal on Circular Procurement and the Green Deal on Circular Construction. This person works at Vlaanderen Circulair (in English, Circular Flanders) which serves as the hub, catalyst, and inspiration for advancing the circular economy in Flanders. It is a strategic partnership involving the government, businesses, civil society, and knowledge institutions, all working collaboratively to drive the transition from a linear to a circular economic model. The initiative is stewarded by OVAM (the Flemish Public Waste Agency).
- A Policy Advisor at EURIC (European Recycling Industries' Confederation) that is an association that represents the interests of the European recycling and waste-management industries.
- An EBC Senior Technical Officer, expert on standardization for SMEs.
- A co-founder and Director at Imperfect, a Brussels-based company focused on promoting circular economy practices in the construction sector.
- A Programme Manager at ECOS. ECOS is an international Non-governmental Organization that ensures the environmental voice is heard in the development of technical standards, policies and laws-working with and around standardization bodies and EU product policy.

Informed consent

All participants were informed about the purpose and voluntary nature of the study, as well as their rights regarding anonymity, confidentiality and withdrawal without consequences. Prior to data collection, participants received an information form and provided explicit written informed consent. The procedures complied with the Horizon Europe Ethics Appraisal Procedure and with the General Data Protection Regulation (GDPR, Regulation (EU) 2016/679). Consent records are securely stored, and no personal data has been processed beyond the purposes described.

Purpose and Methodology

To complement the questionnaires data and deepen understanding of public perceptions, we conducted a focus group with stakeholders from different areas of expertise across the construction industry. The objective was to explore awareness, misconceptions, concerns, and perceived environmental benefits related to sustainable material supply and CDW management.

The focus group duration was one hour and forty minutes (1h40m). Participants were recruited through EBC. The meeting was held on the 9th of September 2025 and it was moderated online using a semi-structured discussion guide. At the beginning of the discussion all participants presented each other, describing their role at their enterprise and they briefly described their experience or involvement with sustainable materials and/or waste management. Later, the moderator started with the guiding questions to start the discussion.

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The discussion guide is presented hereafter:

- What are your biggest **concerns or frustrations** with current policies related to sustainable materials or CDW?
- Are there any important areas that you think **current regulations miss or poorly address** when it comes to circularity in construction?
- From your position, what **policy changes or new measures** would have the biggest impact on making material supply and CDW management more circular/sustainable?
- Who should take the lead in implementing these policies, local governments, national bodies, industry associations, or others?
- **List of policy recommendations from D1.2.** Let's prioritize two or three **policy actions** that we think would have the biggest positive effect and enable a more circular construction industry.

Key themes and insights

1) **Standardisation:** harmonized and ambitious standards are essential to build trust in reused products and recycled aggregates. Priorities include standards for pre-demolition audits, design for reuse, and the integration of circular practices into building codes.
2) **Green Public Procurement:** stable demand for secondary materials can only be achieved through mandatory circularity criteria in public tenders. Current procurement processes still lack trust and long-term vision.
3) **Extended Producer Responsibility (EPR):** the French scheme was cited as a promising model but requires careful adaptation to the construction sector, given long lifespans of buildings and the complexity of materials.
4) **Design for circularity:** new and renovated buildings must increasingly be conceived for disassembly and reuse. Clear examples and practical guidance can support uptake, while developers need to see tangible benefits in terms of asset value and future-proofing.
5) **Logistics and collection:** local bottlenecks persist, including insufficient collection points, lack of storage space, and unclear permitting rules. These challenges disproportionately affect SMEs.
6) **Knowledge and financial models:** beyond regulatory barriers, scalable supply solutions and viable business models for reuse remain underdeveloped. Social and economic aspects of circularity, such as affordability and job creation, require further attention.

Focus Group findings

Barriers remain systemic: Fragmentation across sectors such as breaches between demand and supply, inconsistent legal requirements, and overlapping EU legislation (e.g. CPR, Waste Framework Directive, Circular Economy Act) risk creating confusion.

SME concerns: Small firms face high costs and logistical burdens when implementing selective demolition or reuse, underlining the need for proportionate obligations.

Ongoing reforms (taxonomy, procurement, waste directives) are expected to shape the sector significantly in the coming years.

Participants noted that while environmental aspects are well-studied, the social and economic impacts of circular construction require **more research** (e.g. affordability, labour, community hubs).

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Implications

Policy Recommendations:

- Advance EU-wide standardisation for reuse, pre-demolition audits, and recycled aggregates to provide certainty and comparability.
- Introduce clear, ambitious criteria for green public procurement to guarantee demand for secondary materials.
- Explore the expansion of EPR to construction, but tailor it to sectoral realities (long lifespans, traceability of hazardous substances).
- Address local-level bottlenecks through investment in collection points, storage infrastructure, and support for SMEs.

For SUM4Re: Findings reinforce the project's emphasis on combining technical pilots with policy input. They highlight the importance of:

- Developing financial models for reuse and recycling.
- Embedding social and economic impacts into assessments.
- Linking project outputs to upcoming EU legislative reviews.

2.3. Metrics and Indicators

To systematically assess societal perceptions of circularity in construction, the project developed a comprehensive set of metrics and indicators. These were designed to capture the levels of public awareness, the prevalence of misconceptions and the intensity of concerns surrounding CDW management and secondary materials. Together, they form a structured evidence base to inform both policy strategies.

Awareness indicators measured whether respondents had previously heard of CDW, were familiar with secondary construction materials or had encountered examples of their use in practice.

Knowledge and misconception metrics evaluated factual understanding of recycled materials through yes/no questions. Key misconceptions identified include the belief that recycled materials are inherently less safe, more expensive or unable to meet performance standards.

Concern indicators captured the extent to which citizens and professionals expressed hesitation regarding the adoption of recycled materials. This not only highlights the most common concerns but also quantifies their relative weight in shaping acceptance or rejection of circular practices.

The detailed metrics and indicators that were used can be seen in Table 13.

Table 13. Metrics and Indicators

Indicator	Metric	Purpose
Socio-demographic indicators	Gender, age, level of education, position within the company and country.	Profile respondents and identify correlations with attitudes
Environmental habits	Frequency of awareness towards use of secondary materials and CDW management.	Measure pro-environmental behaviours and intentions.
Attitudes towards secondary materials	Agreement on use of secondary materials in the workplace.	Measure acceptance of secondary materials in the workplace.
Barriers, knowledge and misconceptions to usage of secondary materials	Concerns: health, safety, durability, quality, higher cost, limited experience; psychological barriers (knowledge, fairness, irrelevance)	Identify psychological, gaps and practical obstacles to adoption.

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2.4. From Perceptions to Policy Gaps

Findings from the perception study reveal that while there is broad conceptual support for sustainability in the construction sector, significant perception-based barriers continue to limit the adoption of circular practices and secondary materials. These barriers, rooted in limited awareness, low trust, quality concerns, and unclear environmental value, highlight several policy gaps that must be addressed to align social perception with circular economy objectives.

1. Low Awareness → Information Transparency and Digital Tools

A large share of respondents demonstrated only a basic understanding of what secondary materials are, with confusion between recycled, reused, and waste-derived materials. This lack of awareness constrains demand and undermines acceptance in both professional and public spheres.

Policy implication: National and regional governments could introduce awareness and knowledge-building mechanisms such as digital product passports (DPPs) and open-access databases documenting material origin, composition, and environmental performance. Integrating such digital tools into building permit systems or procurement platforms would increase visibility of certified secondary materials and help normalize their use.

2. Low Trust and Quality Concerns → Certification and Quality Standards

Perceived risks regarding the reliability, durability, and safety of secondary materials remain among the strongest barriers identified. Even among construction professionals, trust in current quality assurance systems is moderate.

Policy implication: Stronger standardization and certification frameworks are needed, harmonizing technical requirements across regions and project types. Regular performance testing and public reporting of compliance data can further strengthen credibility and consumer trust.

3. Limited Perceived Environmental Benefits → Communication and Demonstration Projects

Although respondents often support sustainability principles, many underestimate the actual environmental gains of using secondary materials compared with conventional ones. This perception gap reduces motivation to shift from linear practices to circular practices.

Policy implication: Governments and industry associations can address this through evidence-based communication, publishing quantified life-cycle assessments (LCAs) and case studies demonstrating emission and waste reductions achieved by circular construction projects. Funding demonstration sites or "circular building showcases" can also help make benefits tangible and visible to stakeholders and the public.

4. Cost and Market Perceptions → Incentives and Green Procurement

Respondents frequently associate secondary materials with higher costs or lower market availability. These beliefs, whether accurate or not, deter potential adopters.

Policy implication: Policies should introduce economic incentives (e.g., reduced landfill taxes, subsidies for using certified secondary materials, or preferential VAT rates) and mandatory green public procurement criteria that reward projects incorporating high percentages of secondary materials. Transparent reporting of price differentials and lifecycle cost data could also counter misconceptions about economic disadvantages.

5. Limited Behavioural Intention → Education and Skills Development

Finally, even when awareness and attitudes are positive, intention to adopt circular practices remains limited, especially among smaller firms.

Policy implication: Embedding circular construction modules in vocational training, university curricula, and professional accreditation systems can translate awareness into practice.

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Continuous education supported by public-private partnerships would strengthen the sector's human capital for circular transition.

2.5. Linking Social Perception Findings to Policy Development

The survey and focus group findings provided critical insights that directly informed the formulation of the project's policy recommendations. While quantitative data revealed levels of awareness, knowledge gaps, and prevalent misconceptions among citizens and professionals, qualitative discussions uncovered the underlying reasons for these perceptions and the conditions under which they might change. Together, these findings created a base to design policies that are not only technically sound but also socially accepted and effective in practice.

One of the clearest messages from the perception study was the disconnect between policy ambition and public understanding. Many participants supported the idea of recycling but lacked information about CDW management, secondary materials or the environmental benefits of reuse. This gap underscores the need for policy instruments that go beyond regulation, specifically those that embed education, communication, and transparency as part of implementation. Consequently, several recommendations emphasize awareness campaigns, public procurement visibility and certification systems that build trust in recycled materials.

The study also highlighted that concerns about safety, quality, and cost remain major barriers to acceptance. These findings informed policy areas focused on standardisation, quality assurance and product labelling, ensuring that technical standards are clear and accessible to both professionals and consumers. By aligning these social insights with regulatory improvements, policymakers can reduce uncertainty, foster confidence, and encourage broader market adoption of secondary materials.

In summary, the perception study shaped the policy framework by grounding policy recommendations in real-world behavioural evidence, the project ensures that circular economy strategies are not only technically viable but also socially supported and effective in driving long-term change. It ensured that recommendations address not only what should change in policy terms but also how those changes can gain societal legitimacy and uptake.

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3. Policy recommendations and guidelines to enhance social and economic impact of circularity.

The document focuses on generating policy recommendations to enhance the recovery for reuse and recycling of construction products and materials at both EU and regional levels. A central question posed throughout is how the project can help policymakers by providing guidance, solutions and evidence-based options that address current barriers.

Recommendations should be framed around the concrete challenges faced by policymakers, offering actionable and realistic alternatives. Identifying weaknesses in existing policies, such as lack of enforcement or misaligned priorities, is positioned as a valuable service, enabling policymakers to redirect resources, address inefficiencies, and advocate for change. In doing so, recommendations should always consider the political realities and resource limitations in which decisions are made.

The document highlights the need to consider the audience and tailor guidance accordingly. Policymakers, regulators, and policy influencers at EU, national, and regional levels have different priorities and constraints. Therefore, recommendations must be adapted to their perspectives, ensuring clarity and practical relevance. This includes emphasizing variables that have proven useful in practice and drawing on successful case studies and best practices to support credibility.

Another guideline is to create a menu of policy options rather than a single prescriptive solution. Policymakers should be presented with alternatives that balance effectiveness, feasibility, and costs. Each option must account for potential trade-offs, recognizing that some solutions may deliver strong results but require substantial resources, while others may mitigate one problem but create new challenges. Explicitly asking “why is this not being done already?” is encouraged as a way to uncover hidden barriers and ensure recommendations are distinctive and impactful.

The document also stresses the importance of actor identification and cross-sector collaboration. Recommendations should specify which actors, such as EU standardization bodies like Digi-Connect, local authorities, or industry partners, are best placed to overcome barriers. By clarifying responsibilities and operational pathways, the recommendations can move from abstract goals to actionable guidance. Best practices should be documented and shared to demonstrate how different actors have successfully implemented circular policies in practice.

Based on the findings of D1.2 after reviewing existing EU/national/local frameworks on CDW management and circular construction from the SUM4Re project, thereupon are displayed six policy recommendations for enhancing circularity of construction products as follows:

Legal instruments

1. Harmonising rules for categorisation of products and waste.

Technical instruments

2. Methods for performance assessment and quality.
3. Design for disassembly and reuse.

Information instruments

4. Development of digital competences and infrastructure.

Economic instruments

5. Circular public procurement practises.
6. Economic policy instruments.

As discussed in the workshop held on the 10th of June in Oslo and from the perspective of the SUM4Re project, #4 is most relevant, followed by #2 and then by #1. #3 is seen as the least

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relevant for SUM4Re, whereas #5 & #6 are seen as key instruments to support circularity in the construction sector in general.

The focus is on “Development of digital competences and infrastructure” because these tools enable transparent access to verified information on material origin, composition, and environmental performance. Moreover, digital literacy supports the effective implementation of policy instruments, including green procurement requirements and incentives for circular practices, while also facilitating broader knowledge dissemination and market development.

At the same time, “methods for performance assessment and quality” are essential to overcoming key perception barriers identified in our study, particularly concerns about the reliability, durability and safety of secondary materials. Standardized testing, certification, and clear quality benchmarks provide stakeholders with objective evidence that these materials meet technical and regulatory requirements. By reducing uncertainty and building trust, such methods facilitate market adoption, support policy instruments like green procurement and incentives and create a foundation for continuous improvement in circular construction practices.

Lastly, “Harmonising rules for categorisation of products and waste” are essential to reduce confusion and legal uncertainty around the use of secondary materials. Consistent definitions clarify whether a material can be reused, recycled, or sold, enabling regulatory compliance. With clear and predictable rules, trust among stakeholders and wider adoption of secondary materials in construction is encouraged.

1. Harmonising rules for categorisation of products and waste	
Context	The product and waste definitions in the Waste Framework Directive are general and further clarification is needed for the construction products to be recovered from a building. Moreover, the standards and industry guides in the sector provide different interpretation of the waste/product status than the legislation and create confusion in the practical applications. The lack of a common definition/interpretation of dismantled building components/materials as waste or products creates significant barriers in uptake of reusable construction products in new construction. Clear assessment approaches, criteria, protocols (e.g. for traceability and use history) and certification schemes are needed. End-of-waste status improves acceptance and trust for the construction product and clear criteria improve also the quality and trust for reusable products. Also, the administrative burden related to permits for waste management can be avoided. Circularity in the construction sector is closely linked to bridging the gap between demolition and construction, which in turn is closely related to requirements for documentation and technical specifications of products and materials. The process of determining the EoW status should be transparent and clear, with minimal costs to all parties concerned; the process and criteria should be aligned within the EU. However, for some specific applications or streams, a national decision considering actual national or regional conditions and parameters could be applied.
Challenges	Keeping a material, that in practice is perceived and treated as a product, under waste legislation creates some uncertainties. When practices related to the categorisation of a waste/product vary between different countries, this can create conflict in trans-boundary movement. The legislation is perceived as unclear, and would benefit from harmonisation. Furthermore, stakeholders find inconsistencies between waste and product regulation. Classifying dismantled materials as waste creates barriers for reuse at another construction site. However, retaining product status may imply less quality control, raising some concerns related to safety.

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Implementation	• EoW criteria (national and EU-wide). • Harmonised rules for secondary materials/components to retain or to obtain the product status and for their quality control.

2. Methods for performance assessment and quality	
Context	There is a market need for a uniform system for documentation and testing. This would assure that recycled materials and reusable products are suitable for their use as resources in building or other products. This assurance needs to cover both the technical and environmental suitability, also including assessment of potentially harmful substances. The testing procedure must be relevant, clear, and replicable. Standardized guidance on procedures for assessment of suitability of end-of-life products and materials for reuse and recycling would meet these needs. Certification of recovered materials, traceability systems, and End-of-Waste status are means of fulfilling requirements on quality and supporting the market for recovered and reused materials and products. According to the Construction Products Regulation, the CE marking of construction products is mandatory, if the construction product is covered by a harmonised product standard or the construction product conforms to a European Technical Assessment which has been issued for the product. Currently the harmonized products standards for CE-marking rarely address the reuse of construction products. In the development of the harmonized standards, it is important that key characteristics related to reuse of construction products are considered and that relevant methods as well as assessment methods will be included for relevant applications for reusable products in the harmonized standards.
Challenges	For proving the performance and conformity of reusable construction products and construction products with recycled content, several new aspects (e.g. origin of products, history of use, potential repairs etc) need to be taken into account in the assessment. Also new test methods need to be developed. The DoPC of reused products shall be applicable for the full scope of the new CPR, including putting the product on the market or its direct installation without remanufacturing. This is not reflected in the existing harmonized product standards, where the requirements such as FPC may directly narrow their applicability for the reused products. Doubts about the performance (e.g. quality) are a key barrier to reuse and recycling. Concerns about the material degradation and potential presence of hazardous substances lead to a lack of confidence or trust in the recovered waste streams. In planning the disassembly of reusable construction products (elements, components), special measures might be needed to prevent damage. Also, for recycling, it is important that demolition contractors know the requirements for (the quality of) different materials for recycling (e.g. avoiding unwanted fractions or impurities contaminate the target material) and can identify and collect high quality materials for recycling. The required quality of the recovered material depends on the application. Typically, high quality materials are needed for high grade recycling. In addition, the competence of the auditors/demolition experts needs to be ensured to guarantee a high-quality pre-demolition audit and follow-up process. Here the knowledge of construction methods, of materials (especially hazardous), and construction products used in the building, provides an important base for the assessment of valuable streams for reuse and recycling. Often there is no obligatory experience or education required prior to the drafting of a pre-demolition audit. In many countries, mainly identification and removal of asbestos is mandatory.
Implementation	• Pre-demolition audit to focus more on reuseable products.

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	• EU-wide recommendations for the content and procedures for the pre-demolition audit. • Guidelines for dismantling. • Standardized methods for performance assessment and quality implemented in or connected to structural/construction standards (e.g. Eurocodes). • CE-marking.

3. Design for disassembly and reuse	
Context	Buildings must be designed for flexibility and demountability to facilitate the reuse of materials and products. The technical solutions for the interfaces between different products or material layers must ensure their separation and possibility to exchange those products or materials during the building's life with a minimum effort. This also includes selecting durable and recyclable materials and ensuring that the production, use and maintenance of those materials are harmless over the service life of the reusable product, which may be longer than the typical design life of the building. The materials and components needs to be linked to their design documentation, certification documents and inspection reports throughout the life of the building.
Challenges	The environmental benefits of such solutions applied today will be visible after several decades, and therefore they do not directly contribute to most of the sustainability targets and policies. This is also the reason why there are not very specific requirements for design for disassembly and reuse, harmonized qualitative or quantitative assessment methods and industry guides. Reused materials and products will be competing on the market with the new products, and therefore their circulation may be directly against the business strategies of the material producers and product manufacturers. Return of investment in the improved building design is uncertain and the net present value of the end-of-life material after the decades of use is very small.
Implementation	• Include the design for deconstruction and reuse in the policy documents, strategies and regulations on EU and national level. • Provide financial support for the implementation of circular design practises. • Develop harmonized rules for the assessment of environmental impacts beyond the current building's life or circularity in general and integrate them in the current requirements for the environmental impact of the building design. • Support the transition of European manufacturing industry to the circular business models.

4. Development of digital competences and infrastructure	
Context	In the construction sector, digital solutions are applied as tools to boost a circular economy via reuse and high-grade recycling. The level of digitalization is generally low in the construction and demolition sector, and many digital solutions are at early development stages. Although the type of digital system in use is important, the reliability of data still depends on several other factors. For assessment and reporting of sustainable performance of construction products, reliable product information, from manufacturing to the installation in the building and demolition, will be needed. Target groups are all stakeholders along the value chain. Digital product passports (DPP) are new concepts under development. DPP can be linked to Building Information Modelling and to Digital Building Logbook. These new digital tools are needed to complement existing non-digital solutions. The

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	creation of a collective infrastructure of (building) passports, would enable more efficient execution of current legislative requirements on materials overview and traceability. A collective infrastructure of (building) passports would facilitate the reduction of various costs of dealing with regulatory requirements, as there would be a common information base. This information base would also serve as a coordination instrument for reaching other stakeholders. For waste amount monitoring, good quality data is key for policy-making, to set and follow-up on targets. How waste data is collected or reported, information on generated or treated waste, quality of waste streams. Documentation of CDW flows and development of national waste statistics are done differently in different countries. Digital solutions also offer possibilities for improving the reliability of waste statistics which is the basis for monitoring and regulative actions and decisions for new activities and financial investments. ➢ Initiatives to increase the level of digitalization, which enables documentation of waste flows and enhances treatment of CDW. ➢ Traceability of waste enables meeting the quality requirements for recycling and reuse. ➢ Digital marketplaces facilitate new business models within reuse and recycling.
Challenges	The digital system highly depends on stakeholder acceptance to be effective. The digital systems must be easy to access and user-friendly and ensure protection of intellectual property rights. Absence of data governance presents concerns regarding data safety. The digital systems need to be flexible and allow adding and removing new information as well as contributors without compromising reliability There are risks related to data quality, overflow of data, and upgradability. Data quality could be compromised due to lack of data, while poorly defined content requirements may lead to the upload of all available data. Due to the long lifespan of construction products, it should be ensured that the data is updated as needed. Problems with different stakeholders carrying the costs from data acquisition and those benefiting from data availability. The digital solutions need to be based on open standards because of shared responsibility between many private and public actors across the value chain and during the life cycle of the building. However, the open standards are only marginally supported by the large software companies because wider interoperability may affect their own business strategies. BIM (Building Information Modelling) is lacking in old constructions.
Implementation	• Digital product passports (DPPs) to increase data availability and sharing, and traceability of the construction products during their lifecycle. • A collective infrastructure of building logbooks/passports including product passports with Blockchain technology as one of the fundamental technologies behind this infrastructure. • C-BIM – providing products information on ownership and materials characteristics so that those products can be delivered in the future. • Developing clear and detailed requirements/specifications on EU and national level for information needs, exchange and delivery in open formats including BIM and digital passports. • Open data specifications to enable collaboration and cooperation regardless of software applications. • Establishing tracing systems and certification schemes.

5. Circular public procurement practises	
Context	Local, regional, and federal authorities possess significant purchasing power for implementing various new construction and renovation projects, as well as

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	building maintenance and demolitions. These investments can be directed to support circularity in the sector by implementing strict public procurement requirements. By promoting the use of recycled materials in construction products or reuse of construction products, not only are circularity goals addressed, but can also contribute to reducing the embodied carbon in constructions.
Challenges	The public sector often lacks knowledge about structures, products, materials that could be recovered and used in new constructions. Tendering documents do not often specifically address recycling, reuse and the uptake of secondary products and materials.
Implementation	• Templates for the public procurement tendering documents supporting sustainability and circularity in various construction projects. • Procurement requirements to include requirement on reuse of construction products or recovered material contents in new products used in construction.

6. Economic policy instruments	
Context	Financial support is needed to facilitate circular construction projects. Currently circular construction projects suffer from increased overhead costs and material costs related to sourcing of circular products and the implementation of the circular solutions. As reuse of building materials still is its nascent period of development, there is a large potential to streamline the circular processes to make them more competitive compared to building products based on virgin materials. Reuse aspects must be considered early in the demolition or renovation process, since it requires a longer lead time as well as new ways of working which take time and effort to learn and implement. There is also a need to develop continuous and comprehensive reuse inventories to increase the supply of reusable building products, developing more efficient reverse logistic solutions, and providing storage solutions. Collaboration between parties in a circular system is currently characterized by a lack of coordinating institutions, which would ensure that parties can collaborate more easily with regard to supply and demand.
Challenges	Markets for recycled materials depend on the quality, clear property rights, the price and the material availability. The main obstacle for reuse and recycling is often the low price of competing virgin materials. Furthermore, the sorting and processing needs of demolition waste to secure high-quality material for recycling or dismantling cost for reusable products increase the demolition costs. An identified challenge for the implementation of CE concepts is related to the market´s readiness, it can be difficult to find the right materials that could meet the requirements and expectations if essentials elements of a functioning marketplace are not organised. Without a clear information base about (quality of) products in building and the liability of the owners to deliver those products to the future, new (virgin) products will always be considered by many stakeholders as cheaper and better than recovered products. Organising market for secondary materials means that property rights for those products should be established, for example by combining building and products passports with blockchain technology, as a foundation layer in the information infrastructure on buildings. For reusable products, there are also difficulties to match the supply and demand. Constructors may have difficulties to find acceptable products and materials, and there is often a lack of timely information about generated materials and components that can be reused or recycled.
Implementation	• Providing a collective infrastructure of building- and products passport. • Market places for reusable materials to connect supply with demand. • Government grants and subsidies, tax incentives, sanctions or fees, as well as subsidies to promote reuse and recycling.

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	• Taxation of virgin material. • Landfill taxes and landfill ban on recyclable materials. • Green public procurement. • EU taxonomy (clarification of guidelines for circular economy in buildings).

To move from pilot success to systemic change, the following policy directions are recommended, building on SUM4RE's goal to enhance urban mining and enable circular construction across Europe

The SUM4RE project underscores that unlocking circularity in construction depends not only on technological advances but on multi-level governance, local capacity and regional coordination. By embedding circular principles in local plans, empowering municipalities, and scaling insights from pilots, Europe can transform its cities into material banks, turning waste into value and urban development into a cornerstone of the circular economy.

These brief outlines priority actions at EU and local/regional levels to accelerate the circular transition, with clear objectives and implementation measures.

EU recommendations:

- Develop a pricing mechanism for externalities: Internalize environmental and social costs through carbon pricing, landfill/incineration taxes, and resource taxation.
- Expand the scope of the CE Taxonomy.
- Further develop CE indicators and labelling: Introduce harmonized CE KPIs, digital product passports, and EU-wide eco-labels.
- Encourage the use of new valuation tools.
- Communicate the non-environmental benefits of CE.
- Support Standardization and Certification: Boost market confidence in secondary raw materials. Measures: Develop EU-wide standards and product passports.
- Facilitate Trade in Secondary Raw Materials: Remove barriers to cross-border resource flows by improving logistics and harmonizing rules across the EU.

Local and regional recommendations:

- Take the lead in supporting circular businesses: Provide funding, tax incentives, and preferential procurement.
- Provide support and coaching to CE entrepreneurs: Develop incubators, accelerators, and advisory services.
- Promote multi-stakeholder collaboration: Foster regional clusters and partnerships where waste becomes input.
- Use Cities as CE Testbeds: Pilot reuse hubs, repair centers, and material banks.
- Build Skills and Awareness: Integrate CE in education, vocational training and citizen awareness campaigns.

The SUM4Re project highlights that advancing circularity in the construction sector requires not only technological and material innovation but also **policy frameworks that address perception barriers and market gaps**. Our research on stakeholder awareness, trust, and attitudes toward secondary materials identifies several levers that can guide policy development:

1. Enhancing Awareness and Knowledge Sharing

- **Research insight:** Many professionals and end-users have limited understanding of what secondary materials are and their environmental benefits.
- **Policy direction:** Governments and industry bodies should promote digital product passports, open-access material databases, and educational campaigns to make information on material origin, composition, and sustainability performance widely accessible. Integrating these tools into professional training and certification programs will increase familiarity and confidence in secondary materials.

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2. Strengthening Quality Assurance and Standards

- **Research insight:** Low trust in secondary materials' performance remains a critical barrier to adoption.
- **Policy direction:** Promote unified performance assessment methods and certification schemes, supported by clear technical standards. Policies can mandate testing, third-party verification or harmonised quality marks to reduce uncertainty, ensure safety and enable wider market acceptance.

3. Harmonising Regulatory Frameworks

- **Research insight:** Stakeholders report confusion regarding how materials are legally categorized, whether as products, by-products or waste.
- **Policy direction:** Standardize rules for product and waste classification across regions and sectors to reduce legal ambiguity, facilitate material circulation, and support market development. Harmonization will also enable more reliable monitoring of material flows and policy effectiveness.

4. Incentivizing Adoption Through Economic and Procurement Measures

- **Research insight:** Cost perceptions and limited availability of secondary materials deter adoption.
- **Policy direction:** Introduce economic incentives, such as subsidies, tax benefits, or preferential treatment in green public procurement, to encourage the use of verified secondary materials.

5. Developing Digital Competences and Infrastructure

- **Research insight:** The benefits of transparency, traceability, and policy compliance depend on stakeholders' ability to use digital tools effectively.
- **Policy direction:** Support training programs to enable the use of digital product passports, BIM integration, and material tracking systems. Competent use of these tools will facilitate informed decision-making, compliance with circular policies and adoption of secondary materials.

Overall, SUM4Re's research indicates that policies must combine technical, regulatory, informational, and economic measures to address perception barriers, enhance trust, and create a supportive ecosystem for secondary materials. By integrating these directions, policymakers can help translate positive stakeholder attitudes into tangible adoption of circular construction practices, aligning with SUM4Re's goal of fostering a sustainable, resource-efficient built environment.

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4. Conclusion

The transition to a circular economy in the construction sector is both a necessity and an opportunity for Europe. CDW remains one of the largest waste streams in the EU, while demand for raw materials continues to put pressure on natural resources. By focusing on secondary material use, recycling, and recovery, the EU can reduce environmental burdens while simultaneously generating economic and social value. The evidence gathered in this project demonstrates that advancing circularity requires a dual emphasis on effective policy frameworks and societal acceptance.

The social perception study highlighted that while general awareness of recycling is high, knowledge of CDW and secondary materials is limited, and misconceptions persist. Concerns about safety, durability, cost, and resale value reduce willingness to adopt recycled materials, even where environmental benefits are acknowledged. However, the study also showed that when citizens and professionals are provided with clear information and visible assurances, their acceptance increases significantly. This demonstrates that communication, trust-building, and certification systems are central to unlocking social support for circularity.

The policy recommendations developed respond directly to these findings. They emphasize problem-solving approaches, political realism, and the importance of tailoring guidance to different audiences. Recommendations call for harmonized EU standards for secondary materials, stronger certification and labelling systems, and a clear menu of policy options, including economic incentives, landfill levies, and procurement mandates. They also underline the need to identify and mobilize key actors, from EU institutions and national governments to municipalities, industry, and civil society, to overcome barriers and operationalize solutions.

Equally important, the recommendations highlight the social and economic opportunities that circularity can bring. By strengthening trust in recycled materials, fostering innovation, and stimulating demand, Europe can reduce waste costs, create new green jobs, and enhance regional resilience. Public acceptance, once secured through education, training and transparent communication, will multiply these benefits by accelerating market transformation and reinforcing policy legitimacy. The combination of social engagement and robust regulation is therefore essential for circularity to achieve its full potential.

In sum, this project demonstrates that the path forward requires integrating policy innovation with societal readiness. Circular construction cannot succeed on technical solutions alone; it depends equally on how people perceive, trust, and adopt these practices. The EU Horizon mission provides a unique framework to bridge these dimensions, ensuring that sustainability objectives are not only ambitious but also feasible and socially supported. By aligning policies with public perceptions, addressing misconceptions, and creating clear incentives, Europe can lead the way in building a construction sector that is environmentally sustainable and economically efficient.

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SUM4Re

Creating materials banks
from digital urban mining

APPENDICES

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LIST OF APPENDICES

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APPENDIX A Do you know where secondary materials can be obtained in your area? If so, where?

- At Sloopwerken Limburg.
- At Sloopwerken Limburg or DuSpot.nl.
- Avfallsbransjen, e.g. Norsk Gjennvinning.
- Backmarket: refurbished technology.
- Certified recycling plant (5).
- Certified suppliers.
- Second-hand companies (3).
- Second-hand companies.
- Demolition sites and specialized suppliers (3).
- At the material warehouse.
- At CDW managers that produce recycled aggregate.
- Waste managers located by the Purchasing and Environment Department.
- Bookstore.
- Local suppliers, demolition sites, and companies specializing in recycling.
- Many stores in the city of Brussels.
- Throughout the region.
- Stationery store.
- Pipe factory using recycled PVC material.
- There are some non-profit organizations that buy and sell secondary materials. Others are state-owned.

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APPENDIX B Do you consider secondary materials to be economically viable, or do you prefer to obtain materials elsewhere? Where?

- Specialized warehouse (2)
- Quarries
- NS/NC (3)
- Regular supplier of office supplies
- Manufacture of new construction materials for civil engineering and building works
- In civil engineering, recycling of road surfaces
- Not a relevant question for me
- Question 14 should have included more nuances regarding the economic vulnerability of these companies and, in general, their inability to compete with large-scale raw materials.
- Being able to purchase some second-hand materials at any time does not mean that all (or any) of them are economically viable
- Local recycling facilities and certified suppliers
- From sustainable and certified sources (2)
- Certified primary material suppliers
- Suppliers of recovered materials and government-supported circular economy initiatives
- Materials recovered from demolition projects

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APPENDIX C Do you consider the materials used to be safe? What materials are you considering?

- Recycled steel (8), recycled plastic (3)
- Paper (3)
- CDW
- Asphalt (3), soil (3), ballast, gravel, concrete (5), mortar (2)
- Wood (10)
- Beams, purlins, and battens
- Construction materials (7)
- Aluminum (2)
- Technology
- Demolitions
- Bituminous mixtures (2)
- Glass (5)
- Integral base material
- Rubble (2), rebar, cardboard
- Materials that are central to the SUM4RE project
- Floors and ceilings
- While regulations generally require hazardous materials to be removed before recycling or reuse, this is poorly described in product standards (which secondary materials must also comply with), and in some cases, both regulatory requirements and practical large-scale compliance are unclear
- Many materials have been inventoried
- Windows... There is a lot you can get and try
- Many materials that have been inventoried
- Windows... There is a lot you can achieve

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