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Urban Materials' Role in Climate Change: BIBLIOMETRIC MAPPING

ONLINE PRESENTATION

Meryem BELADJILA, Atef AHRIZ ,Rania GHRIEB

Department of architecture, Echahid Cheikh Larbi Tebessi University
Laboratory of Applied Civil Engineering, Echahid Cheikh Larbi Tebessi University

INTRODUCTION

Climate change, primarily caused by rising greenhouse gas emissions, is a significant global challenge. Urban materials, such as cement, steel, and glass, are major contributors to these emissions. Their production is energy-intensive, releasing carbon dioxide and other greenhouse gases. The use of dark, low-albedo materials in urban areas exacerbates the urban heat island effect, increasing energy demand for cooling and further emissions. As urban populations grow and cities expand, the demand for construction materials and emissions is projected to rise, exacerbating the climate crisis. Addressing the environmental impacts of urban materials is crucial for mitigating climate change and paving the way for a more sustainable future. This article explores the intricate relationship between urban materials and climate change, exploring pathways through which these materials contribute to greenhouse gas emissions and the urban heat island effect

Data Sources and Methodology:
This article employs a bibliometric analysis following a three-step methodology, illustrated in Figure 1

01 MATÉRIEL

PHASE/ PARTI :Data Collection:

The bibliometric approach employed in this study relies on a robust data collection process leveraging the Scopus multidisciplinary bibliographic database. A variety of terms, including "urban materials ," "urban climate;climate change , global warming ; climate crises " (impact ; influence ; affect ; contribute; exeberate) were included in the search approach. To provide comprehensive yet targeted search results, keywords are carefully selected. Using the Boolean operator OR—AND

PHASE/ PARTI :Data filtration:

By limiting the timeframe to the past eleven years, the study aimed to capture the most up-to-date and influential research findings, reflecting the latest developments and emerging trends in the field. This approach ensured that the analysis was informed by the most recent insights and advancements related to the role of urban materials in the climate change crisis.
The initial search results, comprising 574 publications, provided a robust foundation for the subsequent data filtration and analysis stages. This comprehensive set of literature allowed for a thorough exploration of the research landscape, enabling the identification of key themes, patterns, and potential mitigation strategies involving urban materials and their impact on climate change. After filtration 490 documents found

PHASE/ PARTI :data analysis:

The VosViewer application (Dissanayake and Weerasinghe, 2021)(van Eck, 2010) was used to analyze the bibliometric data obtained using a CSV file containing the data downloaded into the main unit of the application Research clusters were identified and links between research networks were quantified, visualized, and shown utilizing a CSV file using the VOSviewer

02 RÉSULTATS AND DISCUSSION

1- What is the distribution of publication types, ranging from the most frequently published to the least, within the research domain of urban materials and climate change?

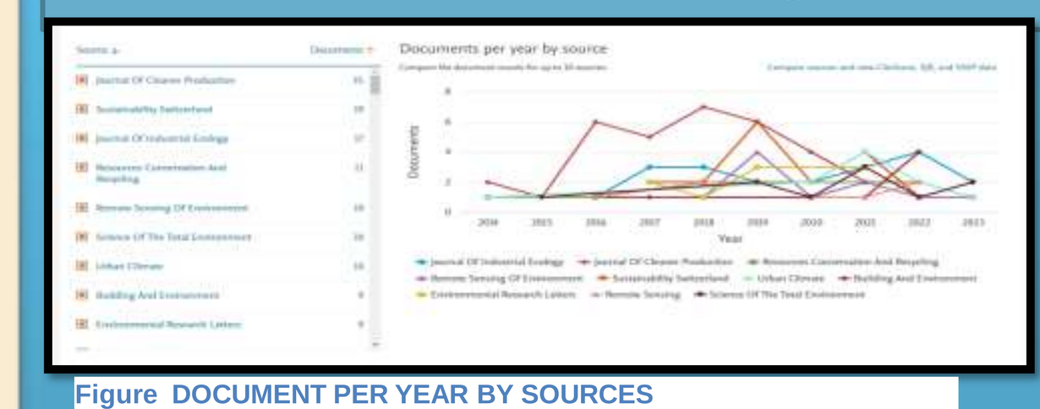


Figure DOCUMENT PER YEAR BY SOURCES

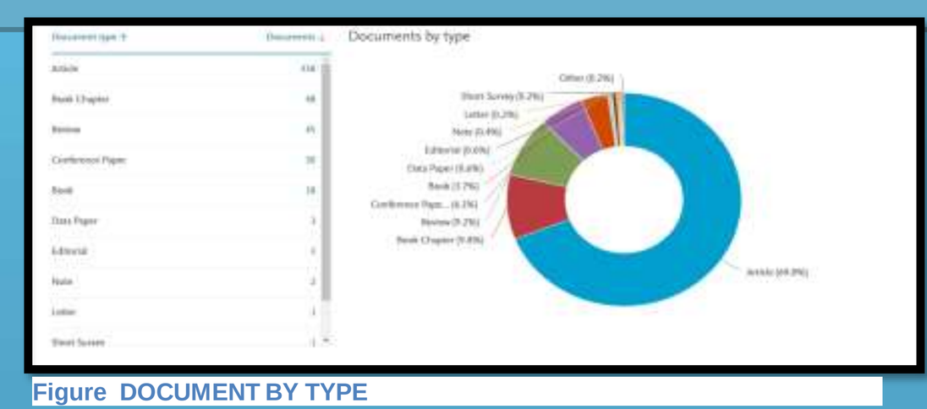
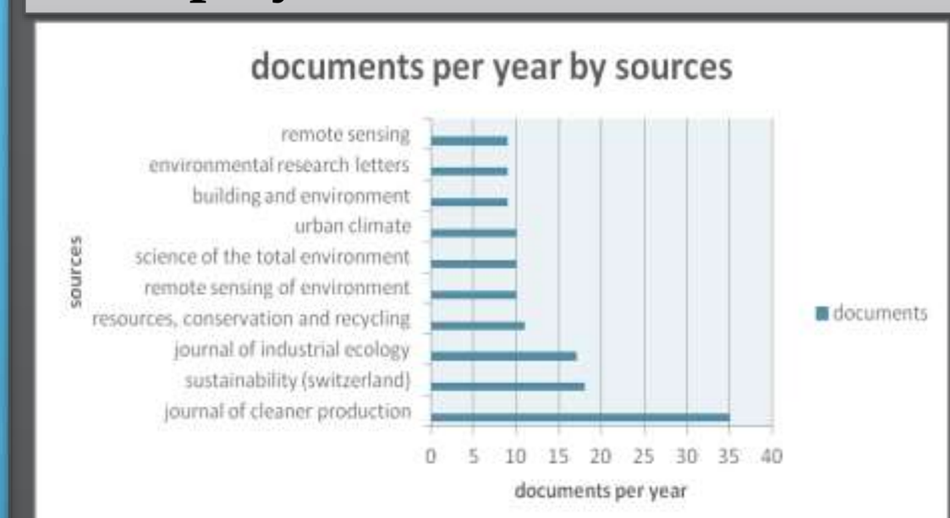
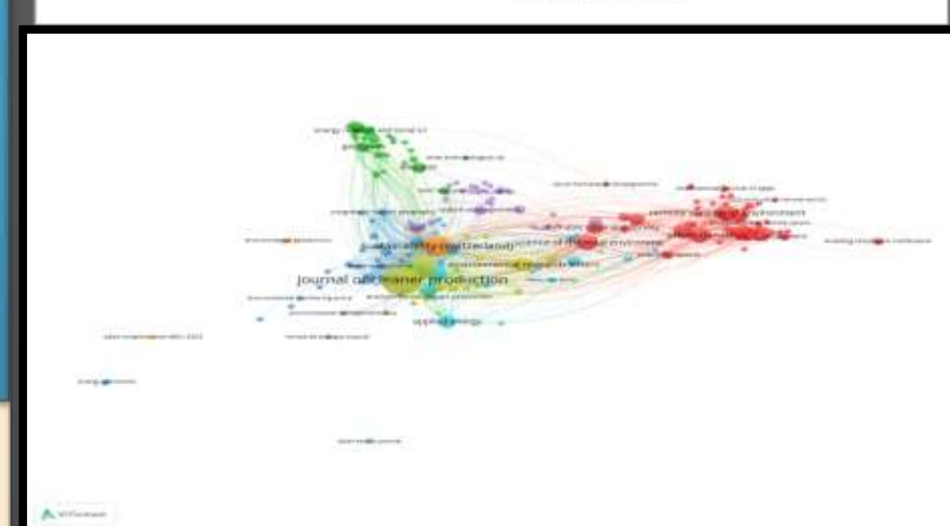


Figure DOCUMENT BY TYPE

The analysis of the chosen publications reveals a clear dominance of research articles, which constitute a substantial majority of 69%. This finding highlights the prominence of original research contributions within the selected corpus. Following closely behind are book chapters and review papers, occupying 9.8%; 9.2 of the publications. various sources focus on sustainability and the environment ; energy and urban climate

2- Influential Journals: Which scientific journals have emerged as the leading publishers of research related to urban materials, climate change, and their interplay?

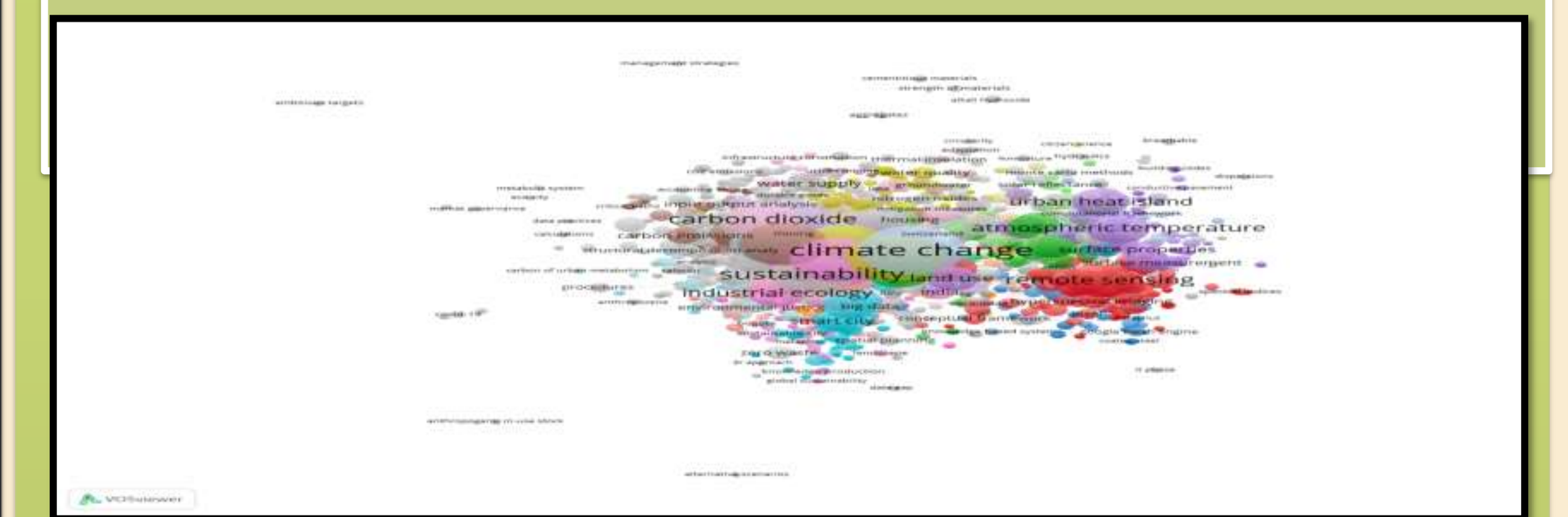




Source	publishe	h-index	quartile
journal of cleaner production	Elsevier	309	Q1
Sustainability Switzerland	(MDPI)	136	Q1
journal of industrial ecology	Wiley-Blackwell	130	Q1
resources, conservation and recycling	Elsevier	196	Q1
remote sensing of environment	Elsevier	350	Q1
science of the total environment	Elsevier	353	Q1
urban climate	Elsevier	75	Q1
building and environment	Elsevier	205	Q1
environmental research letters	IOP Publishing Ltd.	183	Q1
remote sensing	(MDPI)	193	Q1

The bar chart titled "documents per year by sources" shows the number of documents published annually across various journals. Here are some observations:
Journal of Cleaner Production is the leading source, publishing the highest number of documents per year, with a count approaching 35.
Sustainability (Switzerland) and Journal of Industrial Ecology follow, each publishing around 15 documents per year.
Resources, Conservation and Recycling and Remote Sensing of Environment publish approximately 10 documents per year.
Science of the Total Environment, Urban Climate, Building and Environment, Environmental Research Letters, and Remote Sensing each contribute fewer than 10 documents annually.
This data highlights the prominence of the Journal of Cleaner Production in contributing research articles, significantly outpacing other journals listed.

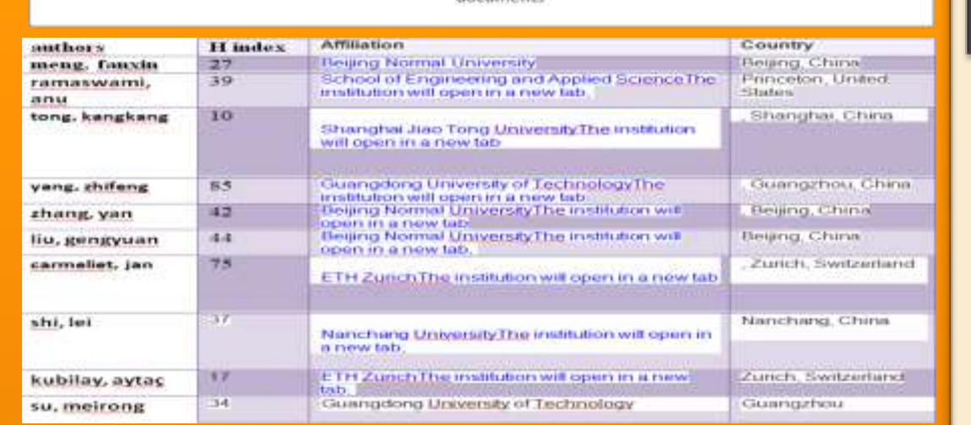
3- Thematic Co-occurrence: What are the most relevant and frequently co-occurring terms that characterize the research scope, indicating the key themes and concepts explored?



One of the most useful methods to show how science subjects and patterns have changed over the past few decades is keyword co-occurrence analysis
Over 5 cluster networks are shown in Figure
•Impacts of Climate Change on Urban Environments and Public Health:carbon dioxide; air pollutant ;air temperature ;atmospheric radiation ; deterioration ;disasters health risks; outdoor thermal comfort ;public health; quality of life; surface temperatures ;urban heat islands
•Material Dynamics in Urban Infrastructure:albedo ;asphalt ;envelopes ;building materials ;cement ;concretes ;emissivity ; infrared radiation ;land surface temperature ;land cover ; mean radiant temperature ;pavements ; radiation effects ;roads and streets roofs ; storage (materials) ;strength of materials ; thermal characteristics ;vegetation cover ;visible and near infrared walls (structural partitions)
•strategies for Sustainable Urban Development and Climate Mitigation: sustainable development; climate change mitigation ;climate change adaptation; conservation of natural resources ;cooling systems ;evaporative cooling systems ; heat mitigation ;material efficiency ;smart city
•assessment methods: remote sensing analytic; atmospheric modelling ;aviris-ng calibration; computational fluid dynamics (cfd) ;computer simulation efficiency ;measurement ;empirical studies ;envi-met ;estimation; method experimental ;study field measurements ;geographic information system (gis) ;quantitative analysis questionnaire satellite imagery ; scenarios analysis surveys
•Epistemological positioning: bioclimatology; biodiversity bio energy; city planning ;climate and environment

4-Influential Authors: Who are the most productive authors and co-author networks driving research in this field, contributing significantly to the advancement of knowledge?

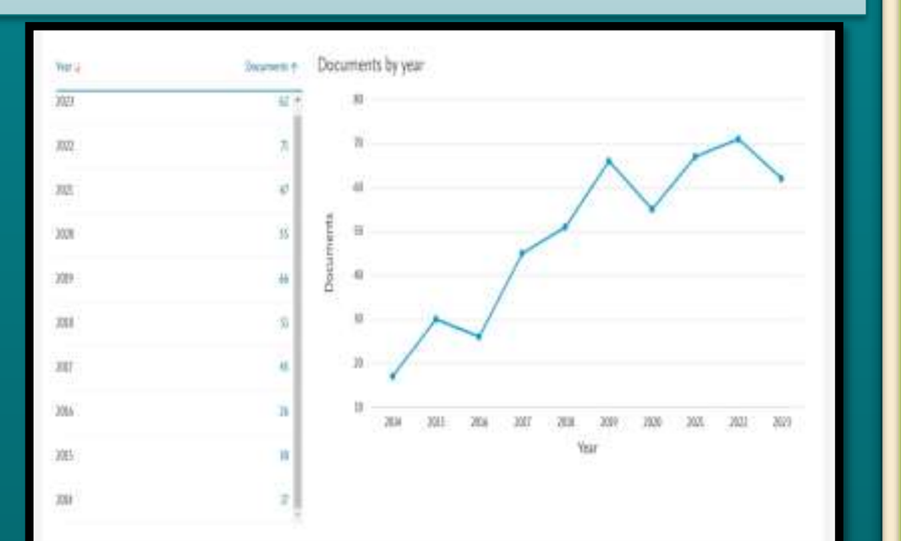
•Based on the information provided in the table and The graph, it appears that Chinese universities have produced a significant number of authors among those listed.
•Furthermore, authors affiliated with Chinese universities seem to have relatively high h-index values, which is a metric often used to measure an individual's research productivity and impact. For example:
•meng, fanxin from Beijing Normal University with 27 H index has the highest number of documents at around 10, significantly more than others on the list.
•ramaswami, anu. tong, kangkang. yang, zhifeng. zhang, yan have around 9 documents each, placing them second highest.
•liu, gengyuan . carmeliet, jan. shi, lei have around 7-8 documents each, forming the mid-range group.



•kubilay, aytaç. su, meirong have the lowest numbers at 6 documents each.
• Chinese universities are indeed productive in terms of research output and scholarly contributions

5-Temporal Evolution: How has the publication output on the theme of urban materials and climate change evolved over time, and what is the current level of research activity and relevance within the broader literature?

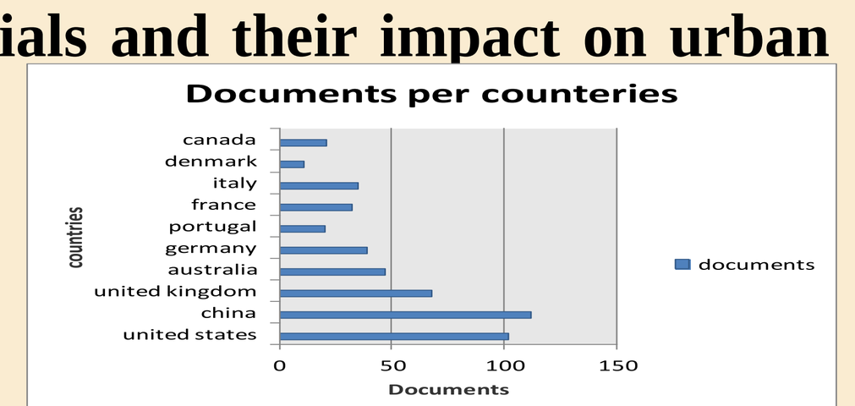
Initial Period (2014-2016): The number of documents increased steadily from 17 in 2014 to 46 in 2016. This represents a substantial growth, indicating a rising interest in the topic.
Middle Period (2017-2019):The publication output saw a slight dip to 45 in 2017, but then it climbed to 66 documents by 2019. This period shows variability but maintains a general upward trend.



Recent Period (2020-2023):The number of documents fluctuated but remained high, peaking at 71 in 2022. In 2023, there is a slight decrease to 62 documents. This suggests sustained high interest and research activity, with a minor decline in the most recent year.

6-Geographic Distribution: Which countries demonstrate the highest research engagement and concern regarding urban materials and their impact on urban climate?

The United States and China have the highest number of documents with Approximante 112 and 102 documents , significantly more than the other countries listed. Australia and the United Kingdom follow, with a moderate number of documents. The rest of the countries have relatively fewer documents.



Which articles have garnered the highest number of citations within the Scopus database, indicating their influential and widely recognized contributions to the field?

Energy, 137, pp. 556–565	Q1	10486	156000	14.9	Smart energy and smart energy systems	701	1.989	Elsevier
Ecological Economics, 145, pp. 75–89	Q1	1134	12453	11.0	Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the Circular Economy	608	1.899	Elsevier
Urban Climates, pp. 1–525	Q1	840	7349	8.7	Urban climates	400	1.185	Elsevier
Energy Economics, 62, pp. 104–124	Q1	1852	27184	14.7	A literature study for DEA applied to energy and environment	379	3.039	Elsevier
Science Advances, 4(6), eaaq0390	Q1	7534	153500	20.4	City-level climate change mitigation in China	272	4.598	American Association for the Advancement of Science
Nature Sustainability, 1(7), pp. 341–349	Q1	509	20446	40.2	The urban south and the predicament of global sustainability	253	6.568	Springer Nature
Remote Sensing of Environment, 228, pp. 164–182	Q1	1894	46909	24.8	Understanding an urbanizing planet: Strategic directions for remote sensing	229	4.057	Elsevier
Applied Energy, 184, pp. 905–914	Q1	6584	138931	21.1	Urban energy–water nexus: A network perspective	227	2.907	Elsevier
Nature Climate Change, 8(12), pp. 1097–1103	Q1	534	17353	32.5	Diurnal interaction between urban expansion, climate change and adaptation in US cities	202	6.849	Springer Nature
Journal of Cleaner Production, 247, 119113	Q1	19022	351758	18.5	A comprehensive review of industrial symbiosis	201	1.981	Elsevier

04 CONCLUSION

For a comprehensive conclusion, we could consult the top 10 most-cited articles addressing the question: What role do urban materials play in contributing to climate change, and what are some potential alternatives or mitigation strategies that could reduce the environmental impact of these materials?

Urban materials, such as pavement and buildings, play a significant role in contributing to climate change through the releasing of greenhouse gases and urban heat island effect. due to their production processes, construction, transportation, use, and disposal. The extraction, manufacturing, and transportation ; This effect occurs when urban areas experience higher temperatures compared to surrounding rural areas due to the absorption and retention of heat by materials like asphalt and concrete .

To mitigate the environmental impact of urban materials and reduce the urban heat island effect, several strategies can be implemented, innovative materials and sustainable practices offer promising solutions :
•Cool Roofs: Cool roofs are designed to reflect more sunlight and absorb less heat compared to traditional dark-colored roofs. This can help reduce the heat absorbed by buildings and lower urban temperatures .
•Evaporative Roofs and permeable pavements : Evaporative roofs and permeable pavements utilize water evaporation to cool the surface, reducing heat absorption and contributing to lower temperatures in urban areas .
Street Trees: Planting trees in urban areas can provide shade, reduce surface temperatures, and enhance evapotranspiration, thereby cooling the surrounding environment .
•Reduction of Urban Material Thermal Admittance: Changing paving materials to reduce thermal admittance can help cool urban areas, particularly at night when urban expansion warming is most pronounced .
•Urban Greening: Increasing green spaces, such as parks and green roofs, can help absorb heat, provide shade, and enhance evapotranspiration, thereby reducing the urban heat island effect .
•Reflective Materials: Using reflective materials for pavements and buildings can reduce heat absorption and lower surface temperatures in urban areas .
•Circular Economy Practices: Implementing circular economy principles such as recycling, reusing, and remanufacturing materials can reduce the need for virgin resources and minimize waste generation.
•Use of Sustainable Building Materials: Incorporating sustainable building materials such as recycled materials, locally sourced materials, and renewable resources can reduce the carbon footprint of construction projects
•Urban Planning and Design: Implementing compact urban forms with mixed land uses can promote walkability, reduce the need for car travel, and lower carbon emissions from transportation

This transition not only addresses the urgent need to combat climate change but also enhances urban livability and environmental health for future generations..

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