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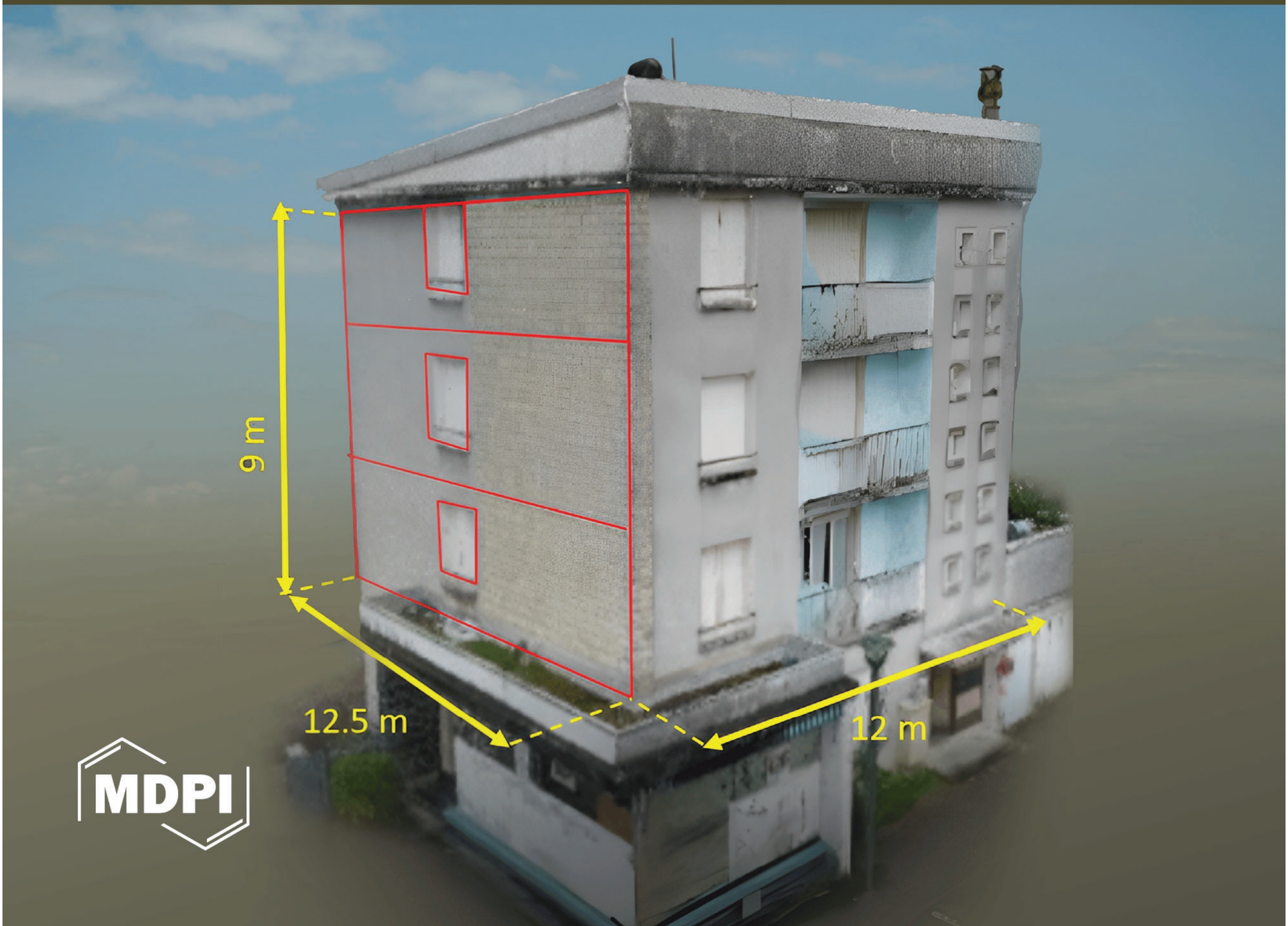

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Ugo Maria Coraglia, Davide Simeone and Marco Alvise Bragadin

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Review

Research Perspectives on Buildings' Sustainability after COVID-19: Literature Review and Analysis of Changes

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Abstract: The concept of sustainability introduced in 1987 has characterised the world of research in the AEC (*Architecture*, *Engineering*, and *Construction*) sector, directing it to try to tackle the problems inherent to the impacts of climate change on buildings. In addition, the advent of COVID-19, disrupting the world and people's habits, has obviously also strongly affected the academic world. Indeed, this paper aims to analyse the changes and differences between the pre- and post-pandemic periods through a two-stage hybrid literature review. First, through a systematic literature review, 90 articles were selected, filtered through different keywords (*sustainability*, *climate*, *architecture*, and *buildings*). Once the reasoned selection of papers had been made, it was possible to proceed to the second phase, which involved a thematic analysis according to the three classic macro themes of sustainability (*Environment*, *Social*, and *Economic*) and the inclusion of a fourth macro theme (*Management and Development*), which made it possible to reintroduce a holistic view of the problem. The results of this literature review revealed the presence of a growing interest in the topic analysed and a more homogenous distribution across all continents, with no distinction between developed and developing countries. *Economic* sustainability interests emerge post-COVID-19 through the deepening of the themes of clean energy and direct control of consumption. At the level of *Environmental* sustainability, on the other hand, COVID-19 replaced the house at the centre of people's lives. In addition, the *Management and Development* macro theme highlighted the need for an integrated view of the problem and the unexpected return of researchers preferring new constructions, which, despite alternative green approaches and renovations, can guarantee better performance.

Keywords: sustainability; climate change; COVID-19; impacts; architecture; building

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1. Introduction

The topic of environmental sustainability and the effects of climate change are growing rapidly in every sector and represent a global interest.

Non-scientists and people without a technical scientific background have also started to become aware of this through the considerable efforts of activities and programmes not strictly related to academia. The activities proposed, for example, by the young Swedish activist Greta Thunberg in favour of sustainable development and against climate change, as analysed by researchers at the Swedish University of Gävle, embodying the typical characteristics of the "moral leader", seek to direct people towards the prevention of climate change through the dissemination and promotion of more sustainable solutions aimed at environmental protection [1]. At the school and student levels, the strikes promoted in favour of climate action launched by G. Thunberg in 2018 contributed to many students asking the question "What is the point of education if we have no future?" and then coming together in the international student movement *Fridays for Future*. Some Australian schoolchildren in the city of Brisbane, stimulated through research and programmes in which they were personally involved, have come to the conclusion, even at a very young age, that better education with a focus on sustainable environmental management is the winning strategy for having a future [2].

Therefore, keeping in mind what is happening outside the academic world helps with better understanding how the topics of sustainability and climate change in the last five years are no longer the prerogative of commissions and institutional bodies. On the contrary, perhaps due to a growing lack of trust in political institutions, the world of education, and more specifically teachers, is being asked to take on the task of educating professionals and non-professionals alike on the most effective strategies to best address sustainable development and the impacts of climate change.

Indeed, the university academic world has contributed and continues to contribute through specific research programmes. In the European context, for instance, the Finnish University of Tampere, together with the Alma Mater Studiorum—University of Bologna in Italy, the TalTech of Tallinn in Estonia, the Irish University of Dublin, and the University of Aarhus in Denmark, coordinated the Erasmus Plus Programme, called Arch4Change, with the aim of studying and analysing existing methods and tools and proposing new pedagogical approaches based on innovative digital tools to support and improve the knowledge and skills of AEC students and teachers regarding environmental and climate sustainability in Design [3].

Research usually aims to try, albeit through very small steps, to change the world and the lives of the people in it for the better. Having been able to take part in the aforementioned Erasmus Plus project and having had to live with the pandemic events that have completely turned the world upside down in the last 3–4 years have given rise to inverted reasoning with respect to the classic point of view of research. The underlying thread of this reasoning is aimed at trying to understand if, how, and to what extent the tragic event that began in the first months of 2020 may have changed the way in which researchers in the fields of architecture and construction perceive and deal with issues related to sustainability and the impact of climate change on buildings.

To develop this research, we started with the analysis of data related to the construction sector, which is one of the main causes of the climate crisis in Europe, contributing 36% of the carbon dioxide emitted annually due to it making up 40% of the annual energy consumption [4]. Hence, the aforementioned events and opportunities led us to inquire, "In what manner has the research perspective on sustainability issues and the impact of climate change on buildings changed in light of the COVID-19 pandemic?". This query subsequently became the final goal of this survey.

2. Literature Review

2.1. Introduction to Sustainability and Sustainable Development

The concept of *sustainability*, or *sustainable development*, was introduced in 1987 through the UN Brundtland Report, in which it is defined as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [5].

The strong and proper impetus included in the aforementioned report to protect countries in crisis or developing countries has not, however, distracted the attention of the Urban Crisis Commission from what was and is happening in the cities of the industrial world, given that these "represent a high share of global resource use, energy consumption, and environmental pollution". Indeed, due to their behaviour and needs, many of these cities have an impact that goes beyond their urban boundaries by sourcing "resources and energy from distant territories, with enormous overall impacts on the ecosystems of these lands" [5].

2.2. The Construction Industry and Approaches to Sustainability in the Global Context

The construction industry is a complex and articulated machine and, at the same time, decisive for the world economy (and, consequently, for each individual nation). For a clearer reading of these statements, let us look at the data on the volume of business sustained in 2021, the year of recovery after the advent of the SARS-CoV-2 virus. The market value of the construction industry in that year was valued at USD 7.8 trillion, and with a production expenditure volume of USD 13.2 trillion and more than 180 million workers employed worldwide, it recorded revenues of more than USD 12 trillion. According to industry experts, these numbers are expected to increase in the coming years, and it is predicted that in 2030, with an expenditure volume of USD 14.4 trillion, revenues will exceed USD 22 trillion [6–8]. In Italy alone, driven by the tax incentives proposed by the state, such as *Bonus 110*, the construction sector grew by 27% in 2022 [9].

In order to tackle the issue of sustainability—a concept that is in itself far too vast, even if restricted to the field of construction—over the years, an attempt has been made to simplify it by breaking down the *problem* into several variables or areas of intervention. For this reason, although the ultimate aim is always to reduce the impact generated by the construction sector, in specific terms, it has started to refer to three different types of interconnected sustainability: *environmental*, *social*, and *economic–financial*. The CEN (European Committee for Standardisation) has also tried over the years to make its own contribution by supporting the various professionals involved in the AEC sector by dictating the rules of this new way of perceiving architecture. For example, the latest updates of the standards UNI EN ISO 14008—*Monetary assessment of environmental impacts and related environmental aspects* and UNI EN ISO 14006—*Environmental management systems—Guidelines for the integration of ecodesign* date back to 2019 and 2020, respectively [10,11].

2.3. The Intersection between Sustainability, Climate Change, and COVID-19

The concept of sustainability is closely linked to climate change issues, and for this reason, in 2022, the European Commission "committed to supporting the integration of climate resilience considerations into the construction and renovation of buildings", by commissioning the Danish consultancy Ramboll and the CE Deft, a Dutch research and consultancy centre, to undertake "a study to collect and synthesise existing methods, specifications, best practices, and guidelines for climate resilient buildings" with the final aim of drafting guidelines entitled *EU-level technical guidance on adapting buildings to climate change* [12].

One of the main goals of these guidelines will be to mitigate the priority risks that may affect buildings due to climate change so as to achieve an in-depth review of vulnerability and climate risk assessment methodologies (see Figure 1, RAMBOLL infographic).

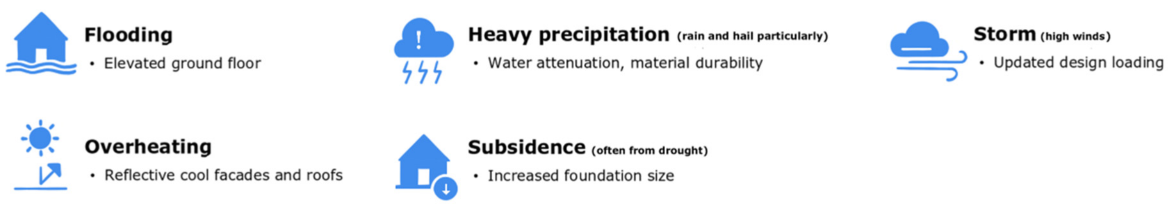

Figure 1. Infographic on priority risks that can affect buildings.

This research examines a multitude of documents of various types and provenance from recent studies undertaken by the European Union and academic studies, until the regulatory instruments that guide the building sector in each individual country, "will consider any variation required for different scales of buildings, from the individual to the whole block, providing feedback on the impact, ease of use, and synergies/conflicts of the methodologies" [12].

2.4. COVID-19 Implications of Environmental and Economic Sustainability

In the field of *environmental* sustainability, with regard to the problem of climate change, research has already been trying to make its contribution for several years, but three years ago the world was shaken by a totally unexpected event, the COVID-19 pandemic.

This worldwide pandemic upset and transformed, in the space of just a few months, the way people behaved and the way they perceived the world around them, drastically altering their perception of the spaces and environments in which they daily lived, worked, or simply spent their free time [13].

The link between the advent of COVID-19 and sustainability consists of a multiplicity of psycho-sociological and perceptual aspects, such as the fact that the occupancy pattern of buildings turns out to be one of the determining factors in assessing the energy performance and sustainability of buildings [14].

During the pandemic, due to the lockdown, there was an almost complete emptying out of offices, resulting in an improvement in the sustainability rating of the buildings that housed them and a profound decrease in transport pollution, both public and private, at the disadvantage of a consequent worsening of the sustainability rating of individual buildings in the residential sector.

As shown in Figure 2, in fact, considering that the minimum cubature of a classic office room, e.g., that of a public administration, must be at least 10 cu. m. per employee, multiplying by the number of employees present (4) and dividing by the mandatory minimum height (2.7 m for residential), we obtain approximately 15 sq. m. per employee. This size turns out to be the same as required for the living room (minimum 14 sq. m.) of a residential building [15,16]. Assuming for approximation that both rooms (office and living room) have a similar number of radiant elements, it can be assumed that during the periods spent working at home, the energy consumption required to heat the classic office room is no longer shared by the four colleagues but must be multiplied by four, i.e., to heat each individual room, in this case the living room, in which each employee worked. (NB: this is of course only an example estimate, but it is intended to quickly show the effects of the lockdown and the impact on individual homes.)

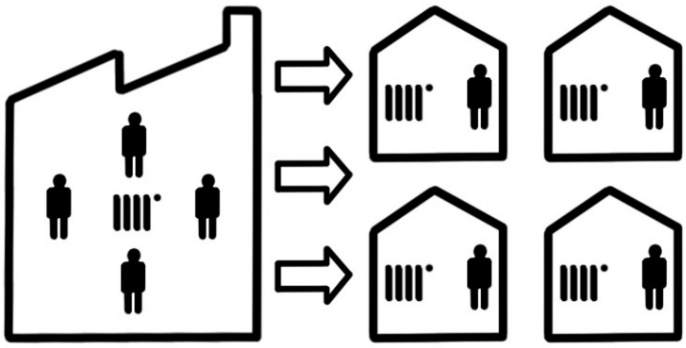

Figure 2. Diagram of the evolution of energy consumption attributable to 4 employees before and during the COVID-19 pandemic.

Professionals and workers were not the only ones who had to quickly change their work habits, transforming their homes into private offices from which to interact by video call with colleagues. In many of those home offices, students also had to coexist and find their own space while busy trying to attend classes, study, and interact with their peers through online classes and courses. On the level of *social* sustainability, it should be noted that some students, for example, those engaged in the transition from middle school to high school or from high school to university, found themselves interacting for at least a year with colleagues they had never met except in virtual spaces. The future will allow us to understand how much such an event may have affected young minds in the midst of physical, intellectual, and hormonal development and what kind of social side effects it may have caused [17,18].

2.5. Renovations and Energy Efficiency Improvements in the Construction Sector

Once the lockdown period had passed, the slow return to normal occupation of workplaces began, which at the same time had often been subjected to a complete redesign of spaces and a strict separation of internal pathways.

Certainly, if compared regarding the concept of sustainability, the impacts resulting from climate change and that due to COVID-19 appear to be travelling on parallel tracks but at completely different speeds. Compared to the disruptions caused by the pandemic, the impact attributable to climate change appears to have effects on buildings and their users that can be observed more in the long term. In both cases, however, the more or less significant consequences of these impacts will lead to non-negligible changes in the behaviour and perception of re-occupied spaces [19,20].

Taking climate emergencies into account during the design phases becomes a fundamental aspect of the new way of conceiving sustainable architecture, and professionals must be an active part of this radical change in perspective. Driven by these motivations, a number of researchers initiated a project to direct students towards these issues even before they became professionals. By working on teaching methods and students, in fact, it is possible to ensure that they, through their academic careers, acquire the appropriate tools to implement the changes in perspective that the AEC sector needs in order to pursue better sustainable architecture [21].

In the construction sector, the desire or need to converge efforts as much as possible to achieve ever greater levels of sustainability is also dictated by purely economic and practical aspects.

In recent years, both in the Italian and international contexts, the desire to pursue the *economic* and *environmental* sustainability of buildings has encouraged the preservation of the existing heritage with respect to possible demolition, reconstruction, or new construction. Renovations aimed at preserving the aforementioned building heritage have the main objective of improving the building's performance in various aspects, mainly energy.

In Italy, for example, considering only the hospital sector, 85% of healthcare facilities were built before the early 1900s, with the consequent result that 80% of operating theatres today are non-standard in terms of minimum suitability requirements [22].

The data for the residential sector are no longer comforting. The Italian government, with the aim of restarting the economy and overcoming the problems that had emerged due to the coronavirus, by exploiting the flywheel of sustainability, proposed significant tax breaks for renovation work in the residential building sector with the purpose of improving energy efficiency. In order to obtain these reductions, renovations had to aim for a mandatory improvement of two energy classes of the building compared to the situation at the beginning of the work.

According to the report of the Italian National Agency for New Technologies, Energy, and Sustainable Economic Development (ENEA), as of September 30, 2021, the number of renovations attributable to the *Bonus 110* tax break exceeded 46,000 properties, for a total of EUR 7.5 billion in investments [23].

Concerning the issues related to the sustainability of the existing building heritage, in 2013 researchers from numerous European universities and research institutions, thanks to the European Union's Intelligent Energy Europe programme (IEE), began to be concerned and deal with "making transparent and effective energy refurbishment processes in the European housing sector", first through the cataloguing of building types present in Europe (Project TABULA), which then extended to the "development of building stock models to assess renovation processes and predict future energy consumption", leading to the drafting of an "agreed set of energy performance indicators that will allow key actors and stakeholders to ensure, at different levels, a high quality of energy renovations, compliance with regulations, to monitor and guide renovation processes in a cost-effective way and to assess the energy savings actually achieved", the ultimate goal of the EPISCOPE project [24].

2.6. COVID-19 and Its Impact on the Global Supply Chain

Environmental sustainability and *economic* sustainability, although they both serve the same purpose, due to the different domains in which they operate, may find themselves making choices in opposition to each other. A glaring example, which emerged during the pandemic and has largely persisted up to the present day, is the negative impact of COVID-19 on the global supply chain. This problem has an even more serious impact when materials produced in one country are denied the shortest route to their destination site. This interruption makes it impossible to implement a sustainable supply chain, the ultimate aim of which is to try to reduce greenhouse gas emission levels by designing the fastest link between supply and demand. A link was, indeed, impossible to make during a pandemic with entire nations in lockdown [25].

Moreover, global supply problems are exceedingly difficult to address, not only for highly developed nations but especially for small developing states. Within this category, for example, the Small Island Developing States (SIDS), basing their economy purely on the tourism sector (e.g., the Seychelles' GDP is 67% due to tourism), in addition to suffering from the negative impacts of climate change for years, have suffered dramatic drops in their GDP due to COVID-19, on average 7.3%, with peaks of 16% for the Maldives and Seychelles. Furthermore, the obligation to deal with disasters caused by the increasingly frequent occurrence of extreme weather events has deeply undermined their already fragile economy, hampering their ability to deal with further natural disasters. In the same year as COVID-19, for example, the pandemic and quarantine prevented SIDS from providing the necessary health and humanitarian assistance after Cyclone Harold struck.

The scientific community, through the International Science Council (ISC), set up a scientific committee to support these small states as early as 2020, while the Organisation for Economic Co-operation and Development (OECP) has initiated studies to map the disastrous consequences on the economies of these states due to the advent of COVID-19. According to the UN, SIDS face substantial challenges in terms of sustainable development from the pandemic, climate change, and the political choices of the rest of the world and therefore require urgent support—financial, technical, and material—from the entire international community, scientific and otherwise [26–28].

In light of the analysis of the main issues related to sustainability in the building sector, the main objective of this research is to understand, through a review of the literature inherent to the topic, how the way of perceiving sustainability and the impact of climate change on buildings have changed since the advent of COVID-19.

3. Methodology

The main purpose of this investigation is to try to analyse and understand how much a dramatic and shocking event such as the advent of COVID-19 in everyday life may have contributed to changing the perception in academia of both the concept of sustainability and the importance of the impact of climate change in the construction sector.

In order to better structure the search for useful data and be able to start answering our main question, we decided to follow a four-step survey methodology, each one useful to direct the next step to be taken and respond to a precise query (see Figure 3).

Once we had defined the starting point, namely the reason for this literature review, the next step was to define where to look for our answers. In this case, in the first instance, the idea was to work directly on several databases at once and weave the data between them. Specifically, the choice was initially oriented towards two Elsevier databases, Scopus and Engineering Structure, and one ASCE.

This approach, although later abandoned, was useful to test through 30 articles the type and feasibility of the analyses that would later be conducted; it practically assumed the function of the prototype of the review itself. The motivation that initially led us to abandon this way of working in favour of the use of a single database, in this case Elsevier's Scopus, was not only the practicality of managing data from a single source, but above all the fact that we could deal with comparable data without having to *invent* correspondence systems due to the different treatments that each database reserves for its own data, such as the keywords for indexing the article, the evaluation or citation system, or having to take into consideration the differences in the dissemination of the database itself.

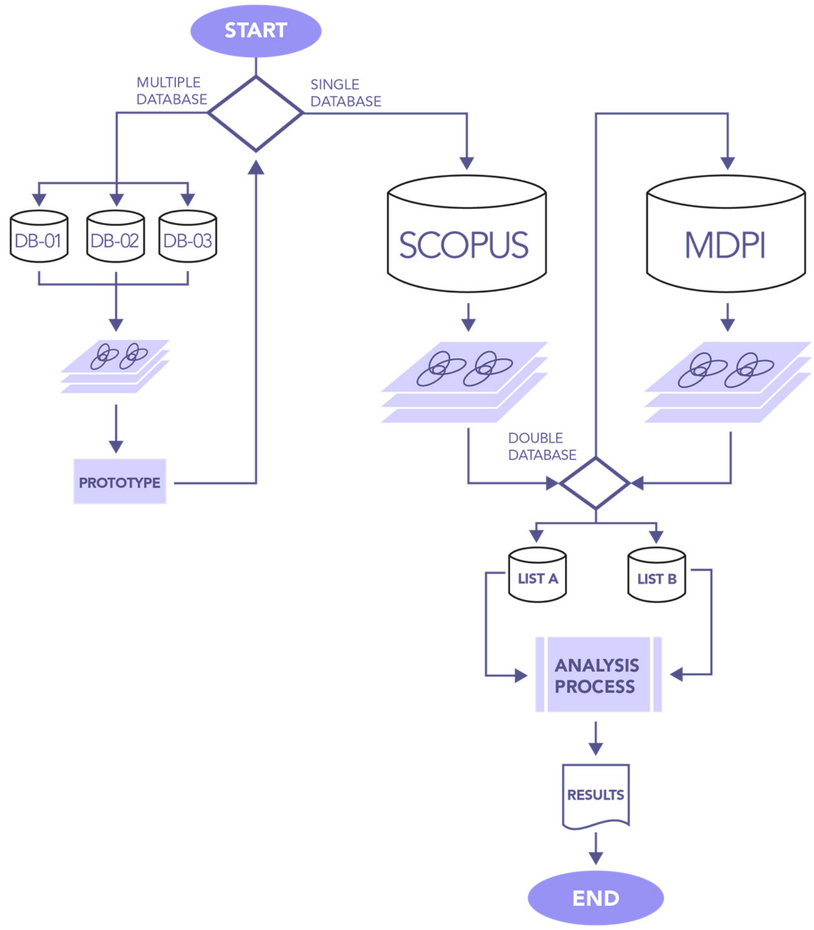

Figure 3. Literature review process flowchart.

Once we had defined the knowledge database to refer to and draw data from, we tried to define the amount of data at our disposal by using the two main keywords, *sustainability* (165,018 articles available since 1982) and *climate change* (301,788 articles available since 1901), and defining a time range. For the keyword *climate change*, in order to avoid losing any other associations, e.g., with *impacts*, *problems*, etc., we preferred to take into consideration the larger dataset related to the word *climate* alone (498,868 articles available since 1907).

Although the definition of sustainability dates back to the late 1980s [5], the keystone event of our analysis comes from 2020, and examining 40 years of research might have been counterproductive without the introduction of a careful analysis of all the other world events that have brought about more or less important stances and/or upheavals on the issue of sustainability and climate change. For this reason, taking into consideration only the data obtained from the intersection of the datasets relating to both keywords, we preferred from the outset to move the extreme left-hand side of the time span directly from 1988 to 2007, the year in which at least 100 articles began to be published annually. On the other hand, the right extreme, having little wiggle room, only suffered the 2023 cut-off, which cannot be considered a stable source of data because it is still in progress and undergoing daily changes and updates. Finally, with the last modification of the left extreme from 2007 to 2008, a time span of 15 years was defined, from 2008 to 2022, with a total database of 11747 searchable articles.

To further circumscribe the data in our possession, we introduced two additional keywords: *architecture* (365,255 articles, 2008–2022) and *building* (337,416 articles, 2008–2022).

This, in addition to limiting the number of articles, allowed the available data to become more relevant to the AEC sector in which we operate.

In contrast to what was carried out before with the datasets from the words *sustainability* and *climate*, in this case the data from the four keywords were not intersected all together, as this could have led to the exclusion of many interesting data, but instead it was preferred to operate with two distinct clusters through the intersection of three datasets at a time, as illustrated in Figure 4.

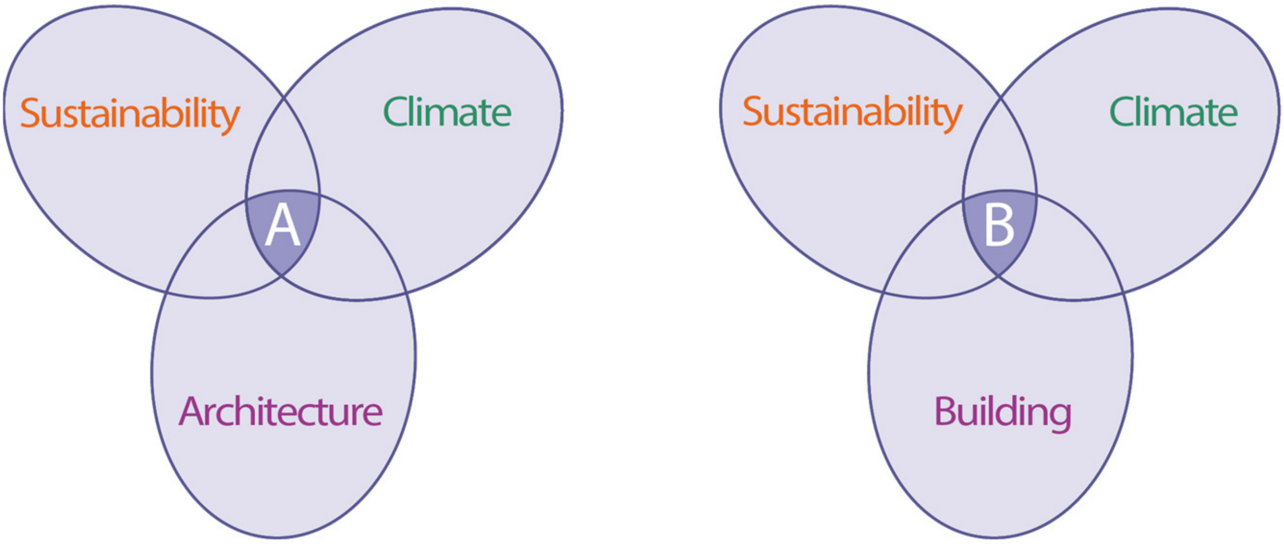

Figure 4. Dataset intersection of keyword triples to obtain the collections of papers from which lists A and B will be extracted.

This operation allowed us to arrive at under 1000 available data, namely 798 articles, obtained from the union of two collections of data: the first of 124 articles, obtained from the intersection of the sets referring to the three keywords *sustainability–climate–architecture*, and the second of 674 articles, obtained from the intersection of *sustainability–climate–building*.

Two lists were extrapolated from these two collections, taking for each of them 5%, in excess, of the articles published each year. The first, referred to as List A, consists of 13 articles, while List B consists of 36, for a total sample of 49 articles published from 2008 to 2022.

For the creation of both lists, articles were chosen by considering those that had obtained the highest number of citations by January 2023, skimming off any articles that, for indexing reasons, were in the set but were distant from the main research topic.

Although the final database defined by 49 articles allowed the various analyses useful for answering the questions that gave rise to this survey to be conducted, the idea of being able to conduct an even more accurate analysis through the use of multiple databases still seemed to be the best strategy. In order to implement it, however, we decided not to repeat the process just described on the other databases hypothesised at the beginning, but, due to the subject of the survey, we considered it more correct to focus on the analysis of a database characterised by articles strongly linked to the theme of sustainability. For this reason, MDPI's *Sustainability* journal database was chosen.

For this database, all the same steps described for the Scopus database were conducted.

Firstly, we again circumscribed the amount of data present through the keywords *sustainability* (1,021,319 articles available from 2002 to 2022) and *climate* (40,603 articles available from 2005 to 2022). Further, by interweaving the data from these two sets and using the same time range defined for the Scopus database analysis (2008–2022), we obtained a total database of 953 searchable articles.

The subsequent level of skimming involved, again, the introduction of the two keywords *architecture* (2903 articles, 2008–2022) and *building* (6652 articles, 2008–2022).

Even with this database, the intersection of the datasets obtained by means of keyword triples allowed us to stay under 1000 data available. In detail, the 956 data obtained are divided into two clusters: one of 139 articles obtained from the *sustainability–climate–architecture* keywords and one of 818 articles from the *sustainability–climate–building* keywords.

Finally, to define the two lists A and B of the MDPI database, we noted that we could further narrow the range to 2013–2022 due to the few papers present in the five-year period 2008–2013.

Thus, by taking from each collection 5% in excess of the articles published each year—and by default, at least one article in the rare cases where this percentage was unable to meet the requirement—we obtained List A of 13 articles and List B of 31.

Also in this case, the articles were chosen by taking into consideration those that had obtained the highest number of citations, discarding any articles that, for indexing reasons, were in the set but were distant from the main theme of the search.

Having reached this point and having obtained comparable datasets from each database, we merged both the A and B lists, resulting in a total of 93 papers. The merging of lists A and B of the two databases revealed that three articles selected in the MDPI database had already been selected through the first systematic review. For this reason, we obviously eliminated them, resulting in a total of 90 unique articles (see Figures 5 and 6).

List	Author	Title	Year
A01	Ezeh C.I., et al.	*High rise office building makeovers—Exploiting architectural and engineering factors in designing sustainable buildings in different climate zones*	2022
A02	Salameh M., et al.	*Traditional Passive Design Solutions as a Key Factor for Sustainable Modern Urban Designs in the Hot, Arid Climate of the United Arab Emirates*	2022
A03	Qureshi R.A., et al.	*Investigating Sustainability of the Traditional Courtyard Houses Using Deep Beauty Framework*	2022
A04	Schiano-Phan R., et al.	*Pedagogy Pro-Design and Climate Literacy: Teaching Methods and Research Approaches for Sustainable Architecture*	2022
A05	Paris, M., et al.	*Simulation Tools for the Architectural Design of Middle-Density Housing Estates*	2022
A06	Khan R., et al.	*Energy Sustainability Survey on Technology and Control of Microgrid Smart Grid and Virtual Power Plant*	2021
A07	Seyrek C., et al.	*Sustainability-Related Parameters and Decision Support Tools for Kinetic Green Façades*	2021
A08	Røstvik H.N.,	*Sustainable Architecture—What's Next?*	2021
A09	Pais M.R., et al.	*Understanding Bunker Architecture Heritage as a Climate Action Tool: Plan Barron in Lisbon as a "Milieu" and as "Common Good" When Dealing with the Rise of the Water Levels*	2021
A10	Muraj I., et al.	*Sustainability Environmental Performance and Energy Efficiency in Higher Education Faculty of Architecture University of ZagrebIOP Conference Series Earth and Environmental Science*	2020
A11	Costa M.L., et al.	*Strategies for thermal comfort in university buildings The case of the faculty of architecture at the Federal University of Bahia, Brazil*	2019
A12	Pilař L., et al.	*Twitter Analysis of Global Communication in the Field of Sustainability*	2019
A13	Chiou Y.S., Elizalde J.S.	*Thermal Performances of Three Old Houses: A Comparative Study of Heterogeneous Vernacular Traditions in Taiwan*	2019
A14	Mileto C., et al.	*The Influence of Geographical Factors in Traditional Earthen Architecture: The Case of the Iberian Peninsula*	2019
A15	Lozano Miralles J.A., et al.	*Comparative study on the environmental impact of traditional clay bricks mixed with organic waste using life cycle analysis*	2018
A16	Mancini F., et al.	*Energy and environmental retrofitting of the university building of Orthopaedic and Traumatological Clinic within Sapienza Città Universitaria*	2017
A17	Bajcinovci B,. et al.	*Achieving energy efficiency in accordance with bioclimatic architecture principles*	2016
A18	Holstov A., et al.	*Hygromorphic materials for sustainable responsive architecture*	2015
A19	Vazquez E., et al.	*Incorporation of bioclimatic conditions in architectural projects A case study of the Solar Hemicycle building, Madrid, Spain*	2014
A20	De Waal R.M., Stremke S.	*Energy Transition: Missed Opportunities and Emerging Challenges for Landscape Planning and Designing*	2014
A21	Conejos S., et al.	*AdaptSTAR model_A climate friendly strategy to promote built environment sustainability*	2013
A22	Baek J.	*Fudo: An East Asian Notion of Climate and Sustainability*	2013
A23	Almatawa M.S., et al.	*Passive and active hybrid approach to building design in Saudi Arabia*	2012
A24	McPherson E.G., et al.	*Million trees Los Angeles canopy cover and benefit assessment*	2011
A25	Indraganti M.	*Understanding the climate sensitive architecture of Marikal, a village in Telangana region in Andhra Pradesh, India*	2010

Figure 5. List A—intersection of the sustainability–climate–architecture keywords [29–53].

Figure 6 shows the flowchart of the entire literature review process, from the initial question (START), which started the survey, to the collection of data and their analysis, as described in this chapter, and finally to the final results and conclusion (END), which will be shown in the following chapters.

List	Author	Title	Year
B01	Meena C.S., et al.	*Innovation-in-Green-Building-Sector-for-Sustainable-FutureEnergies*	2022
B02	Fnais A., Rezgui Y., et al.	*The-application-of-life-cycle-assessment-in-buildings-challenges-and-directions-for-future-researchInternational-Journal-of-Life-Cycle-Assessment*	2022
B03	Silva R., et al.	*Opportunities for passive cooling to mitigate the impact of climate change in Switzerland*	2022
B04	Mannan M., et al.	*Investigating environmental life cycle impacts of active living wall for improved indoor air quality*	2022
B05	Debrah C., et al.	*Green finance gap in green buildings A scoping review and future research needs*	2022
B06	Cortese T., et al.	*Understanding Sustainable Energy in the Context of Smart Cities: A PRISMA Review*	2022
B07	Monna S., et al.	*Potential Electricity Production by Installing Photovoltaic Systems on the Rooftops of Residential Buildings in Jordan: An Approach to Climate Change Mitigation*	2022
B08	Pérez-Carramiñana C., et al.	*Optimization of Architectural Thermal Envelope Parameters in Modern Single-Family House Typologies in Southeastern Spain to Improve Energy Efficiency in a Dry Mediterranean Climate*	2022
B09	Teo Y.H., et al.	*Urban Heat Island Mitigation: GIS-Based Analysis for a Tropical City Singapore*	2022
B10	Niza I.L., et al.	*Thermal Comfort and Energy Efficiency: Challenges, Barriers, and Step towards Sustainability*	2022
B11	Albatayneh A., et al.	*Reducing the Operating Energy of Buildings in Arid Climates through an Adaptive Approach*	2022
B12	Im Y.H.	*Assessment of the Technological Sustainability of the Tri-Generation Model in the Era of Climate Change: A Case Study of Terminal Complexes*	2022
B13	Gounden K., et al.	*A Perspective on Four Emerging Threats to Sustainability and Sustainable Development*	2022
B14	Nematchoua M.K., et al.	*Strategies and scenarios to reduce energy consumption and CO2 emission in the urban, rural and sustainable neighbourhoods*	2021
B15	Bardzell J., et al.	*Wanting-to-live-here-Design-after-anthropocentric-functionalism*	2021
B16	Khahro S.H., et al.	*Optimizing-energy-use-cost-and-carbon-emission-through-building-information-modelling-and-a-sustainability-approach-A-casestudy-of-a-hospital-buildingSustainability-Switzerland*	2021
B17	Fishman T., et al.	*A comprehensive set of global scenarios of housing, mobility, and material efficiency for material cycles and energy systems modeling*	2021
B18	Elshafei G., et al.	*Towards an Adaptation of Efficient Passive Design for Thermal Comfort Buildings*	2021
B19	Khalaf R.W.	*World Heritage on the Move: Abandoning the Assessment of Authenticity to Meet the Challenges of the Twenty-First Century*	2021
B20	Zarco-Periñán P., et al.	*Influence of Population Density on CO2 Emissions Eliminating the Influence of Climate*	2021
B21	Giresini L., et al.	*Environmental and Economic Impact of Retrofitting Techniques to Prevent Out-of-Plane Failure Modes of Unreinforced Masonry Buildings*	2021
B22	Raveendran R., et al.	*A Meta-Integrative Qualitative Study on the Hidden Threats of Smart Buildings/Cities and Their Associated Impacts on Humans and the Environment*	2021
B23	Fabbri K., et al.	*A Replicable Methodology to Evaluate Passive Façade Performance with SMA during the Architectural Design Process: A Case Study Application*	2021
B24	Wretling V., et al	*Are Local Authorities Building Their Capacity to Plan for Reduced Climate Impact? A Longitudinal Analysis of Swedish Comprehensive Plans*	2021
B25	Bulbaai R., et al.	*Energy-Efficient Building Design for a Tropical Climate: A Field Study on the Caribbean Island Curaçao*	2021
B26	Tokazhanov G., et al.	*How-is-COVID19-experience-transforming-sustainability-requirements-of-residential-buildings-A-reviewSustainability-Switzerland*	2020
B27	Goldstein B., et al.	*The-carbon-footprint-of-household-energy-use-in-the-United-StatesProceedings-of-the-National-Academy-of-Sciences-of-the-United-States-of-America*	2020
B28	Stegmann P., et al.	*The circular bioeconomy Its elements and role in European bioeconomy clusters*	2020
B29	Amaral A.R., et al.	*A review of empirical data of sustainability initiatives in university campus operations*	2020
B30	Maraveas C.	*Production-of-sustainable-construction-materials-using-agrowastesMaterials*	2020
B31	Mancini F., Lo Basso G.	*How Climate Change Affects the Building Energy Consumptions Due to Cooling, Heating, and Electricity Demands of Italian Residential Sector*	2020
B32	Xue J., et al.	*Applications of Local Climate Zone Classification Scheme to Improve Urban Sustainability: A Bibliometric Review*	2020
B33	Zheng Y., Weng, Q.	*Modeling the Effect of Green Roof Systems and Photovoltaic Panels for Building Energy Savings to Mitigate Climate Change*	2020
B34	Keniry, L.J.	*Equitable Pathways to 2100: Professional Sustainability Credentials*	2020
B35	Pardo-Bosch F., et al.	*Key aspects of building retrofitting Strategizing sustainable cities*	2019
B36	Lanau M., et al.	*Taking-Stock-of-Built-Environment-Stock-Studies-Progress-and-Prospects*	2019
B37	Edwards R.E., et al.	*Sustainability-led design Feasibility of incorporating whole-life cycle energy assessment into BIM for refurbishment projects*	2019
B38	Sesana E., et al.	*Mitigating Climate Change in the Cultural Built Heritage Sector*	2019
B39	McEvoy D., et al.	*Integrating Teaching and Learning with Inter-Disciplinary Action Research in Support of Climate Resilient Urban Development*	2019
B40	Orr S.A., et al.	*Wind-driven rain and future risk to built heritage in the United Kingdom, Novel metrics for characterising rain spells*	2018
B41	Invidiata A., et al.	*Selecting design strategies using multi-criteria decision making to improve the sustainability of buildings*	2018
B42	Breton C., et al.	*Assessing-the-climate-change-impacts-of-biogenic-carbon-in-buildings-A-critical-review-of-two-main-dynamic-approachesSustainability-Switzerland*	2018
B43	Padilla-Rivera A., et al.	*Evaluating the Link between Low Carbon Reductions Strategies and Its Performance in the Context of Climate Change: A Carbon Footprint of a Wood-Frame Residential Building in Quebec, Canada*	2018
B44	Toparlar Y., et al.	*A review on the CFD analysis of urban microclimate*	2017
B45	Mahmoud A.S., et al.	*Energy-and-economic-evaluation-of-green-roofs-for-residential-buildings-in-hothumid-climatesBuildings*	2017
B46	Spaans M., Waterhout B.	*Building up resilience in cities worldwide – Rotterdam as participant in the 100 Resilient Cities Programme*	2017
B47	Pianella A., et al.	*Substrate Depth, Vegetation and Irrigation Affect Green Roof Thermal Performance in a Mediterranean Type Climate*	2017
B48	Alrashed F., et al.	*The Role of Vernacular Construction Techniques and Materials for Developing Zero-Energy Homes in Various Desert Climates*	2017
B49	Khan H.S., et al.	*Case Study of a Nearly Zero Energy Building in Italian Climatic Conditions*	2017
B50	Kammen D.M., Sunter D.A.	*City-integrated renewable energy for urban sustainability*	2016
B51	Coma J., et al.	*Thermal assessment of extensive green roofs as passive tool for energy savings in buildings*	2016
B52	Kim D., Lim U.	*Urban Resilience in Climate Change Adaptation: A Conceptual Framework*	2016
B53	Alibaba H.	*Determination of Optimum Window to External Wall Ratio for Offices in a Hot and Humid Climate*	2016
B54	Yang J., et al.	*Environmental impacts of reflective materials_Is high albedo a 'silver bullet' for mitigating urban heat island*	2015
B55	Clear A.K., et al.	*Catch my drift Achieving comfort more sustainably in conventionally heated buildings*	2014
B56	Kumar P., Imam B.	*Footprints of air pollution and changing environment on the sustainability of built infrastructure*	2013
B57	Kok K.H., et al.	*Evaluation-of-green-roof-as-green-technology-for-urban-stormwater-quantity-and-quality-controls*	2013
B58	Sun F.	*Chinese Climate and Vernacular Dwellings*	2013
B59	Erkal A., et al.	*Assessment of wind-driven rain impact, related surface erosion and surface strength reduction of historic building materials*	2012
B60	Haggag M.A., et al.	*Design-with-nature-Integrating-green-faades-into-sustainable-buildings-with-reference-to-Abu-Dhabi*	2012
B61	Jane Wilkinson S., Reed R.	*Examining-and-quantifying-the-drivers-behind-alterations-and-extensions-to-commercial-buildings-in-a-central-business-district*	2011
B62	Kelly M.J.	*Energy-efficiency-resilience-to-future-climates-and-longterm-sustainability-The-role-of-the-built-environment*	2010
B63	Gosztonyi S., et al.	*Challenging-the-engineering-view-Comparative-analysis-of-technological-and-biological-functions-targeting-energy-efficient-facade-systems*	2010
B64	Isaksson R., Steimle U.	*What does GRI reporting tell us about corporate sustainability*	2009
B65	Kharrufa S.N.	*Evaluation of Basement s Thermal Performance in Iraq for Summer Use*	2008

Figure 6. List B—intersection of the sustainability–climate–building keywords [54–118].

4. Results and Discussion

The main objective of this review is to attempt to highlight, through the management and analysis of the 90 papers extracted from Elsevier's Scopus database and MDPI's *Sustainability* database according to the procedures described in the previous paragraph, any changes in perception (that can be recorded) within the world of research regarding the concepts of sustainability and the impact of climate change on buildings after the advent of COVID-19.

After conducting a systematic analysis of the literature, we decided to investigate through a thematic analysis of the papers, which, starting from the analysis of their distribution and annual publication trend, arrives at a comparative analysis according to four macro themes (see Figure 7). In addition to the three classic macro themes of sustainability (*Environmental*, *Social*, and *Economic*), we have in fact added a new macro theme—Management and Development—which focuses more on the aspects of planning/management and sustainable development with an integrated long-term vision.

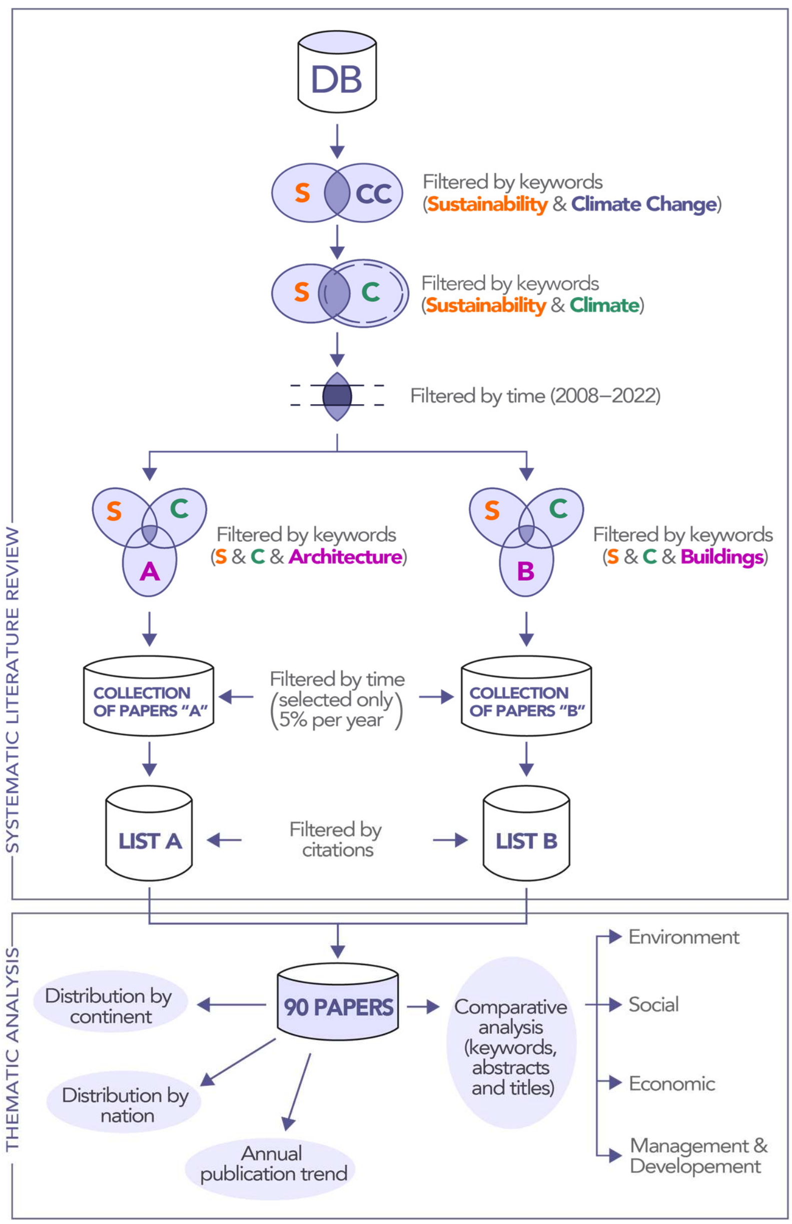

Figure 7. Focus on systematic literature review and thematic analysis.

The papers involved authors from universities and research institutions from 47 different countries distributed over five continents (only Antarctica remains excluded). As can be seen from the pie charts, prior to COVID-19 (Figure 8A), the data analysed show an interest expressed more by academics from European universities (50.8%) and the presence of articles from only four continents (Europe, the Americas, Asia, and Oceania). From 2020, on the other hand, we can see that interest is more evenly distributed across all continents, with academics from countries on the African continent also participating (see Figure 8B). The greatest growth can be seen among papers from the Asian continent—from 22.3% to 37.6%—partly attributable to the media exposure of the Chinese city of Wuhan as the epicentre of the epidemic.

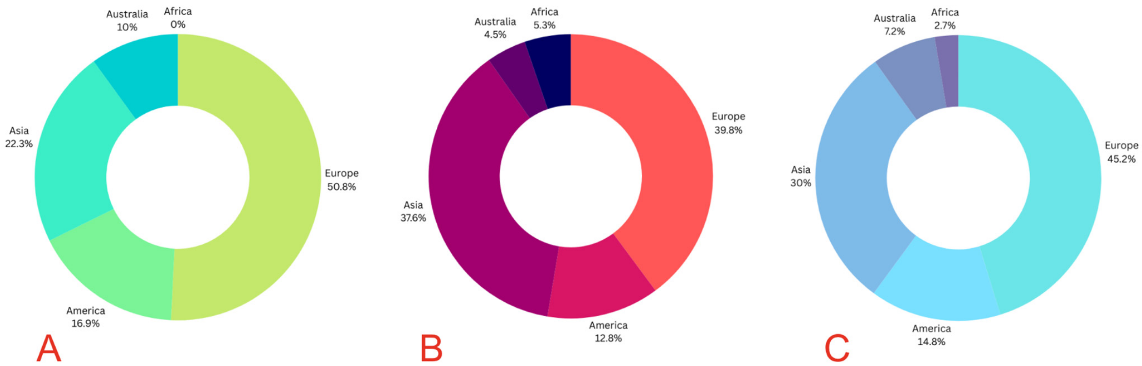

Figure 8. Papers distribution by continent ((**A**) pre-COVID-19, (**B**) post-COVID-19, and (**C**) total).

This difference in distribution can also be seen in the bar graphs (Figure 9), where before COVID-19, a more punctual distribution could be seen. The greatest interest in sustainability topics is concentrated on a few nations (green bars pointing downwards), among which the United Kingdom stands out especially, followed by Australia, Spain, Saudi Arabia, and Canada, while post-COVID-19 the interest in the same topics is less confined to a few nations in favour of a wider distribution (red bars pointing upwards), with a growing interest of academics from Asian (from 22.3% to 37.6%) and African (from 0% to 5.3%) nations. These data testify to the scientific community's commitment to tackling major global challenges, irrespective of which university they come from, whether from a highly developed nation or a small developing state.

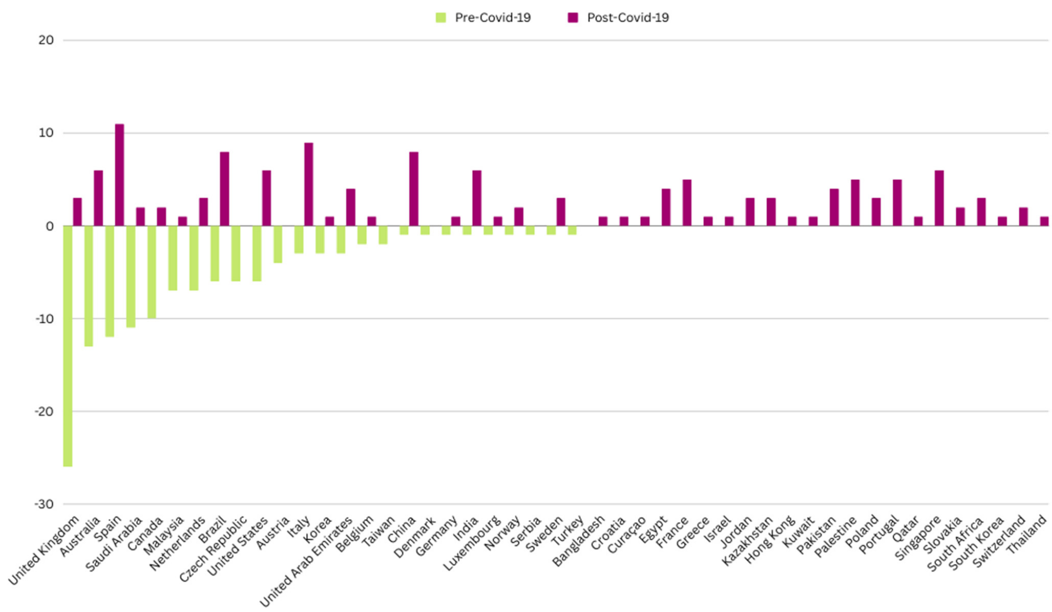

Figure 9. Papers distribution by nation (pre-COVID-19, in green, and post-COVID-19, in purple).

The graph in Figure 10, on the other hand, based on the data obtained by rounding up the 5% of annual publications selected for this research, shows the growing interest in the topics/issues of sustainability and climate change, highlighting how the advent of the pandemic has led to a decisive increase in publications. According to the extrapolated data, almost as many papers were published in the three-year period 2020–2022 as in the entire previous decade.

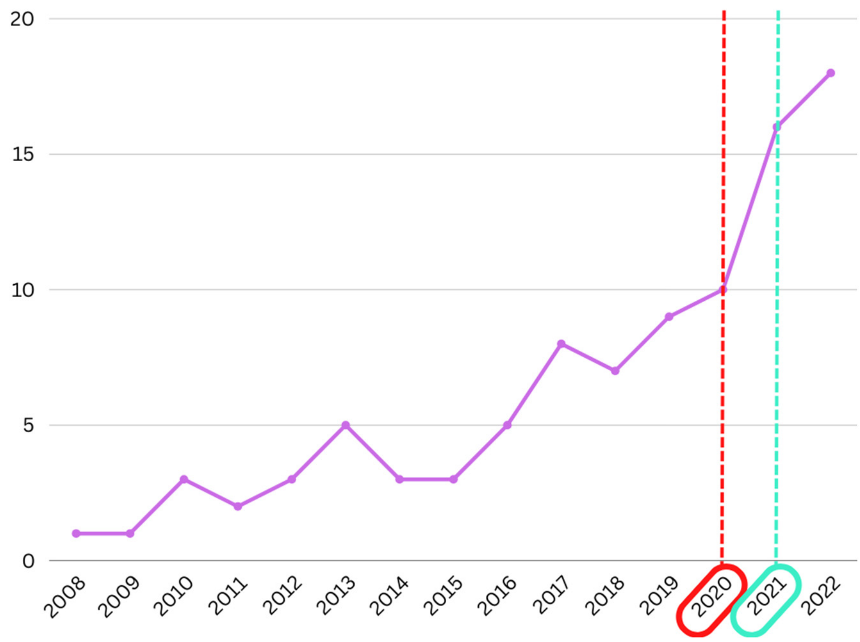

Figure 10. Annual publication trend (in purple) with COVID-19 key points: first pandemic outbreak (in red) and vaccine availability (in green).

The second type of analysis, on the other hand, involves keywords, titles, and abstracts.

Taking into consideration the keywords chosen by the authors at the time of publication of their paper, an attempt was made to identify the main themes and issues dealt with within the various papers, subdividing them by pre- and post-COVID-19.

In order to bring out more clearly the themes with which the concepts of sustainability and climate change were dealt with during the 15 years examined, the extrapolation algorithm was set up so as to group similar words, e.g., *develop* and *development*, or words with overlapping meanings, e.g., avoid considering *assessment* and *evaluation* as two separate words, so as to avoid miscounting. Furthermore, since it did not make sense to bring them up in this context, the keywords (*architecture*, *architectural*, *building*, *buildings*, *climate change*, *sustainability*, *sustainable*) previously used to obtain the 94 articles under examination from the Elsevier and MDPI databases were excluded in the algorithm settings.

After the counting, we proceeded to subdivide the keywords according to four macro themes: the three classic areas of sustainability—*Environmental*, *Economic*, and *Social*—to which we added a fourth area, defined as *Management and Development*. This subdivision not only brings the analyses in line with the main theme of this survey but also makes it possible to conduct a targeted comparative analysis.

The comparative analysis of the *Environmental* macro theme (see Figure 11) highlights the constancy and importance of the *Energy* theme, which continues to be a central pillar of the environmental debate, regardless of external circumstances. In addition, it can be seen that before COVID-19, interest was more focused on technical–scientific aspects (*efficiency*, *performance*, *humid*, *bioclimatic*), with an interest in the entire life cycle of the building (*life cycle*), while after the epidemic, the topics most discussed were those concerning clean and renewable energy (*zero*, *emission*, *renewable*, *green*).

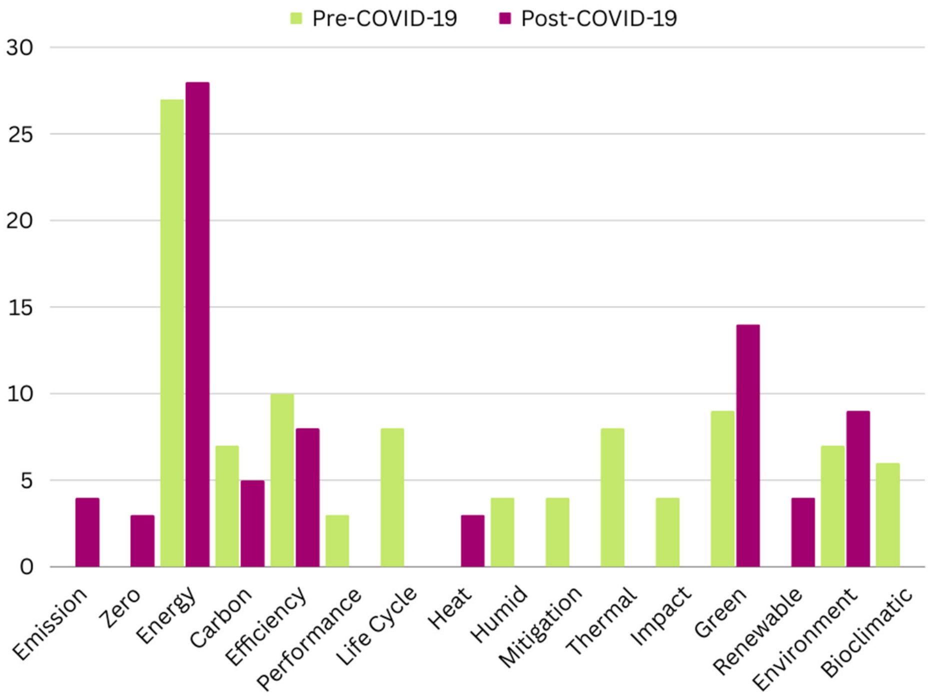

Figure 11. Comparative analysis of keywords related to the macro theme Environmental.

The second comparative analysis concerns the *Economic* macro theme (see Figure 12). Through this analysis, we can see how the importance that in the past was given to analyses and evaluations (*assessment*, *analysis*), which we could say were linked to the technical–scientific aspects we spoke of in the previous comparative analysis, from 2020 passes into the background, joined by purely economic interests (*demand*, *economy*) but, above all, replaced by interest, or perhaps more so by concern, for the theme regarding energy consumption (*consumption*). Thus, a transition can be noted from approaches linked to detailed studies and analyses towards the search for *immediate* answers triggered by compelling needs and necessities, daughters of the advent of COVID-19.

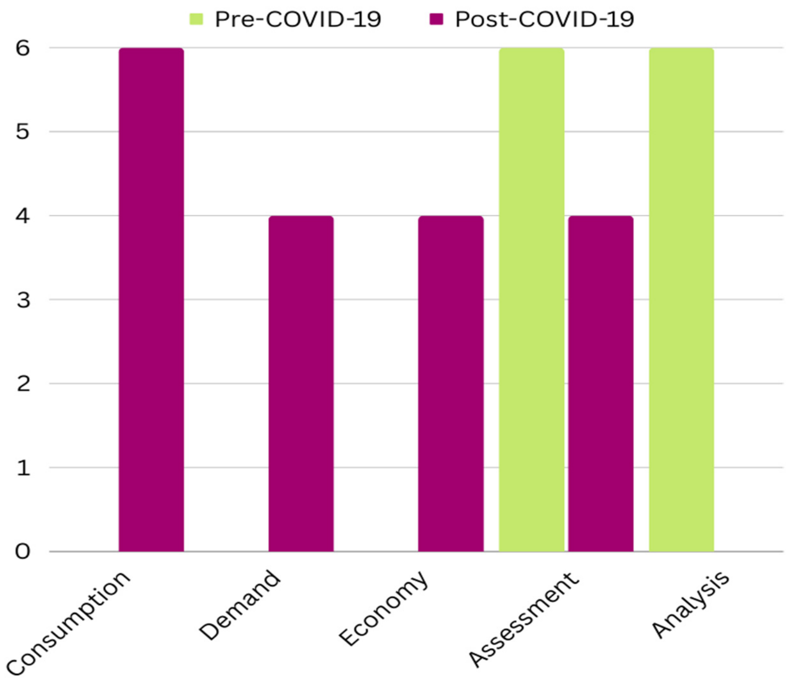

Figure 12. Comparative analysis of keywords related to the macro theme Economic.

The third macro theme covered by this comparative analysis is the *Social* one (see Figure 13). In this case, the importance of design remains constant, as does interest in the urban aspect and the heritage it contains (*design*, *urban*, *heritage*). However, we can see how, post-COVID-19, there is a marked increase in interest in the home and the environments that make it up (*residential*, *comfort*). This can be attributed to the forced rediscovery of the home as the fulcrum of everyday life, due to the months of isolation. Place(s) that allowed us to live and work even if not expressly designed to meet these new extraordinary needs became important. The resilience of a building (*resilience*), a characteristic studied and, above all, researched in the pre-pandemic period, is completely neglected, probably also in this case to meet extraordinary demands that needed immediate design responses/solutions. This comparative analysis, although focused on the comfort of the building—both in terms of the spaces it is made up of and in its urban reality—highlights the importance of trying to think more and more globally and how it is no longer possible and convenient to limit ourselves to the management of our own back yard (*world*).

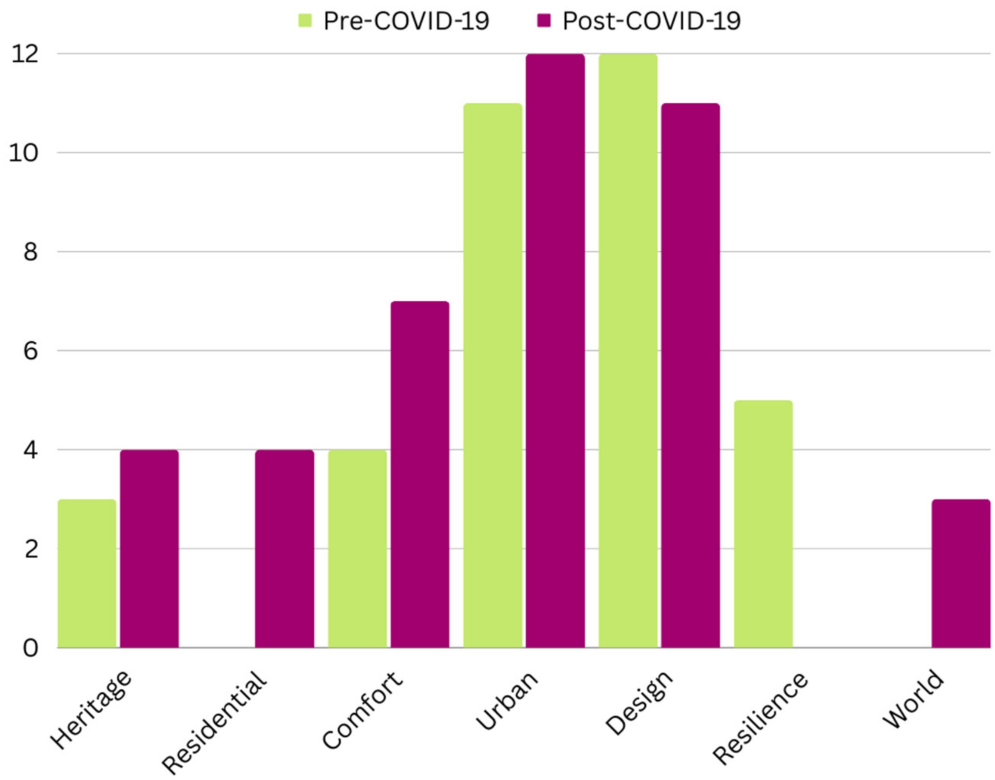

Figure 13. Comparative analysis of keywords related to the macro theme Social.

In this comparison between the data referring to papers published before the advent of COVID-19 and those from 2020 to 2022, we can easily observe how, with the exception of construction materials (*materials*), which remain a constant topic of interest over time, there has been a net change in interest. The various green building approaches that, until 2020, were considered among the best strategies to address the sustainability of a building or the climatic impacts to which it could be exposed are totally sidelined (*biomimetic*, *facade*, *passive*, *wood*, *roof*, *vernacular*). After the advent of COVID-19, there seems to be no more time to look for alternative forms of sustainable architecture; on the contrary, there is more of a demand for concreteness and development that directs projects towards a high-performance future (*smart*, *development*, *planning*).

The last comparative analysis focuses on the keywords that have been collected under the macro theme of *Management and Development* (see Figure 14).

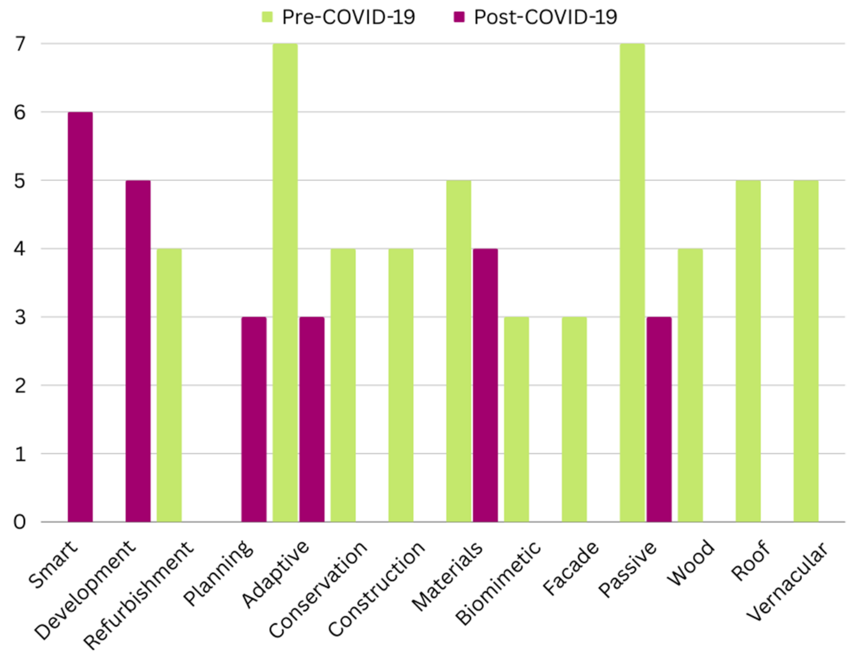

Figure 14. Comparative analysis of keywords related to the macro theme Management and Development.

Moreover, with the health emergency, one of the architectural industry's certainties of the past years has come undone (*refurbishments*, *conservation*, *adaptive*). For almost two decades, in fact, the idea was supported that renovating and refurbishing existing buildings was the best solution to make the AEC sector more sustainable due to less CO_2 production. However, the needs arising from the pandemic have shown that lower CO_2 production also corresponds to a limitation of the performance achievable through renovation. Instead, the performance required to satisfy the post-pandemic demands would only be achievable through a renovation so far-reaching that it could be compared to a new construction. New construction, although a cause of heavy pollution, allows greater freedom of action and total fulfilment of requirements in a dramatic situation such as the pandemic.

The emergence of these three themes (*smart*, *development*, *planning*) in the post-COVID-19 period, moreover, underlines the importance and necessity of the introduction of this fourth macro theme, a different point of view from which to analyse *sustainability*. In fact, the classic subdivision into the three macro themes—*Environmental*, *Social*, and *Economic*—makes it possible to address the three P's (*people*, *planet*, and *profit*) but at the same time neglects certain interconnections and interdisciplinary challenges present upstream of the aforementioned three macro themes, addressing their issues without a complete integrated long-term vision, which can instead be reintroduced through the fourth P of *planning*, characteristic of the *Management and Development* macro theme.

What emerged from the comparative analyses of the keywords was also examined in the titles and abstracts. Naturally, more emphasis was placed on keywords precisely because of their non-discursive characteristic, which makes it possible to summarise the topics in extreme synthesis. Titles and abstracts, on the other hand, due to their discursive characteristics, are more suitable for confirming trends, possibly bringing out some eccentricities. For this reason, the comparative analysis conducted on them did not envisage the subdivision of the words into macro themes but the highlighting of the trends in order to compare them with those that emerged from the comparative analysis of the keywords.

As can be seen in Figure 15, highlighting only the extremes of the comparative analysis conducted on the titles, the interest in the topics *carbon* (*Environmental*), *analysis* and *assessment* (*Economic*), *resilient* (*Social*) and *material*, *vernacular*, and *roof* (*Management and Development*) is only confirmed for the pre-COVID-19 period. Post-COVID-19, on the other hand, confirms the strong interest in the topics *emission* (*Environmental*), *residential* (*Social*), *plan*, and *smart* (*Management and Development*). The eccentricities we can record, instead, concern a greater interest in the theme *environment* (*Environmental*), in the pre-COVID-19 period, and in the themes *efficiency* (*Environmental*) and *design* (*Social*), in the post-COVID-19 period. In addition, it is possible to detect the presence of the word *challenges*, a characteristic theme of post-COVID-19 recovery.

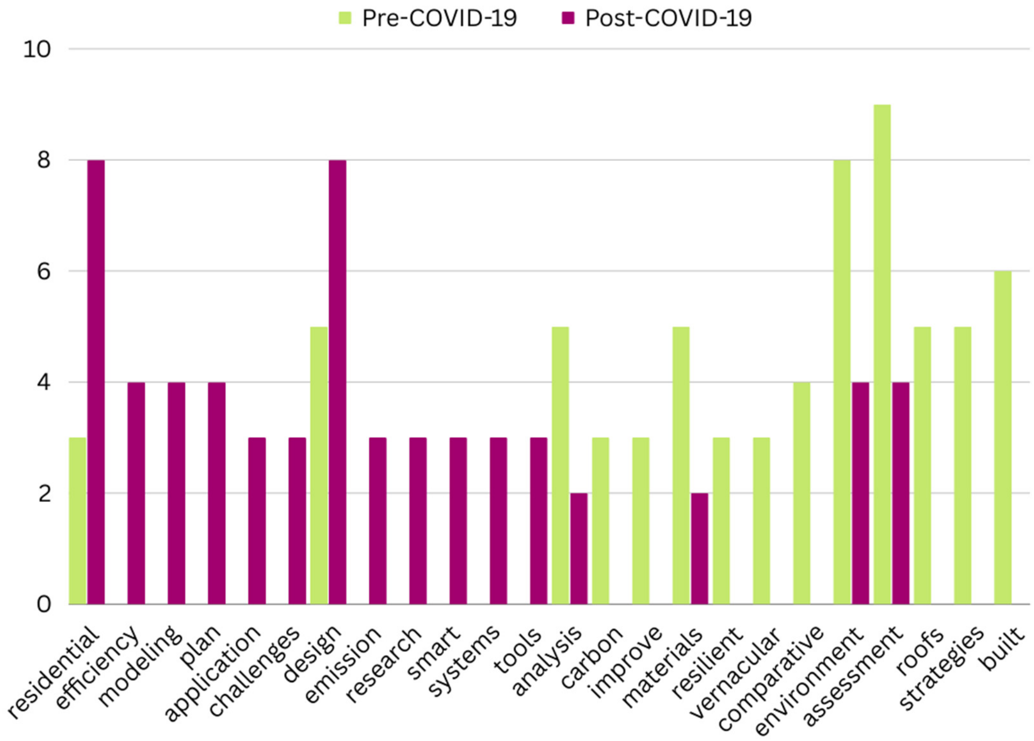

Figure 15. Extreme edges of the comparative analysis of titles.

In any case, these eccentricities all involve themes that were in an equilibrium situation in the keyword comparative analysis and, for this reason, do not alter when previously deduced.

Figure 16, on the other hand, considers only the extremes of the comparative analysis conducted on the abstracts. In this case, except for the confirmation of the interest in the topic *temperature* (previously *heat* or *thermal* in *Environmental*) being only in the pre-COVID-19 period, we have the majority of confirmations for the three-year period 2020–2022. The topics *renewable* (*Environmental*), *economic* (*Economic*), *global* and *existing* (comparable, respectively, to *world* and *heritage* of the *Social* macro theme), and *development* and *project* (*Management and Development*) confirm what was previously deduced. Two eccentricities can be recorded in the post-pandemic period: *adaptive* and *materials*, both from the *Management and Development* macro theme. These two themes, like the eccentricities that emerged previously, are part of those already in the balance and therefore, again, do not contribute to altering the previous results. New words also appear in this analysis, mainly due to the discursive/descriptive character of the abstract. For example, the words *needs*, *aims*, and *order* could confirm an increasing need since 2020 for concreteness but at the same time could only be part of the discourse and, for this reason, have not been included in the reasoning from the comparative analyses described so far.

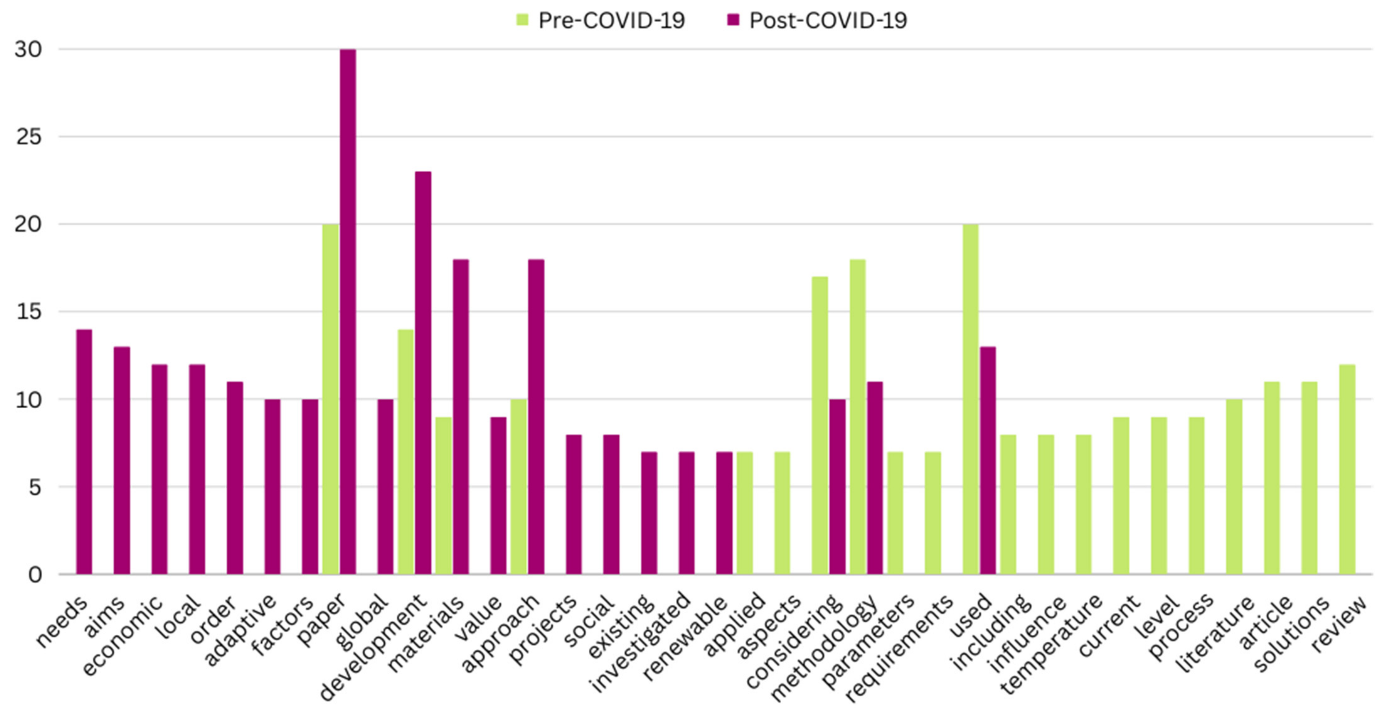

Figure 16. Extreme edges of the comparative analysis of abstracts.

5. Conclusions and Future Developments

The analysis of the 90 papers extracted from Elsevier's Scopus and MDPI's *Sustainability* databases, according to the procedures described in Chapter 3, produced some interesting insights.

At the level of academic interest, we can start by asserting that the concept of sustainability and the problems related to the impact of climate change are both fast-growing research topics. In fact, taking into consideration the sample of articles examined, the number of papers published in the last 3 years has a similar weight to those presented in the 10 years prior to the advent of COVID-19.

Furthermore, it emerges that both are no longer topics of interest purely for the preservation of a few super-developed nations but have begun to interest the entire academic world through a more homogeneous distribution across all continents.

We can also state that, as has emerged from the comparative analyses conducted on keywords, titles, and abstracts, there is a clear demand for more practical and concrete solutions than in the past. The rise in the number of papers presenting the use of case studies within them can also help to support this fact. For the sample examined, papers supported by case studies increased from one in five in the period 2008–2019 to about one in four in the period 2020–2022.

The pandemic emergency has driven the world of research to focus not only on the technical–scientific aspects of the energy sector or on alternative architectural solutions (*biomimicry*, *passive house*, and *vernacular*) but to try to deepen the topics of clean energy (*green*), of zero emissions, and direct control of consumption. In this regard, the economic aspects seem to be starting to interest the research world more.

The comfort of residences has become a central theme in research papers, precisely because homes have once again become the centre of people's private and working lives. The themes of *comfort* and *design*, highlighted in the comparative analysis of the third macro theme (*Social*), confirm the need that emerged with the advent of COVID-19 to introduce a new concept of the workspace. If, due to the mandatory lockdown caused by the pandemic, the home returned to being the centre of people's working lives, in the post-pandemic period, the workers themselves tried to maintain at least some of the privileges acquired from working remotely. The Smart Working Observatory of the Polytechnic University of Milan, a research group founded in 2012 precisely to study the evolution of the way of working, affirmed that thanks to COVID-19, many companies have had the opportunity to try Smart Working, appreciating the benefits of the autonomy and flexibility of spaces and hours left to workers [119,120]. Obviously, for some kinds of jobs and/or companies, the possibility of growing the team of workers within their (well-defined) workplaces has always meant a further guarantee of success, precisely as a result of the fellowship and feeling that was established between colleagues. In order to meet the aforementioned company needs and to avoid displeasing workers by denying them their acquired privileges (during a dramatic period), in the post-COVID-19 period, the concept of the "Smart Office" has gained traction: a *smart* and continuously *developing* office (both themes emerged from the comparative analysis of the fourth *Management and Development* macro theme), where people's work needs redesign the office space [121].

Another change, completely unexpected until just before the advent of COVID-19, is the return of researchers towards new constructions that can ensure better performance than renovations. Relating to construction activities, in addition, the *needs*, *economic*, *materials*, and *global* themes that emerged in the comparative analysis of the *abstracts* can highlight how much COVID-19 has changed not only the habits related to people's daily lives but also the economic patterns of consumption and distribution worldwide. Restrictions on cross-national travel and shipments, implemented during COVID-19 and prolonged even during the post-pandemic period, generally generated higher costs of raw materials and, consequently, of finished products. The AEC sector, exploited by some nations as a booster for the post-pandemic recovery of their economies (e.g., Italy), has suffered a setback in planned interventions, about 50 percent, precisely because of the rising cost of construction materials [9,122]. For example, in Italy alone, comparing prices for the two-year period 2022–2023 with those for 2020, there was an increase of more than 70% for steel and lumber, 59% for concrete and cement, and 38% for bricks, mainly due to the cost of CO_2 emission rights and rising energy costs [122,123].

A further relevant fact that emerged is the introduction of the fourth macro theme (*Management and Development*), and its fourth P (planning), in the management and analysis of sustainability issues and data. This has made it possible to highlight the need—growing in the post-COVID-19 period—on the part of the scientific research world of the building sector to address the issues related to sustainability and the impact of climate change on buildings through a more integrated vision, which takes into account long-term planning and allows the observation of sustainability and sustainable development phenomena through a holistic approach, contributing to a better assessment of the *social* and *economic* impact of sustainability in the building sector.

Naturally, this article does not claim to be a definitive analysis of the issues relating to sustainability and the impact of climate change in the field of architecture and construction but rather an opportunity to reflect on the topic and possibly a starting point for even more in-depth analyses in the future. In this regard, one of the future developments hypothesised for this literature review is to expand the available data pool both by including new databases and by increasing the percentage of selected articles in the already-analysed databases. A further in-depth study could consider a division into three periods: pre-COVID-19 (2008–2019), COVID-19 (2020–22), and post-COVID-19 (2023–2025), which would make it possible to understand whether the interests that emerged due to the pandemic have maintained their appeal or, instead, have undergone a further change.

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