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Inquiry on Perceptions and Practices of Built Environment Professionals Regarding Regenerative and Circular Approaches

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Abstract: The circular economy and regenerative design approaches, although still emerging in the built environment, are important pathways to move away from the degenerative business-as-usual practices in the sector. In this paper, we investigate the perception, awareness, and practices of built environment professionals regarding the adoption of a combined regenerative circularity approach for buildings and cities, and if current practices and 'neighbourhood sustainability assessment' (NSA) tools should be improved and how. The inquiry was conducted using a convergent mixed methods approach with professionals from around the globe through: (a) online questionnaires which collected 146 responses, and (b) 18 semi-structured interviews which delved further into relevant aspects of the survey. Quantitative and qualitative responses were coded, grouped, and analysed. Results indicate an average awareness of topics with large space for improvement of practices. The main pathways for improvement for NSA tools include performance requirements, aspects of flexibility and adaptability, and engagement and communication, to which are added opportunities and enablers to improve the sector. The authors hope that this study will contribute towards the improvement and design of better tools and practices to support the implementation of regenerative circularity in the built environment sector.

Keywords: barriers; circular economy; circularity; community engagement; enablers; survey; interview; sustainability assessment tool; regenerative paradigm; urban sustainability

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1. Introduction

There is extensive literature examining the strong connections between the built environment (BE) and the deterioration of natural systems. From the increasing extraction of natural resources [1], to the impacts on biodiversity and ecosystems [2,3], and the physical attributes of cities that are key drivers of energy use and greenhouse gases (GHG) emissions [4]; the connections between the urban heat island effect and air pollution [5], and the overshooting of the ecological and social planetary boundaries (PB) [6].

As the global urban population increases [7], so does the need for the construction of new buildings and infrastructure. A great challenge, however, is the retrofit of the existing inefficient urban building stock. This calls for improved expertise, new governance structures, and support tools to better respond in a systemic manner to the socioenvironmental, technological, and economic challenges of large transitions [8]. That scenario requires better training and the engagement and cooperation of BE professionals. From the advocacy for building and neighbourhood sustainability assessment (BSA/NSA) tools or rating schemes, to collective actions to take a stand and positive action in response to the climate and biodiversity emergency, as 'Built Environment Declares' [9], there is still a long way to go.

1.1. Overview of Circular and Regenerative Approaches in the Built Environment

Despite the advances, so-called green or sustainable practices and tools used in the BE sector in the past two decades seem to be incapable of fully dealing with the current socioecological challenges of cities and the planet. They are based on linear and mechanistic

perspectives in which impacts are still acceptable, although to a smaller degree, by adopting the paradigm of *efficiency*. New visions that try to learn from how the natural world works have emerged.

The circular economy (CE) and regenerative design (RD) approaches advocate for a systemic mindset that seek to do good rather than just less bad [10,11]. The origins of CE intertwine with those of RD and may be traced back to various social, political, economic and ecological lines of thought that emerged in the second half of the 20th century [12]. A commonly used definition from the Ellen MacArthur Foundation (EMF) states that:

> "A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models" [13] p. 7.

Although this notion of 'regenerative' does not address the regeneration of the social fabric of humankind, it aligns with Lyle's definition that "[r]egenerative design means replacing the present linear system of throughput flows with cyclical flows at sources, consumption centers, and sinks" [14], p. 10, which has a more technical approach. It doesn't clearly address other cultural and psychological underpinning aspects either, as the idea of living beings co-evolving, living systems, the importance of place-based context, and a notion of wealth that encompasses aspects of wellbeing and quality of life to support thriving communities and economies [15].

Elsewhere, we proposed a preliminary and simplified notion of a '*regenerative circularity for the built environment*' (RC4BE) by merging CE and RD based on five pillars: (1) positive impact, (2) systemic and life cycle thinking, (3) circular cycles and just use of resources, (4) inspired by nature, and (5) inclusive, equitable and safe urban spaces, later proposed as a conceptual model [16], and used as a baseline for the herein discussions.

1.2. Literature Review

Previous research has established how NSA tools generally lack a systemic approach, being insufficient to deal, in isolation, with the rapidly increasing local and global challenges [17]. Their requirements are usually not designed to be applied in existing urban areas, and only recently some schemes have taken this in consideration, as the LEED (Leadership in Energy and Environmental Design) scheme for cities and communities. General limitations include inadequate consideration of sustainability dimensions and non-enforcement of basic aspects, excessively complex and prescriptive criteria, incompatibility between different tools' methodologies, lack of context consideration, opaque top-down methods, non-systemic approach to different indicators, and lack of adequate boundary considerations [18]. LEED-ND (neighbourhood development) criteria for urban heat island mitigation may be inadequate to respond to future changes of a warming planet in some contexts [19]. Additionally, most tools adopt a focus on merely reducing impacts rather than eliminating them and creating a positive impact that gives back more to ecosystems than taking from them [20].

A few NSA tools have emerged based on regenerative and positive impact paradigms, as the Living Community Challenge (LCC) [21], LENSES (Living Environments in Natural, Social and Economic Systems) [22], OPC (One Planet Communities) [23], and STARfish [20]. There are still few cases applying these tools, but tools like LENSES, despite a perception they may not support future-proof projects, have demonstrated good results in promoting systemic thinking in the development of communities [24]. STARfish adopts the 'positive design and development' concept, which would provide a net-positive impact based on fixed pre-development biophysical baselines, in contrast to restorative and regenerative practices, which on the author's view, would use current conditions as a reference for improvement [20].

At the building scale, one study argued that regenerative tools like the Living Building Challenge may be considered too individualistic for countries like Sweden, due to its

self-sufficiency building-centred approach that would collide with the Nordic welfare state mindset in which the public must provide a network of services and infrastructure [25]. CE applied tools, i.e., outside of academia, have only emerged for buildings, as Level(s) [26], but none for the urban scale. This shows there is space to improve the design and implementation of these tools to achieve more systemic approaches for the transition of the existing building stock of cities.

Indicators in NSA tools should be able to adapt, early in the planning stage, to context through place-based and value-centred approaches, thus responding and creating positive impact on social, natural, produced, human, and financial capital [15]. Recommendations for frameworks applicable at the local scale, such as university precincts, include making the issues more understandable, enable sufficient flexibility for each development to consider its local context and develop bespoke approaches, define concrete objectives, and consider thinking and working as part of a larger network to facilitate closed cycles [27].

Other aspects found in the literature that are relevant for a regenerative and circular transition of the existing built environment include: awareness, professional practice, tools and frameworks, regulations and standards, barriers and opportunities, and participatory approaches. Their main ideas are summarised in Table 1.

Table 1. Summary of aspects relevant to a regenerative and circular transition of the existing built environment.

Topic	Comment	Source
Awareness	Good CE awareness in UK construction sector (3.3 on a 1–4 scale), but lack of in-depth or unified understanding of CE concepts among built environment stakeholders	[27–30]
	Good awareness about bio-related concepts in design. On a 0–1 scale: 0.55 for 'biophilia', 0.61 for 'biophilic design', 0.79 for 'bio-inspired design', and 0.76 for 'bio-design'.	[31]
	85% of BE professionals in Australia have very high awareness of sustainability challenges and opportunities. Property professionals have inconsistent understanding and use of language.	[32]
Professional practices	25% of BE professionals prefer to step in with circular practices in low-risk projects. Pathways for CE uptake construction include circular design, new business models (e.g., performance-based contracts and products-as-services), through take-back schemes and material passports facilitating resource loops, and better system conditions through policies, market mechanisms, collaborations, finance, and pilot projects.	[33–36]
	Cities still ignore the potential ecosystem services from nature-based solutions (NBS). Main NBS adopted include vegetation abundance and biodiversity, accessibility, naturalness, and wilderness areas, increase in fauna, features to facilitate social interactions, walkways, and water features.	[37,38]
	Ease of access to services (walkability) and neighbourhood appearance (attractiveness) seen as important enablers of wellbeing and recreation activities.	[39]
	Access to civic and public spaces and recreation facilities, local food production, walkable streets, and local schools are the most valued design elements in LEED-ND.	[40]
Barriers and challenges	Barriers to regenerative solutions include defining boundaries of impacts (local vs. not local), encouraging sustainable lifestyles through design, increasing complexity of projects, constraints of highly urbanised contexts and retrofitting the existing building stock, predicting changes, shifting from site to neighbourhood, including future potentials, predicting performance, codes and regulatory limitations to innovative practices, lack of collective vision, conflicting goals, institutional constraints, implementation challenges, in-the-box-thinking, and broader socioeconomic challenges.	[33–36]
	Large-scale regeneration of habitats that existed prior to any urban development taking place may also be a challenge in highly urbanised areas	[41]
	Barriers to urban green infrastructure (UGI): large variety of UGI solutions, and accounting for the full range of benefits and impacts, social benefits and costs, and monetised benefits, the dynamic nature of UGI, sensitivity to local conditions, and accounting for cumulative urban-scale impacts have been identified	[42]

Table 1. *Cont.*

Topic	Comment	Source
Regulations and standards	Fragmented and poorly designed regulatory environments. But changes in regulations without a more holistic approach may not be enough.	[35,43,44]
	Standards for construction and materials mostly voluntary.CE experts in Europe expect stronger standards and norms for circular production, changes in taxes, expansion and facilitation of circular procurement, global databases and resource exchange platforms, awareness and innovation initiatives, and support for eco-industrial parks.	[45]
Community engagement	Innovative participatory methods: co-design sessions, community engagement in the collection of data, such as air quality or noise through citizen science, "do-it-yourself" or tactical urbanism, urban transition labs, and gamified approaches.	[46–52]
	Need to increase early participation of stakeholders in decision-making processes and place everyone on the same page at the start thorough, clear, and straightforward communication.	[53]

Few studies have focused on the awareness of circular economy concepts, from more general perspectives [54–56] to some focused on the BE sector. In theory, there seems to be a good understanding of these ideas, but if and how these are translated into real practice is unclear.

Different studies have examined the barriers and challenges for the implementation of a circular economy [28,30,43,57,58]. In general, they fit into one of six categories: economic and financial viability, market and competition, product characteristics, standards and regulation, technology, users' behaviour [43]. Risk also appears as an important barrier to broader adoption of CE practices [59]. This could indicate that awareness and willingness to act, in isolation, are not capable of sufficient changes; thus, stronger initiatives to change consumer behaviour are required, such as government programmes that induce innovation and change the mindset [42]. Even there, different studies point to poorly designed and fragmented regulatory environments as relevant barriers to advancing the regenerative and circular agenda [35,40]. Despite some advances in the inclusion of CE requirements in the public sector, such as the European Circular Economy Action Plan [60], and Chile's CE roadmap at the country level [61] and for the construction sector [62], these still need to be translated into policies and regulations, and into new business models [63]. Procurement practices still need improvement [29] to enforce a wider uptake and reduce the weight of cost at the expense of socioenvironmental criteria [64].

While traditional planning practices tend to rest on expert-led (top-down) approaches, there is a growing understanding of the need to integrate citizens in planning and governance through citizen-led (bottom-up) approaches. Community engagement and activities play important roles in the sustainability of an area [65] and in the implementation of nature-based solutions [38]. But despite the different possible levels of engagement, from non-participation, to tokenism, up until true citizen empowerment [66], NSA tools like LEED and BREEAM (building research establishment environmental assessment method) usually do not foster adequate citizen participation in their implementation [67]. Regenerative tools, on the other hand, tend to emphasise citizen-led planning, although it is suggested that the Living Community Challenge scheme, despite its emphasis on participation, has a strong dependence on expert knowledge and favours universal rather than local solutions [68].

Considering all the above, to the best of the authors' knowledge, there are no comprehensive studies examining awareness, perception, and possible pathways regarding NSA tools and the transition of urban areas based on circular economy, regenerative design, and related concepts. Particularly focusing on a wider global built environment audience. Hence, this study seeks to contribute to filling this gap by engaging with BE professionals to better understand their perception, knowledge, practice, challenges, and possible pathways for the adoption of a regenerative and circular approach in the built environment. The following questions are explored:

1. What is the perception and awareness of professionals regarding the application of circular economy and regenerative design concepts in the built environment?
2. How do built environment professionals perceive existing sector practices and sustainability tools in the light of circular economy and regenerative design concepts?
3. What changes should be implemented to move sector practices and tools towards a regenerative circularity for the built environment?

2. Materials and Methods

This research applies a mixed-methods approach (Figure 1) with a convergent design [69] through surveys and interviews with BE sector professionals. Questionnaire and interviews, available online in English, Portuguese, and Spanish, were delivered online, thus reaching a broad and diverse range of professionals.

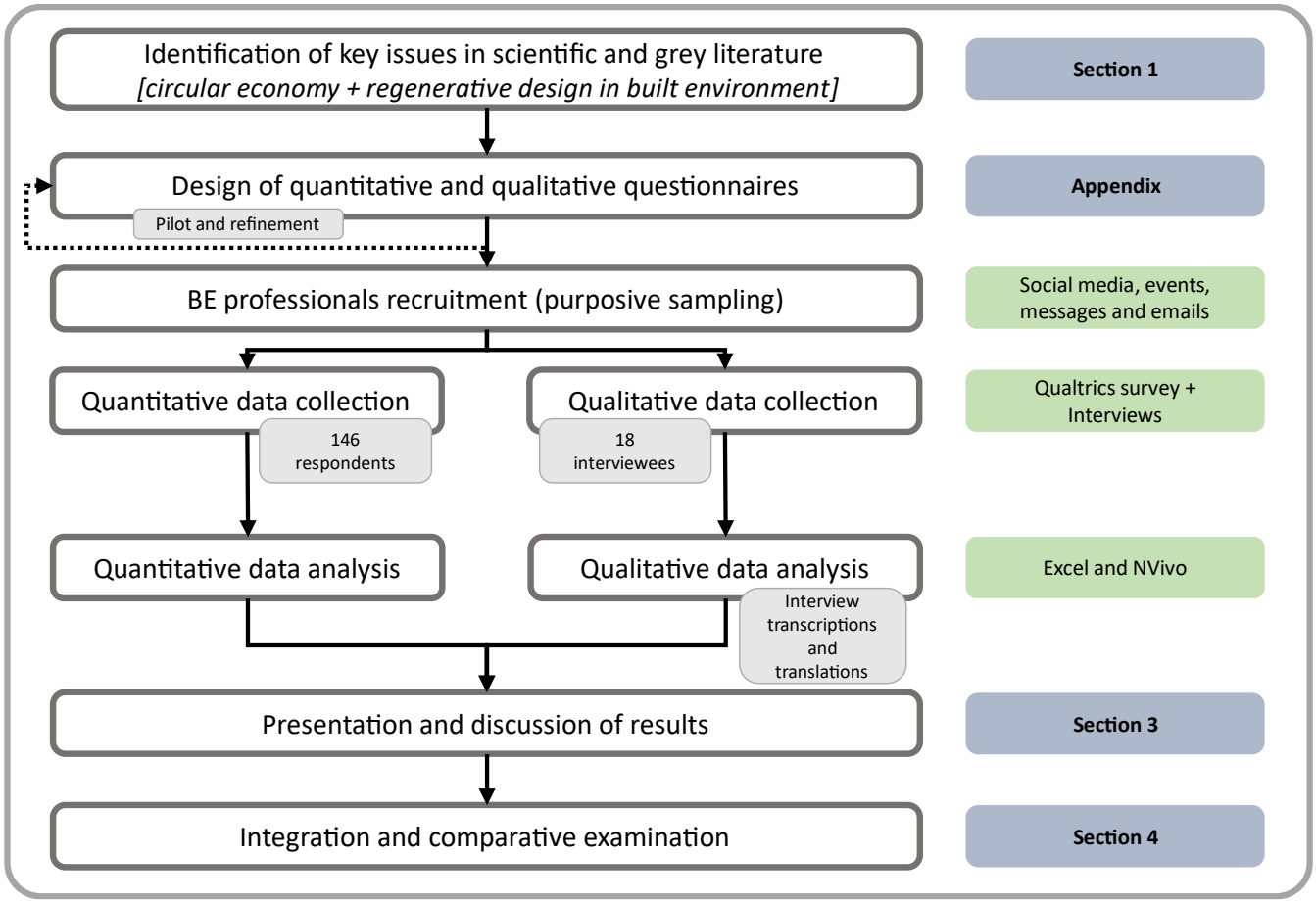

Figure 1. Research methodology schematics: convergent mixed methods design.

Literature was examined to identify key issues that would be relevant for further investigation with the stakeholders. A non-systematic literature review was adopted. Searches in Scopus and Google Scholar used different combinations of the keywords "circular economy", "circularity", "interview", "neighbourhood sustainability assessment", "perceptions", "regenerative design", "regenerative development", "survey", "sustainability", "sustainability assessment tool", "rating system", "framework", "built environment", "urban planning", "urban development", "neighbourhood", "district", and "infrastructure". Other relevant documents were detected through snowballing. Circular economy, regenerative design, and green building platforms, databases and organisations were used for grey literature identification. Documents were then scoped based on their relevance for the study.

The questionnaire, designed mostly with Likert-type scale and a few open-ended questions (see Supplementary file S1), was available between October 2020 and April 2021. Recruitment took place by posts in social media targeting built environment professionals, and direct contact with companies and professionals by email, direct messages in social media, or during lectures and events. The quantitative data were analysed in Excel. The semi-structured interview (see Supplementary file S2) was designed using a deductive approach to partly reflect the structure of the questionnaire with the opportunity to further explore relevant themes. The survey and interview had similar structures, which were later merged into common refined themes used for response coding and organising this paper (Figure 2).

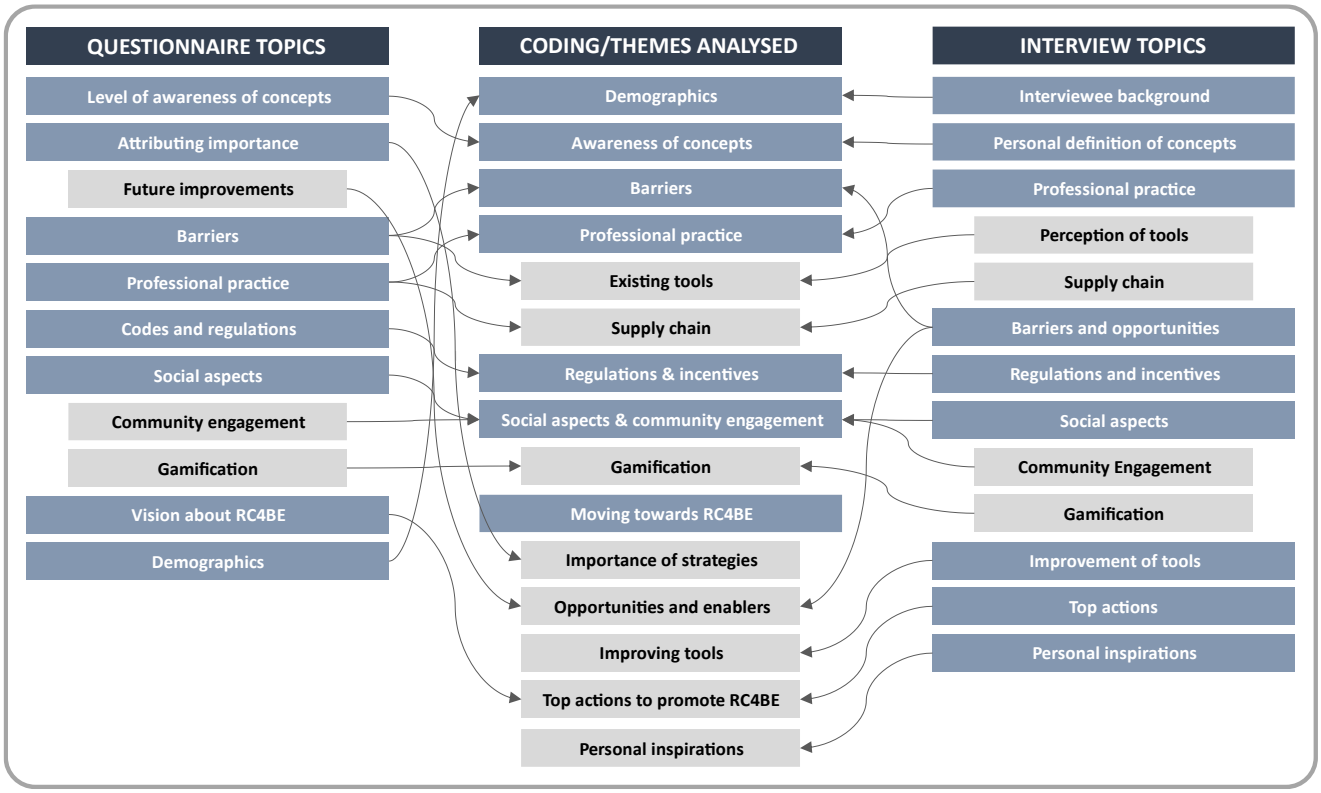

Figure 2. Merging between questionnaire/interview topics with coding/themes analysed. Blue and grey refer to topics and subtopics.

Interview questions were slightly adjusted to suit the profile of the respondent by either removing, rewording, or changing the order of questions, but retaining the same idea. Interviewees were selected using purposive (or judgemental) sampling [70] from a variety of built environment subsectors based on their company's or their own contribution, knowledge and engagement in topics related to the research. Recruitment took place through direct contact by email or direct message with the invited professionals or their companies. Transcriptions of audio recordings were made through automated tools, and then revised. Translations to English were made when necessary, using automated tools and revised for corrections. The data were analysed in NVivo.

Quantitative and qualitative data are presented and discussed in Section 3, organised by each of the themes indicated in Figure 2. The complete results of the survey are provided in Supplementary file S3. In Section 4 they are integrated and comparatively examined.

3. Survey and Interview Findings

Here we explore and discuss the main findings of both the survey and interviews.

3.1. Demographics

The detailed demography of survey and interview respondents may be found in Supplementary file S4. The list of interviewees is presented in Table 2. The demographic data discussed below is illustrated in Figure 3 (personal profile) and Figure 4 (professional profile).

Table 2. Profile of interviewees.

Interviewee Code *	Gender **	Subsector	Location
001.NGO.BR	F	NGOs or Civil Society	Brazil
002.REG.BR	F	Regulator	Brazil
003.DES.PT	M	Designer	Portugal
004.SUS.BR	F	Sustainability consultant	Brazil
005.ACA.BR	F	Academic	Brazil
006.REG.BR	M	Regulator	Brazil
007.SUP.NL	M	Sustainability consultant	Netherlands
008.SUS.BR	F	Sustainability consultant	Brazil
009.SUP_DES.BR	M	Supplier/Designer	Brazil
010.SUP.AU	F	Supplier	Australia
011.SUS.AU	F	Sustainability consultant	Australia
012.SUS.NL	M	Sustainability consultant	Netherlands
013.SUS.BO	F	Sustainability consultant	Bolivia
014.SUP.BR.AU	M	Supplier	Brazil/Australia
015.SUS.NL	M	Sustainability consultant	Netherlands
016.SUP.BR	M	Supplier	Brazil
017.PM.FI	F	Project manager	Finland
018.REG.CL	F	Regulator	Chile

* See Figure 4 or Supplementary file S4 (Table S4.3 for subsector codes). ** (F) female, (M) male.

The ratio (Figure 3a) of female (F, 51%) and male (M, 49%) survey respondents (excluding 'prefer not to say' and blank responses) (gender) was similar to that of interviewees—56% females and 44% males. In the BE sector, the Brazilian Council of Architecture and Urbanism [71] found that, from its active registered professionals, 64% are female, and 36% male. A survey of the Commonwealth countries [72] shows an opposite reality, with the female architects' accounting for 31% in Australia, 29% in the United Kingdom, 27% in South Africa, and 33% in Hong Kong. Town Planning has a more balanced gender distribution and engineering a stronger gender inequality in the Commonwealth countries, with men prevailing. Regarding age (Figure 3b), most respondents fall between 36–45 (46%) and 26–35 (31%) years old.

We were able to identify from the language used in the survey (Figure 3c) that 49% of responses were in Portuguese, 44% in English, and 7% in Spanish. However, there were not enough responses to adequately represent the location of respondents due to an initial error in setting the online questionnaire to collect that data (Figure 3d).

As seen in Figure 4a, most survey respondents (30%) work as designers (product designers, architects, urban designers, or landscape architects), closely followed by sustainability consultants (23%), and those in academia (20%). The predominance of respondents working in roles related to sustainability, environment, or climate topics (78%) is expected given the interest of those who would spend their time with the survey (Figure 4b).

As 67% of survey participants have more than 10 years in the built environment industry (Figure 3c), we understand they have an adequate maturity working in the sector, which would make their responses a closer reflection of reality. Size of organisation (Figure 3d) shows a distribution at the extremes of the spectrum, with 25% working as independent professionals, and 27% in companies with more than 500 people.

3.2. Awareness of Concepts

In both survey and interviews, participants were asked about their level of awareness or their own definition/understanding of research-related concepts before being exposed to any question that could influence their answers. Only then they were introduced to the list of five pillars for a '*regenerative circularity for the built environment*' approach (preliminary version of the one presented in [16], see Supplementary file S2, interview questionnaire).

Survey respondents seem to have a good awareness of most of the presented concepts (Figure 5). 'Urban quality of life/liveability' is the most well understood concept (81%), followed by 'circular economy' (59%) and 'regenerative design/development' (53%). 'Ecosystem services', 'biomimicry/biomimetics', and 'biophilic design' are tied in the fourth position with 49%. The least well-known terms, which respondents have never heard of, are 'urban mining' (51%), 'building as material banks' (42%), 'citizen science' (40%), and 'urban metabolism' (36%). The overall high levels of awareness may derive from the predominance of participants in sustainability-related roles.

Interviewees were asked to provide their personal definition or understanding of three concepts, discussed below.

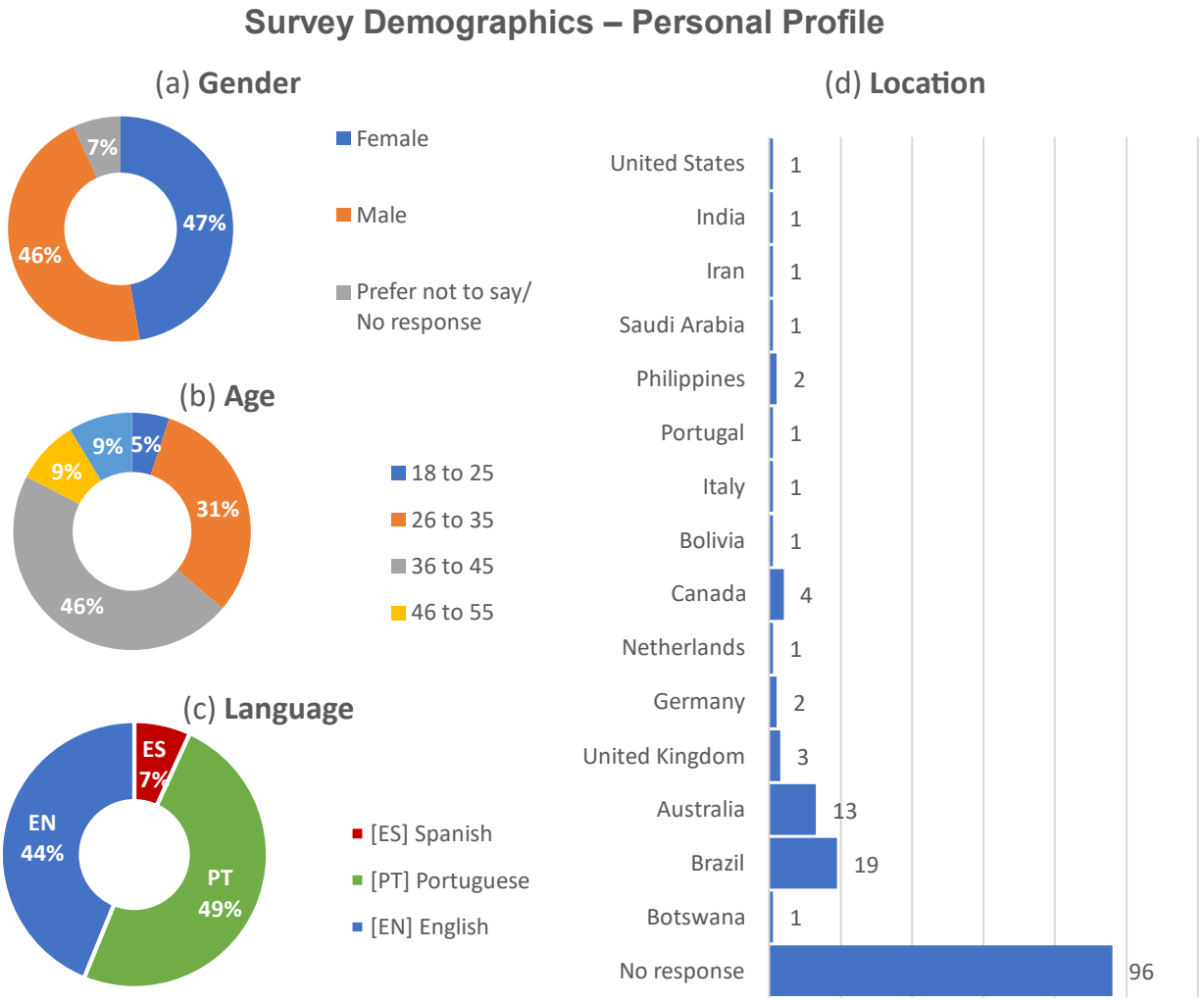

Figure 3. Demographics: personal profile of survey respondents regarding (**a**) gender, (**b**) age, (**c**) language, and (**d**) location.

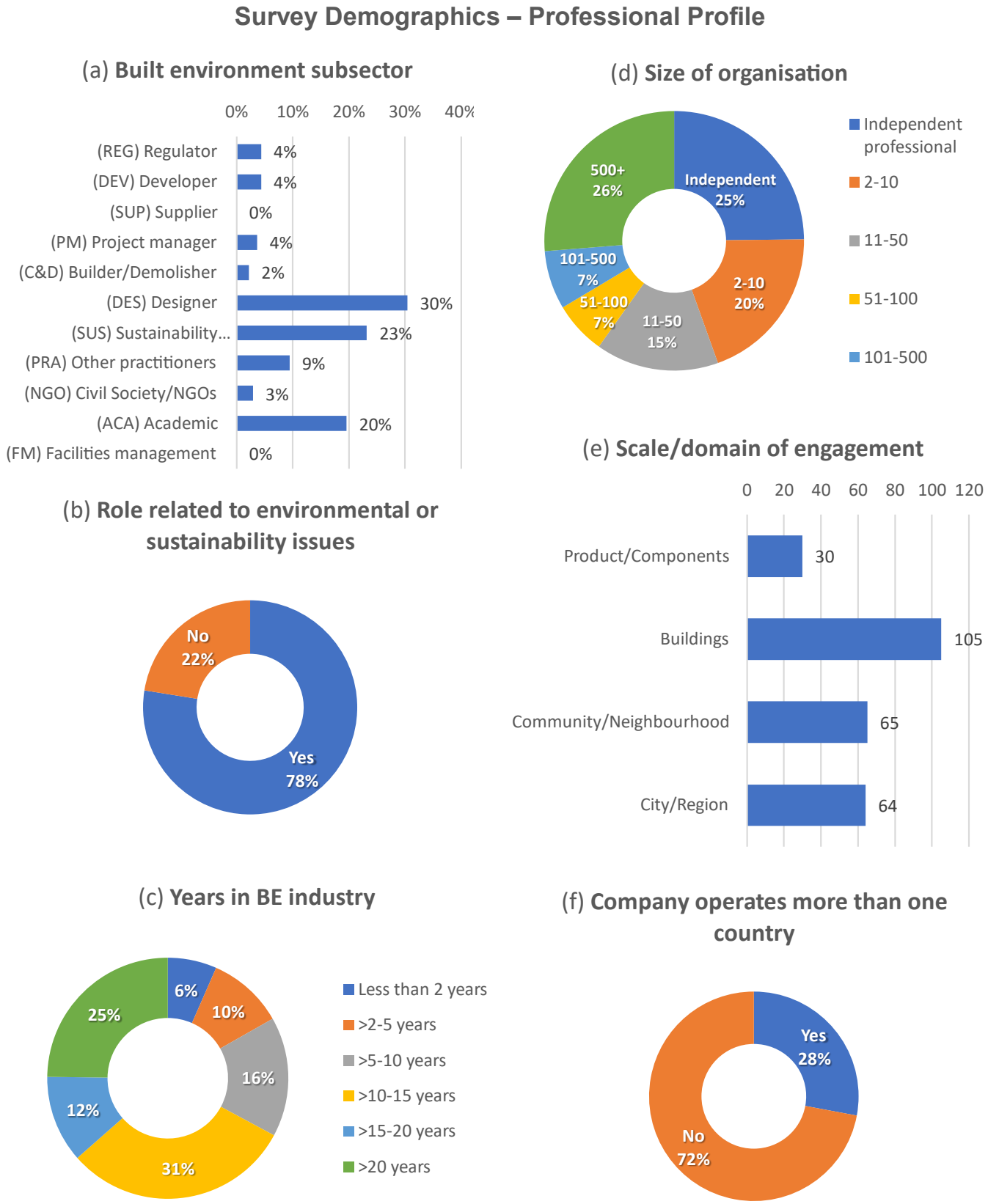

Figure 4. Demographics: professional profile of survey respondents regarding (**a**) BE subsector, (**b**) link to sustainability roles, (**c**) years in the sector, (**d**) size of organisation, (**e**) domain/scale of engagement, and (**f**) if company operates in more than one country.

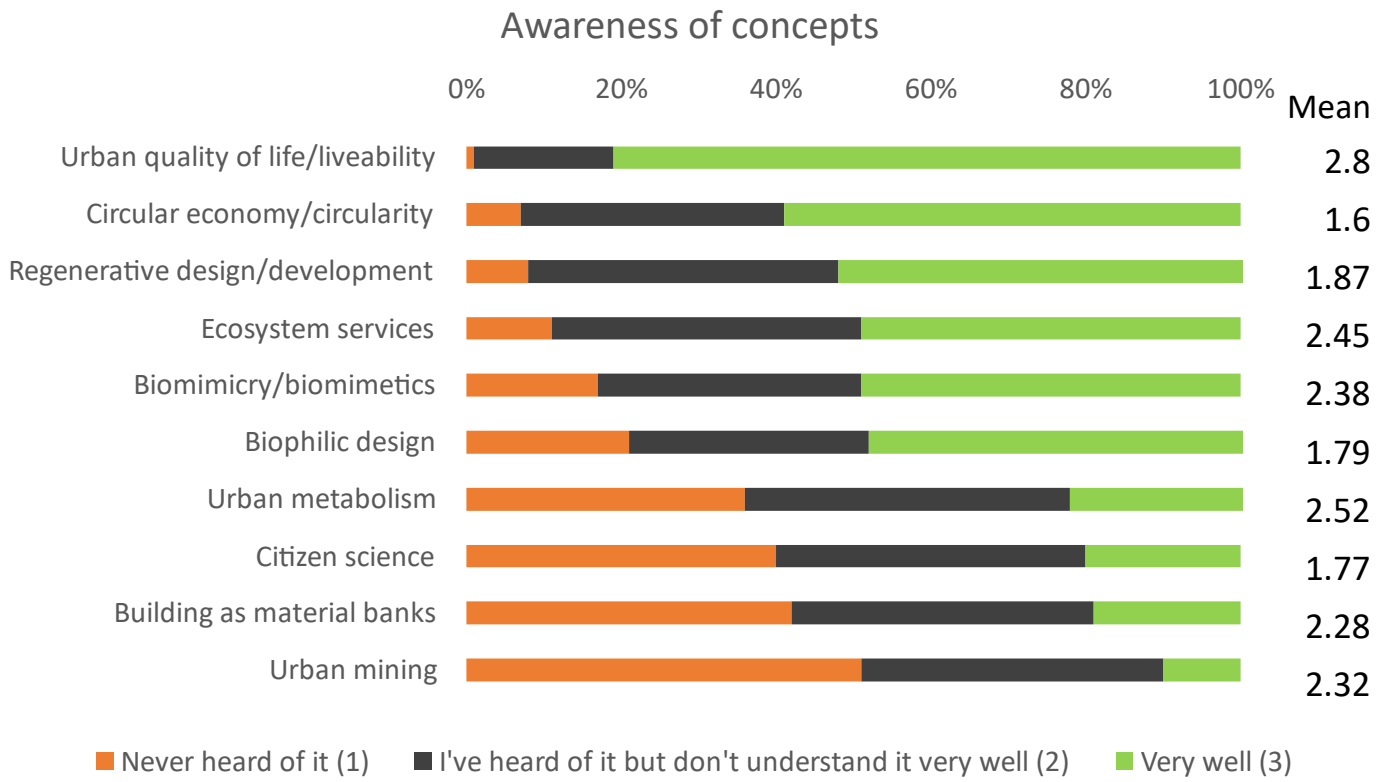

Figure 5. Awareness of concepts.

3.2.1. Circular Economy (CE)

Most interviewees somehow linked their definition to rethinking the flow of materials and energy, the "dominant way of understanding it", as mentioned by 017.PM.FI, rethinking and redesigning the flows of materials to close the loop, extend their life cycles, keep their highest possible value, and reintroduce them into the economy. A common perspective has also been an inspiration by how nature works. Just like the outputs from one organism feed other organisms without wastes (018.REG.CL), the different nodes of a productive chain should feed each other (009.SUP_DES.BR).

On a different take, four participants chose an interesting social perspective for their definitions, stressing the importance of improving and supporting local economies, e.g., by using 'local currencies', as suggested by 001.NGO.BR, and enabling the equitable sourcing of materials (003.DES.PT). The idea of a 'solidarity economy', one based on cooperation rather than competition, and egalitarian organisation [73], was mentioned by 005.ACA.BR, who also stressed the horizontality of ownership and decisions taking into account the environment, but not from an "anthropocentric or sociocentric" perspective. A different but somewhat related perspective was proposed by 017.PM.FI, who mentioned the importance of a 'sharing economy' of products (as services) and spaces, reflecting their own experience with district participatory planning.

3.2.2. Regenerative Design or Development (RD)

The coupling of 'regenerative' with both 'design' and 'development' was intentional to see if any specific comments would arise regarding their differences in definition, as discussed by [74,75]. When presented with this concept, there was a lot more hesitancy and uncertainty in presenting their understanding and definitions. Most of the responses established a direct link either to circular economy or to some of its principles regarding the cycle of resources, similarly to the emerging ideas of regenerative design proposed by Lyle [14]. The idea of positive impact and giving back more than taking was also strongly prevalent—"we need to regenerate because there is nothing left to sustain", as stated by

001.NGO.BR and others with similar ideas. An interesting consideration of 'positive', with hesitation about using 'regenerative' in tandem with design, may be seem in the following definition:

> "I can't adjectivize design. The only thing I can imagine is that when a good design is well done, it brings positive development, the entropy of the process increases in a positive way. It does not have characteristics that allow it to be exclusionary or pejorative or to bring harm to any category of people, environment, or other products. I can only think of regenerative design from this point of view. Regenerative is an adjective that I can't classify." (009.SUP_DES.BR)

Indicating the preference for 'prosperity', the idea of 'development' was frowned upon by 005.ACA.BR, due to its historic ties to a strong focus purely on economy indicators. The same interviewee added that in a regenerative paradigm, the environment governs, as it is bigger than anything else, and that it should "presume a movement as nature-based solutions, or a kind of energetic constancy and immaterial biotics, so that there would be no imbalance". 003.DES.PT outlined that "when a human system resembles a natural system, there are multiple layers of complexity that reinforce one another to create a stronger, larger organism." This idea aligns with other participants' mention of reconnecting with nature, and 008.SUS.BR's emphasis that projects should respond to the different global crises and incorporate resilience, flexibility, and change of use.

3.2.3. Planetary Boundaries

While a few participants clearly stated they had never heard of Planetary Boundaries (PB) [76], or they didn't know what it really meant, most definitions very clearly mentioned ideas of Earth as a closed system and as such, there is no waste; the need to work within the existing available resources and regenerate the capacity of ecosystems to cycle those resources with future generations in mind. Only a few participants clearly linked it to the 'Planetary Boundaries' framework [76], with one mention to the author's name, one to the Club of Rome's 'The Limits to Growth' report [77], and more frequently there was a link to the 'Doughnut Economics' model [78]. The idea that we have exceeded those boundaries has been pointed out by the majority, with some mentions to the 'Earth Overshoot Day'. On that matter, 001.NGO.BR emphasised how unbalanced is our planet in a way that the Southern Hemisphere is always compensating for the Northern Hemisphere standards of consumption.

It is worth noting 005.ACA.BR's argument that we need to move on from this anthropogenic vision in which we, humans, believe the resources are readily available to us—even the idea behind the word resource is problematic, as something at humanity's disposal. 009.SUP_DES.BR adds that while we may be able to use technology and the optimisation of processes to push those boundaries further, many times the ethical implications are ignored: "we know the limits, but have not yet managed to define, at a global scale, what are the ethical standards of consumption or production that we intended to have on Earth".

3.3. Barriers

The list of barriers was gathered and summarised from literature, to identify those perceived as the strongest or most relevant (Figure 6).

Most topics were signalled by more than 50% of respondents as being strong (4) or very strong (5) barriers. The main issues identified are the 'lack of financial incentives' followed by the 'lack of enforcing policies and regulations', 'limited awareness of circular and regenerative practices' and 'tendering based on lowest prices', seen by 81% or more as strong or very strong barriers (4 or 5). It is also worth noting that the lack of knowledge of the secondary resources offered by other industries, the reduced market mechanisms for resource recovery, and the inertia of the construction sector also scored as relevant

barriers. From a social perspective, the lack of support or opportunities structured by the government for public engagement, low community cohesion, and predominance of socioeconomic issues over environmental factors should be highlighted.

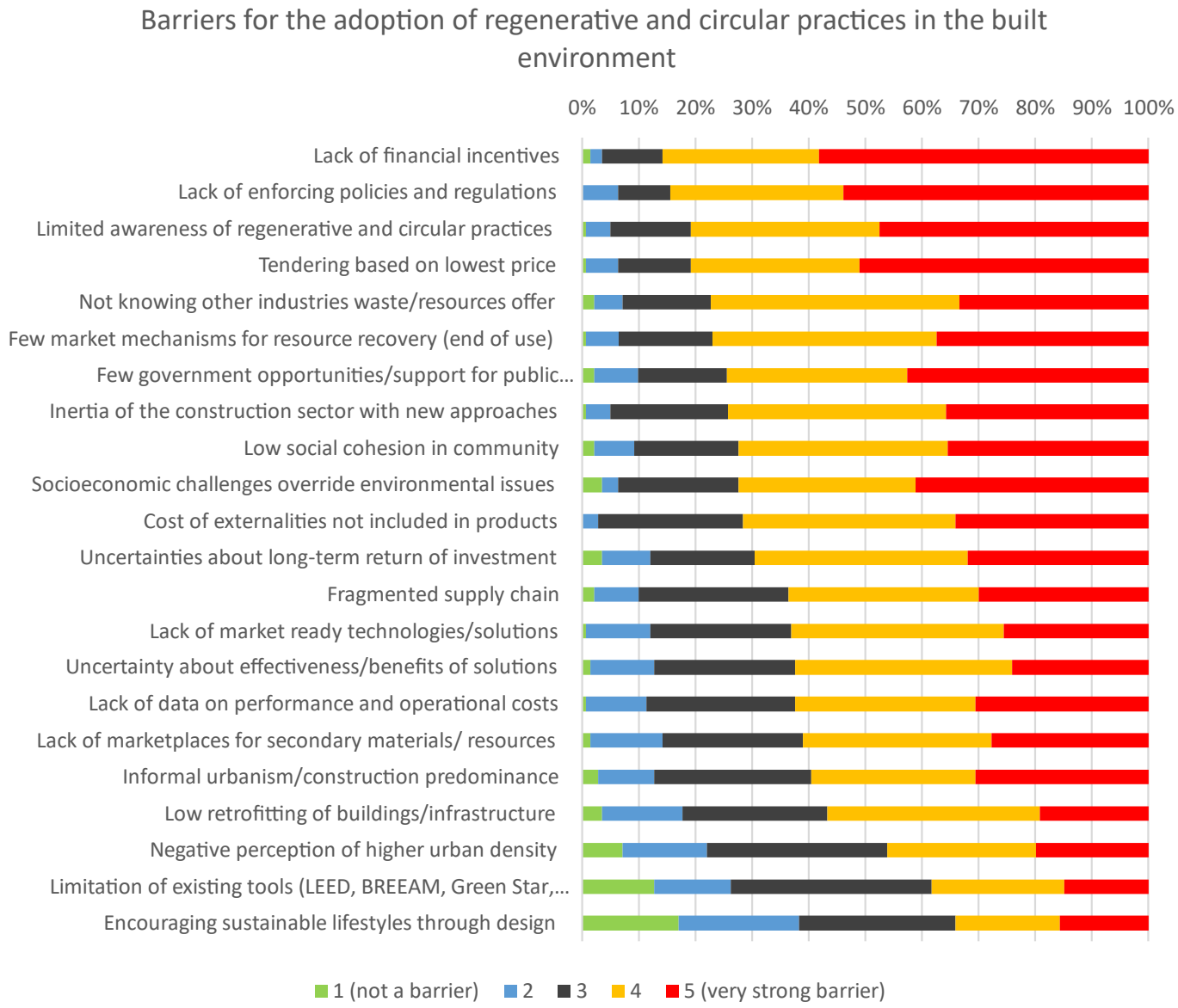

Figure 6. Perception of barriers for regenerative and circular practices.

Items that are not perceived as relevant or strong barriers include 'encouraging sustainable lifestyles through design', 'limitation of existing tools' (as LEED or BREEAM), and the 'negative perception of higher urban density', seen by 22% or more as not a barrier or a weak barrier.

Interviewees were queried on general barriers to implement a RC4BE and more specific ones for the transition of the existing building stock. We categorised them (Table 3) in 8 themes expanded from [43].

Table 3. Barriers for regenerative and circular practices identified in interviews.

	General Barriers	Barriers in the Existing Built Environment
Economic and finance viability	- Cost to implement new processes. - Lack of life cycle costing.	- Lack of affordable solutions/cost to implement initiatives and retrofit the existing stock. - Lack of financial resources and qualified practitioners.
Standards and regulations	- Poor procurement practices with focus on price [QT]. - Lack of powers for more stringent requirements at the local level [QT]. - Excessive liability hinders innovations. - Lack of well-structured and targeted financial incentives [QT].	- Inadequate and fragmented policies for urban renewal.
Market and competition	- Balance between pushing innovation and market feasibility (for certifications). - Focus on competition rather than collaboration. - Focus on high-end market. - Long-term uncertainty for investments due to changing or unclear regulations [QT]	- Lack of secondary resources marketplaces. - Success of innovations highly dependent on local context and entrepreneurial climate.
Value chain management	- Aligning policies and technical themes in certification credits. - Short term vision. - Fragmentation and inertia in the value chain re innovations, action, and collaboration [QT].	- The large number of stakeholders. - Inadequate match between budgeting, technical solutions, and the right projects. - Lack of collaboration between stakeholders.
Technology & knowledge	- Practitioners and supply chain with inadequate technical knowledge [QT]. - Translating technical knowledge to non-technical people. - Political/citizen ignorance of technical aspects when making decisions. - Partial communication between certifications' metrics and goals [QT]. - Lack of projects that seek to positively impact their surroundings. - Focus on recycling and waste management. - Non-systemic vision in certifications [QT]. - Lack of adequate LCA (life cycle assessment) databases at national level.	- Difficulty in defining common urban performance indicators in certifications. - Lack of sufficient feedstock to kickstart circular initiatives [QT]. - Outdated, conflicting, and monofunctional hard infrastructures do not fit a circular and regenerative approach.
Product and urban conditions	- Unsolved fundamental socioeconomic issues place environment behind [QT].	- Public spaces do not foster interaction. - The scale of larger cities, coupled with excessive density and verticalization, makes the transition more challenging.
Stakeholders' behaviour and awareness	- Anthropocentric approach and focus on profit over equity.	- NIMBY (not in my backyard) approach towards medium and higher density development [QT].
Governance andparticipation	- Lack of government pushing participation [QT]. - Unequal power balance between developers' wishes and communities' needs. - Fragmented public sector does not incentivise innovations. - Fragmented land ownership hinders integrated urban scale developments.	- Lack of time to dedicate to the cause and engage with the community. - Lack of citizen participation culture [QT]. - Poor instruments that hinder effective participation—focus on public hearings.

[QT] Barriers also listed in the quantitative survey.

3.4. Professional Practice

There seems to be a gap between the high level of awareness and the actual practice, with a few practices more established, but the majority rarely occurring (Figure 7).

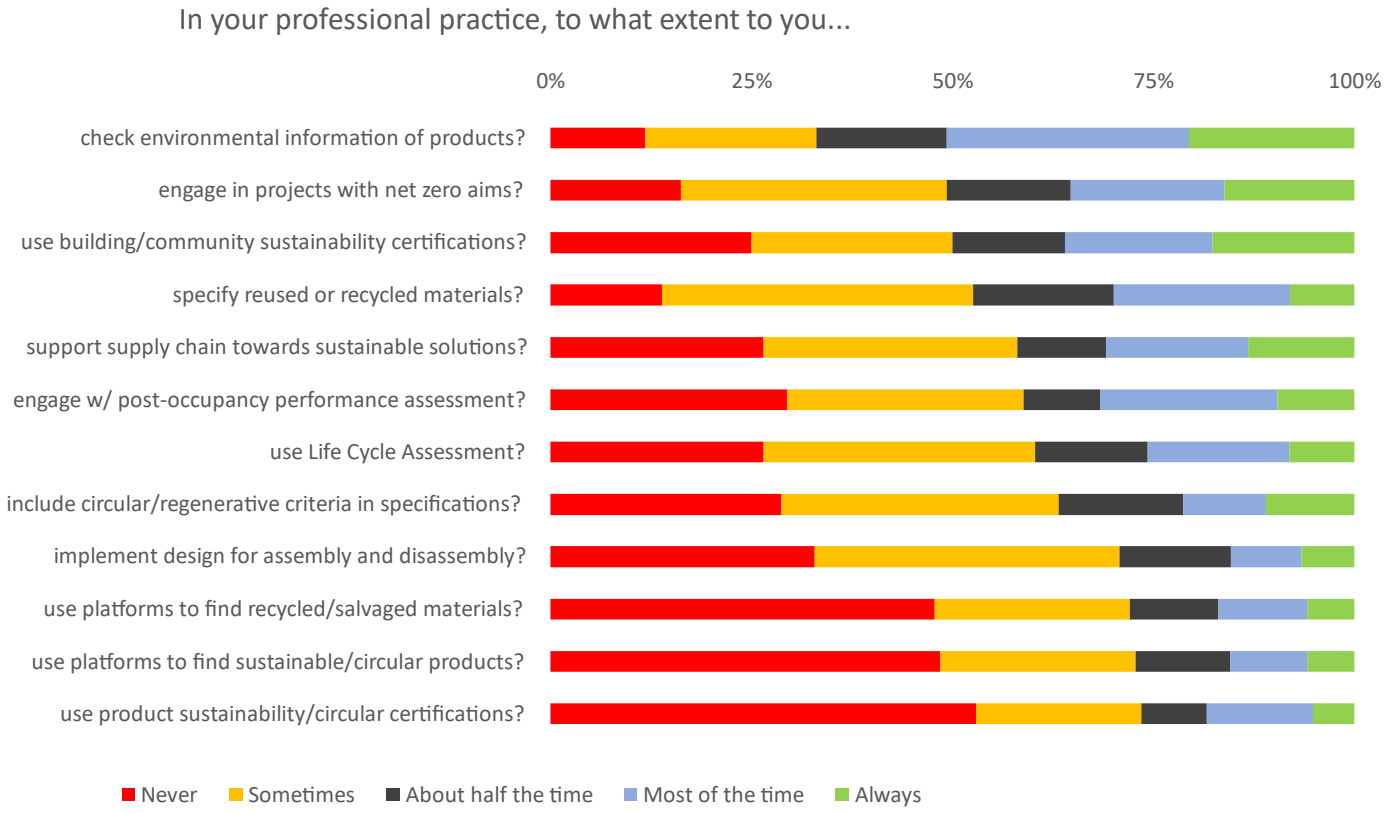

Figure 7. Frequency of practices that support a regenerative and circular approach.

More than half of the professionals (51%) check the environmental information of the products or components they specify, buy or use, most of the time or always, and 67% do it at least half the time. 50% engage with building or community-level certification half the time, showing how widespread these kinds of tools are in the sector. Surprisingly, a similar number of professionals (51%) have been engaging half the time with projects with net zero aims (water, energy, waste). The engagement with life cycle assessments is also remarkable. Despite 26% never using it, and 34% using it sometimes (60% in total), 40% use it at least half of the time, raising the question to what type of use/engagement is taking place here. It could be either an actual application of LCA (life cycle assessment) to projects, or a consultation of LCA data to support design and product use.

At the other end of practice, the use of product certifications, the use of databases or platforms to find salvaged/recycled materials like Madaster (the Netherlands), Werflink (Belgium), B2Blue (Brazil), and Residuo@Recurso (Chile), or circular/sustainable solutions, and implementation of design for assembly and disassembly, is very low—74%, 73%, 72% and 71% do it never or only sometimes (Figure 7).

These results show there is a market opportunity for digital platforms with circular and sustainable solutions (Figure 8). On a scale from 1 (disagree) to 10 (agree), 70% have attributed a level of agreement $\geq$8, and 87% to a level of agreement $\geq$ 7, when asked if platforms to identify regenerative and circular strategies and solutions would be useful. These figures rise to 74% and 87% for the same levels of agreement when asked about platforms to find second-hand materials. Mean values of 8.3 and 8.44, respectively for each question.

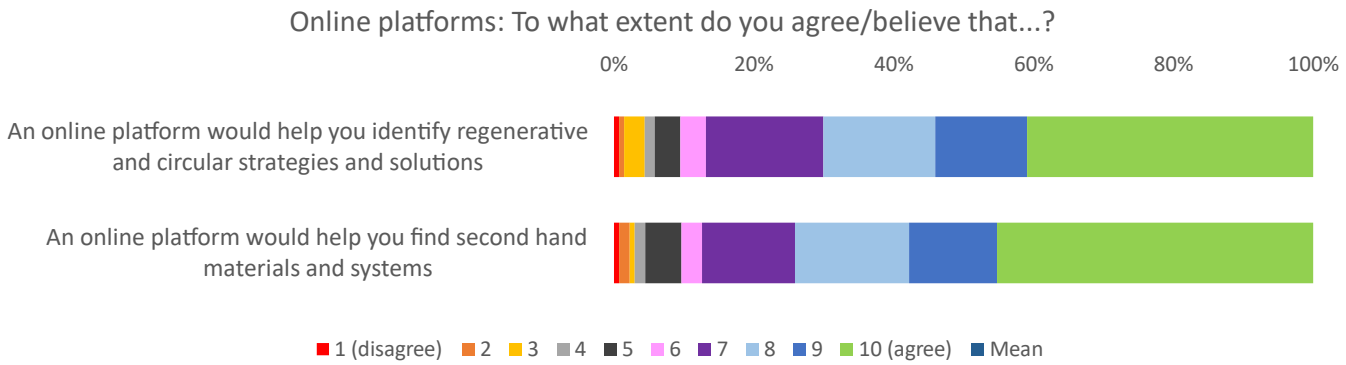

Figure 8. Perception of usefulness of online platforms.

3.4.1. Perception of Existing Tools

In Section 3.3 the perception of survey participants of 'limitation of existing tools' (LEED, Green Star, BREEAM, etc.) as a barrier to regenerative and circular approaches had a mean value of 3.14 (from 1 to 5). In the open-ended question about current green/sustainable sector practices, many mentioned the need to improve current tools, as they are not enough to deal with the growing challenges. Tools are seen as important catalysts during a transition period where regenerative and circular practices are not mainstream.

In the interview, participants were specifically asked to elaborate if and how such existing tools would be able to respond well to regenerative and circular concepts. The main ideas that have arisen were categorised under six themes, presented in Table 4.

Table 4. Perception of existing tools.

Market and knowledge restrictions	- There is space for manipulation in which higher scores is not a result of better design, but rather of technological gadgets. - Voluntary passive tools whose adequate use depends on whoever is applying them. - Integration of full LCA studies still not possible in many countries. - There is an issue with consultants who have a shallow understanding of the concepts and require inadequate changes in projects.
Performance requirements	- They are the bare minimum and many buildings do not perform as designed. - Some tools may have included some life cycle or circular concepts, but it is only a shallow approach that does not consider end of life effectively. Mostly a focus on material and waste management.
Incompleteness and inadequacy of tools	- They still have a fragmented approach, not a systemic vision. - They evolve very slowly when compared to what we know and can do.
Flexibility and adaptability	- Only a combination of different certifications may be able cover the various aspects. - LEED is a very top-down approach exported from the United States without adequate adaptation.
Engagement and communication	- A positive aspect of these tools is spreading awareness and translating some concepts. - They support some level of collaboration among those who have some concern. - They facilitate communication with novice professionals and stakeholders. - They help distinguish among business-as-usual, good practices, and future trends.
New trends and current improvements	- BREEAM seems to have some overlap with material passports. - There is an increasing trend towards wellbeing certifications due to the COVID-19 pandemic. - There is increasing space to utilise different certifications to demonstrate compliance with ESG (environmental, social, governance) investment funds requirements spreading in the real estate sector. The only full compliant certification is IFC (international finance corporation)'s EDGE, for buildings. - Some voluntary schemes, like Green Star, are improving, including circular economy concepts and net zero targets. - The Living Building Challenge seems to be the only one with a more regenerative approach.

3.4.2. Supply Chain

Regarding participants' experience engaging with the supply chain and possible pathways for a better integration, surfaced perceptions were classified under 8 characteristics as presented in Table 5.

Table 5. Perceptions and possible pathways for a more integrated supply chain.

Standards and regulations	- Better regulations need to come in tandem with tighter inspections to ensure compliance and penalties, as well as closing loopholes. - There's need to tighten up controls. In Brazil, construction waste management companies know how to circumvent the legislation regarding the CTR (Waste Transport Control document) and there are huge irregularities even in projects with sustainability certifications.
Market and competition	- Customers (companies) and their ESG requirements are the main drivers of change pushing suppliers to improve their products and services. - Sustainability certification schemes have been the main drivers pushing EPDs (environmental product declarations) for construction products.
Value chain management	- Need to specialise local supply chains to tackle the invasion of cheaper imported products, increasing competitivity at regional and global levels. - Green roof suppliers working with a more horizontal and cooperative structure, where different companies produce/supply different components, facilitates the sector expansion. - Regarding EPDs, in Brazil, the construction sector is more advanced than others, but it has been a slow progress and yet with few EPDs and companies engaged. The fashion and food industries are following the lead. - The need for specific professionals to be engaged throughout all phases (e.g., builders supporting design, and designers engaged in construction phase). - Need to work with supply chain stakeholders to better understand circularity gaps in BE sector.
Technology & knowledge	- Lack of technical knowledge to understand what sustainability means in their context, and where they should focus their actions. - The work with suppliers needs to focus on linking their database of information with those of 'material passports' platforms to facilitate digital twinning of buildings.
Technology & knowledge	- Understanding the concepts is the easy part, showing the benefits, particularly the monetary, is the hardest part. But it is already becoming clear that an investment in an LCA study and EPDs (environmental product declarations) will have a high return of investment.
Governance	- Informality is still a big issue. - Contracts as important tools to establish methodologies to integrate all stakeholders and performance requirements early in the process.

3.5. Regulations and Incentives

Many respondents (82%) admit they are not aware of policies that enforce or promote circular or regenerative practices in their locality. However, 'non-awareness' may also mean the non-existence of codes. The non-awareness of policies is complemented by a majority attributing a level of agreement $\geq$8 (on a scale from 1 to 10) to the need to implement policies (83%) and financial schemes (84%) to foster circular practices in the sector. Mean values of 8.79 and 8.93, respectively (Figure 9).

When inquired about changes needed in the regulatory environment, interviewee 001.NGO.BR suggests a need to change their rationale from the current economy/companies-centred approach to a nature/people-centred vision, while also promoting de-growth and less-consumption, aligning with 008.SUS.BR observation that urban regulations should embed the idea "that not all urban land needs to be used for real estate development. They need an ecological or environmental function to bring quality of life to people and (as a result) an economic impact on the city". To make this happen, 004.SUS.BR suggests we need to override the existing lobby of interest groups, as the real estate market, who influence the design of urban planning instruments, as the strategic master plan, to respond to their needs, and not those of the population. The development of policies and regulations needs, therefore, a long-term approach and to engage more the various social groups in the city, making them more friendly and with less jargon, so that anyone can understand them. It also requires, according to 013.SUS.BO, acknowledging the importance of nature and

traditional knowledge, as in the 'Framework of Mother Earth and Integral Development for Living Well' [79], which seeks to protect Pachamama (Mother Earth) and includes concepts connected to the idea of circularity and regeneration.

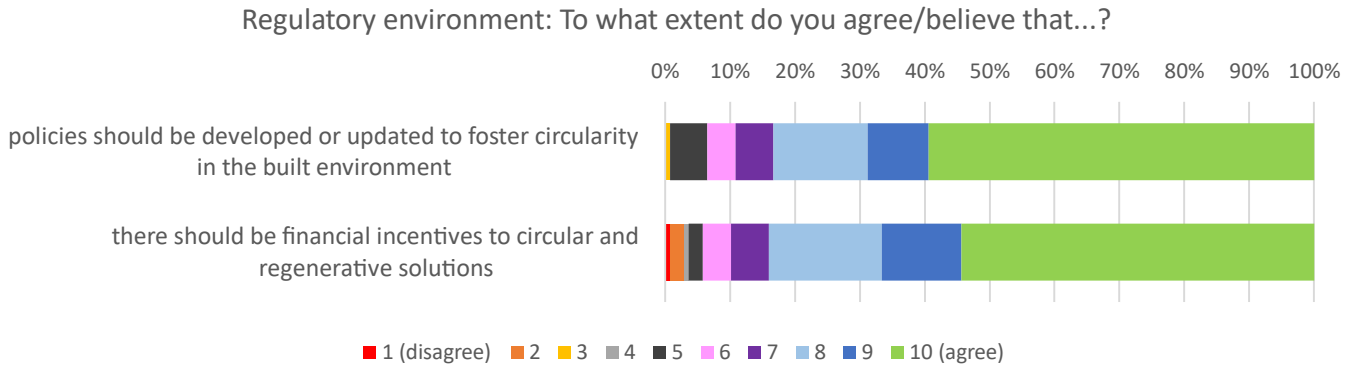

Figure 9. Perception of the need for policies and incentives.

Different participants pointed out the importance of governments' purchase power to catalyse change through circular procurement practices, innovation pilots, and clear guidelines for investment in research and innovation focused on problem-solving. Other considerations included making policies less prescriptive and more focused on performance levels, thus supporting more flexible and evolving systemic approaches (018.REG.CL). These policies could benefit from using LCA data and environmental product datasheets to demonstrate the environmental performance of solutions. 014.SUP.BR.AU mentioned this is an emerging alternative compliance pathway being accepted by some local government planning authorities. In many cases, however, local governments have little or no authority to require stricter performance levels than those from state and national policies, so there is a need for an integrated but multitiered approach. Finally, circular economy standards, as those being developed by the International Standards Organisation (ISO) [80], also have a role in creating models to be used by all actors, to make the ecosystem inclusive, linking the formal and informal sectors, fostering collaboration.

Incentives

Regarding incentives, there is a consensus of their importance to accelerate the circular and regenerative practices. These may be financial, such as tax cuts and direct funding or financing programmes that benefit good practices, and pollution taxes to penalise bad practices. On the other side, there are building benefits or construction bonuses, such as an increased floor area ratio.

There is a general welcoming of municipal initiatives, as 'green property taxes' in Brazil [81], in spite of a warning on how these policies are sometimes poorly designed and lack trained personnel to audit and enforce their implementation. They could be complemented or enhanced by embedding the cost of externalities, such as embodied and operational carbon. While this may be more complex to consider in urban scale interventions (004.SUS.BR), it could work to penalise bad practices and promote sustainable products (011.SUS.AU).

As criticised by 009.SUP_DES.BR, there is yet strong bureaucracy and lack of incentive policies and financing programmes to support innovative circular solutions. This reflects the need for a new mindset to enable financing for circular solutions, as they are based on extensive collaboration and need time to establish. The general agreement is that there is a need for programmes to support entrepreneurship, promote collaboration, and provide some seed capital with a long-term vision, either from government grants, or private initiatives. Despite some problems, as exemplified by 018.REG.CL, Chile seems to be progressing on that with specific grant initiatives for businesses implementing circular solutions (many in the construction sector). Another advancement regards the compliance

with ESG performance requirements required by Investment and Asset Management in Brazil to finance real estate projects, in addition to impact bonds and green bonds initiatives, as mentioned by a few participants. To really enable regenerative business models, 001.NGO.BR remarks that "there has to be an investment in everything that is small, in everything that is artisanal, in everything that is small scale."

3.6. Social Aspects and Community Engagement

On a scale from 1 (disagree) to 10 (agree), 70% have attributed a level of agreement ≥8 to the statement that 'the design of urban spaces and buildings may have an impact on social inequities and environmental injustice', whereas 74% have attributed the same level of agreement to the statement that 'the design of urban spaces and buildings may be a reflection of social inequities and environmental injustice'—mean values of 8.02 and 8.09, respectively (Figure 10).

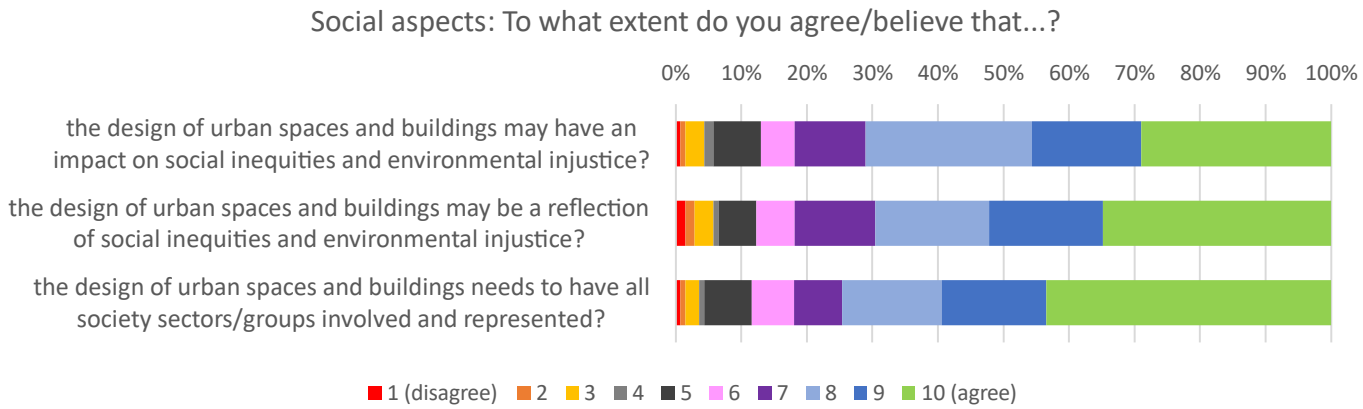

Figure 10. Perception of the relation between built the environment and social aspects.

The responses of interviewees about the need to improve social sustainability in the development of cities also reflect these issues considered in the survey. Many emphasised how many cities and countries still fail on fundamental and more urgent issues with informal contracts and unfair labour practices in construction sites, inadequate and unequal access to infrastructure and green spaces, inequity in urban planning that leads to urban sprawl and social segregation of low-income citizens to the fringes to the city. In some contexts, regenerating the social ties of communities may be a lot more important and an essential step before regenerating the environment. In the perception of 005.ACA.BR, "there is a tension between human rights, urban rights, rural rights, and taking care of the environment—in that, the environment comes a little bit behind". From the perspective of sustainability certifications, these social aspects may be strongly context-based. In Brazil, 002.REG.BR mentions the need to consider labour informality, i.e., a lack of formal job contracts, in construction sites and suggests there should also be aspects to foster enhancing access to green spaces, sanitation, and clean water outside the project boundaries.

Human health and affordability or financial accessibility have been mentioned by 011.SUS.AU and 014.SUP.BR.AU as important characteristics of social sustainability. In the first, eliminating design and materials that may result in diseases, using for instance, LCA's ecotoxicity indicators, and in the latter, facilitating the development of socially mixed communities and designing to reduce operational expenses through life cycle thinking.

When it comes to a circular economy approach, it is seen as a real opportunity to make things much more local, developing urban or regional areas, and creating local jobs, local support, and helping social enterprises by providing them with meaningful work and real impact. Nevertheless, this requires reducing the level of mistrust in the community, as CE depends upon collaboration, and addressing the previously mentioned social issues, normally neglected in linear business models. The perception from 018.REG.CL is that in general, construction companies are more reactive than proactive, but they're starting to

look at communities because society is reacting more to the impacts, nuisances, and other negative impacts.

We then explored the aspects of community engagement in planning and design. The majority (75%) indicates a level of agreement ≥8 (on a scale from 1 to 10) with the need to engage and have representation of the different society sectors and groups—a mean value of 8.38 (Figure 10). Regarding how these processes should be undertaken, the responses very clearly leaned towards a balanced approach to decisions, with 47% indicating 5 on a scale from 0 (top-down) to 10 (bottom-up), a mean value of 5.44 (Figure 11).

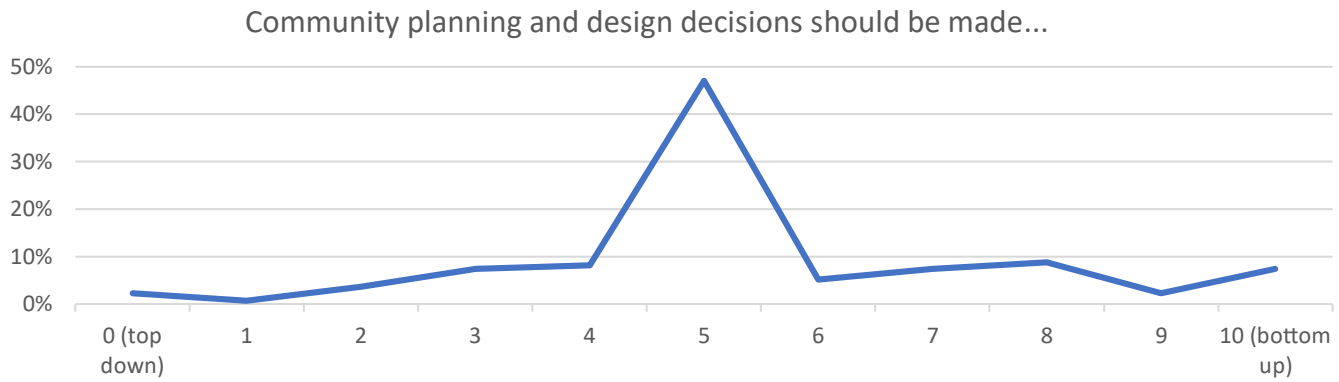

Figure 11. Perception of the need balance for community planning and design decisions.

Regarding community engagement practices, there is consensus among interviewees that there is urgent need for improvement towards truly effective engagement at all stages of developments and with the different social groups through co-design and participatory planning. And while citizens may be willing to participate, there is a lack of opportunities put forward by governments and, as put by 017.PM.FI, the need to systematise and use the right tools to make such processes interesting and with actual results—it's also about finding the right timing, the right methodology, and the right target groups to get the information from people. The experience of 003.DES.PT, as a technical person, is more focused on inspiring the imagination of citizens by working a bit in the background, so that that whole experience is led and directed by a bigger collective of people. 008.SUS.BR mentions tactical and guerrilla urbanism as relevant bottom-up approaches, as "they make things happen more naturally through lighter urban social dynamics that are less bureaucratic and more spontaneous."

On the attendance and composition of community engagement sessions, 011.SUS.AU mentioned that, in Australia, many times there is a predominance of certain groups, "sometimes the older, Eurocentric, and more conservative people and you don't get the full spectrum of people's ideas". So, in addition to mixing online and face-to-face sessions, there is need to proactively go after the different socioeconomic, cultural, and ethnic groups that constitute the community. And both 003.DES.PT and 011.SUS.AU agree on the importance of bringing children to co-design and participatory planning:

> "When children are allowed to have full freedom of expression, the results can be really astounding, enjoyable and funny, which is just really refreshing in this field of work." (003.DES.PT)

It is important, on one side, to make more use of existing civil society organisations. 001.NGO.BR warns that it is very hard to have community groups prepared for coexistence and collective construction. It requires adapting communication strategies, accepting diversity, and respecting divergent opinions and each other's boundaries. More importantly, having a clear purpose and the desire and time to get involved.

Gamification

We wanted to examine the perception of professionals regarding the adoption of gamification or playful/game-like methodologies with different audiences (Figure 12). There is a clear trend in responses indicating that such approaches would be helpful in facilitating participatory planning and co-design with a mean value of 6.7 for BE professionals, 7.58 for community residents, and 7.83 for urban planning and architecture students.

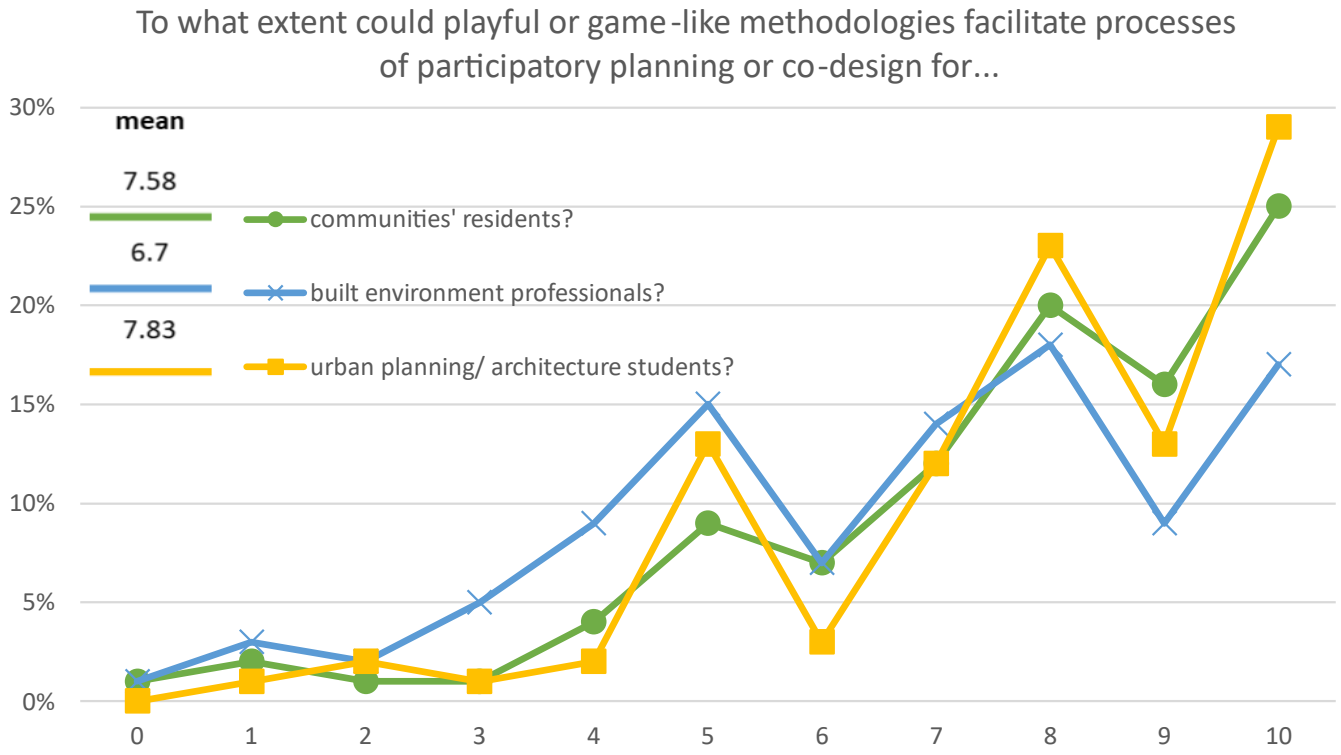

Figure 12. Perception of usefulness of gamified methodologies in the built environment.

Asked about their experience and perception of gamified approaches, there is a general perception that more interactive or gamified approaches seem to work better to engage people and may contribute a lot to behavioural changes, as they help removing solemnity from people so that everyone is at the same level. They may also help bring developers and practitioners on board sustainable practices and facilitate training construction site workers. Regarding the various ways of using it, participants mentioned looser approaches, as bringing in theatrical elements to group and community design, the use of cards to translate complex concepts, and playful ways to calculate one's carbon footprint. The latter, nevertheless, requires a crafted approach and intent, aligning with the key attributes mentioned in [82]:

> "Playfulness is also a serious thing. To conduct playful work that generates pleasure, which is also intellectual and affective because you only laugh at things you understand, is a very sophisticated practice." (005.ACA.BR)

3.7. Moving towards a RC4BE

In this section we wanted to start exploring visions of future and pathways for a regenerative and circular future.

3.7.1. Importance of Strategies

Here, we sought to identify to what extent participants considered certain strategies or solutions (a) to make a circular a regenerative neighbourhood, and (b) to enable a circular and regenerative management of resources.

For the neighbourhood question (Figure 13), all topics, but one, have a major agreement as being very or extremely important. 'Public transportation availability', 'street trees', 'nearby green spaces', 'accessibility for disabled people', 'cycle paths', 'areas for exercise and play', 'designated pedestrian crossings', and 'diversity of walking distance shops/basic services' were deemed the most important topics, being considered by 90% or more of respondents as very or extremely important. The concern with preparing the built environment for climate change, drainage systems integrated with the landscape, and seating either in public areas or in transit shelters, and community engagement is strongly present.

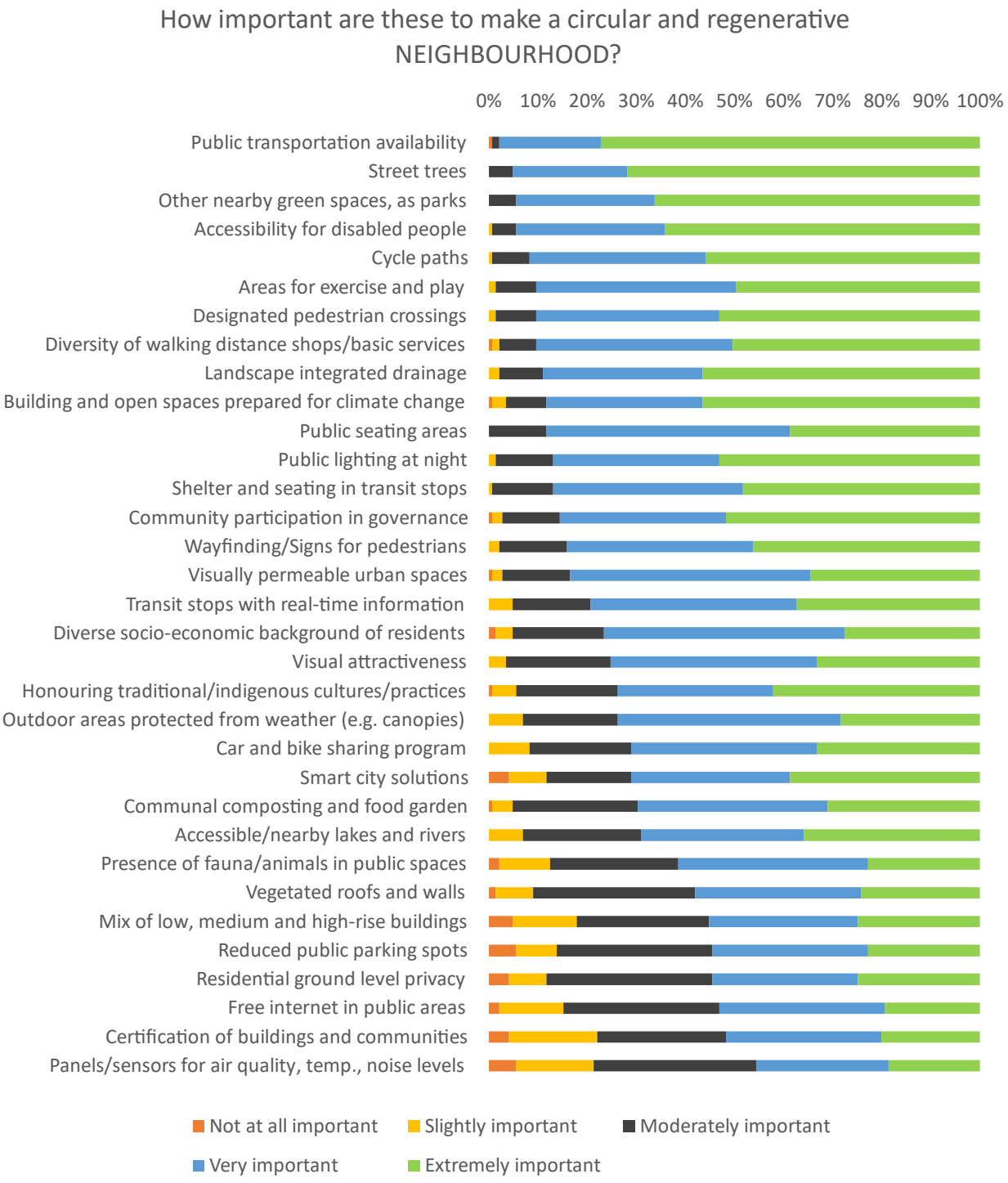

Figure 13. Perception of importance of strategies for a regenerative and circular neighbourhood.

At the other end of the scale, the least important topics are 'certification of green buildings and communities', 'panels/sensors for air quality, temp., noise levels', 'mix of low, medium, and high-rise buildings', and 'free internet in public areas', with 15% or more of respondents considering them not at all important or just slightly important. It should also be highlighted how respondents do not see the reduction of public parking spots and the presence of fauna as important issues.

On resource management aspects (Figure 14), similar to the previous question, respondents have identified all topics but one as being very or extremely important. 'Water self-sufficiency', 'local renewable energy production', 'use of non-toxic resources', 'adapting/retrofitting old buildings', 'reconvert degraded sites', and 'waste as resource/input' were deemed the most important topics for a regenerative and circular use and management of resources, with 90% or more of respondents seeing them as very or extremely important. It is worth noting that participants are aware of the importance of life cycle assessment and the need for flexibility, adaptability and multifunctionality in design.

On the other hand, '3D printing of components and buildings' is by far the least important strategy, followed by 'energy from waste incineration' (which indeed is neither a circular or regenerative solution), 'product-as-service/pay-per-use building components', 'product upgrade', and 'increase urban density', seen by 12% or more of participants as not at all important or just slightly important. 'Public areas for composting' has not received a high score of importance, leaving the question if the issue is on 'public areas' or 'composting' itself.

3.7.2. Opportunities and Enablers

As this survey was undertaken during the COVID-19 pandemic, we sought to understand if participants expected change on how the built environment would be dealt with in the near future (Figure 15). There is a general agreement that there will be a change for the better regarding 'the need for more public open spaces' (66%), 'the use of public open spaces' (74%), 'the design of buildings and houses' (70%), and 'the possibility of working from home' (88%).

We deliberately chose not to mention the pandemic and gave the possibility of an open question where respondents could expand their views on why or how these changes would happen. The following ideas have surfaced:

- Working and studying from home will consolidate as an option (although to a lesser degree than during the pandemic) and demand for office spaces will decrease, thus resulting in less commuting, less pollution, and more time for non-work activities.
- Need to invest in and expand open and green spaces, as well as communal public facilities and infrastructure, when there is densification, with attention to cultural issues and public safety.
- Developers focus on short-term profit and regulators do not push design to improve communities.
- Quality of life strongly connected to maximum use of renewable energies and best management of resources.
- Regeneration is very context specific, with a diverse set of possibilities, as the "relationship between ecological functions and quality of life is very steep in a dense city". Prescriptive approaches may not allow co-evolution.
- Regulations are expected to be tightened for carbon-intensive industries like construction.
- There is a feeling or urgency resulting from the combined set of "humanitarian crisis, health crisis (pandemic), environmental crisis (climate change) and economic crisis".

When asked about barriers, interviewees were also given the possibility of addressing specific opportunities to enable a RC4BE. The main ideas are summarised in Table 6 and categorised in the same eight themes adapted from [43] for barriers.

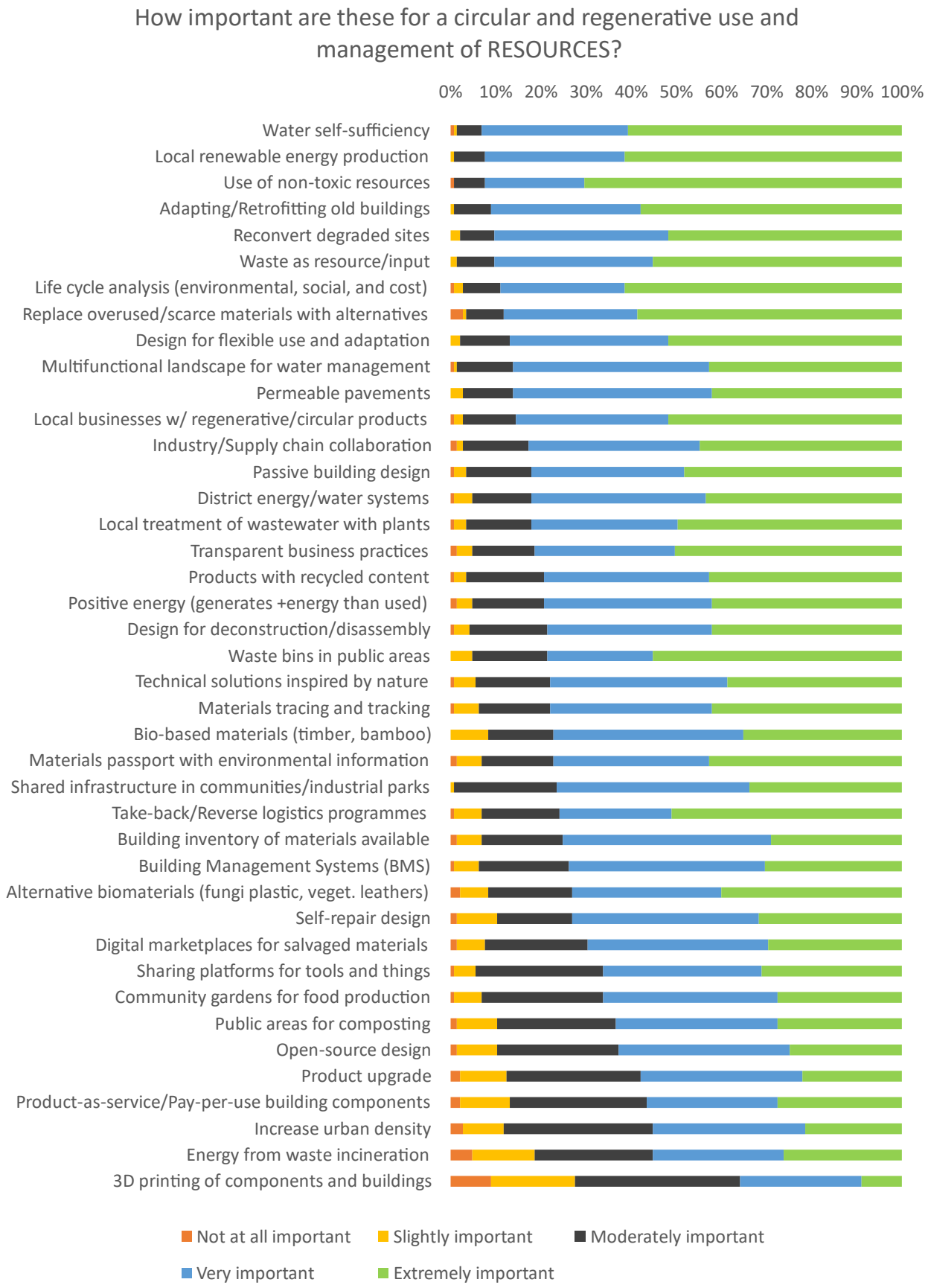

Figure 14. Perception of importance of strategies for a regenerative and circular management and use of resources.

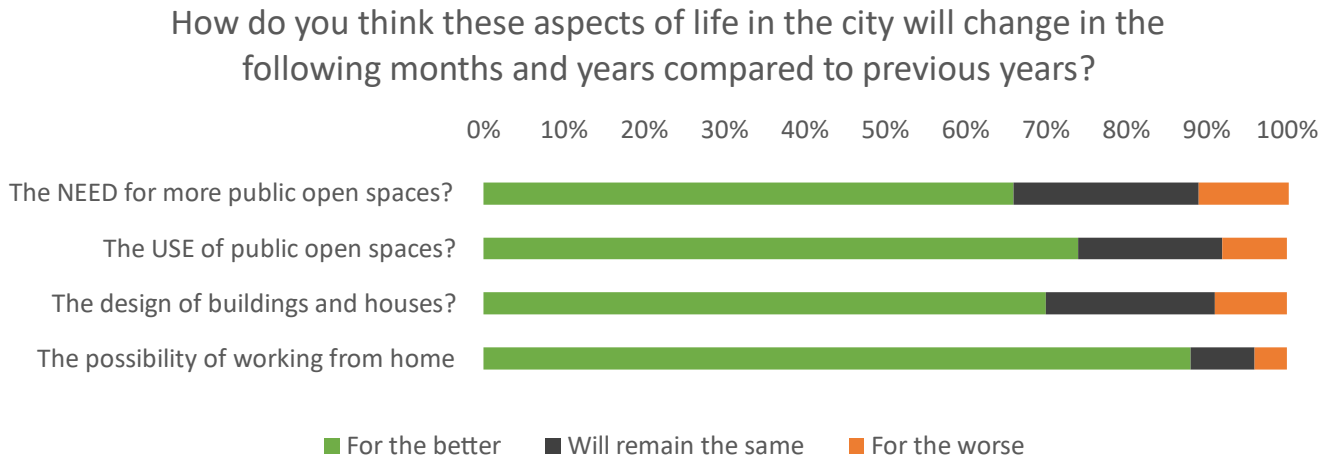

Figure 15. Perception of future change in the use and design of the built environment.

Table 6. Summary of identified opportunities to enable a RC4BE.

	General Opportunities
Economic and finance viability	- Finance sector shifting its mindset to future-proof assets. - Financing and funding schemes open to risks and innovation inherent to circular initiatives. - Financially and technically accessible products. - Post-COVID green recovery stimulus funding.
Standards and regulations	- Circular public policies and procurement practices. - Mandatory material passports. - Policies with friendly language for the citizen. - Easing restrictions of creating regulation-free zones to foster innovation.
Market and competition	- Circular depots and digital platforms to store and sell/donate secondary resources.
Value chain management	- Promote cooperation among stakeholders to push industry to accelerate the pace of change. - Rethink how the supply chain engages to support collaboration. - Sector associations to foster discussion and good practices. - Place all stakeholders on the same page from start (agreed guiding principles and design sprints). - Giving flexibility for developers to define their own targets and metrics.
Technology & knowledge	- Knowledge that leads to action. - BIM (building information modelling) and digital twinning as enablers of the circular economy. - Qualified LCA professionals. - Standardised LCA databases. - Innovation and product development. - Games and books to communicate technical knowledge to lay people.
Product and urban conditions	- Pilots and small urban interventions to create awareness.
Stakeholders' behaviour and awareness	- Finding what moves you—that inner strength. - Increase levels of trust in the community as enabler of sharing solutions.
Governance and participation	- Local scale, bottom-up action with power to create pressure.

3.7.3. Improving Tools

Interviewees were asked if better tools were needed and how these tools should be or what should be changed. Ideas have been classified under three of the six overarching themes previously identified in Section 3.4.1 (Table 7).

Table 7. Summary of identified opportunities to enable a RC4BE.

	Recommendations for Tools' Improvement
Performance requirements	- Require positive impact inside and outside project boundaries. - Penalise less bad practices and inaction besides rewarding good practices. - Include requirements for building and material passports. - Possibility of tailoring or strengthening national legislative requirements to the local context. - Facilitate inclusion and objective self-assessment of circular concepts by designers. - Life cycle thinking that facilitates retaining and increasing the ecological, economical, and environmental value. - Integrate LCA and define performance targets based on reduction of impacts - Promote and reward innovation and circular design. - Credits that integrate all quantifiable issues facilitating a systemic assessment and consideration of trade-offs. - Promote platforms for sharing resources. - Integrate social and economic aspects more strongly. - Better integrate carbon credits in them.
Flexibility and adaptability	- Context-based approach to social impacts. - Adapt tools like 'sustainability appraisal' or 'strategic environmental assessment' to regenerative approaches. - Flexible and context-based (bespoke) framework/indicators definition by each project. - Use existing tools better and in a more articulated way.
Engagement and communication	- Importance of cooperative social methodologies, group dynamics, and design sprints that integrate all stakeholders. - Tools and methodologies that translate technical concepts for non-technical people. - Promote active citizen engagement in making the city (e.g., citizen science). - Improve the communication of actions to the population. - Early engagement of the community in defining the bespoke framework.

3.7.4. Top Actions to Promote RC4BE

For a broader perspective, they were then asked to mention the top three actions or initiatives to move towards regenerative circularity in the built environment. Those ideas are organised in Table 8, also categorised in the eight themes adapted from [43].

Table 8. Summary of recommended top actions to promote a RC4BE.

	Priority Actions or Initiatives to Promote a RC4BE Approach
Economic and finance viability	- Offer more accessible products to scale up beyond high-end and corporate market. - Articulating contracts that (a) promote an integrated working methodology of all parts, and (b) with incentives, not necessarily monetary, but requiring certain methodologies and performance levels
Standards and regulations	- Public policies and action based on sociotechnical criteria. - Create an entrepreneurial environment that rewards circular/sustainable choices and innovation (e.g., taxes and incentives). - More specific definition of sustainable requirements by the finance sector to foster investments and ESG approach. - Incorporate circular economy into procurement and decision-making frameworks. - Mandatory national scale requirements and possibility of more stringent requirements at local planning schemes. - Mandatory environmental impact assessment or qualification for all types and scales of projects. - Policies at different levels to differentiate between 'good behaviour' and 'less good behaviour'. - Political and public action and funding to regenerate cities with nature-based solutions.
Market and competition	- Provide digital platforms and physical spaces to facilitate the flows and cascading of resources.

Table 8. *Cont.*

	Priority Actions or Initiatives to Promote a RC4BE Approach
Value chain management	- Create win-win-win situations to bring on board groups resistant to changes and new practices. - Promote a more collaborative and less transactional way of working with joint incentives in the supply chain to foster better outcomes for all parts.
Technology & knowledge	- Capacity building in the whole ecosystem. - Create tools for citizens, not for technicians, translating hard concepts with playfulness and gamification. - Focus on translating the environmental and economic benefits of solutions. - Industry-focused research based on hotspots and areas of interest. - Scale up the application of concepts from current pilots to everywhere else. - Consider the need for flexibility and resilience for future transformation. - Promote certification tools. - Promote waste as a resource.
Stakeholders' behaviour and awareness	- Promote the internal transition to facilitate the external transition. Find your fun, that is what helps creating and sustaining. - Increase the awareness of the big issues to facilitate cultural change. - Focus on what is really needed to create well-being for the society.
Governance and participation	- Connect citizens at the neighbourhood or block level and promote events to perform community bond. - Support mechanisms that reinforce the connection, like repair cafes and banks of talents. - Participatory/cocreation processes to build a city based on real needs and not on the interests of the real estate sector. - Facilitate cross-sectoral co-design processes allowing space for bottom-up solutions to emerge. - Discuss and include solutions in the masterplans early in the planning stages. - Stronger integration of social and environmental variables to the economic model.

3.7.5. Personal Inspirations

We concluded the interviews with a more philosophical approach by asking what inspired the participants the most regarding sustainability, circularity, and regenerative design outside of their professional practice. The main ideas are presented in Figure 16 as a cloud of statements. A common concluding remark from many participants was a special request to spread these ideas outside of the academic environment, so that we really enable awareness, action, and collaboration towards a regenerative circularity for the built environment.

Figure 16. Statement cloud with personal inspirations from interviewees to act and embrace sustainability practices.

4. Discussions and Recommendations

In this paper we explored the perceptions and practices of built environment professionals regarding current practices and sustainability tools in the sector in the light of a regenerative circularity for the built environment. The mixed-methods study gathered 146 survey responses and 18 semi-structured interviews with built environment professionals across the globe.

In Table 9 the main ideas behind the quantitative and qualitative responses collected for each analysed team in the survey and interviews are summarised. While the goal of the study was not to achieve a statistically representative sample of professionals on a global scale due to the constraints of the COVID-19 pandemic, there has been a good level of agreement between responses from surveys and interviews, and with what was found in the literature. Despite that, these results should be seen as an indication, not the absolute truth, particularly when there is a need to see all these issues in context.

Table 9. Summary (integration) of quantitative and qualitative responses per theme of analysis.

Theme	Survey (Quanti)	Interview (Quali)	Discussion
Awareness of concepts	X	X	There is an overall good understanding of most topics in both quantitative and qualitative. What becomes clear in qualitative is that, while there may be inaccuracies in definitions, there is a connection with their basic principles.
Barriers	X	X	There is a high perception of most of 22 topics being a barrier to some extent in quantitative. Out of those, 13 were spontaneously mentioned in some way in qualitative, agreeing with other literature findings.
Professional practice	X		Checking environmental information of solutions, projects with net zero aims, and sustainability certifications seem to be a more established practice, whereas on the opposite side, there is still space for the uptake of product certifications, platforms for solutions and recovered resources, circular design, LCA studies, post-occupancy assessment and supply chain engagement.
Perception of tools	X	X	Despite being the second least important strategy identified (Figure 13), certification tools (LEED, AQUA, Green Star, BREEAM, etc.) are still seen as very or extremely important by 46% of survey respondents. They are also seen as the second least relevant barrier to a regenerative and circular approach, with only 34% seeing them as strong or very strong barriers (Figure 6). Many survey respondents mentioned the need to improve tools. Interviewees pointed out that, despite the improvement of some tools and new trends as linkages with ESG requirements for financing, they are generally unable to adequately address regenerative and circular concerns in the built environment.
Supply chain	X	X	64% of quantitative respondents consider supply chain fragmentation a strong or very strong barrier (Figure 6), a perception that also surfaced in qualitative (Table 3).
Regulations and incentives	X	X	The survey reveals a general ignorance of local policies to promote or enforce circular or regenerative practices, and a high agreement about the need for more and better circular and regenerative regulations and financial incentives. The perception of a need to improve the current situation is mirrored in the qualitative responses, with specific concerns about poorly developed/enforced regulations or incentives.
Social aspects in planning	X	X	There's widespread agreement, in the survey, that the built environment both impacts on and reflects existing social inequities and environmental injustice. This reflective surfaces in different qualitative responses, with a clear call to address these issues. There is a very clear difference between issues mentioned by interviewees in developing countries, more tied to inequality and lack of access to basic services, and those in more developed countries, where aspects of participation and healthy building materials stood out, but with mentions to affordability.

Table 9. *Cont.*

Theme	Survey (Quanti)	Interview (Quali)	Discussion
Community engagement	X	X	High level of agreement that all society groups need to be represented in the design of built environment, and a consensus that there should be a balanced bottom-up/top-down in decisions. Interviews revealed existing biases in the participation of only a few majority groups in public audiences and similar events, with a call for more proactive recruitment of the different societal groups, including children. Responses also showed the need for more engagement opportunities and the use of adequate methodologies, as well as the importance of finding a common purpose to unite community groups.
Gamification	X	X	In the survey, responses indicate an agreement about the use of gamified methodologies for participatory planning and co-design activities. Interviewees mentioned its importance to better engage people from all groups, convince practitioners about certain approaches, translate complex ideas, and support learning.
Importance of strategies	X		There is a high perception that most of the strategies or solutions are important, what could indicate a clear understanding that there is no single solution, but rather the need of a combined and multiple approach.
Opportunities and enablers	X	X	The survey showed a perception that there will be improvements in how we use and design public open spaces and buildings. And while there was no mention to the COVID-19 pandemic, it appeared in the open-ended responses as one of the main reasons for the expected changes. Regarding opportunities and enablers to a regenerative and circular BE, interviewees also mentioned aspects related to the economy, policies, market offers, value chain, technology and knowledge, urban conditions, stakeholder behaviour, and governance.
Improving tools		X	Recommendations for the improvement of tools encompassed performance requirements, flexibility, and adaptability to respond to specific context/issues, and aspects of engagement and communication.
Promoting RC4BE		X	Recommendations of priority initiatives to move towards regenerative and circular practices in the built environment are widespread among many different areas of action, such as: economy, policies, market offers, value chain, technology and knowledge, urban conditions, stakeholder behaviour, and governance.

The responses allowed us to find some answers for the proposed questions:

What is the perception and awareness of professionals regarding the application of circular economy and regenerative design concepts in the built environment?

There is, overall, a good level of awareness, but not a unified definition or understanding of concepts, as identified in [29,30,83]. Also, it is unclear to what extent this awareness is truly reflected in professional practices.

How do built environment professionals perceive existing sector practices and sustainability tools in the light of circular economy and regenerative design concepts?

Participants voiced a strong perception of current practices and tools (as LEED, BREEAM, etc.) as insufficient to advance circular and regenerative practices in the built environment. Despite a few supportive comments about current tools, mostly from professionals strongly engaged in their marketing and implementation, they are seen as open to manipulation and fragmented, and only a combination of different tools would be able to partially support regenerative and circular solutions. The revision of some tools to adhere to these concepts, as Green Star, or the existence of some designed from scratch based on these principles, has been acknowledged by some participants.

There is also agreement on the need to improve the practices and interconnections of the supply chain, and about the importance of adequate regulations and incentives to promote change, in line with other practices from the public sector, as procurement. The

need for consideration of social aspects is a strong component, particularly in places where fundamental issues as access to infrastructure, have not been solved yet, and in many cases hindering the progress towards sustainability.

What changes should be implemented to move sector practices and tools towards a regenerative circularity for the built environment?

An overall feeling of urgency has been demonstrated for better practices and tools under a more systemic and positive impact approach, and at the same time expectation of positive changes in the design and use of the built environment in the following years, in a post-COVID scenario. Participants agreed and emphasised the need for inclusive and balanced community engagement in city processes, and the need for methodologies and tools to better engage citizens and translate complex concepts. There is an openness towards innovative methods, as gamification and citizen science.

We identified a good comprehension of the importance of different solutions, and the need to embrace them as part of a systemic approach. There is space for business opportunities that enable regenerative and circular practices, such as digital platforms for the exchange of resources and solutions.

Recommendations for the improvement of tools, many aligning and complementing the recommendations and discussions in [15,18,27], have been organised into six categories: market and knowledge restrictions, performance requirements, incompleteness and inadequacy of tools, flexibility and adaptability, engagement and communication, new trends and current improvements.

Future Research Recommendations

Given the comprehensive nature of topics and questions herein covered, a broad perception of varied themes is provided. At the same time, this imposes limitation on the depth of analysis to each topic. We highlight some aspects that understand should be further examined in future studies:

- Investigating some of these issues more in-depth with larger samples in specific regions or sub-groups of BE professionals.
- Local opportunities for the implementation of digital platforms as enablers of resource exchange and industrial symbiosis, in line with the use of resources passports. Different pathways have been identified by [84,85]. One important aspect to consider is the access to standardised data that is reliable and comprehensible by different platforms. The development of a 'Product Circularity Data Sheet' as part of ISO's family of standards for the circular economy may be a direction to guide practice [86].
- The use of serious games and other gamified methodologies as a support for participatory planning, awareness, and education process to scale up the application of regenerative and circular concepts in cities [87]. Here, besides traditional analogue approaches as cards and tabletop games, digital technologies may support immersion and visualisation of solutions and proposals for city planning [88].
- The configurations that are required for the implementation of new circular business models in the construction sector [63,89,90] to enable systemic changes and the uptake of the various aspects discussed in this paper.
- Specific enablers and conditions for the use of regenerative circularity in the built environment as a development catalyst in places with poor socioeconomic performance.

The results of this study will support the development of a framework to support positive-impact transitions of existing urban areas based on the implementation of regenerative and circular concepts. It is also expected to guide in the definition of a set of indicators to support the implementation and performance monitoring.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/buildings13010063/s1, file S1: survey questionnaire; file S2: interview questionnaire; file S3: survey results; file S4: demographics.

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