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GREEN SPACE EVALUATION OF SHAH ALAM LOW CARBON CITY, SELANGOR, MALAYSIA

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Abstract

This study examines Shah Alam's progress towards achieving its 2030 low-carbon city goal, focusing on the balance between rapid development, population growth, and carbon emissions. It emphasizes the necessity of a holistic approach to sustainable urban development that integrates societal needs with environmental concerns. The study aims to identify (i) the defining characteristics of green spaces in Shah Alam and (ii) the effectiveness of stakeholders' development strategies related to these green spaces. A qualitative methodology was adopted, utilizing six expert interviews conducted both face-to-face and online. Thematic analysis of these interviews revealed detailed insights into the interplay between green spaces and low-carbon urban development. A strong correlation was found between the attributes of green spaces and their carbon absorption capacity, influenced by factors such as area size, plant diversity, and absorption rates. Initiatives like the "Tree for Life" campaign have notably advanced the low-carbon city goals through strategic green space development. These collective efforts underscore the growing trend towards sustainable urban environments and highlight the critical role of comprehensive programs in enhancing green spaces to achieve low-carbon, sustainable cities.

Keywords: Green space, Low Carbon City, carbon reduction, development strategy, sustainable city

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INTRODUCTION

As a rapidly growing city, Shah Alam has experienced significant changes in land use and urban development, leading to a reduction in green space and an increase in carbon emissions. According to the Draft Rancangan Tempatan Majlis Bandaraya Shah Alam 2035, green spaces cover over 29,000 hectares in Shah Alam, constituting 12.9% of the city's total area (MBSA, 2017). However as highlighted in Shah Alam Voluntary Local Review 2021, due to Shah Alam's location in the Klang Valley and promixity to Kuala Lumpur, it faces environmental concerns, making it difficult for municipal management to combat climate change (Urbanice Malaysia, 2021). In response, the MBSA aims to transform Shah Alam into a low-carbon city through Local Carbon City (LCC) initiatives, targeting a 45% reduction in GHG emissions by 2030 (Yusfida Ayu, Khalid, Nor Baizura, Marlyana Azyyati, & Mohammad Yusup, 2023). In 2023, the Shah Alam City Council stood out as a prominent leader in the Malaysian Low-Carbon City Awards, clinching the most awards across five key categories, including greenery (as stated on the official MGTC reporting website for 2024) (Malaysian Green Technology And Climate Change Corporation, 2024).

Therefore, the enhancement of urban public green spaces stands as a pivotal strategy for fostering low-carbon cities, particularly in densely populated regions, because they play a crucial role in attaining carbon neutrality (Zhao, Cai, Xu, Liu, & Yao, 2023).

Shah Alam, a high-density city situated near Kuala Lumpur, faces unique challenges compared to other urban areas. The rapid development and significant population growth in this region contribute to increased carbon emissions, further complicating efforts to maintain sustainable urban environments. To address these challenges, the study aims to (i) identify the defining characteristics of green spaces in Shah Alam and (ii) assess the effectiveness of stakeholders' development strategies related to these green spaces. These findings provide valuable insights for policymakers and urban planners to enhance the sustainability of green spaces within LCC initiatives. Additionally, recommendations for improving carbon sequestration in green areas are proposed based on the evaluation results.

This paper provides a review of the pertinent literature on urban green spaces as carbon sinks in densely populated cities, focusing on the reduction of carbon emissions and the development of low-carbon cities. It then outlines the methodology employed for data collection and analysis, primarily through interviews with stakeholders. The data collection involved consulting experts in climate change, landscape architecture, and town planning to highlight the significance of green spaces in urban areas. The results of the study are then presented and discussed, followed by the conclusion.

Overall, this study aimed to understand the initiatives taken by the authorities, emphasising the importance of green spaces as carbon sinks to support carbon reduction efforts, particularly in densely populated cities such as Shah Alam.

LITERATURE REVIEW

Definition Low Carbon City Concept

A low-carbon city (LCC) can be defined as a city that comprises societies that consume sustainable green technology and green practices and emit relatively low carbon, or GHG, as compared with present-day practices to avoid the adverse impacts of present-day climate change (Haliza, 2020). The aim is to reduce urban carbon dioxide emissions through eco-friendly policies, economies, and governance. LCCs seek to enhance urban liveability, improve residents' quality of life, and boost urban community resilience to climate change (Gao & Zhang, 2020). Over the past 15 years, significant research attention has been focused on LCCs as a crucial effort in combating global warming (Wang, Wang, Chen, Zeng, & Heng, 2023). Research on the successful development of LCCs for carbon reduction should serve as exemplary models for countries facing challenges in reducing their carbon emissions (Wei & Wenmei, 2019).

The LCC concept has been introduced previously in Malaysian urban development and practice through the Low Carbon Cities Framework (LCCF), which delineates local authorities' targets to achieve zero carbon status (Nor Baizura, Yusfida Ayu, D. Ary Adriansyah, Nurul Shakila, & Na'asah, 2023). While the concept of a Low Carbon City (LCC) and its benefits are well-documented, there is limited detailed analysis on how high-density cities like Shah Alam specifically implement these strategies compared to lower-density or less developed urban areas. This study focused on how Shah Alam successfully implemented the LCCF to reduce carbon emissions and achieve a zero-carbon status, providing valuable insights for other countries striving to develop low-carbon cities.

Urban Green Spaces Important Elements in Carbon Sequestration

Urban Green Space (UGS) encompasses urban areas adorned with vegetation, including parks, community gardens, cemeteries, rooftop gardens, meadows, and wooded areas, often referred to as the blue-green zone (Haas, Hassink, & Stuiver, 2021). These spaces are vital in cities for promoting sustainability by enhancing liveability and fostering active community engagement. However, high dense cities like Kuala Lumpur face challenges in preserving green spaces due to land scarcity and competing demands for commercial and residential developments (Mohd Johari, Helmi Zulhaidi, & Junainah, 2019). This necessitates meticulous planning and collaboration among urban planners, policymakers, and community members to ensure sustainable urban landscape for present and future generations

(Owen, Mohd Johari, Sreetheran, Kei, & Junainah, 2022). Prioritising the preservation and creation of urban green spaces allows cities to mitigate the adverse effects of urbanisation, such as air pollution (Venter, Hassani, Stange, Schneider, & Castell, 2024) and heat island effect (Aram , García, Solgi, & Mansournia, 2019). The plant community and vegetation structure in urban green spaces have a high potential for carbon sequestration compared with other areas in the city (Alamah, Sakurah, & Siti Mazwin, 2015)

Therefore, this study aims to address these gaps by defining the characteristics of green spaces in Shah Alam and assessing their contributions to the city's carbon reduction efforts. By exploring the specific attributes of these green spaces and evaluating stakeholder strategies, this research seeks to provide valuable insights and practical recommendations for policymakers and urban planners to enhance the sustainability of green spaces within the LCC framework.

RESEARCH METHODOLOGY

The qualitative research employed interviews as the primary data collection method, chosen for their ability to provide an in-depth exploration of the characteristics of green spaces and low-carbon city initiatives. This approach allows for a comprehensive understanding of participants' experiences and perspectives, as highlighted by Bakhary (2023). The interviews were conducted with diverse individuals, including key stakeholders such as officers from the Shah Alam City Council (MBSA), the Malaysian Green Technology and Climate Change Corporation (MGTC), and experienced landscape architects specialising in green spaces and low-carbon city initiatives. Six individuals were interviewed face-to-face and online to address the study objectives (Table 1).

Table 1: Profile of key informants

No.	Department	Responsibilities	Role	Code
1	Malaysian Green Technology and Climate Change Centre (MGTC)	Review reliable data and identify the improvement.	Analyst	Key Informant 1
2	Planning Department, Shah Alam City Council (MBSA)	Site analysis for land use	Assistant Town Planning Officer	Key Informant 2
3	Landscape Department, Shah Alam City Council (MBSA)	Planning decisions and interpret data on land use	Assistant Town Planning Officer	Key Informant 3
4	Landscape Department, Shah Alam City Council (MBSA)	Planning and identify land use	Assistant Town Planning Officer	Key Informant 4

No.	Department	Responsibilities	Role	Code
5	Associate Professor UiTM Puncak Alam	Conducting significant and impactful research	Landscape Architecture	Key Informant 5
6	Senior Lecturer UiTM Puncak Alam	Conducting independent research in landscape	Landscape Architecture	Key Informant 6

The data analysis for this study employed thematic analysis to identify recurring themes and patterns, providing valuable insights into perspectives on green spaces and low-carbon urban development in Shah Alam. The process began with the transcription of six expert interviews, ensuring accuracy and completeness. In the initial coding phase, an open coding approach was used, highlighting significant statements and assigning initial codes with the help of Microsoft Excel. Following this, focused coding was conducted to review and refine these initial codes, grouping similar or related codes into broader categories. This phase involved constant comparison to refine and develop themes further.

The final stage involved the development of overarching themes based on the research objectives: (i) identifying the defining characteristics of green spaces in Shah Alam and (ii) assessing the effectiveness of stakeholders' development strategies. These themes encapsulated the essence of the data, providing a structured understanding of the study's findings.

ANALYSIS AND DISCUSSION

Overview of Green Space

The interviews conducted with key informants have illuminated the importance of green spaces in Shah Alam as a means to advance towards a low-carbon city, as depicted in Table 2. According to Key Informant 1, green spaces encompass various types of trees that absorb carbon, including city parks, landscape parks, urban forests, and lakes. These areas are crucial for cooling the surrounding environment. Key informants 2 and 3 shared similar views, defining green spaces as areas aiding carbon sequestration and greenhouse gas reduction. These include roadside trees, recreational spaces, parks, and mature trees. They exclude rooftop gardens from the green space category because of the use of flowering trees, which are seen as maximising greenery rather than carbon absorption. Shah Alam's land area allocates 7.33% (equivalent to 30,210.72 hectares) to green spaces, with 40% of this area already developed. Similarly, Key Informants 5 and 6 emphasised the importance of green spaces in landscape architecture. They highlighted specific tree types that efficiently absorb carbon, which is essential for urban planning. Green spaces are described as areas with grass, plants, trees, lakes (such as Taman Tasik Shah Alam), football fields, golf courses, rooftop gardens, and public parks. The presence of mature trees is particularly noted for

their role in creating a robust tree canopy and regulating microclimates by cooling the environment.

Table 2: overview of the interview findings from key informants regarding the characteristics of green spaces of Green Space

No.	Key Informant's Answer	Code
1	*"Green space consists of types of trees that absorb carbon. It includes urban parks, urban forests, landscape parks and even lakes."*	Key Informant 1
2	*"Green space is an area that helps in carbon sequestration including roadside trees, recreational areas, parks and mature trees. However, rooftop garden does not count as green space because it is just a way to maximize greenery, not as a carbon absorber."*	Key Informant 2
3		Key Informant 3
4	*"Any types of trees and land that absorb carbon and help in carbon sequestration. It is also included Shah Alam Lake (Carbon sink), forests (calculate ratio / plot by percent / estimate), farm, grass (count by area)."*	Key Informant 4
5	*"Green areas that help in carbon sink. Lakes and certain types of trees in green areas such as by the side of the road also included as green area."*	Key Informant 5
6	*"Any space that has a green area. It is contributed to the microclimate, reduces the temperature and plays a role in terms of carbon sequestration. This green area consists of either grass, plants, trees, lake (Taman Tasik Shah Alam). The football pitches, golf course, public park is the example of green space."*	Key Informant 6

However, there is a difference in opinions regarding the classification of these green areas. One perspective emphasises carbon sequestration primarily by mature plants, excluding grasses, fields, and flowering plants. This difference stems from the varying backgrounds and viewpoints. Despite this disagreement, there is consensus on the function of lakes as effective carbon absorbers, contributing to Shah Alam's goal of becoming a low-carbon city. Lakes in Shah Alam, such as the prominent Taman Tasik Shah Alam in Section 14, are divided into three zones: northern, central, and southern. These lakes serve multiple purposes, acting as recreational areas, public parks, and significant carbon sinks. In summary, the interviews revealed differing opinions on the classification of green areas, with one viewpoint focusing on mature plants used for carbon sequestration. However, all agree on the crucial role of lakes, such as Taman Tasik Shah Alam, in absorbing carbon and aiding Shah Alam's efforts toward a low-carbon city, and Figure 1 illustrates the conceptual framework on the distinctive attributes of green spaces within the context of Shah Alam low-carbon city.

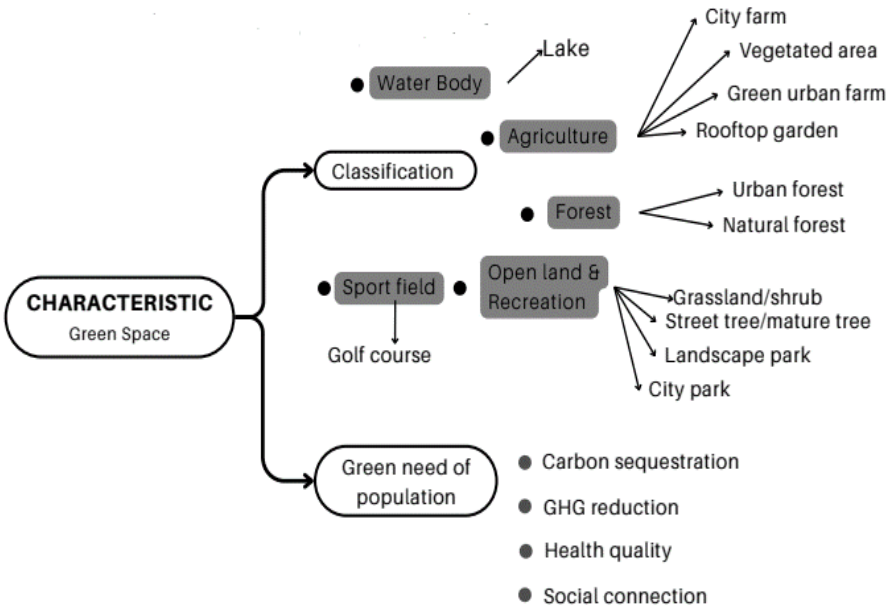

Figure 1: The conceptual framework pertaining to the characteristics of green spaces within Shah Alam Low Carbon City.

In summary, the key informants collectively agree that green areas in Shah Alam play a significant role in carbon absorption and the reduction of local temperatures. These areas contribute to carbon sequestration, microclimate regulation, greenhouse gas reduction, and environmental sustainability. Understanding the elements within urban green spaces is crucial for developing effective carbon reduction strategies in city planning.

Low Carbon City Strategies and Initiatives in Shah Alam

Interviews with key informants revealed numerous programs and initiatives dedicated to green spaces within Shah Alam Low Carbon City, exemplifying a holistic strategy toward environmental sustainability, as depicted in Table 3. Key Informant 1 highlighted the Shah Alam City Council's (MBSA) initiatives aimed at reducing carbon emissions through various programs. These include a car-free day, 3R (reduce, reuse, recycle) activities, community tree planting under "Shah Alam Tree for Life," "Mini ZeeBee," "Green Earth," "Back Alley Greening Initiative," and "Community Garden." Additionally, initiatives, such as green buildings, rainwater collection systems, and rooftop gardens, are encouraged to reduce carbon emissions.

Key Informant 2 and Key Informant 3 emphasised a multifaceted environmental strategy, featuring programs like "Tree for Life," extensive street planting efforts, and city center restoration with a sustainability focus. The city aims to decrease its reliance on vehicles, promote greener alternatives, and designate forested areas for protection. In accordance with the PLAN Malaysia Guidelines, every development project is obligated to dedicate a minimum of 10% of its area to green space. This underscores a firm's commitment to integrating nature into urban planning, reflecting a proactive approach towards fostering sustainable and eco-friendly environments. The implementation of the SPAH system for buildings ensures an eco-friendly approach for water resources.

Key Informant 4 elaborated on initiatives such as the "Green Urban Farm," "Tree for Life," street planting, and the Community Orchard program. These initiatives engage residents, academic institutions, NGOs, and private companies in tree-planting and community engagement activities. Gazetting forests, implementing compulsory litter systems for housing, and conducting tree inventories for mature trees contribute to the Low Carbon City Catalyst Grant (LCC 2030 challenge). Key Informants 5 and 6 provided insights from a landscape architecture perspective. The Low Carbon Building Campaign aims to raise awareness and promote innovative green practices among building owners. It emphasises the preservation of mature trees with specific codes and promotes a sustainable urban ecosystem through the Greening and Placemaking Initiative (GPI).

Table 3: Overview of the interview findings from key informants regarding the strategies and initiatives for establishing a Low Carbon City in Shah Alam.

No.	Key Informant's Answer	Code
1	*"The awareness program with public (3R activity, planting trees), Shah Alam car free day, MBSA building, SPAH, Rooftop Garden (energy, greenery applied in building). The addition of trees after the construction is replaced with new trees. Trees planted high absorption rate tree, so that carbon is balanced. The collaboration with building owner that attract other building to practice the same concept."*	Key Informant 1
2	*"The program of tree planting program (Tree for Life), street planting, restore the city center to make it more sustainable, reduce the use of vehicles, gazette the forest. Every development is required 10% is not reserved for green areas and SPAH system for the building. MBSA have target 80,000 trees planting per year."*	Key Informant 2
3	*"LCC Greenery, tree inventory on how many trees are planted, rooftop garden, green urban farm (encourage planting together). Urban Kid Farm (plant and sell)".*	Key Informant 3
4	*"Include the concept of greenery in urban and development planning: solar energy usage for our street lights, increase these green areas in the initial plan, develop it into a green area, SPAH system for the building"*	Key Informant 4

No.	Key Informant's Answer	Code
5	*"Increase on the landed property, the rooftop garden, street planting (greenery along the street), urban design, GPI (plant trees either in the building or in front of the building), infield development, mature trees are gazetted (there is a code)."*	Key Informant 5
6	*"The importance of greenery in community engagement, including programs for planting and sustainability education."*	Key Informant 6

Thus, the interviews suggest that effective initiatives for green spaces in Shah Alam involve programs such as "Tree for Life," "Community Orchard," and "Mini ZeeBee." These initiatives are well received and foster a sense of belonging among residents to preserve greenery and trees. Collaboration with the government and NGO agencies encourages volunteerism and community involvement in Shah Alam's sustainability efforts.

Partnerships and Collaborations

The key informant interviews highlighted the significant partnerships and collaborations between the city government and various organizations or stakeholders to support green space initiatives in Shah Alam Low Carbon City. As illustrated in Table 4, Key Informant 1 emphasised the involvement of the community, students, and stakeholders in programmes organised by the Shah Alam City Council (MBSA). An example is the ZeeBee program, which utilises backyard spaces for activities such as agricultural competition and vegetable crop cultivation. In Section 7 residential areas, the council collaborated with village committees to design a green programme involving mini gardens and rest areas. The agriculture department also provided briefings on effective planting methods. This inclusive approach, involving households, village committees, and government departments, reflects MBSA's commitment to community and collective responsibility for sustainable urban development.

Key Informant 2 and Key Informant 3 echoed similar sentiments regarding collaboration in Shah Alam. Various entities across governance and community sectors collaborate actively with the city council, highlighting the shared responsibility for sustainability. This includes engagement with SUK Selangor, developers, manufacturers, university students, the Ministry of Agriculture, and PKNS in programs such as Low Carbon Building and Low Carbon Innovation initiatives. These collaborations underscore the concerted effort to reduce carbon emissions and achieve environmental objectives.

Key Informant 4 emphasised the importance of agency collaborations, starting with MBSA's efforts to promote the Low Carbon City agenda in town planning and city management. Initiatives, such as tree-planting programs, involve school and university students. Green Technology Malaysia, a government agency, plays a crucial role as a financial provider and promoter of sustainability initiatives.

Key Informants 5 and 6 highlighted a collective approach in which educational institutions and government agencies work together under MBSA. This collaboration involves local authorities, stakeholders, NGOs, large developers, and building owners to address the environmental, social, and sustainable development issues.

Table 4: Overview of the interview findings from key informants, significant partnerships and collaborations between the city government and various organizations or stakeholders

No.	Key Informant's Answer	Code
1	*"Most programs organized by MBSA involve the community, students and stakeholders. This involvement is not only from the lower level, but also involves the owner of the building together with the organized activities. Example: ZeeBee program uses the backyard of the house, agricultural competition, greening the backyard for vegetable crops. Under flat section 7, create a green program, mini garden, resting place between village committees. The cooperation with the agriculture department to give briefings on planting methods."*	Key Informant 1
2	*"Different level of agency and community have a collaboration with the city council such as SUK Selangor, developer, manufacturer, University students, Ministry of agriculture, PKNS in many types of programs. The involvement to make sure the carbon reduction and ensure goals are achieved."*	Key Informant 2
3	*"Shah Alam community, student from different level of education."*	Key Informant 3
4	*"Local authorities, stakeholders, NGO, UiTM student and community."*	Key Informant 4
5	*"Big developers, owner of the building, community and authorities."*	Key Informant 5
6	*"Community-focused programs, stakeholders' involvement in eco-friendly initiatives."*	Key Informant 6

This discovery reveals the collaborative of diverse stakeholders aimed at realizing the vision of a low-carbon city. These stakeholders exemplify their dedication to environmental sustainability by making significant investments in impactful projects and leading the charge of embracing green technologies. Nevertheless, persistent challenges, such as constrained resource allocation and the need for heightened community awareness have emerged, posing hurdles to achieving a harmonious equilibrium between development and conservation. These challenges compel the nation to initiate and sustain efforts towards low-carbon city initiatives (Siti Afiqah, Zakiah, Aisyah , & Fatiah, 2023). Figure 2 illustrates the development strategies and initiatives aimed at enhancing green spaces within the context of Shah Alam Low Carbon City.

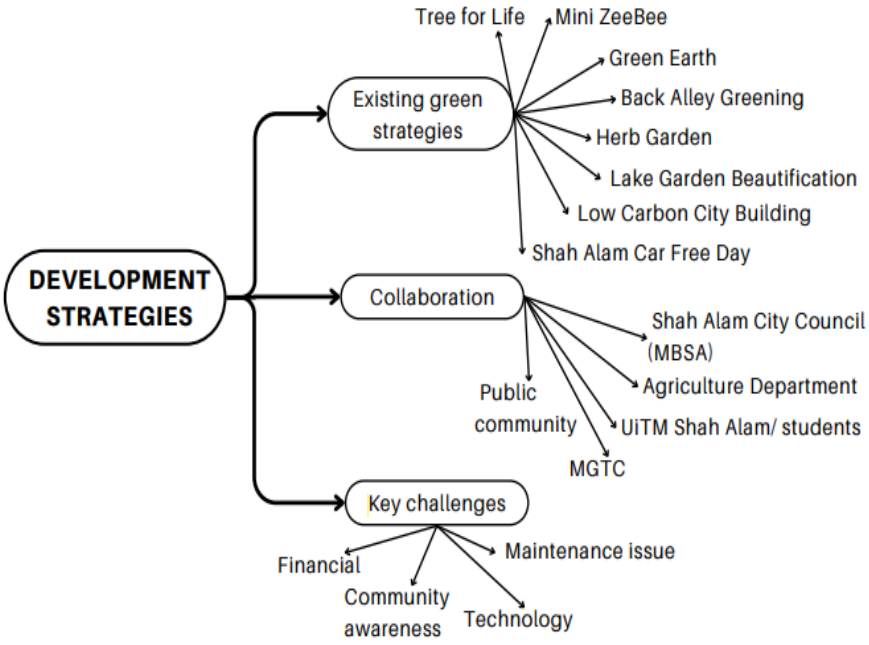

Figure 2: The development strategies and initiatives for green spaces within Shah Alam Low Carbon City.

The study's findings are based on six expert interviews, which, while providing in-depth insights, may not fully capture the diversity of perspectives on green spaces and low-carbon development strategies in Shah Alam. The limited number of interviews may affect the generalizability of the findings.

CONCLUSION AND RECOMMENDATION

This research has shown the significant potential of green spaces in Shah Alam for carbon sequestration through action plans and effective management. These spaces play a crucial role in carbon capture and retention, thereby contributing to environmental sustainability. All stakeholders play an important role in preserving and improving this green space as a valuable asset in reducing climate change and greenhouse gas emissions. It is encouraging that the recommendations can be applied to other locations for the development of low carbon city.

The suggestions addressed in this study emphasise the importance of fostering partnerships among stakeholders, including authorities, community members, and students, to improve communication and integration. Additionally, this study suggests adopting best practices from developed nations and implementing advanced technologies to optimise green space utilisation and

reduce carbon emissions from the industrial and transportation sectors. Future researchers may conduct in-depth research on carbon sequestration in urban planning, particularly by assessing the effectiveness of green spaces and renewable energy integration, and analysing the development strategies across different cities. These insights may support future actions for sustainable urban development and highlight the crucial role of green spaces in carbon capture and environmental sustainability within the broader context of LCC initiatives.

For scaling the findings to other cities, it is essential to consider the unique socio-economic, cultural, and environmental contexts of each urban area. Customizing the action plans and management strategies to fit local conditions can enhance the effectiveness of green space initiatives. Furthermore, collaboration and knowledge-sharing between cities can facilitate the adaptation of successful practices. By doing so, cities can collectively progress towards achieving low-carbon goals and mitigating climate change.

Future researchers may conduct in-depth studies on carbon sequestration in urban planning, particularly by assessing the effectiveness of green spaces and renewable energy integration, and analyzing development strategies across different cities. These insights can support future actions for sustainable urban development and highlight the crucial role of green spaces in carbon capture and environmental sustainability within the broader context of LCC initiatives. By exploring these areas, researchers can provide valuable guidance on how cities worldwide can implement similar strategies and achieve low-carbon urban environments.

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