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Review

How Can the Circular Economy Contribute to Resolving Social Housing Challenges?

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Abstract: The construction sector stands as the predominant consumer of cement, steel, and plastic and is accountable for a substantial 55% of industrial carbon emissions. Greenhouse gases and other forms of pollution linked to the housing sector significantly contribute to the adverse environmental impact of the construction industry. This study underscores the need to incorporate pertinent issues into the Circular Economy (CE) agenda for a lasting and effective mitigation strategy. Through a Systematic Literature Review (SLR), this article explores answers to the research question: "How can the Circular Economy contribute to resolving social housing challenges?" The findings from this comprehensive review highlight that refurbishing the social housing (SH) built environment and formulating public policies targeted at the SH sector emerge as pivotal themes for effective solutions. The principles of the Circular Economy present a sustainable model that can play a crucial role in addressing the social housing challenge. In conclusion, this SLR demonstrates that Circular Economy principles offer a viable approach to tackling the social housing crisis. By embracing these principles, a sustainable model can be established to address the challenges posed by social housing, thereby contributing to the broader goal of environmental conservation in the construction sector.

Keywords: social housing; circular economy; refurbishment; housing policy

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1. Introduction

The construction sector, responsible for consuming the largest share of cement, aluminium, steel, and plastic and contributing to 55% of industrial carbon emissions [1], faces environmental challenges exacerbated by pollution from the housing sector. Due to the social housing challenge, it is imperative to address and mitigate its impact on the environment.

Research indicates that approximately 75% of the European Union's building stock is energy-inefficient, necessitating renovation to enhance energy efficiency, reduce carbon emissions, and lower energy consumption, especially in social housing [2]. P. Nejat et al. (2017) [3] emphasise the global perspective, highlighting the rise in residential energy consumption and CO_2 emissions, particularly in developing countries experiencing population growth and urbanisation, with house production incurring high costs and environmental impacts.

The absence of a universally accepted definition of social housing across the European Union [4] and other regions has led to diverse country-specific definitions, influencing the extent of government involvement. Most EU nations predominantly limit social housing to households with the lowest income [4].

This study, drawing on [4,5], defines social housing as affordable housing for low-income households or people with difficulties in finding housing, owned and managed by the government or non-profits, for rent or accession to ownership, based on defined governing rules. Fundamentally, is an essential tool for addressing housing inequality and

ensuring everyone has a place to call home. A social housing (SH) project has the function of using urban space to promote socio-environmental sustainability. However, challenges such as social inclusion, access to healthy housing conditions, economic improvement, and optimal natural resource utilisation must be addressed for effective and permanent social housing.

The global issue of informal settlements, housing approximately 1 billion people [6], adds urgency to the need for sustainable housing solutions. The construction of a 40 m^2 social housing unit using traditional methods in Brazil emits around 9 tons of CO_2 [7], emphasising the pressing need for efficient social housing projects to promote socio-environmental sustainability.

Renewing ageing social housing stock in European countries and China is crucial due to outdated infrastructure issues [8]. Retrofitting existing buildings, a demonstrated method for significantly reducing energy consumption [8], emphasises the efficient utilisation of embedded resources, reducing the demand for new materials and minimising waste.

Introducing the Circular Economy (CE) proposal, which aims to minimise waste and maximise resource use, is crucial. Kirchherr et al. (2017) [9] worked above this concept, and in this study, the authors would like to follow their concept of Circular Economy: "an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes".

When describing the Circular Economy in a built environment, the focus should be on how this concept applies to constructing, operating, and maintaining buildings and infrastructure. In a circular built environment, the focus is on designing for durability, adaptability, and disassembly, ensuring that materials and components can be easily reused, recycled, or repurposed at the end of their life cycle [10].

The Circular Economy model can be related to the provision of social housing in several ways. When the CE is applied to the provision of social housing, it can be incorporated into the following actions: (i) Retrofit and Sustainable Upgrades; (ii) Balancing Needs; (iii) Policy integration; (iv) Environmental Justice and Equity; and (v) Economic and Social Benefits [11,12].

Marchesi et al. (2020) [13] suggest that some social housing policies around the world incorporate CE principles, although the extent of implementation varies. Certain countries, like the Netherlands and Denmark, actively incorporate CE principles into social housing policies, promoting circularity, recycled materials, and sustainable design [14]. In China, sustainability concerns have led to research and incentives for environmentally friendly social housing, aligning with the government's sustainable development objectives [15,16].

To ensure the long-term sustainability of social housing projects, prioritising environmentally responsible construction and renovation practices is paramount. This involves cultivating community bonds, preventing disadvantaged neighbourhoods, and offering high-quality, comfortable, affordable, and easily maintainable housing amenities [8].

Numerous studies have examined the potential of implementing a circular economic model to tackle challenges in the social housing sector. In particular, [14] emphasises the importance of combining technical and social innovations, with the latter highlighting the role of social housing communities in promoting sustainable practices. Regarding [17], a circular approach to urban resource management will significantly reduce the consumption of finite resources globally. For example, Zairul et al. (2018) [18] suggests adopting a Circular Economy in a flexible housing project to curb price consumption and extend the lifespan of housing units. Additionally, Mazur (2021) [19] supports implementing a Circular Economy in housing construction, primarily using recycled materials.

These studies underscore the potential of a circular economic model in addressing social housing challenges, emphasising resource efficiency, sustainable practices, and affordable housing solutions. Recognising social housing solutions and incorporating them into the CE agenda is crucial for effective implementation.

Despite the technological focus of CE implementation, attention to social practices and changes in user behaviour remain limited [11]. Çetin et al. (2021) [12] emphasise the

overlooked potential of social housing organisations in generating circular resource flows within the built environment.

CE principles are available and can help to face the social housing crisis. CE principles propose a sustainability model to participate in the social housing challenge. In this sense, this study can help to scrutinise the primary efforts that have been made by the academic sector towards this cause and understand how SH and CE can work together.

Based on a Systematic Review of Literature (SLR) methodology, this study intends to explore "How can the Circular Economy contribute to resolving social housing challenges?". To this end, this research aims to understand, through a Systematic Literature Review, how CE has been related to SH studies.

Guided by this objective, the questions designed to be answered in this research are:

QP1. Which themes related to the Circular Economy have been studied in social housing research?

QP2. Which Circular Economy principles have been addressed in studies on social housing?

QP3. How can the construction sector contribute to a Circular Economy model addressing social housing challenges?

QP4. What gaps remain in the relationship between social housing and the Circular Economy?

Given this context, urgent discussions are needed regarding social housing in the context of new housing production and stock renewal. This must be a priority for the sustainability of the built environment.

2. Materials and Methods

2.1. Literature Review Approach

The use of Systematic Literature Reviews (SLRs) is crucial in gathering evidence that meets specific eligibility criteria to address research questions. SLRs employ explicit and systematic methods to minimise bias and are considered the gold standard in research methodologies.

In addition to mapping, evaluating, and synthesising the literature to develop knowledge in a particular field, SLRs can identify gaps and foster new research agendas. These benefits enable researchers to obtain robust and reliable findings, informing policy and decision-making.

This Systematic Literature Review aims to conduct a descriptive and exploratory analysis of the literature data to examine how academic contributors and professionals in the field of social housing have interpreted and implemented the concept of the Circular Economy. Although this study may have limitations, such as reliance on search strings, databases, and exclusion criteria, the authors believe that it provides a comprehensive coverage of the literature.

2.2. Stages of Systematic Review Protocol

2.2.1. Planning

A systematic, transparent, impartial review protocol was created to achieve the research objectives. The protocol was developed with the guidance of the *Cochrane Handbook for Systematic Reviews of Interventions*, Version 6.4, 2023 [20], to ensure methodological rigour. It includes a detailed description and justification for the review objectives, intended research methods, criteria for study inclusion, and methodology for data extraction, processing, and synthesis. Adopting a specific Systematic Literature Review (SLR) process enhances the legitimacy of the evidence and the authority of the results.

To ensure the successful completion of a systematic review, it is crucial to have strong data management practices, effective project management techniques, and reliable quality-assurance mechanisms [21]. For this particular study, the *Cochrane Handbook for Systematic Reviews of Interventions*, Version 6.4, 2023, was utilised as the methodological guide. Following the study's established protocol (See Table 1), the initial step in conducting an SLR

involved identifying the issues to be examined and developing a rationale for the selected topic from the authors' perspective.

Table 1. Systematic Literature Review protocol for this study.

Protocol	Stages Protocol Steps	Research Aspects
1. Planning	Background to review	Problem: Solve the social housing crisis based on CE principles. Rationale: Circular Economy (CE) principles are available to help solve the social housing challenge. Initial RQ: How can the Circular Economy contribute to resolving social housing challenges?
	Objectives Statement	Primary objective: 1—Exploring the most-used terms related to SH and CE on an academic basis. 2—Selecting, through an SLR, documents that deal with SH and relate to CE principles. 3—Listing the study themes covered in SH studies related to CE. 4—Listing which Circular Economy principles have been addressed in studies on social housing. 5—Listing the main proposals made in the documents. 6—Identifying potential future gaps and opportunities to fuel the process towards a CE in the SH sector. Sub-questions—Question problems: QP1. Which themes related to the Circular Economy have been studied in social housing research? QP2. Which Circular Economy principles have been addressed in studies on social housing? QP3. How can the construction sector contribute to a Circular Economy model addressing social housing challenges? QP4. What gaps remain in the relationship between social housing and the Circular Economy?
2. Processing	Criteria for selecting studies	Context: social housing, social housing policies, circular economy, life cycle assessment, reused materials, recycled materials, refurbishment, material passports, designing for assembly, designing for disassembly, cradle-to-cradle, built environment, energy efficiency, sustainable urban development. Interventions, mechanisms, and outcomes: strategies, theories, practical examples, concepts, principles, guidelines, recommendations. Types of studies: both qualitative and quantitative.
	Search strategy for identification of studies	Databases: Scopus, Web of Science, and ScienceDirect. Timeframe: 2015 to the present time of the study. Keywords: social housing, public housing, housing estate, affordable house, circular economy, circular material, cradle-to-cradle. Language: English. Article type: indexed journal papers, conference proceedings, books, book chapters. Grey literature: included.
3. Analysis	Eligibility	Inclusion/exclusion criteria: - Journal papers, conferences, proceedings, book chapters, editorials, abstracts. - Open access.
		- Social housing, public housing, housing estate, affordable housing, - Circular Economy, life cycle assessment/costing (LCA/LCC), circular material, - cradle-to-cradle. - 2015 to the time of the study. - Three reviewers screen the articles.
	Quality appraisal	The paper is accepted only if approved by at least two of the three reviewers who assess its quality.

Table 1. *Cont.*

Protocol	Stages Protocol Steps	Research Aspects
4. Extraction and Reporting	Data collection	The eligible articles are screened, analysed, and sorted by themes, environmental aims, proposals, and countries. Additional sources and studies are included.
	Results synthesis	Type of synthesis: interpreted through a descriptive and exploratory analysis of the bibliographical research content.

The implementation of a Circular Economy in social housing requires the development of technological solutions and the integration of social value within the housing community. Both components are essential in achieving success. Due to this challenge, exploring "How can the Circular Economy collaborate on the issue of social housing?" seems to be an essential step on a long road towards ecologically correct, socially fair, economically viable, and culturally appropriate solutions.

The period for this research was defined as 2015 to 2023. Only articles written in English were considered for this review. Qualitative and quantitative studies developed within the scope of SH and CE were considered for this review.

By the protocol designed for this study, the focus of this review was oriented towards the following specific objectives:

1. Exploring the most-used terms in academic bases related to SH and the CE.
2. Selecting, through an SLR, documents that deal with SH and relate to CE principles.
3. Listing the study themes covered in SH studies related to the CE.
4. Listing which Circular Economy principles have been addressed in studies on social housing.
5. Listing the main proposals made in the documents.
6. Identifying potential future gaps and opportunities to fuel the process towards a CE in the SH sector.

2.2.2. Proceedings

The significance of researchers having access to high-quality, relevant, accessible, and up-to-date information while conducting systematic reviews cannot be overstated, as emphasised by [20]. To ensure the comprehensive coverage of studies, the researchers employed information sources from three academic databases: Web of Science from Clarivate Analytics, ScienceDirect, and Scopus from Elsevier.

Web of Science was preferred due to its ability to cover all indexed journals with an impact factor calculated in the Journal Citation Report (JCR). ScienceDirect provided access to international multidisciplinary studies, while Scopus had broad global and regional coverage of scientific journals, conference proceedings, and books [22]. The filter applied to the databases was "type of documents", choosing all documents.

2.2.3. Analysis

The research structure was organised into three levels of action.

With attention to specific objective 1, at the first level, the researchers in this study struggled to understand the concept of HSPs. This action was necessary because it is a complex term that can vary depending on the culture, governments, programs, and needs of each country and location. At this level of research, the related terms that appeared most in the state-of-the-art literature related to SH were affordable house, public housing, and housing estate.

Still, at this level, the state-of-the-art Circular Economy principles pointed to the following terms: life cycle assessment/costing (LCA/LCC), circular material, and cradle-to-cradle.

The second level of research dealt with the systematic review in question. A requirement for carrying out an SLR is a concise description of document inclusion and exclusion criteria [20]. The following criteria for document inclusion were adopted: all types of documents; within the range of 2015 at the date of this research; availability in English; and complete text available with free access.

At level two of the research, we sought to fulfil specific objective 2. For each of the three databases, the search for SH (and other terms defined at level one) was combined with CE (and other terms defined at level one). Three selection lists were created from this selection, with 905 documents from Scopus, 37 from Web of Science, and 70 from ScienceDirect.

These three lists selected by the databases were exported to Microsoft Excel version 16.77.1 for data processing. In Excel, these lists were unified, and duplicate articles and those without free access to the full text were excluded, bringing the total to 939 documents.

In this phase, 157 documents were added and cited in the documents' bibliographic references and met the pre-defined criteria for the initial research, finalising the selection of 1096 valid documents (See Figure 1).

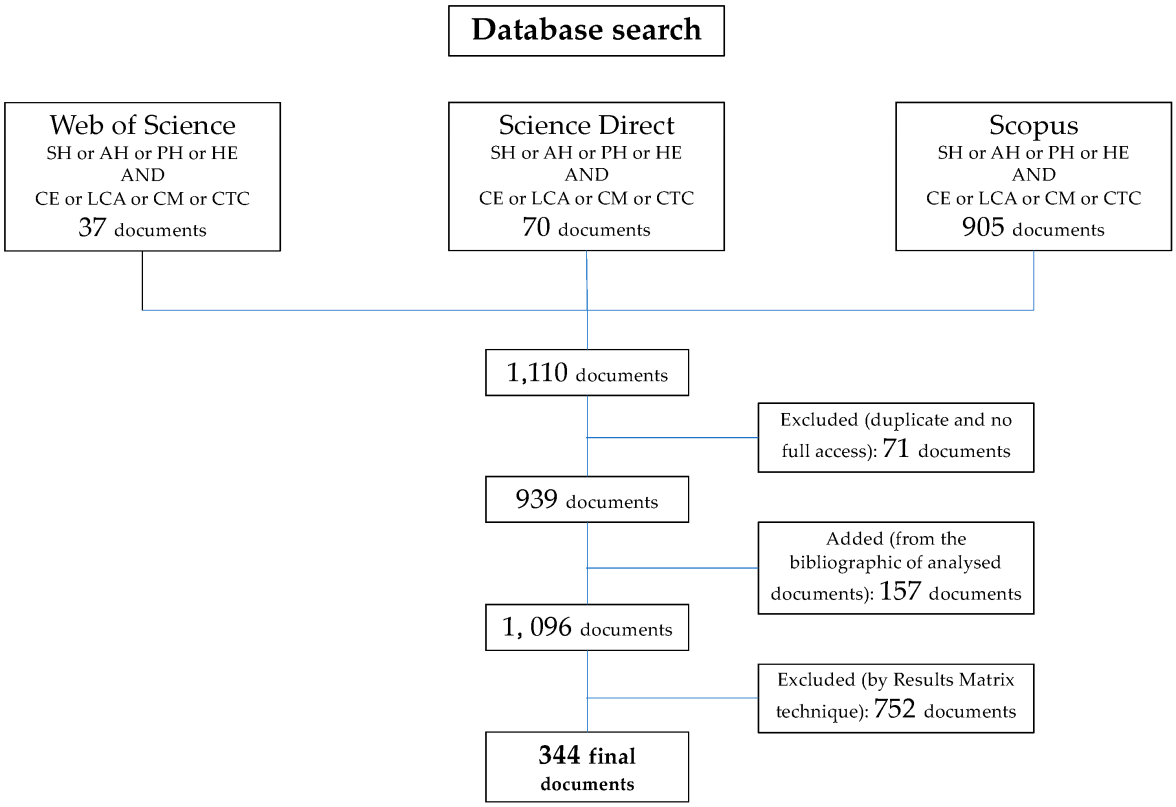

Figure 1. Processing of an SLR in the scientific literature (review date: 3 October 2023).

The research was then dedicated to level three of this study, developing a Results Matrix, a technique that facilitates the organisation of results. It is a table capable of presenting the results of research in a concise and easy-to-understand way. When dealing with extensive information, the instrument allows easy understanding, visualisation, and organisation [22]. In addition to a recording instrument, the Results Matrix can be considered a form of analysis, considering that as the information is classified and selected, it is possible to identify the relationships between them [22].

In Results Matrix 1, the 1096 documents (identified by title and Doi) were listed in column 1 of the Excel document. We sought to determine whether there was significant content about the SH theme and the CE for each document. After thoroughly scrutinising the documents, 344 documents were found that compulsorily met the 2 study themes. Figure 2 illustrates part of Results Matrix 1. Only articles marked with "X" in the last column (SH + CE) were selected (see Figure 2).

Results Matrix 1			
Title	**SH**	**CE**	**SH + CE**
A BIM-Based techno-economic framework and tool for evaluating and comparing building renovation strategies	.	X	.
A BIM–LCA Approach for the Whole Design Process of Green Buildings in the Chinese Context	.	X	.
A burden or a tool? Rationalizing publichousingprovisioninChinesecities	X	.	.
A Circular Economy Life Cycle Assessment (CE-LCA) model for building components	.	X	.
A combined scientometric and conventional literature review to grasp the entire BIM knowledge and its integration with energy simulation	.	X	.
A Comparative Study of Concrete Hollow Blocks with and without Rice Husk Powder as Partial Replacement to Cement	.	X	.
A comprehensive review of urban regeneration governance for developing appropriate governance arrangements	.	X	.
A comprehensive scientometric analysis on hybrid renewable energy systems in developing regions of the world	.	X	.
A cost-effective and efficient electronic design for photovoltaic systems for solar hot water production	.	X	.
A critical review and comparative analysis of cost management on prefabricated construction research (2000–2022)	.	X	.
A critical review of circularity,"design for disassembly" assessment methods applied in the development of modular construction panels - an Irish case study	.	X	.
A critical review of occupant energy consumption behavior in buildings: How we got here, where we are, and where we are headed	.	X	.
A Critical Review on Optimization of Cold-Formed Steel Members for Better Structural and Thermal Performances	.	X	.
A data-driven approach for sustainable building retrofit-A case study of different climate zones in China	X	X	X
A decision-support framework for residential heating decarbonisation policymaking. https://doi.org/10.1016/j.energy.2023.126651	.	X	.
A digital-twin evaluation of Net Zero Energy Building for existing buildings	X	X	X
A field-level examination of the adoption of sustainable procurement in the social housing sector	X	X	X
A Framework for Exploring Livable Community in Residential Environment. Case Study: Public Housing in Medan, Indonesia	X	X	X
A Grammar-Based Approach for Generating Spatial Layout Solutions for the Adaptive	X	X	X

Figure 2. Print from part of Results Matrix 1.

With this selection, the following data were extracted from each document and noted in the following columns, corresponding to each document: study theme; Circular Economy principles related to the study topic; proposals suggested by the studies; country dedicated to study; year of the document; and the bibliographic reference. Specific objectives 3, 4, and 5 were thus met. Figure 3 illustrates part of Results Matrix 2.

The study themes are directly related to the keywords that the authors and the index indicated. They are presented in the Results.

In studies on social housing, several Circular Economy principles have been addressed. With the contribution of [23,24], in addition to the results of this SLR, Circular Economy principles related to the issue of SH were defined:

1. Develop sustainable construction practices such as industrialised building systems (IBSs) and prefabricated and precast construction; modular construction; green buildings (GBs); Industry 4.0 technologies; Internet of Things (IoT); Artificial Intelligence (AI) and Digital Twin; sound insulation; social innovations; nature-based solutions; rainwater solutions; sustainable design; environmental product declarations (EPDs); Passive House; green roof; embodied energy; embodied carbon; passport material; water reuse, alternative water supply systems, water consumption and living labs;

Circular Materials (CMs); clean technology; Nearly Zero Energy Building (NZEB); refurbishment; retrofit; use adaptation; renewable energy sources, Design for Adaptability (DfA); Design for Disassembly (DfD); Life Cycle Assessment (LCA); Life Cycle Costing (LCC); Social Life Cycle Assessment (S-LCA); social innovation (SI); decision-making methods; Key Performance Indicators (KPIs); and seismic systems, among others.

2. Promote more-efficient thermal comfort systems, such as efficient lighting; Heating, Ventilation, and Air Conditioning systems (HVAC); Photovoltaic/Thermal systems (PV/T); building-integrated photovoltaics (BIPVs); low-energy-consumption heating and cooling systems; Life Cycle Energy (LCE); and energy assessment methods, among others.
3. Minimise waste such as reuse; recycle; redesign; remanufacturing; recover; composting; and construction and demolition waste (CDW).
4. Protect and preserve the natural environment, such as protecting green areas; recovering degraded ecosystems; promoting biodiversity; Urban Agriculture (AU); permeabilisation; open spaces; green areas, and indigenous housing, among others.
5. Advance sustainable public policies such as land-use and occupancy policies; social housing policies; social value creation (SVC); Public–Private Partnership (PPP); citizen engagement; participatory design; incremental architecture; accessibility; triple helix; self-construction programs; health conditions; energy poverty; user behaviour; user satisfaction; property laws; public services; government incentives; rental social housing; heritage; multi-stakeholders; technical regulation; and neighbourhood concerns, among others.

Results Matrix 2

Title	Themes	CE principles	Country	Proposal
A data-driven approach for sustainable building retrofit-A case study of different climate zones in China	refurbishment; energy performancy; thermal control; HVAC systems	1; 2	China	The reduction in heating and cooling consumption is the priority in retrofit decisions.
A digital-twin evaluation of Net Zero Energy Building for existing buildings	NZEB; BIM; energy performancy	1; 2	UK	NZEB is feaseble on existing built environments.
A Framework for Exploring Livable Community in Residential Environment. Case Study: Public Housing in Medan, Indonesia	incremental architecture	5	Indonesia	Designs that adapt to the development of the family economy and housing space.
A Grammar-Based Approach for Generating Spatial Layout Solutions for the Adaptive Reuse of Sobrado Buildings	adaptative reuse	1; 2	Brazil	A framework for repurposing historic buildings into social housing and considers the allocation.
A holistic strategy for successful photovoltaic (Pv) implementation into singapore's built environment	BIPV	2	Singapure	A holistic strategy for successful PV .
A home for all within planetary boundaries: Pathways for meeting England's housing needs without transgressing national climate and	refurbishment; land use	1; 5	England	A rapid retrofitting, and policies disincentivising the overconsumption of floorspace.
A Method of Multi-Criteria Assessment of the Building Energy Consumption	energy performancy	2	Poland	A multi-criteria optimization method for components that influence the energy efficiency of buildings.
A Methodological Framework to Foster Social Value Creation in Architectural Practice	social value creation (SVC)	5	Denamark	Combine social housing and physical building initiatives in construction and renovation for rent.
A model to assess thefeasibility o fpublic–private partnership for socialhousing	PPP; decision-making methodology	1; 5	Italy	A model that allows evaluating the financial evaluation of a SH initiative in PPP.
A multi-case study of innovations in energy performance of social housing for older adults in the Netherlands	energy performancy; citizen engagement; innovations	2; 5	Netherlands	The active participation of tenants and the willingness to change their behavior and lifestyle about saving energy.
A multi-criteria decision-making framework for residential building renovation using pairwise comparison and TOPSIS methods.	decision-making methodology; refurbishment	1	Spain	Presents TOPSIS as a multi-criteria decision-making (MCDM) framework to support the reform decision-making process
A new heat cost allocation method for social housing	refurbishment; energy performancy; fuel poverty;	1; 2	Italy	The heat distribution methods available in the literature are ineffective in social housing

Figure 3. Print from part of Results Matrix 2.

3. Results

3.1. Study Themes

Working with filters in Result Matrix 2, a list of the most-covered themes can be seen in Figure 4.

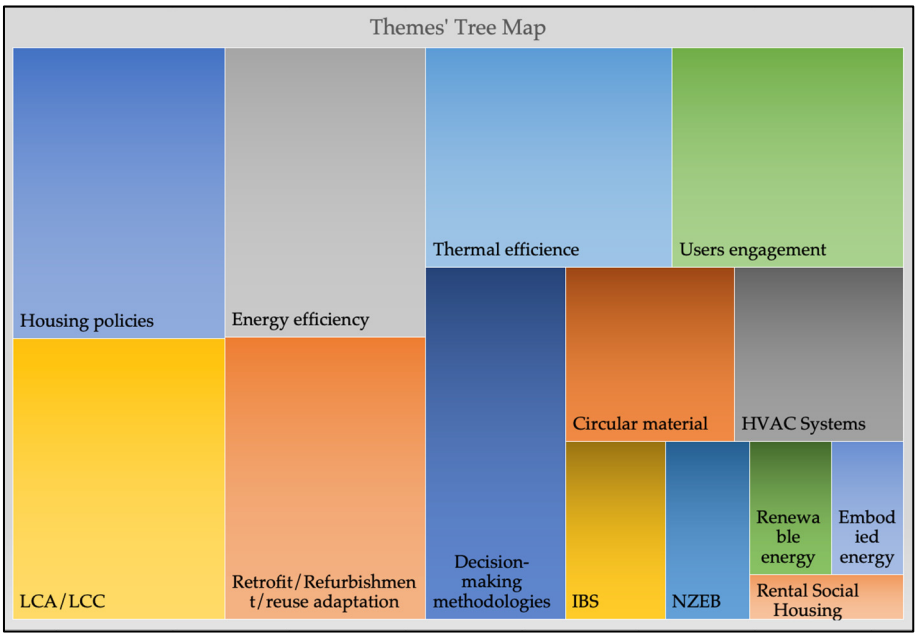

Figure 4. Theme Tree Map.

In Figure 5, it is possible to visualise the distribution of the publications by country.

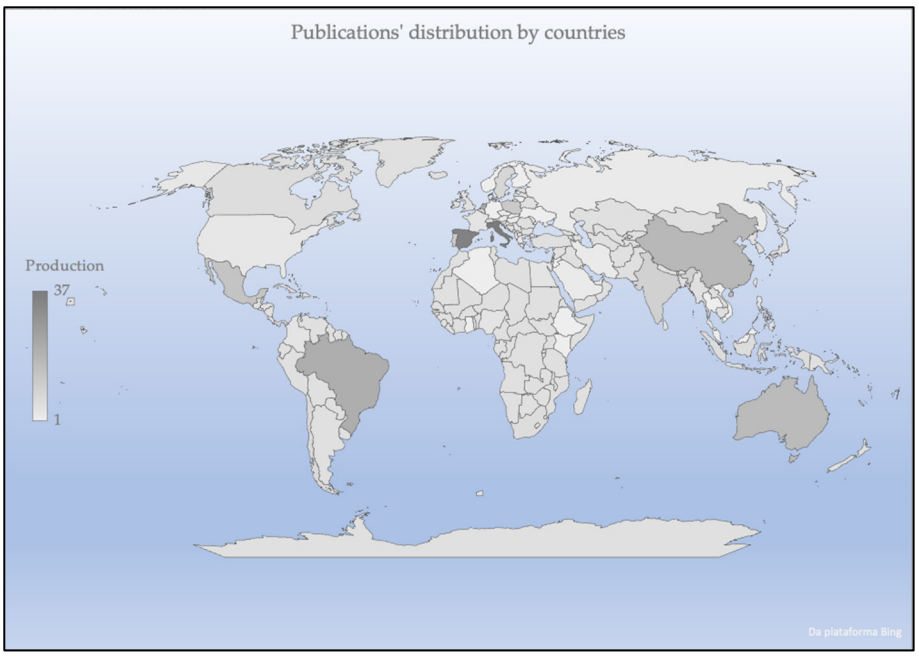

Figure 5. Distribution of publications around the world.

In this SLR, 57 countries produced material with different themes. Figure 6 shows the eleven (England and India tied in the tenth position) countries that contributed most to the total number of publications.

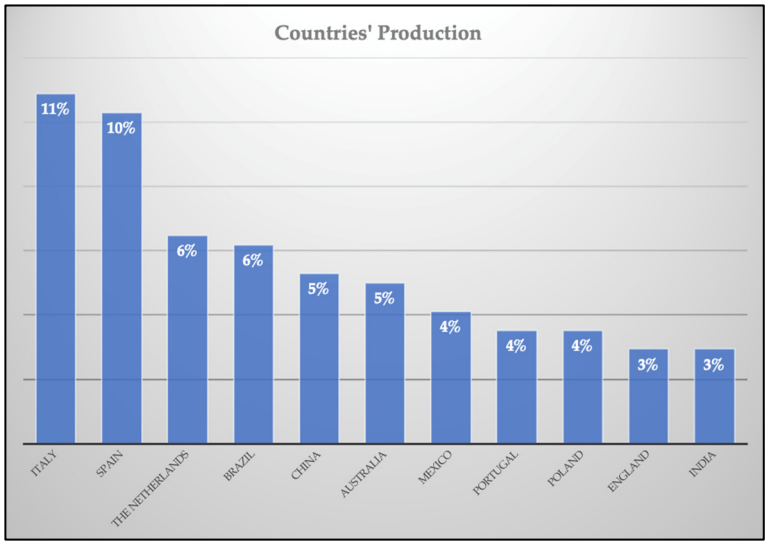

Figure 6. Countries' production.

European countries represent 53% of all studies in this SLR. Italy, Portugal, and Spain produced 47% of this European amount.

Many themes in the 344 documents were organised based on their corresponding keywords. A colour-scale table allows for quickly identifying relevant themes by country and production. Themes with similar meanings are grouped in Figure 7 to enhance sample diversity.

Theme/ Country	Italy	Spain	The Netherlands	Brazil	China	Australia	Mexico	Portugal	Poland	England	India
Housing policies/ techinal regulations/ land use polices/ public incentives	6	4	10	3	13	7	5	3	4	6	0
Retrofit/ Refurbishment/ reuse adaptation	18	10	4	1	2	1	1	3	3	4	0
Energy efficiency	19	6	2	2	2	1	4	4	3	3	1
Life Cycle Assessment (LCA)/ Life Cycle Costing (LCC)	12	10	1	5	3	2	3	5	0	1	6
Thermal performance	3	15	0	2	2	5	7	3	2	2	3
Users engagement/ participatory desing	8	0	10	5	3	5	4	6	1	3	0
Decision-making methodologies	13	2	4	6	1	2	5	2	2	1	0
Circular material	2	2	1	5	1	1	1	0	0	0	5
Heating, Ventilation, and Air Conditioning (HVAC system)	4	7	0	1	0	0	3	0	2	3	0
Industrialised Building System (IBS)/ Prefabrictaion	0	0	0	2	4	0	0	2	3	2	5
Building (NZEB)/ Passive house/ Gree Building (GB)	2	2	1	2	1	2	2	1	0	1	0
energy/ Photovoltaics (PV)/ Building Integrated Photovoltaics (BIPV)	2	1	1	0	0	1	0	0	1	0	0
Embodied energy/ Embodied carbon/ Material passport	0	3	1	0	1	0	1	1	0	3	2
Social rental housing	0	0	0	0	3	1	0	0	0	0	0
Total	89	62	35	34	36	28	36	30	21	29	22

Figure 7. Colour Scale by Theme/Country.

The country in Asia that invests the most in research into the themes of this SLR is China, with 38% of collaborations in this region. China has discussed housing policies and energy efficiency on the issue of SH with attention not only to technical aspects such as prefabrication and renovations but also to user involvement in this challenge (See Figure 8).

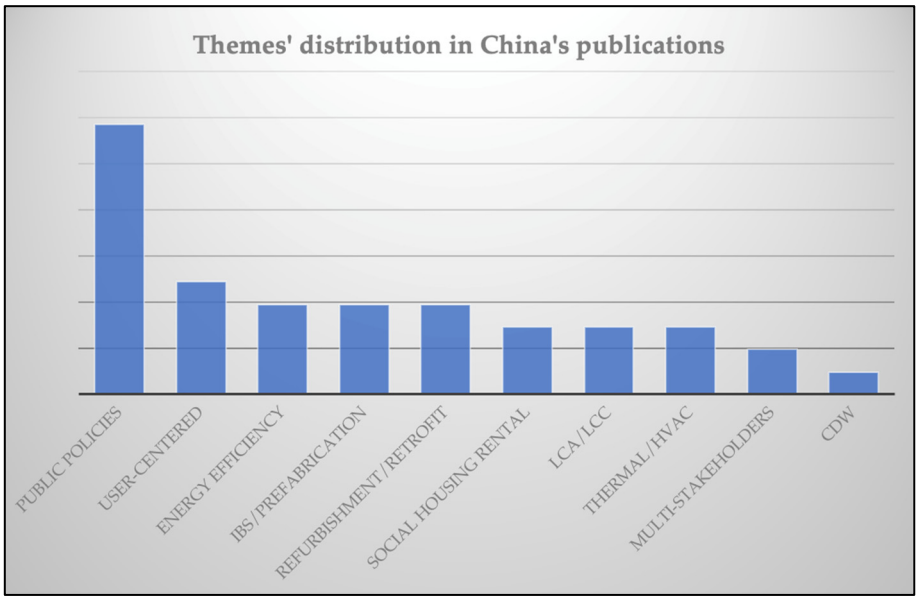

Figure 8. Most-studied themes in China in this SLR.

In Latin America and the Caribbean, with most contributions from Brazil and Mexico, the preferred themes are in Figure 9.

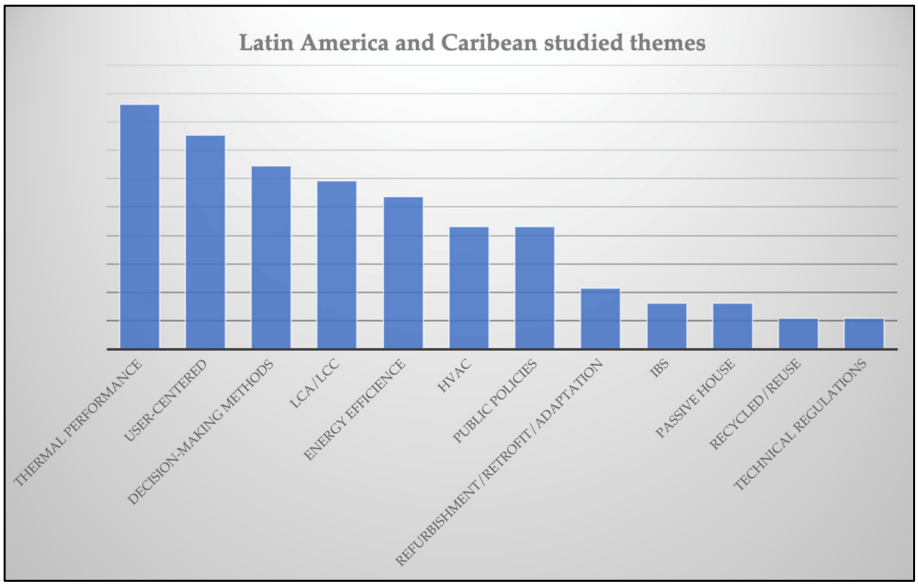

Figure 9. Latin America and Caribbean preferential themes in this SLR.

3.2. Circular Economy Principles

In response to QP2, the Circular Economy principles that have benefited most from this research, listed in order from most related to the themes to the least related, in percentage, are:

1—Sustainable construction practices: 67%.
5—Advancing sustainable public policies: 48%.
2—More efficient thermal comfort systems: 42%.
3—Minimising waste: 3%.
4—Protecting and preserving the natural environment: 3%.

3.3. Proposals

In response to QP3, below is a summary (see Table 2) of the main ideas proposed in the documents that promise to contribute to rectifying the SH issue and moving towards a CE. It is possible to identify the articles not sourced in Table 2 in Appendix A for the 334 selected articles.

Table 2. Identified Proposals.

Proposal	Description	Sources
1. Energy-efficiency measures	The most-cited propositions are about energy-efficiency measures: refurbishment of thermal and comfort performances; paying attention to overheating risk; thermal insulation alternatives; indoor environmental quality; prioritising passive design solutions; use of building orientation design; optimised facade effects; using of ceiling fans, shading, natural ventilation, and wall insulation; efficient HVAC systems; and efficient alternative hot water systems.	[25–104]
2. Users' orientation	Citizens' and users' orientation about the advantages of investing in energy and thermal retrofit is essential. In order to develop citizen engagement, it is necessary to foster a participative design discussion with users about cost/benefits.	[8,77,84,104–119]
3. Social housing policies	Developing new or revised energy and social housing policies and technical regulations should count on the mandatory participation of citizens, non-profit housing organisations, and social housing providers from the public and private markets.	[31,51,87,93,107,112,114,120–149]

4. Discussion

The comprehensive results showed that the recovery of the social housing built environment and the SH public policies are the themes of most significant interest in acting towards solutions. These actions are a positive sign since maintaining what is already built is a principle of the CE. Added to this optimistic horizon is a consensus that the issue of SH worldwide can only be settled at the level of public policies.

European countries, especially Italy, Spain, and the Netherlands, are engaged in renewing the valuable life of SH buildings. Recognising that renovating structures, coatings, and building systems is a more sustainable choice than building new units is a big step Europe is taking in the construction sector. The incentives of the European Climate Law, the European Green Deal, and national policies have stimulated the diagnosis of and proposals to deal with the housing issue based on CE principles [9]. The themes that appear most in European research concern the renewal of the social housing stock, with improved energy efficiency reflected in thermal performance measures with new hot water systems, interior heating and cooling, and the insulation of buildings.

Unlike EU incentives, in Brazil, most housing policies are invested in constructing new units rather than requalifying older units [150]. In developing countries, the challenge of maintaining the existing social housing stock is added to the volume of housing to be built. Housing deficits reach thousands in countries such as Brazil, Mexico, China, and India, among others. The construction of new SH units is necessary, and the volume varies from country to country. According to [151], Brazil had a housing deficit of approximately 5876 million homes in 2019, and around 25 million houses in Brazil need to be considered adequate. In turn, Mexico has delayed about 20 million units. The studies, prioritised by Latin America and the Caribbean, reflect the connection between energy efficiency and thermal comfort performance; decision-making simulation methods; and user-centred solutions. User-centred solutions are essential because by understanding users' needs and preferences, organisations can create solutions that provide a competitive advantage in the marketplace [152]. Based on the findings, it is evident that certain nations must endeavour to augment their focus on exploring methodologies that encourage productiveness at a

relatively low cost while maintaining a minimum level of quality and environmental impact. Notably, the studies did not delve into academic deliberations regarding this milieu.

Relevant data on the rates of vacant homes in many cities, such as Chicago in the United States and São Paulo in Brazil, have been incorporated into discussions on the issue of social housing. For example, Chicago has 50 vacant homes per homeless citizen [153]. In Brazil, the number of empty homes is twice as high as the country's housing deficit [154].

China has a significant stock of SH, but it was built en masse with serious quality problems, confirmed by their studies. The floating population of migrants in China was estimated to be more than 221 million inhabitants [155]. A country that has to settle all these families must think about programs for efficient social housing. Concern about environmental damage must be relevant in this process. The studies carried out by China selected in this SLR strongly focus on discussing public policies, energy efficiency, and recognising that user participation leads to products and services that are more acceptable, intuitive, and effective. Proposals for scenario decision methodologies, the use of IBS, and renewing the quality of SH stock are part of these studies (see Figure 4).

Multi-criteria methodologies for decision-making within CE principles have been studied to systematise all data and simulate cost-versus-nature scenarios. The documents indicate that CE concerns in SH are still in the diagnosis, analysis, and planning phase. The use and development of decision-making methodologies like LCC, LCA, and thermal and energy-efficiency assessments are proof of this. Considering Artificial Intelligence (AI)'s environmental impact is also essential. Advanced technologies such as the Internet of Things (IoT), Digital Twins, BIM, algorithms, data mining, and artificial neural networks (ANNs) can significantly enhance the transition to a CE.

Regarding QP4, when analysing the two Circular Economy principles that have received little contribution, the research gaps are:

- Analysis of ecological indicator systems, sustainable regional/urban planning, and existing green building programs [156]. To this end, updates to sustainability regulations (parameters, regulations, laws, regulations, codes, public policies) in the built environment are necessary, focusing on meeting local needs, such as making sustainability indicators more flexible in areas with low-income residents.
- An important point that must be highlighted in this discussion is the implementation of prefabricated building systems. The theme of industrialised building systems (IBSs) and prefabrication deserve more attention regarding the development and current status of prefabrication techniques, their application in the social housing building sector, and why their use still needs improvement.
- It was also noted that the concepts of Design for Adaptability (DfA); Design for Disassembly (DfD); and material passports needed more space in research.
- Concerning construction and demolition waste in particular (CDW), little has been investigated in terms of the use of this waste integrated into recovery solutions for SH studies and in the production of new SH units.
- Regarding studies on the quality of the surrounding environment, shared spaces, neighbourhoods, green areas, and the recovery of degraded environments, more must be dedicated to studying them parallel to the housing itself.
- Still, little has been studied about sanitation infrastructure, mobility, and accessibility and how they are essential for the sustainability of environments. This literature review clearly shows that the reality of concerns and priorities regarding the provision and maintenance of SH are different in different regions of the globe.

5. Conclusions

Based on the achieved results, a rich and exciting universe has opened up on the horizon. Returning to the main question problem of this research, which intended to explore "How can the Circular Economy contribute to resolving social housing challenges?", some findings should be enhanced:

1. The five most-studied themes are public policies, decision-making methods, retrofit/refurbishment, thermal efficiency, and Life Cycle Assessment/Costing (LCA/LCC).
2. The five main Circular Economy principles addressed are sustainable construction practices, advancing sustainable public policies, more-efficient thermal comfort systems, minimising waste, and protecting and preserving the natural environment.
3. The main contribution proposals provided by these studies are users' orientation, energy-efficiency measures, and social housing policies.
4. Regarding gaps found in this RSL, the most notorious are cultural sustainability criteria and indicators, the implementation of prefabricated building systems; Design for Adaptability (DfA) and Design for Disassembly (DfD) studies, and material passport evolution.

The focus on incorporating aspects related to user behaviour in various contexts, particularly in energy-consumption habits, the importance of engaging users and citizens to ensure that projects and maintenance are truly efficient, and user satisfaction about the renewed environment, takes the sustainability of the built environment beyond technical requirements. Figure 7 clarifies the relevance of understanding the role of user participation in the SH issue. In their studies, Çetin et al. (2021) and Marchesi & Tweed (2021) [11,12] emphasise the importance of combining technical and social innovations, with the latter highlighting the role of social housing communities in promoting sustainable practices. The urgency of revising SH management models, buildings, land use, and environmental quality, along with other forms of legislation and standardisation, could provide a new dynamic with which to tackle SH solutions based on CE principles. Furthermore, it is understood that climatic characteristics vary significantly within the European continent and other continents, leading to the need for environmental comfort parameters and energy-efficiency targets to include adaptations to energy-efficiency indicators and criteria and the cost for each reality.

A whole cultural context naturally emerges when the user is involved in the solution scenario. It makes the challenge more complex, but studies such as [157] show the relevance for everyone's satisfaction in the project. Incorporating culture into sustainable development has proven to be a persistent obstacle [156]. So, embracing cultural sustainability criteria and indicators as a fundamental structure for social housing solutions is crucial. This strategy unlocks fresh avenues for advanced investigations. Integrating culture into sustainable development (SD) has been a continuous challenge. By assuming that the built environment is a cultural resource that reflects the past and shapes the future of society, and by providing cultural sustainability criteria and indicators as a framework to be adopted by social housing solutions, this paper opens new perspectives for further research.

This SLR research draws attention to essential points that should support public policies dealing with SH: (i) maintaining the space already built, avoiding using more natural resources; (ii) the user's role in decision-making processes; (iii) and the political will to resolve the challenge. In this context, public authorities must act creatively, effectively, and transparently in processes that enable citizen participation in SH programs within the principles of the CE.

However, this study must be continued and expanded into many other related areas, which can deepen the level of understanding of the state of the housing issue in the world, including in specific regions and countries. Furthermore, focusing on particular realities will be a priority so that contexts are incorporated into proposals for the evolution of social housing, moving towards the CE model.

This SLR illustrates that the CE principles are available to face the social housing challenge, and with their help, this can lead to a sustainable model with which to solve the social housing crisis.

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Appendix A

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