Policy instruments for circular built environment implementation

A systematic literature review

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Abstract. The built environment (BE) is of fundamental importance in the transition towards circular economy (CE), for it concentrates major consuming and polluting human activities. CE in the BE research has rapidly increased in recent years. However, aspects concerning its policymaking and implementation, governance, and management are acknowledged to be widely over-looked. Such context may jeopardize effective implementation of circular built environments (CBE). In this article, I conduct a systematic literature review to characterize the relation between circular built environments and the policy instruments suggested for its implementation. Results show that only 7% of publications address policy and instruments for CBE implementation. Yet, identified publications seem to cover a wide variety of policy instruments according to prevailing classifications. Finally, operationalized concepts in publications mostly relate to technological aspects of CBE implementation, which calls for increasing research efforts over systemic challenges in governance, and policy integration and coherence.

1. Introduction

Integrating circular economy (CE) strategies into the built environment (BE) has been pointed out as crucial for sustainable urban transitions [1], due to BE's profiles as a major global resource consumer and polluter human activity [2-4]. At different scales, a variety of frameworks and methods are used to measure cities' performance in terms of flows of materials and energy – e.g., urban metabolism, material flow analysis and input/output analysis – and emissions – e.g., lifecycle assessment. Although these measurements are essential to support the management of sustainable built environments [5, 6], predominant narrow perspective on economic and environmental performance [7, 8] may not be sufficient to bring about the CE [2] since, for instance, political, social and behavioral aspects are normally over-looked [1, 9].

Policies for transitioning towards CBE require systemic understanding of BE's constituent parts, their interdependence, and its connection to a wider context of ecological crisis driven by the ever-increasing consumption of energy and resources. However, there is a lack of a comprehensive examination of the policy implications in the transition towards CBE – i.e., the role of governments and of policy, both public and private. Whether current research of CBE address the needed policy settings to make them emerge remain an under-revised aspect. Such a preliminary insight follows the work of Munaro et al. [7], who conducted systematic review of CE in BE research as for 2019. Their results highlight the need for studying the boundaries of CE, and, specifically, the challenges in the governance and management of CBE and their transitions.

The aim of this research is to provide a review of policies for CBE implementation. I do so by answering (1) how many publications elaborate about policy requirements for CBE, (2) what kind of policy instruments are mentioned, and (3) what concepts are operationalized in the selected publication.

2. Environmental policy instruments

Following Huppes and Simonis [10] environmental policy instruments 'link policy development and decision-making to policy implementation' (p. 239), by influencing citizens' and businesses' behavior [11]. What is more, policy instruments are the way policies' visions and goals are operationalized to trigger their desired effects. Such instruments are proven to be essential to operationalize the goals of policy. Echoing this need, the OECD [12] created a world database for policy instruments relevant to the environment and natural resources management. The Policy Instruments for the Environment (PINE) gathers over 3400 instruments around the world.

Several policy instruments are available for the transition towards sustainable BE construction and management. Kibert [13] categorized the ones used for the construction sector in the United States into 5 sub-groups, namely: regulatory instruments, economic instruments, information tools, voluntary tools, and research and development tools. It is worth noting that this kind of categorization is not exclusive to the BE, but common among environmental policy set-ups, as it can be found in Bouwma et al. [11]. However, other classifications also exist, as it is the case of the one proposed by Huppes and Simonis [10], which depends on the kind of actors' relations (political-administrative, regulatory and social instruments), mechanisms (prohibiting, prescriptive, option-creating, economic, cultural, structural and procedural) and objects (single objects or classes of objects) of the policy itself. Likewise, OECD's PINE database divides them into taxes, fees and charges, tradable permits, deposit-refund systems, subsidies, and voluntary approaches. The preference of economic instruments over more traditional binding regulations follows a trend in international policy-making as past command-and-control interventions lose their effectiveness in new global, dynamic contexts that privilege consensus building over strict top-down regulations [10].

3. Methods

For this systematic literature review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was used. PRISMA is the result of an analysis about available methods and tools for systematic literature review in medical studies. It provides a checklist of 27 steps and a flow diagram to summarize the process of study selection in terms of identification, screening, eligibility, and inclusion. Likewise, the checklist is divided in 7 main parts, namely: Title, Abstract, Introduction, Methods, Results, Discussion, and Funding [14], although more steps can be added if needed. Both the checklist and flow diagram enable a rigorous review that can be checked and replicated by others. However, PRISMA does not ensure the quality of a systematic review since study selection can still be biased. Because of its reporting meticulosity, PRISMA is increasingly being used in social science and qualitative research – i.e., [15], [16] and [17].

3.1. Eligibility criteria

Firstly, from the literature search we will only consider published articles, reviews, books, and book chapters available in the selected online databases. Secondly, the period 1990-2020 was selected because it ensures that eligible early developments in the BE in China, Japan, United Kingdom, Germany, and European countries in general, as CE frontrunners are taken into account [7, 18]. This decision seeks to include only those actions strictly aligned with CE research and policy, avoiding those including so-called circular strategies [19] – i.e. reduce, recycle – in previous BE research and policy without a clear CE framework (i.e. publications based on waste or environmental management). Thirdly, eligible manuscripts must be written in English. Fourthly, the words 'circular*', 'built environment', and 'polic*', 'govern*', plan*' or 'manag*' must be included either in the text's title, abstract and/or keywords. I acknowledge that this selection criteria may lead to the discrimination of valuable articles, reviews, proceedings, and books; however, it ensures that only manuscripts explicitly linked to the field of CE in the BE are covered, thus reducing possible bias in the selection process.

3.2. Information sources

Three strategies were used to identify eligible publications. First, I searched 2 online databases, namely: Web of Science and Scopus, to ensure a wide pool of scientific inputs in our literature search. Secondly, to add a more specialized scope to this review, I decided to search publications of 5 top journals – in

terms of number of publications – in the field of CE in the BE. Journal of Cleaner Production; Sustainability; Resources, Conservation and Recycling; Materials; and, Construction and Building Materials were selected as they concentrate approximately 30% of scientific articles in the field in 2019 [7]. Thirdly, I explored Google Books looking for books and chapters matching the above-mentioned search criteria. The last search for these three strategies was October 26, 2020. The information flow is shown in Figure 1.

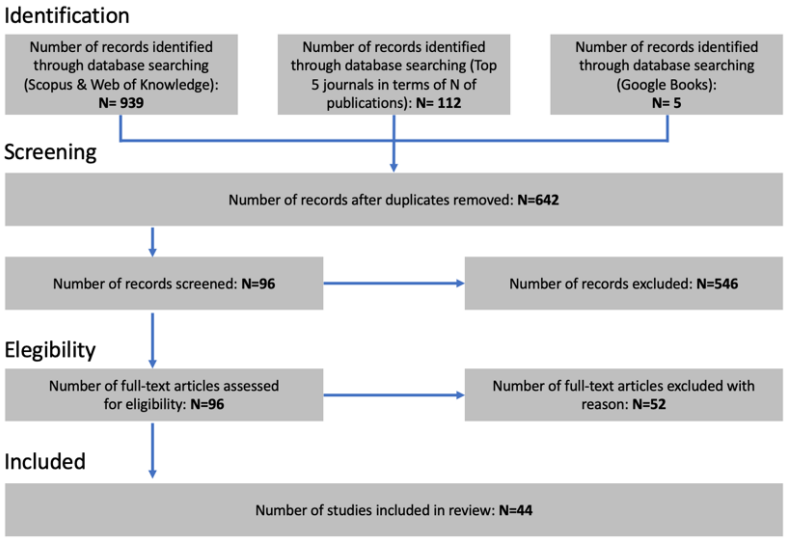

Figure 1. Information flow for final selection of studies included in review, based on the PRISMA protocol. Source: author.

3.3. Search and data collection process

For searching into the two different online databases, I conducted the following search strategy: I searched for the phrases 'circular economy' AND '('built environment' OR 'construct*')'. In Web of Knowledge, the field 'topic', which searches authors, abstracts and keywords was selected. In Scopus, I selected the field 'Article title, Abstract, Keywords'. Only articles, reviews and book chapters were included in the search. For Google Books, I searched for 'circular economy' AND '('built environment' OR 'construct*')'. The resulting findings were exported as RIS, CSV and Plain text files containing full information. They were stored and grouped in EndNotes X9 and visualized using VOSviewer. Finally, using the search engine of EndNotes X9, four groups were created to contain those publications that include 'circular', 'built environment, and (1) 'polic', (2) 'manag', (3) 'govern' or (4) 'plan' in the text's title, abstract or keywords.

4. Results

4.1. How many publications elaborate about policy requirements for CBE?

A total of 44 articles, reviews and book chapters met the selection criteria and were included for analysis (see Table 2). 29 (65%) publications correspond to articles, 9 (20%) to book chapters and 6 (14%) to reviews. In terms of journals with most contributions, Journal of Cleaner Production provided 10 publications, followed by Sustainability with 6, and Journal of Resource Conservation and Recycling with 4.

Four sub-groups were created to contain publications having one or more of the following words in their titles, abstracts, and keywords: polic*, manag*, govern* and plan*, as they can be considered representative of policy related aspects to the BE. My selection of 44 articles equals 7% of the total 642 publications after duplicates were removed. As result, 16 publications were grouped under "policy", 21 publications were grouped under "management", 7 under "governance", and 13 corresponded under "planning". That is to say, firstly, that most publications do not focus on the way frameworks and approach should be operationalized and monitored along policy implementation, but, often, they just mention policy recommendations and further research directions. Secondly, that such a final selection

was only possible by extending the search through multiple queries, otherwise selected publication would have accounted for a smaller sample. Therefore, it is worth noting that, although the above-mentioned words were present in the selected publications' titles, abstracts and/or keywords, only a few of the publications are based on discussions explicitly related to policy aspects of BE in their transition towards circular ones. Figure 2 shows keyword co-occurrence for the final selection. The size of the nodes shows how often a keyword occurred, while the width of the links shows co-occurrence among the nodes. Arguably, none of the keywords relate explicitly to mainstream terms in policy discussion, denoting that, although policy and related concepts were present, they were mostly part of final policy recommendations and further research agendas. A few exceptions argue explicitly about policy aspects of CE in the BE – i.e., [20], [21].

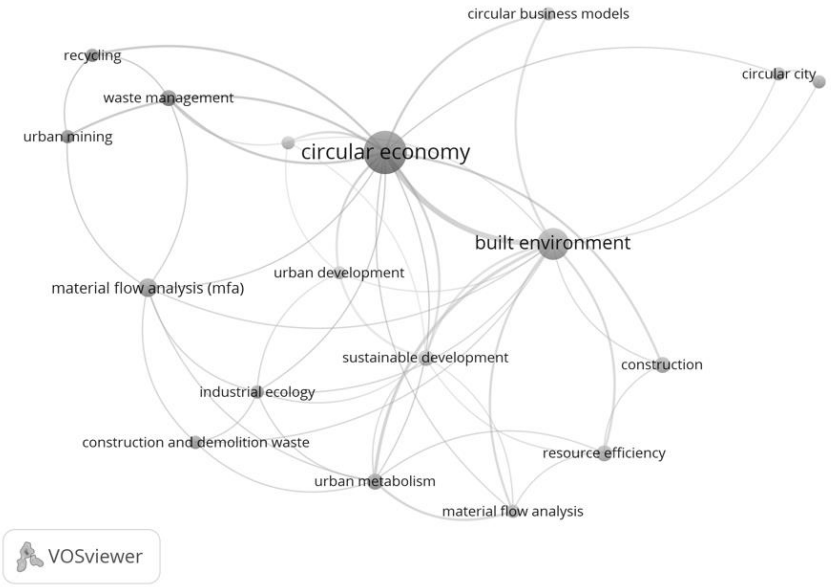

Figure 2. Keywords co-occurrence for final literature selection, based on Scopus database

(37 publications available). Made with VOSviewer, co-occurrence threshold = 2. Source: author.

4.2. What kind of policy instruments are mentioned?

Following Kibert [13] categories for policy instruments, I classified the selected publications according to whether they mention, implicitly and explicitly, policy instruments for the implementation of CBE. Findings are shown in Table 1. Explicitly mentioned policy instruments from implicitly mentioned ones were differentiated through content analysis and the level of detail provided in the publication. For instance, a need for sharing resource information along a circular supply chain was considered as *implicitly* talking about regulatory instruments, while the need for databases to support the implementation of material passports in the construction sector was identified as *explicitly* talking about regulatory instruments. Table 1 is followed by explicitly mentioned policy instruments in highlighted articles.

Regulatory		**Economic**		**Information**		**Voluntary**		**R&D**	
Exp.	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.	Imp.	Exp.	Imp.
15	12	11	13	9	6	5	7	15	12

Table 1. Number of publications referring to policy instruments, explicitly or implicitly, in selection. Source: author.

4.3. What concepts are operationalized in the selected publications?

The policy instruments identified in the previous section resulted from the operationalization of specific concepts in articles, reviews, and books. Therefore, knowing which concepts are discussed when policy for CBE implementation is mentioned or proposed provide an account of the main research directions to date (specifically related to policy, see Munaro [7] for a general overview about CE in the BE research). To answer this research question, I reviewed the methodological section of each publication and identified the main concepts that were operationalized for sake of each research. A reduced number of publications did not have a methodological section. For instance, some present or discuss new approaches to design or construction, for which methods were not required. In such cases I reviewed the abstracts and introductions to identify the main concepts under discussion. Results are presented in Table 2.

Ref. Number & Author	Year	Policy instruments					Operationalized concept(s)
		Reg	Eco	Inf	Vol	R&D	
[20 (Al Hosni)]	2020	E	E	0	0	E	Circular Economy, Built Environment
[22 (Arora)]	2019	0	0	0	0	E	Urban Mining (inflows, stocks and outflows)
[23 (Arora)]	2020	I	0	0	I	0	Urban Mining (inflows, stocks and outflows)
[24 (Attia)]	2018	0	0	0	0	0	Positive Impact Buildings
[25 (Bolger)]	2019	I	I	0	!	I	Strategic Planning, Circular Economy
[26 (Cai)]	2019	E	E	0	0	E	Material Reuse
[27 (Cerreta)]	2020	0	0	0	0	0	Landscape Regeneration
[28 (Cross)]	2017	0	0	0	0	0	Recycle and Reuse of Materials
[29 (Desing)]	2019	0	0	0	0	0	Renewable Energy Potential
[30 (Edike)]	2020	0	0	0	0	0	Eco-bricks
[31 (Eray)]	2019	I	I	I	I	I	Adaptive Reuse, Interface Management
[32 (Gallego-Schmid)]	2020	E	E	E	E	E	Circular Economy, GHG mitigation
[33 (Gassner)]	2020	0	0	0	0	0	Urban Mining (inflows, stocks and outflows)
[34 (Geldermans)]	2019	E	I	E	I	I	Circular Building Design and Health/Well-being
[35 (Ghaffar)]	2020	E	E	E	E	E	Resource Recovery
[36 (Gravagnuolo)]	2019	I	I	I	I	I	Circular City Implementation
[37 (Heesbeen)]	2020	0	!	0	0	I	Circular Business Models
[38 (Heisel)]	2020	E	E	0	0	E	Material Documentation
[39 (Joensuu)]	2020	E	E	E	E	E	Circular Economy, Built Environment
[40 (Katriniaris)]	2018	0	0	0	0	0	Cradle to cradle, Regenerative Design
[41 (Lanau)]	2020	E	E	0	0	I	Urban Mining (inflows, stocks and outflows)
[42 (Lanau)]	2019	0	0	E	0	E	Urban Mining (inflows, stocks and outflows)
[43 (Laurenti)]	2018	I	I	0	0	I	Sustainable Physical Resource Management
[44 (Liaros)]	2019	0	0	0	0	0	Regenerative Development
[45 (Lowe)]	2005	0	0	0	0	0	Sustainable Economic Practices
[46 (Mangialardo)]	2018	0	0	0	0	0	Circular Construction
[47 (Marcellus-Zamora)]	2020	0	I	0	0	I	Urban Mining (inflows, stocks and outflows)
[48 (Marinova)]	2020	E	0	E	0	E	Urban Mining (inflows, stocks and outflows)
[7 (Munaro)]	2020	E	E	E	E	E	Circular Economy, Built Environment
[49 (Ness)]	2017	0	I	0	0	0	Resource-Efficient Built Environment
[50 (Noll)]	2019	E	E	0	0	E	Material Flows
[51 (Omwoma)]	2017	I	0	0	0	0	Technological Tools for Sustainable Development
[52 (Romero Perez)]	2020	0	0	0	0	0	Urban Mining (inflows, stocks and outflows)
[53 (Schiller)]	2017	I	0	0	0	E	Urban Mining (inflows, stocks and outflows)
[54 (Talamo)]	2020	I	I	I	0	I	Building Re-manufacturing and Reuse
[55 (Tingley)]	2017	E	E	E	I	E	Material (steel) Reuse
[56 (Tucci)]	2018	I	E	0	0	E	Resilience in the Built Environment
[57 (van der Leer)]	2018	I	0	0	0	0	CE Integration into Urban Planning
[58 (Wuyts)]	2019	E	E	0	0	0	Short-lived Buildings
[59 (Wuyts)]	2020	I	0	0	0	0	Urban Mining (inflows, stocks and outflows)
[21 (Ness)]	2019	E	E	I	0	E	Policy and Economic Instruments

[60 (Densley Tingley)]	2018	I	I	E	I	I	Embodied Carbon in Buildings
[61 (Chesire)]	2016	0	I	I	0	I	Circular Economy, Built Environment
[62 (Giorgi)]	2020	E	E	I	E	E	Regeneration of Building Stocks and Policy

Table 2. Operationalized concepts and identified policy instruments in selected publications (E = explicitly mentioned, I = implicitly mentioned, 0 = does not mention). Source: author.

5. Discussion and conclusions

Some years ago Pomponi and Moncaster [2] pointed out that *"the initiatives themed around CE in the built environment however demonstrated little interdisciplinarity underpinning the complexity of such transition"* (p. 717). Likewise, more recently, Munaro et al. [7] stated that a "*systematic regulation and policy system, with better interactions among governmental institutions, policymakers, communities, and manufacturing industries*" (p. 15) was still required. Therefore, a systemic view of the CBE transition is still lacking, governance being its Achilles' heel. However, scholars such as Hartley et al. [63] have started to identified necessary policy changes to trigger a more coherent CE transition, although from a more general, regional-based perspective; one that do not address the specific challenges of the BE.

The intention of this research was to characterize the relation between CE in the BE and policies for its implementation. I did so by examining which publications in the field touch upon concepts such as policy, govern, plan and management for CBE. In numbers, to date a reduced quantity of articles, reviews, and book chapters (n= 44) somewhat elaborate about policies needed to transition towards CBE. What is more, most of publications mention policy, but they do as policy recommendations or further research agendas. In terms of policy instruments suggested for such transition, a variety of perspectives are covered –for instance, norms to include material passports, taxation for both secondary resources incentive and unsustainable resources avoidance, circular guidelines for stakeholders in the building sector, sector-wide agreements to accelerate the circular transition, and public investment in research and technology for material recovery and reuse. Finally, when connecting such policy instruments to the operationalized concepts in the selected publications, great attention has been given to technical aspects such as urban mining, material flows and material reuse. Meanwhile, publications with a strict focus on policy and policy instruments – e.g., policymaking, implementation– were scarcely found. It can be argued that the thinking of policy instrumentation is influenced by the thinking in technical solutions, which leads to a focus on policy instruments in support of those particular solutions, while leaving out the more obvious instruments when looking purely at how actors in the BE are influenced by current policies and regulations.

Sustainable transition research [64] may serve to organize future research around CE in the BE and systematic policymaking and -implementation, since its framework is based on lacking/required concepts such as complexity. So far, policymaking and -implementation tend to be associated with governments and State interventions. However, the indispensable role of private policy is increasingly being recognized. Perhaps, one of the main attributes of sustainable transition research is to recognize the limited but still essential role of government in complex decision-making arenas. The latter may help to legitimize long-term intervention for change [65]. Therefore, for sound CE in the BE policy, it is required not only to think about adequate policy, but new complexity-driven ways of governance from which new policies can emerge.

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