Green building development in the US capitals: a focused comparative analysis with Baton Rouge

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Abstract

Purpose – For over 25 years, the United States Green Building Council (USGBC) has significantly influenced the US sustainable construction through its leadership in energy and environmental design (LEED) certification program. This study aims to delve into how Baton Rouge, Louisiana, fares in green building adoption relative to other US capital cities and regions.

Design/methodology/approach – The study leverages statistical and geospatial analyses of data sourced from the USGBC, among other databases. It scrutinizes Baton Rouge's LEED criteria performance using the mean percent weighted criteria to pinpoint the LEED criteria most readily achieved. Moreover, unique metrics, such as the certified green building per capita (CGBC), were formulated to facilitate a comparative analysis of green building adoption across various regions.

Findings – Baton Rouge's CGBC stands at 0.31% (C+), markedly trailing behind the frontrunner, Santa Fe, New Mexico, leading at 3.89% (A+) and in LEED building per capita too. Despite the notable concentration of certified green buildings (CGBs) within Baton Rouge, the city's green building development appears to be in its infancy. Innovation and design was identified as the most attainable LEED benchmark in Baton Rouge. Additionally, socioeconomic factors, including education and income per capita, were associated with a mild to moderate positive correlation ($0.25 = r = 0.36$) with the adoption of green building practices across the capitals, while sociocultural infrastructure exhibited a strong positive correlation ($r = 0.99$).

Practical implications – This study is beneficial to policymakers, urban planners and developers for sustainable urban development and a reference point for subsequent postoccupancy evaluations of CGBs in Baton Rouge and beyond.

Originality/value – This study pioneers the comprehensive analysis of green building adoption rates and probable influencing factors in capital cities in the contiguous US using distinct metrics.

Keywords LEED certification, Green building development, Socioeconomic factors, Sustainability, Rating standards, Capital cities, Urban development

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1. Introduction

1.1 Background

Green buildings (GBs) in urban areas in the US are becoming increasingly popular as cities strive to promote sustainability, reduce their carbon footprint and improve their environmental performance (Kaza *et al.*, 2013; Balaban and de Oliveira, 2017). GBs are designed and constructed to reduce energy and water consumption, improve indoor environmental quality (IEQ) and reduce waste generation. One of the primary drivers of GB development in urban areas is the increasing awareness of the impact of buildings on the environment (He, 2019). Buildings account for a significant portion of energy consumption, greenhouse gas emissions and water use in urban areas (Li *et al.*, 2019; Ahmed Ali *et al.*, 2020). In addition to environmental benefits, GBs offer economic and social benefits: reduce operating costs, improve occupant comfort and health and enhance the building's marketability and resale value (Balaban and de Oliveira, 2017; Darko *et al.*, 2017). This development can also create jobs in the construction and building management sectors, contributing to local economic development.

One of the most significant policies promoting GB practices in the US is the leadership in energy and environmental design (LEED) certification program (Zhang, 2022), which focuses on the design and construction of high-performance GBs. LEED certification is based on a point system and buildings can earn points for various sustainable features, such as energy efficiency, water conservation, indoor air quality and sustainable materials. This program has so far adopted different versions of rating systems, with subsequent ones being an improvement on the previous. The program was created by the US Green Building Council (USGBC) in 1998 and has since become a widely recognized standard for GB design and construction (Ferrari *et al.*, 2022; Zhang, 2022). Some of the factors that may impact the sustainability performance of LEED buildings (LBs) include building location, design, materials and operational practices (Manna and Banerjee, 2019). For example, Buildings with renewable energy systems may have lower energy-related emissions (Younger *et al.*, 2008; Eisenstein *et al.*, 2017), while buildings located in urban areas may have lower transportation-related emissions (Younger *et al.*, 2008). This is because urban areas typically have more compact development patterns that are more conducive to walking, biking and public transportation, which can reduce the need for driving and associated emissions. However, this may not always be the case and can depend on a variety of factors such as the specific location, accessibility of public transportation and commuting patterns of the occupants. One of the challenges facing GB development in urban areas is the high cost of construction and retrofitting (Jagarajan *et al.*, 2017; Franco *et al.*, 2021). GB materials and technologies can be more expensive than traditional building materials, which can make it challenging for developers to incorporate GB tenets into their projects (Chan *et al.*, 2017). However, as the demand for GBs increases and the costs of GB technologies decrease (Aliagha *et al.*, 2013; Darko *et al.*, 2017; Maraveas, 2020), the economic feasibility of GB development is enhanced.

Although other green building rating standards (GBRS) such as Home Energy Score (HES), Home Energy Rating System (HERS), ENERGY STAR and National Green Building Standard (NGBS) exist in the US, LEED offers a comprehensive, globally recognized, flexible, continuously improving, third-party verified (Darko *et al.*, 2013) and market-leading approach to GB design and construction (Ma and Cheng, 2017), making it superior to existing rating standards. For example, many GBRS with the notable exception of LEED, tend to specialize in singular sustainability aspects, like energy efficiency and frequently lack the versatility to cover a diverse range of building categories. However, the choice of a rating system can vary based on project-specific goals, regulatory environments and stakeholder preferences.

1.2 Literature review

1.2.1 Sustainability and urban development. A sustainable city is one that actively integrates considerations of social, environmental and economic impact through urban planning and management. In the field of urban development, selecting and applying appropriate indicators is crucial for assessing sustainability (Brugmann, 2021; Mirrahimi *et al.*, 2016).

While existing literature provides various indicators to measure urban development and its impacts, the significance of GB practices stands out due to their environmental and socioeconomic benefits. However, other critical indicators and infrastructure such as hospitals, transportation, financial institutions, universities, public libraries, community parks and museums play significant roles in shaping urban landscapes (Vargas-Hernández *et al.*, 2023). For instance, universities and public libraries often serve as hubs of information, innovation and research, contributing to urban growth and resilience by driving economic development and fostering an educated populace (Addie, 2017; Leorke *et al.*, 2018). Community parks offer vital green spaces in urban areas, improving mental health, encouraging physical activity and providing ecological benefits through urban greening (Wood *et al.*, 2017). Museums enrich urban culture, preserve history and attract tourism, which can significantly contribute to local economies (Ismagilova *et al.*, 2015).

Since accessibility is a crucial component of urban quality of life and can influence residents' satisfaction and their daily lifestyle choices, shorter distances to key services can reduce the reliance on vehicular transportation, thereby lowering transportation emissions (Wey and Huang, 2018). For GBs, this proximity can further enhance their market appeal, making them more attractive to potential buyers or renters.

Despite the wide array of indicators, there remains a noticeable research gap in understanding the association between GB developments and key community and cultural resources like universities, public libraries, parks and museums, especially within capital cities across the US. This gap suggests a need for comprehensive studies that explore how these elements collectively influence urban sustainability, particularly in areas marked by significant architectural and environmental policy decisions.

1.2.2 Efficacy of leadership in energy and environmental design certification in green building development. The LEED certification program, developed by the USGBC over the last quarter-century, has become a benchmark for evaluating GB practices, thereby serving as a critical decision-making tool (Haapio and Viitaniemi, 2008; Mattoni *et al.*, 2018). This certification program takes into account the geographical relevance of the buildings (Doan *et al.*, 2017) and is scrutinized for its thoroughness, efficiency and the precision of its evaluation criteria (Chen *et al.*, 2015), as well as its adoption rates (Bernardi *et al.*, 2017; Lavy and Fernández-Solis, 2009). However, criticism arises due to its perceived preference for incremental technological solutions over comprehensive, site-specific strategies (Boschmann and Gabriel, 2013). This critique underscores the ongoing debate within the sustainability field regarding the most effective paths to sustainability, such as the distinction between light and deep green approaches.

Dang *et al.* (2020) contributed to this discourse through comparative analyses of urban sustainability standards, demonstrating the necessity for adaptability and cultural sensitivity in sustainability benchmarks, a feature where LEED and similar standards are tested across diverse national contexts.

Notwithstanding, the challenge remains in accurately quantifying the environmental impact of LBs, highlighted by minimal regional climate influence findings (Donghwan *et al.*, 2015). Such results align with broader critiques that LEED may not adequately incentivize or encompass the most impactful GB practices, particularly concerning water efficiency (WE) (Luo *et al.*, 2021) and the nuanced benefits of certification (Wu *et al.*, 2016, 2017).

Pushkar (2021, 2023) further explores limitations of the LEED system in fostering long-term sustainability through its bonus systems, questioning the alignment of LEED achievements with overarching environmental goals. This critique points to the need for a holistic examination of GB certification that goes beyond structural and policy dimensions to include stakeholder motivation toward sustainability. Thus, the study by Olanipekun (2016) is pivotal, offering insights into the motivational dynamics driving the adoption of GB practices through the lens of self-determination theory (SDT). This exploration into the psychological foundations of SDT across 30 articles reveals varied motivational levels among building stakeholders, fundamentally tied to their perceived control over GB engagement. This differentiation suggests the profound influence of internal motivations in the successful implementation of GB practices, beyond mere technical and policy considerations. Therefore, it becomes imperative to further investigate how these insights can be integrated into practical strategies for enhancing the adoption and effectiveness of GB practices.

Recent analyses by Ismaeel (2019, 2022) and Ismaeel and Elsayed (2022) delve into the geographical adoption patterns of LEED, underscoring the strategic importance of site selection and the challenges faced by GBRS in different developmental contexts. A notable study by Ismaeel (2022) models the significant impact of site selection on achieving LEED Gold certification, highlighting the potential to secure a substantial portion of available points through strategic site choices.

1.2.3 City-level green building adoption and the role of state capitals. The adoption of GB practices in US cities is influenced by a variety of factors, including policy initiatives, civic capacity and market perceptions. Washington, D.C., for instance, stands out as a national leader in implementing the USGBC's LEED rating system, showcasing the pivotal role of policy and planning in fostering sustainable development within urban areas (Knaap *et al.*, 2011). This is echoed in the wider observation that cities with greater civic capacity, where organizations actively engage in addressing social and environmental issues, tend to adopt green construction practices more rapidly and extensively (Brandtner, 2022; Gearin *et al.*, 2023). However, the growth of green economies and, by extension, GB practices, varies significantly across different regions, reflecting the influence of state policies, local leadership initiatives and the political culture of each state (Brandtner, 2022; Gearin *et al.*, 2023). This variation stresses the importance of supportive policies and dynamic actions by city leaders to promote green economy growth, including GB adoption. The financial aspect also plays a crucial role, as evidenced by the negative relationship between GB certification and the cost of equity capital for real estate investment trusts, suggesting that market participants view green certification positively (Hsieh *et al.*, 2020). Yet, the adoption of GBs is not without challenges, including the need for sustainable and eco-friendly construction materials and techniques (Alohan and Oyetunji, 2021; Eze *et al.*, 2021).

However, the prominence of GB policies in cities like New York and San Franscisco allows for the improvement in GB adoption. For instance, New York City's Greener Greater Buildings Plan requires building owners to benchmark their building's energy and water consumption and make energy-efficient upgrades (Henderson, 2013; Hölscher *et al.*, 2019). San Francisco's GB Program provides incentives for developers and building owners to incorporate GB practices into their projects (Choi, 2010; Laitner *et al.*, 2007) and California has set ambitious goals for Zero Net Energy commercial construction by 2030, aiming for all new construction to be zero net energy while mandating retrofitting existing buildings to meet the same standard (American Legal Publishing, 2023). Other cities, such as Chicago, Seattle and Los Angeles, have also implemented GB policies and programs to promote sustainability (Kaklauskas *et al.*, 2021; Liberalesso *et al.*, 2020).

Recently, during the Biden Administration, the National Building Performance Standards Coalition, involving state and local governments across the country, was initiated. With support from various federal agencies, labor groups and nongovernmental organizations, these governments have pledged to collaboratively develop and enforce building performance policies and programs within their areas (Council on Environmental Quality, 2024).

Furthermore, the Inflation Reduction Act of 2022 underscores the commitment toward sustainable high-performance buildings by providing significant financial incentives, such as increased tax deductions for energy-efficient commercial buildings (Bistline *et al.*, 2023; Ramirez *et al.*, 2023). These incentives are designed to make green upgrades more accessible to a diverse array of stakeholders, including private building owners, developers and nonprofit organizations, thereby promoting widespread implementation of GB practices.

These regulations set a precedent that influences state and local building codes, encouraging them to adopt similar stringent measures. This policy-driven push toward sustainability is instrumental in shaping a future where GBs become the norm, thereby significantly impacting environmental conservation and energy use nationwide.

Extensive research has focused on the performance of GBs postoccupancy (Geng *et al.*, 2019); however, there is a noticeable research gap in city-level GB adoption and development. Exceptions include studies by Zhao and Lam (2012) and Fuerst *et al.* (2014), which investigate GB adoption in US cities, identifying market size, economic growth and educational attainment as key drivers of LEED project volumes. Furthermore, gaining insights into the design criteria of LBs, such as understanding the prioritization and ease of fulfillment by construction teams and clients, will provide further understanding of the adoption of LEED certification and other GBRS within urban and capital city contexts.

State capitals, as regional influencers, are critical in advancing sustainability initiatives. Their role in showcasing a higher number of certified green buildings (CGBs) than other cities within their states is crucial for promoting policy, practice and public perception changes toward sustainability (Daum and Mauch, 2005; Choe and Roberts, 2011).

1.2.4 The case of Baton Rouge. Baton Rouge, Louisiana's capital, presents a unique case study to explore some of the research gaps, while also examining other capital cities across the contiguous US states to determine comparative performance and probable socioeconomic and cultural drivers toward GB practices.

Louisiana faces significant environmental challenges, including sea level rise and more intense hurricanes due to climate change (Morgan, 2017). Despite these challenges, efforts to reduce emissions from building practices in the state have been slow (Morgan, 2017). While variations in individual preparedness in the event of hurricanes in the state have been reported (Awolesi *et al.*, 2023), the correlation between flooding and rapid development is evident, with areas experiencing substantial growth also witnessing severe flooding (Morgan, 2017). Sustainable site design, a key aspect of LEED certification, offers solutions to Louisiana's flooding challenges (Morgan, 2017). By restricting building on land with high ecosystem service value, such as wetlands, LEED promotes environmentally responsible development and credits for stormwater management are essential for mitigating flood risks and reducing pollution from runoff (Morgan, 2017).

Recently published documents, such as state agency reports, suggest that Louisiana is taking significant steps to promote GB practices through various policies and incentives (Harper, 2019; ICC, 2022). The state's approach combines legislative measures, financial incentives, tax credits and rebates toward the adoption of high energy efficiency standards. Recognized programs encouraging and verifying this adoption include the NGBS and ENERGY STAR, LEED (Harper, 2019; Louisiana Residential Code, 2021). For instance, Tax Credits for Green Job Industries provide financial incentives for companies investing in sustainable projects, supporting both economic growth and environmental sustainability (Louisiana State Legislature, 2024). The Louisiana Residential Code (2021) Section N1101 emphasizes energy efficiency in residential construction, aligning with national standards and programs. Adoption of the latest energy codes ensures that new and renovated buildings meet high efficiency and performance standards, leading to substantial energy savings and reduced greenhouse gas emissions (Morgan, 2017). GB certification plays a vital role in this effort, emphasizing energy conservation through measures such as natural lighting, insulation and energy-efficient appliances (Hirokawa, 2009; Morgan, 2017). The Energy and Atmosphere category of LEED certification is particularly impactful in this pursuit.

With a population of over 220,000 people (U.S. Census Bureau, 2024), Baton Rouge is the second largest city by population in Louisiana after New Orleans and the third largest by land area. The city is the seat and a subset of the East Baton Rouge Parish, comprising other cities like Baker, Zachary and Central. As a major economic and cultural center in Louisiana, Baton Rouge is considered as an urban center (Antipova and Wilmot, 2012), with a diverse economy that includes petrochemical production, manufacturing, health care and education. The city is home to Louisiana State University and Southern University, which are both major public universities. Additionally, the city is located near several major industrial facilities, including one of the world's largest petrochemical companies, ExxonMobil. As a capital city, Baton Rouge faces many of the challenges associated with urbanization, such as traffic congestion and air pollution. The city is home to the Louisiana State Capitol Gardens, which are located on the grounds of the Louisiana State Capitol building and include several gardens and fountains. In addition, Baton Rouge has several organizations and programs that promote sustainability and environmental stewardship. For example, the Baton Rouge Green Initiative is a community-based organization that promotes sustainable practices and environmental education (Baton Rouge Green, 2023). The organization has implemented several programs, including community gardens, recycling initiatives and energy efficiency upgrades.

Evaluating the adoption of GBs in Baton Rouge is important for assessing the overall sustainability of the built environment. The quantity and quality of GBs in the city is also an important indicator of the sustainability of the local real estate market (Dell'Anna and Bottero, 2021; Lambourne, 2022). The city government can consequently use such information to identify areas where incentives or regulations may be needed to encourage more GB practices. Therefore, by evaluating extant data concerning GBs in Baton Rouge, policymakers can develop more targeted and effective policies to promote sustainability in the built environment. GBs have been shown to have positive impacts on the health and well-being of building occupants (Zeiler, 2022; Zhang and Tu, 2021). They can improve indoor air quality, reduce exposure to toxins and enhance access to natural light and views (Thatcher and Milner, 2014; Tsai, 2017).

In the long run, research focusing on quantifying and characterizing GBs in cities will help guide developers, policymakers and researchers in understanding the limitations, state and potentials of GB practices within urban landscapes.

1.3 Scope of the study

This study aims to explore the progress of GB adoption in Baton Rouge compared to other capital cities across the contiguous US. Additionally, it seeks to assess how well Baton Rouge is performing in terms of LEED certification for GB practices. Finally, this study attempts to inspire further scholarly inquiry and practical strategies toward enhancing GB adoption and sustainability in urban centers and capital cities.

In pursuing these objectives, the study:

- analyzes the adoption rate and probable influencing factors of CGBs and the LEED certification program in Baton Rouge, compared to other geographic regions;
- examines LBs in Baton Rouge based on construction and space types;
- examines LBs in Baton Rouge considering their rating systems and rating scores; and
- analyzes LBs in Baton Rouge based on design criteria [e.g. WE vs innovation and design (I)] and subdesign criteria (e.g. thermal comfort vs increased ventilation).

2. Methodology

2.1 Data sources

Data sets for this research were obtained from the following databases: the US Census Bureau, GB Registry, GB Information Gateway and the USGBC. The databases provide a rich source of information regarding socioeconomic factors, certifications and overview of activities within a specific geographic location associated with GB practices that can be used to analyze trends, identify patterns and inform decision-making in sustainable construction management and design. Additionally, city government and publicly accessible websites providing up-to-date information on sociocultural infrastructural services and facilities in selected cities such as Baton Rouge, Des Moines, Indianapolis and Boise were explored for fair comparison and analysis, considering the similarity in their population densities.

2.2 Data analysis

Geographic locations from the data sets were geocoded and visualized using Geocodio and the QGIS software. The variables used for analysis include population, income per capita, CGBs and LBs.

A series of distinct ratios were also developed to compare the adoption of GB practices across different regions. In analyzing LBs in Baton Rouge, variables such as score point (SP), certification type, building size and the different design criteria, were used. The retrieved data were processed and analyzed using MS Excel, Python, and R programing software to examine relationships between variables. Proximity analyses such as nearest neighbor and distance to the nearest hub were conducted using QGIS. To assess the level of each LB in comparison to specified design criteria for a particular rating version and construction type, we established percent weighted criteria (PWC). Further analyses were performed using inferential statistics.

3. Results and discussion

3.1 Factors influencing green building practices in the US capital cities and regions

In the quest to enhance sustainable urban development, understanding the dynamics that influence the adoption of GBs is paramount. This section examines the relationship between adoption rate and socioeconomic factors and demographic factors; geospatial distribution of

CGBs in Baton Rouge; and LEED certification rates across different US capital cities and regions.

3.1.1 Adoption rate and socioeconomic factors. As of April 2024, Baton Rouge boasts 696 CGBs, categorized into five distinct types based on rating standards: Home Energy Score or HES (0.3%), Home Energy Rating System or HERS (87.2%), LEED (3.0%), ENERGY STAR (2.2%) and National Green Building Standard or NGBS (7.3%). About 95.5% of the buildings are categorized as residential property, while the remaining proportion represents commercial properties. These proportions are illustrated in Figure 1. ENERGY STAR focuses primarily on energy efficiency and is often used in tandem with LEED to achieve higher energy performance. NGBS offers a flexible, point-based system similar to LEED but with a focus on residential buildings.

In their study, Zhao and Lam (2012) used household income to investigate its connection with LEED market uptake but discovered no substantial link. Despite this, socioeconomic factors are still presumed to be significant. They noted that the results of their investigation could be skewed by suboptimal feature engineering. Furthermore, they emphasized the significance of educational factors in LEED markets, positing that individuals residing in areas with higher educational attainment are more inclined to possess a heightened awareness of environmental issues.

In this study, the certified green building per capita (CGBC) is used to gauge and compare the adoption of green building practices across various regions. CGBC is calculated as the ratio of the number of CGBs in a given region to the population of that region. While a similar term exists in the literature, it narrowly focuses on LBs alone and is used inversely. For instance, Cidell (2009) conducted an analysis of LBs, emphasizing the ratio of population to buildings. The study prioritized areas with a minimum of three LBs and identified Corvallis, Oregon as the top-performing region among the 20 analyzed. Results indicated that factors such as larger populations, higher levels of education and increased income levels contribute to a city's propensity for hosting more GBs.

Considering a population of 227,470 in Baton Rouge, the city's CGBC is 0.31% compared to Santa Fe with a CGBC of 3.89%. Consequently, the CGBC of all the capital cities in the contiguous US states are ranked by percentile and categorized by a letter grade from A+ to

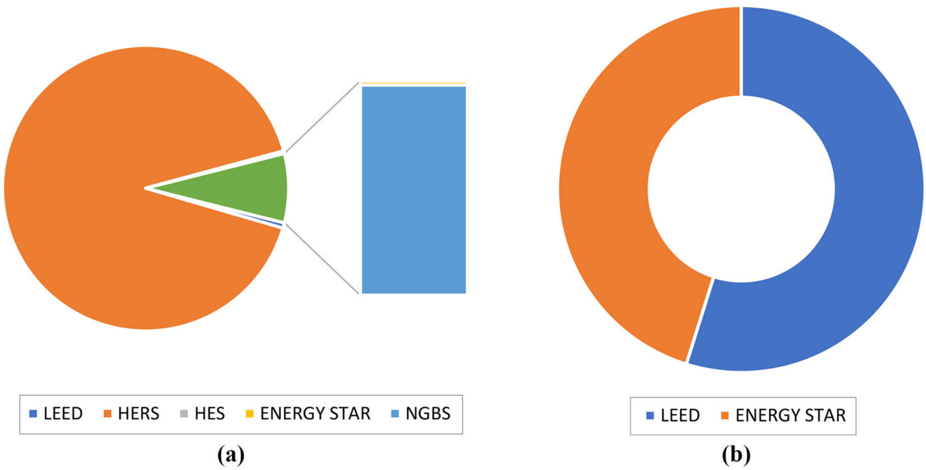


Figure 1. Proportion of certified green building standards in Baton Rouge in both (a) residential and (b) commercial properties

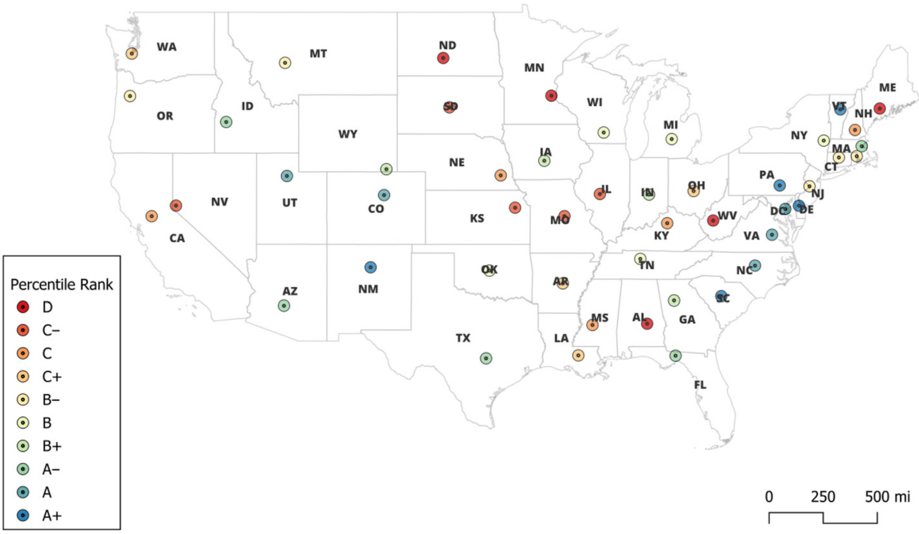
Source: Authors

D, at 10th percentile intervals. The top ten ranking cities, presented in decreasing order, are Santa Fe, NM (A+), Dover, DE (A+), Montpelier, VT (A+), Harrisburg, PA (A+), Columbia, SC (A), Raleigh, NC (A), Salt Lake City, UT (A), Annapolis, MD (A), Denver, CO (A) and Richmond, VA (A). For a visualization of these rankings and additional insights, see Figure 2, which includes a map illustrating the CGBC rankings across the contiguous US. Specifically, Baton Rouge has a C+ rank.

Similarly, Santa Fe leads the rankings in terms of LEED building per Capita (LBC), compared to Baton Rouge which is categorized among the lower-ranking cities. This contrast is depicted in Figure 3. The top-ranking cities in LBC are Santa Fe, NM (A+), Austin, TX (A+), Annapolis, MD (A+), Denver, CO (A+), Atlanta, GA (A+), Lansing, MI (A), Hartford, CT (A), Boston, MA (A), Salem, OR (A) and Salt Lake City, UT (A). The rankings for other cities range from A- to D, with Baton Rouge receiving a C rank, as presented in Figure 3.

The correlation between the CGB metrics (CGBC and LBC) and socioeconomic factors, namely, the percentage of the population with a bachelor's degree or higher (referred to as education) and the income per capita of each city, was measured. Pearson correlation tests, conducted at a 95% confidence level, revealed statistically significant moderate positive associations (r = 0.25, 0.36) between CGBC and each socioeconomic factor and similar patterns were observed for LBC (r = 0.35, 0.30). This indicates that both income and education level are positively correlated with the adoption of GB practices, with education showing a relatively stronger correlation. These relationships are visually represented in scatterplots with regression lines in Figure 4. Furthermore, based on t-test results ($p > 0.05$), there is no statistically significant difference between the correlation coefficients for both pairs of variables.

The Sankey diagram in Figure 5 illustrates the per capita distribution of LBs and CGBs in various capital cities within the southeastern US, in relation to the education levels of each city's population. Atlanta, Georgia and Tallahassee, Florida show a higher adoption rate of



Source: Authors

Figure 2.
Certified green building per capita ranking across capitals in the contiguous US

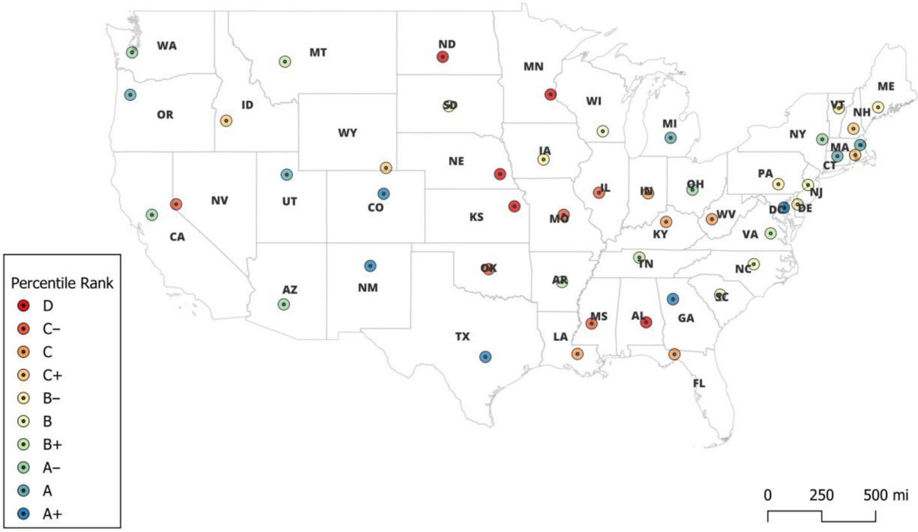


Figure 3. LEED building per capita ranking across capitals in the contiguous US

Source: Authors

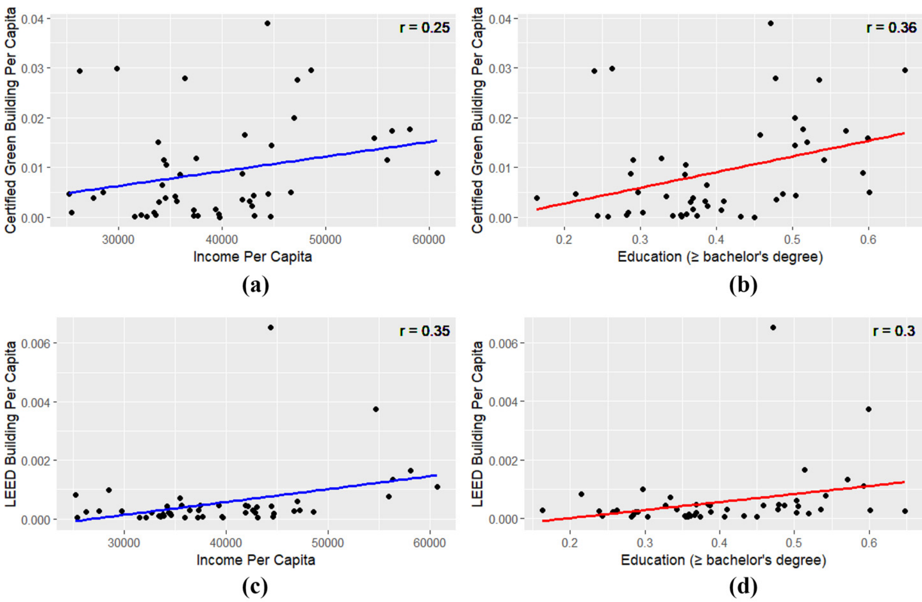
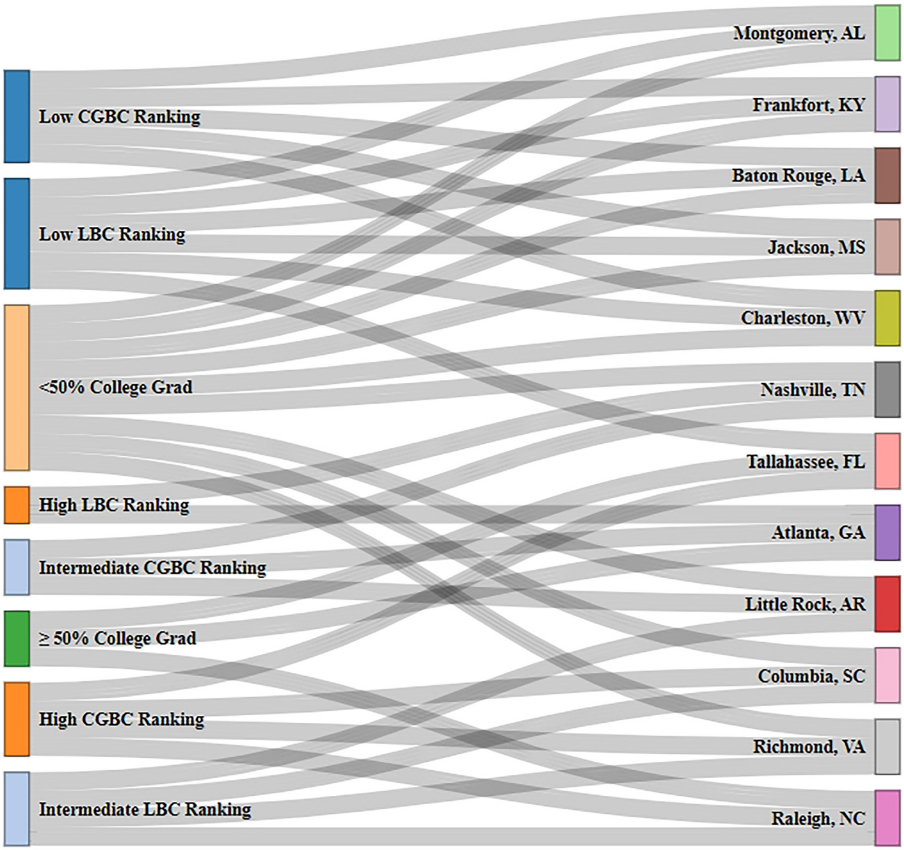


Figure 4. Socioeconomic correlates of green building per capita in US capital cities

Source: Authors



Source: Authors

Figure 5. Educational attainment and green building per capita rankings across capital cities in the southeastern US

GB practices, potentially indicating a stronger emphasis on sustainability initiatives or more progressive building regulations. In addition, the diagram also suggests that cities with higher proportions of college graduates tend to have higher per capita rankings of LBs and CGBs, implying a link between educational attainment and the embracement of green practices. Conversely, cities connected to the lower end of the LBC and CGBC rankings, like Baton Rouge, Louisiana; Frankfort, Kentucky; and Jackson, Mississippi, might indicate a slower adoption of GB practices or different priorities in city planning and development.

Given that Baton Rouge attains a lower ranking in all three categories, policymaking and city planning strategies from the top-ranking cities (e.g. Atlanta, GA) in the southeastern region should be explored and leveraged upon to foster GB practices. By incorporating best practices from more successful cities and addressing city-specific challenges, the adoption of GB practices can be more effectively encouraged. This strategic approach can help to create more sustainable urban environments across the region.

Furthermore, in evaluating the proportion of LBs within a capital city compared to the total LBs across all capital cities in the contiguous US states, Figure 6 depicts the market distribution for LB certification. Austin, TX, notably leads with 39%, followed by Denver,

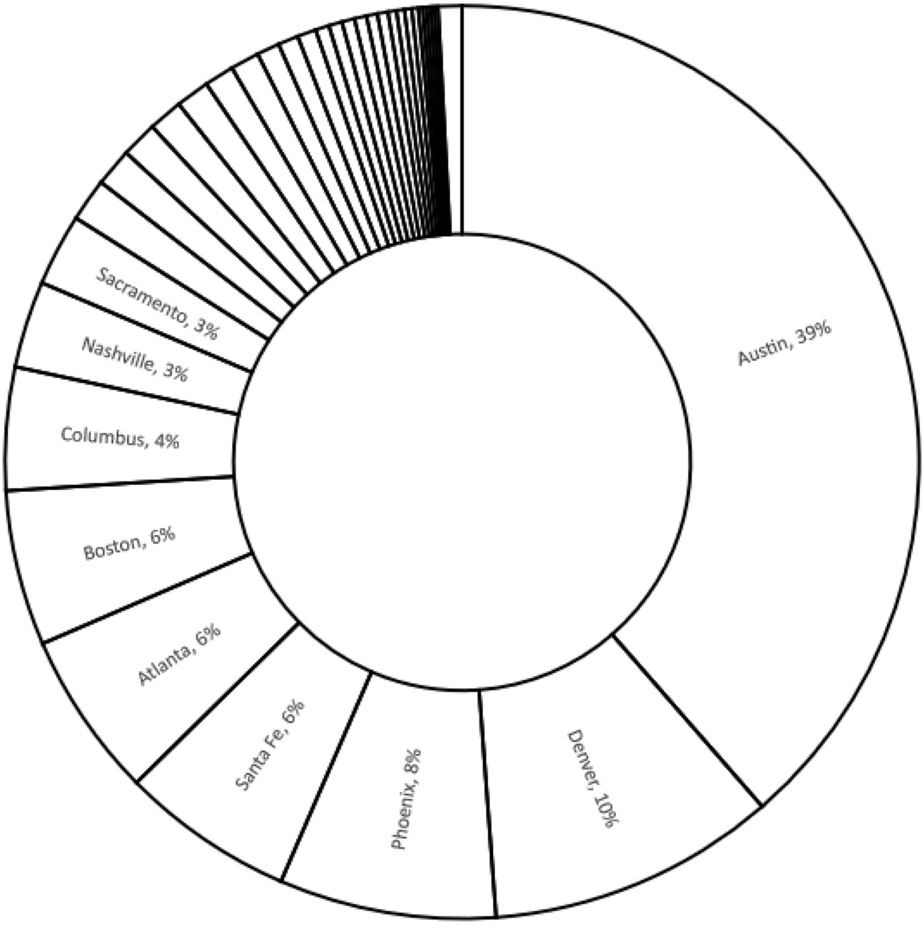


Figure 6.
Market leaders: proportion of LEED buildings in US capital cities

Source: Authors

CO, at 10%, and Phoenix, AZ, at 8%. However, Baton Rouge (0.2%) does not rank among the top market leaders. This metric, along with CGBC and LBC, suggests that GB practices in Baton Rouge are in a nascent stage.

Consequently, these findings imply that supplementary empirical studies are essential to gain an insight on other factors (e.g. impact of policy interventions or incentive programs) that may confound the reported statistics.

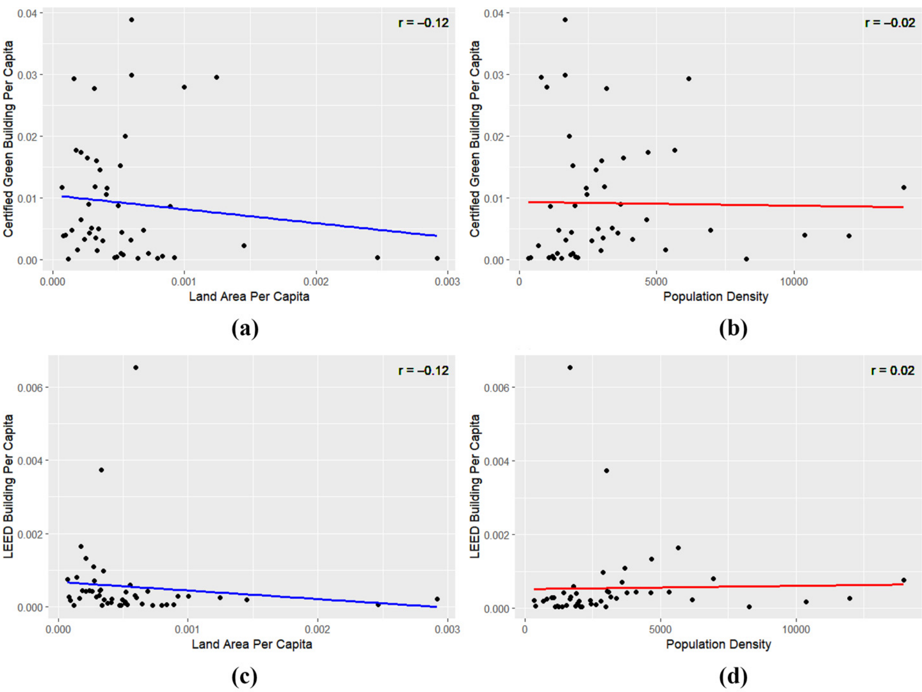
3.1.2 Adoption rate and demographic factors. The relationship between the prevalence of CGBC and two key urban metrics, population density and land area per capita, is explored. Similar exploration is also evident in the research conducted by Zhao and Lam (2012). The rationale behind this analysis lies in the hypothesis that denser populations and varying degrees of land availability per capita might significantly impact the adoption of GB practices. Such an understanding is crucial for urban planners, policymakers and sustainability advocates aiming to promote GBs as a norm in urban development.

The correlation analysis conducted yields low correlation coefficients ($-0.12 \leq r \leq 0.02$), indicating weak relationships between GB adoption and both population density and land area per capita (Figure 7). Specifically, the coefficients suggest a negligible influence of population density on the rate of GB certification per capita. A minor negative correlation indicates that increased land availability per person has a slight, albeit weak, negative impact on the prevalence of GBs per capita.

The near-zero correlation coefficients suggest that other factors beyond population density and land area per capita play a more significant role in GB adoption. Again, variables not captured in this analysis, such as policy frameworks, economic incentives and cultural attitudes toward sustainability, as previously alluded, may be more pivotal in driving the adoption of GBs. This implies that the relationship between urban form and GB practices is likely more intricate than simple linear models can depict, hinting at the need for more complex analytical approaches to fully understand these dynamics.

Furthermore, the analysis suggests a relatively uniform adoption of GB practices across cities with different population densities and land availabilities, underscoring the potential for widespread GB adoption under diverse urban conditions.

3.1.3 Green building adoption and sociocultural infrastructure. We present an analysis of the relationship between GB practices – specifically, the presence of CGBs and LBs – and the availability of sociocultural amenities in various US capital cities. The amenities considered include public libraries, museums, colleges and universities and parks. These elements are critical as they contribute to the social and cultural dimensions of urban sustainability.



Source: Authors

Figure 7. Socioeconomic correlates of green building per capita in US capital cities

For fair comparison, we used data from four capital cities, including Boise, ID; Indianapolis, IN; and Des Moines, IA; due to their similarity with Baton Rouge in terms of population density, ranging from 2,428 to 2,805 per square mile. A clustered column chart with a line graph comparing the number and types of amenities across the cities is shown in Figure 8, where Indianapolis leads in all categories except museums, where Baton Rouge attains leadership, but with fewer parks compared to the rest of the cities.

Correlation analysis revealed strong positive associations ($r = 0.83, 0.84$) between the number of public libraries and both CGBs and LBs across the cities studied. This suggests that cities with a higher commitment to providing educational resources also prioritize environmental sustainability through GB practices. The presence of colleges and universities shows a strong correlation ($r = 0.52, 0.55$) with the number of CGBs and LBs, indicating that cities with more higher education institutions are likely to have more significant GB initiatives. This could be due to the influence of academic research and the higher demand for sustainability within and near campuses. The correlation between GBs and parks ($r = 0.98, 0.96$) is more pronounced than with educational facilities. The strong positive trend suggests that urban green spaces are part of a broader sustainability agenda that includes GB practices. However, with moderate negative correlations ($r = -0.34, -0.36$) found between the number of museums and GB adoption, there might be some trade-offs or prioritization happening between the development of museums and other types of sociocultural amenities and sustainable buildings in the compared cities. Moreover, other factors could be at play, influencing these relationships. These factors may include resource allocation, space and urban planning constraints, varying demographic needs and differing environmental and cultural priorities.

When combining all sociocultural metrics into a single indicator, the correlation with GB metrics strengthens. This is demonstrated in Figure 9, where LBs and CGBs have correlation coefficients of 0.98 and 0.99, respectively, with sociocultural infrastructure. The results indicate a clear link between the richness of a city's sociocultural landscape and its commitment to GB practices. In other words, investments in sociocultural infrastructure

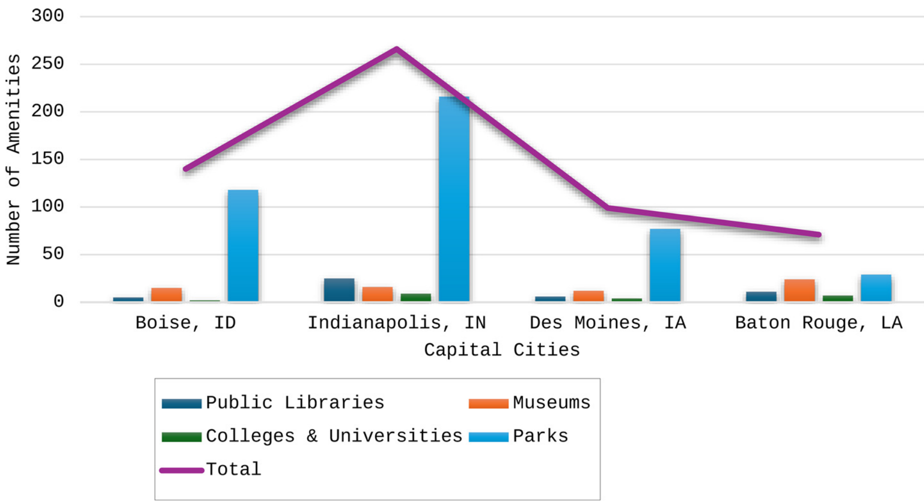


Figure 8. Comparison of sociocultural amenities across US capital cities with similar population density

Source: Authors

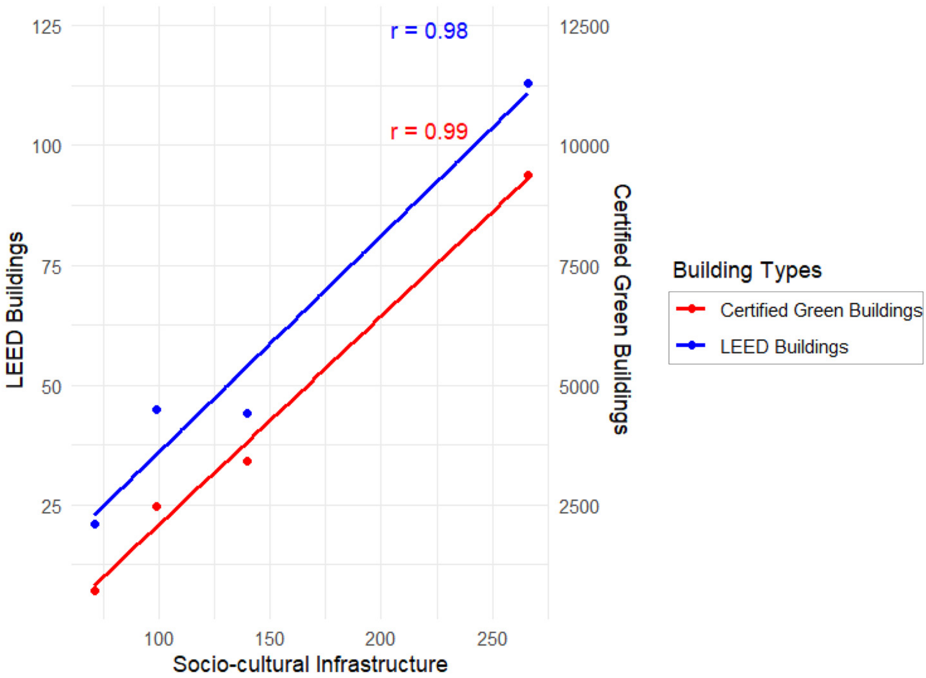


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Figure 9. Strong positive correlation of green building practices with sociocultural infrastructure among the US capital cities with similar population density

could be a catalyst for enhancing urban GB development. Consequently, urban planners and policymakers could leverage this insight to promote more comprehensive sustainability initiatives that encompass both environmental and sociocultural development.

3.1.4 Spatial distribution and proximity diagnostics of certified green buildings in Baton Rouge.

3.1.4.1 Nearest neighbor analysis. The satellite map in Figure 10 depicts the distribution of LBs in Baton Rouge while the map displayed in Figure 11 illustrates the distribution of CGBs within Baton Rouge, both revealing a nonuniform pattern of CGB clustering that diverges from typical urban development norms. The Central–Western part of the map, in particular, shows a pronounced clustering of CGBs. This sector stands out with a high density and diversity of certified buildings, indicating a concentrated effort to integrate GB practices within the city's core.

Complementing the visual data, a nearest neighbor analysis statistically confirms the clustering (see Figure 11). The observed mean distance between CGBs is markedly less than the expected mean in a random distribution, suggesting close proximity among these buildings. The nearest neighbor index (NN_INDEX) is significantly below 1, highlighting the extent of clustering and the exceptionally negative Z_SCORE of −41.209 decisively indicates a nonrandom distribution of CGBs.

To further understand the spatial dynamics, a buffering analysis was performed using a 50-meter radius with 25 segments around each CGB. This approach visualizes the immediate geographic influence of each building and reveals the extent of overlap in GB

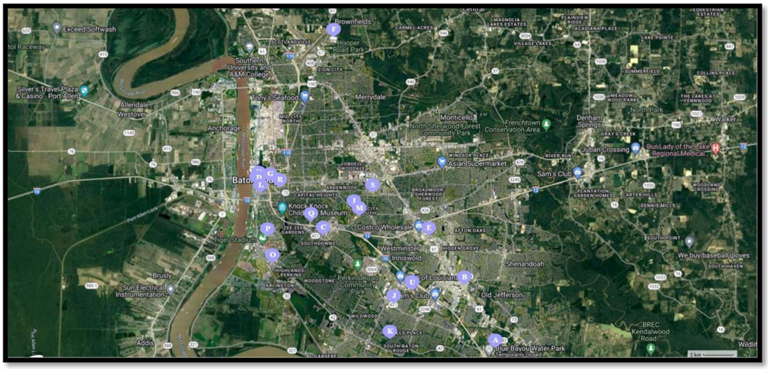


Figure 10.
Satellite map: dispersion of LEED buildings in Baton Rouge

Source: Authors

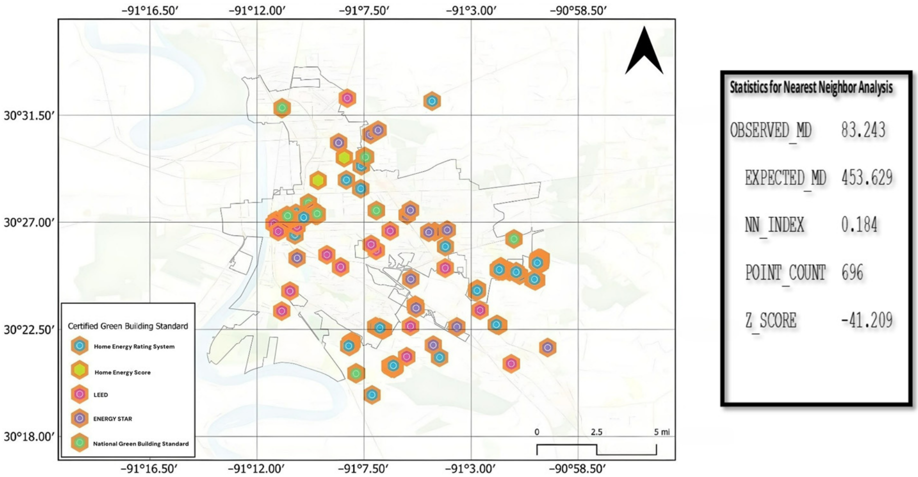
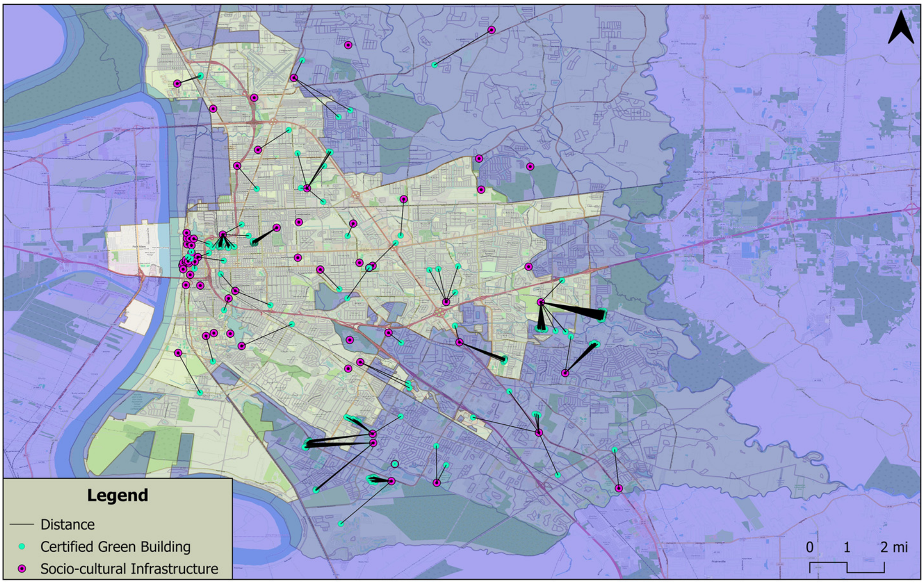


Figure 11.
Spatial distribution and nearest neighbor analysis of certified green buildings in Baton Rouge

Source: Authors

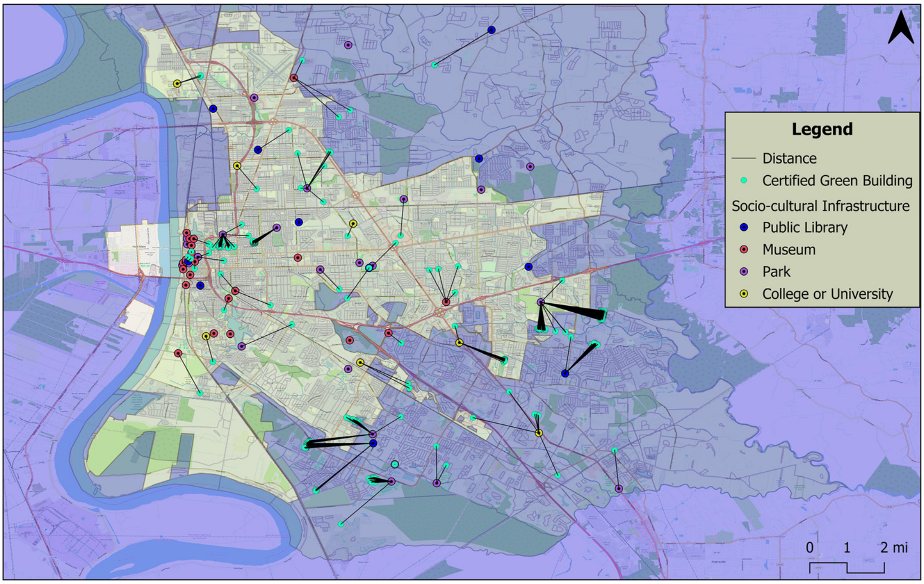
areas, thus providing additional context to the clustering phenomenon observed. The overlapping buffers point to a potential for creating interconnected green spaces or building networks, signifying a possibly deliberate strategy for urban sustainability.

3.1.4.2 Distance to nearest sociocultural infrastructure analysis. Considering the strong positive association existing between GB practices and sociocultural infrastructure as earlier reported, another type of proximity analysis (distance to nearest hub) was performed with Baton Rouge being the focal city. The spatial distribution of CGBs to the nearest social space is visualized in both Figures 12 and 13. Furthermore, the boxplots in Figure 14 suggest that CGBs, and specifically LBs and residential spaces that are green certified, exhibit similar minimum distances to the nearest sociocultural infrastructures. However, the maximum distances reveal more variability, particularly for CGBs generally and green residences specifically. Given the coincidence of having a park and a library being green certified, the minimum distance of CGBs and LBs to the nearest sociocultural space type is 0 miles.



Source: Authors

Figure 12.
Spatial distribution of certified green buildings and their proximity to the nearest sociocultural infrastructure in Baton Rouge



Source: Authors

Figure 13.
Spatial distribution of certified green buildings and their proximity to the nearest sociocultural infrastructure (museums, public libraries, colleges and universities, and parks) in Baton Rouge

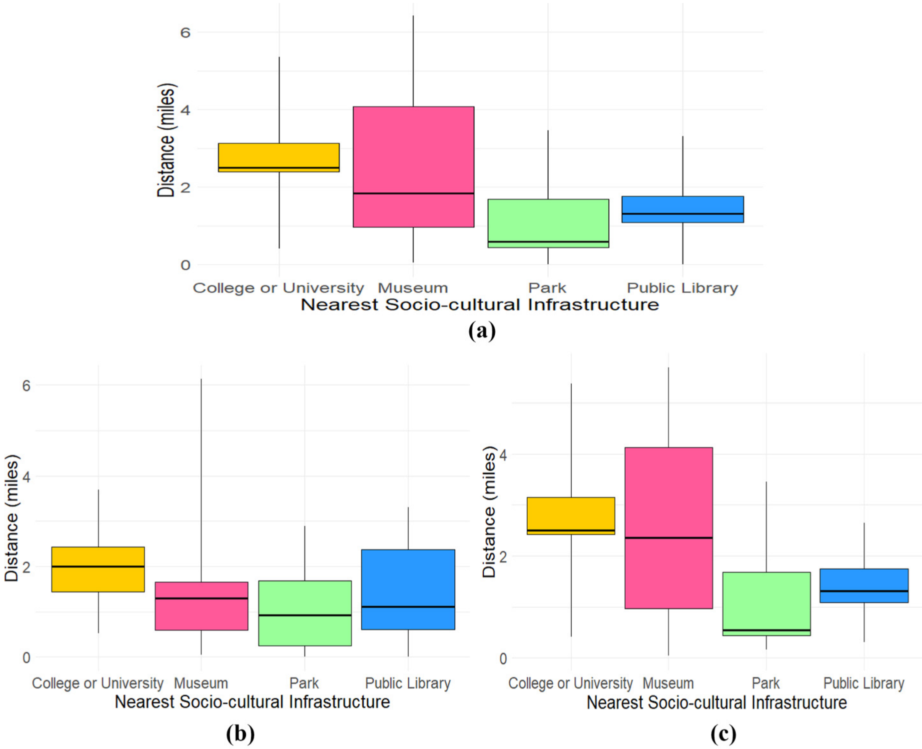


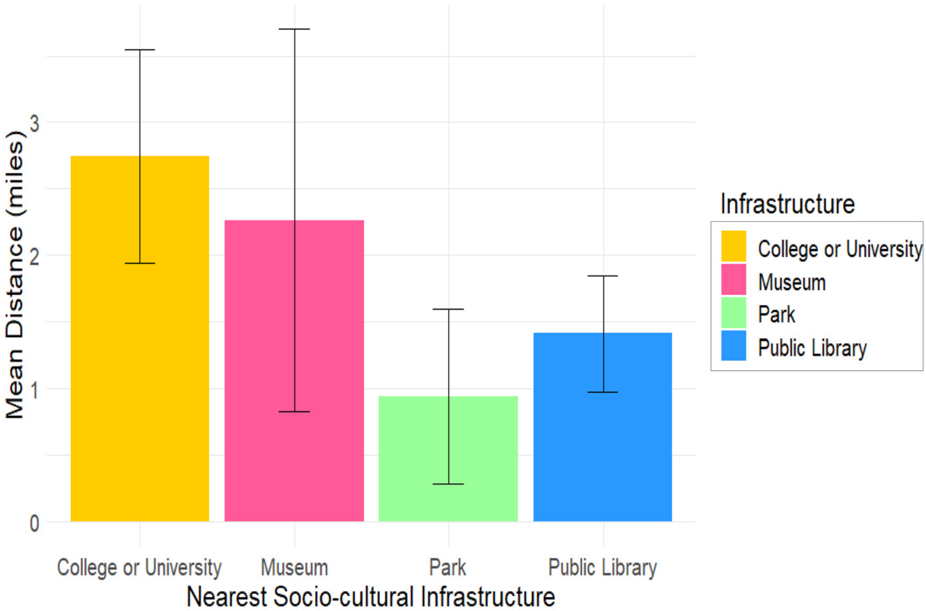
Figure 14.
Boxplots of distances from (a) certified green buildings, (b) LEED buildings and (c) certified green residential buildings to nearest sociocultural infrastructure (museums, public libraries, colleges and universities, and parks) in Baton Rouge

Source: Authors

Comparatively, the mean distances from all CGBs in Baton Rouge to the nearest sociocultural infrastructure are depicted in Figure 15. The figure implies that the mean distances from CGBs to various types of sociocultural infrastructure vary significantly, with museums and universities having the highest mean distances. The standard deviations indicate considerable variability in these distances, especially for museums, suggesting that CGBs are located at inconsistent distances from museums. In contrast, parks and libraries have lower mean distances and smaller standard deviations, indicating that CGBs are generally closer and more consistently located near these infrastructures. This distribution suggests that while some sociocultural infrastructures like parks and libraries are more accessible to CGBs, others like museums and universities, are less so.

While this could reflect urban planning priorities or the historical development patterns of these infrastructures in relation to GBs, the results also suggest that building owners and occupants who prioritize sustainability and energy efficiency may prefer areas where parks are nearby, followed by libraries, museums and universities. This preference hierarchy highlights the importance of parks in the decision-making process for residing in or investing in GBs.

Although these insights are valuable for planners and developers, the relatively low number of CGBs in Baton Rouge compared to other capital cities warrants further investigation. However, the discrepancy could be due to inadequate or poor-quality publicity or a general indifference among stakeholders and citizens toward GBs.



Source: Authors

Figure 15. Mean distance of certified green buildings in Baton Rouge to the nearest sociocultural infrastructure (museums, public libraries, colleges and universities, and parks)

Given the potential health benefits of living or investing in such GBs and the tax incentives offered by state and federal governments for obtaining third-party energy-efficient building certifications, the number of CGBs should ideally increase.

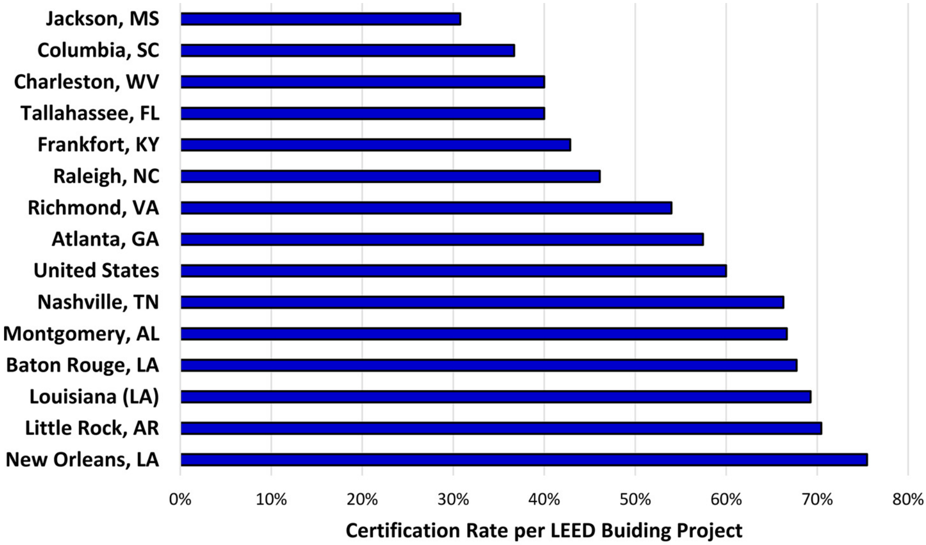
To achieve urban sustainability, it is crucial to have extensive, high-quality publicity that engages all stakeholders. Baton Rouge and similar cities need to enhance their efforts in this area to promote GBs effectively. However, important questions that policymakers and urban planners could cogitate on should include how to proliferate affordable housing that is high-performing and energy efficient and situated in areas easily accessible to essential sociocultural infrastructure.

3.1.5 Leadership in Energy and Environmental Design certification rate across regions. LB certification per registered project (CRP or certification rate) is assessed by calculating the ratio of LBs to the total number of LB projects within a specific geographic region. For example, Baton Rouge has a CRP of 68%, with 21 of its 31 registered LB projects being certified. Notably, New Orleans, Louisiana and the US have CRPs of 75%, 69% and 60%, respectively. CRPs for the stated regions and the remaining 11 capital cities in the southeastern US are depicted in Figure 16.

Chi-square statistics ($\chi^2 = 74.105$, df $= 11$, $p < 0.0001$) indicate a statistically significant variation in CRP across these regions. This variation could be due to several factors, such as construction delays caused by labor shortages and material availability or compliance issues with LEED prerequisites during construction phases. Moreover, the certification review process, particularly for complex projects, can be lengthy, further influencing CRP rates (Ismaeel, 2016).

3.2 Construction and space type

3.2.1 Leadership in Energy and Environmental Design buildings by construction type. In Baton Rouge, the 21 LBs fall into three construction categories – BD + C Homes (3), BD + C

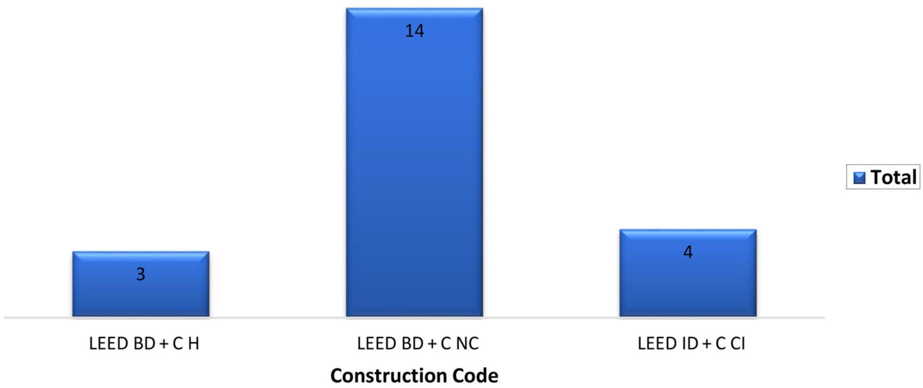


Source: Authors

Figure 16.
LEED building certification rates across capital cities in the southeastern US, New Orleans, Louisiana and the contiguous US

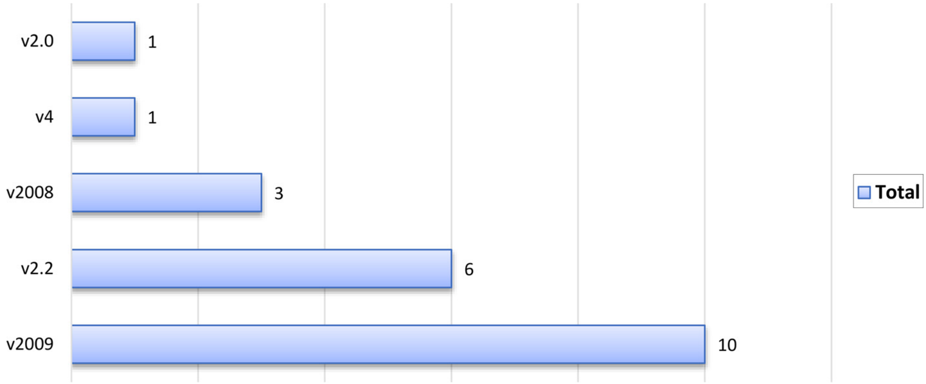
New Construction (14) and ID + C Commercial Interiors (4), as illustrated in Figure 17. These categories, crafted by the USGBC, address distinct sectors: residential (BD + C H), new or significantly renovated commercial and institutional buildings (BD + C NC) and commercial interiors (ID + C CI), ensuring tailored environmental performance assessments for each building type.

3.2.2 Leadership in Energy and Environmental Design buildings by rating versions and year of certification. LBs in Baton Rouge have been rated using various version updates correlating with their certification year, detailed in Figure 18. The LEED versions include v2.0 (one building), v2.2 (six buildings), v2008 (three buildings), v2009 (10 buildings) and v4 (one building). Consequently, only 4.8% of the buildings adhere to the most recent v4 standards, whereas nearly half (48%) are certified under v2009. Figure 19 shows that



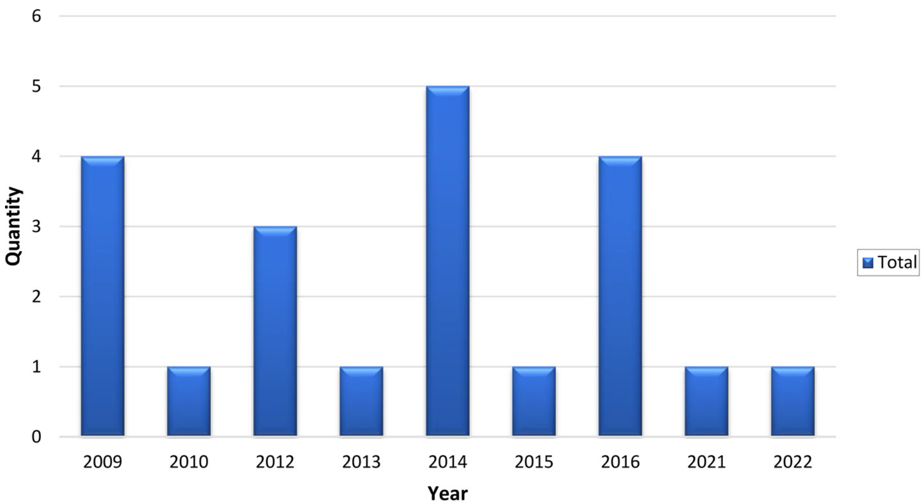
Source: Authors

Figure 17.
Quantity of LEED buildings by construction type



Source: Authors

Figure 18.
LEED buildings by rating system version



Source: Authors

Figure 19.
LEED buildings by year of certification

certifications span from 2009 to 2022, with 2014 seeing the peak (24%) and 2009 and 2016 tying for second (19% each).

3.2.3 Leadership in Energy and Environmental Design buildings by size, space type and certification level. As illustrated in Figure 20, the LBs are classified by space type, namely, retail, higher ed, office, public assembly multifamily residential, industrial manufacturing and multifamily residential/office. Office has the highest quantity accounting for 38% of the LBs while public assembly, higher ed. and industrial manufacturing spaces account for 9.5% each. The total size of the LBs in the study is 1,911,305 ft^2, of which the office space accounts for 14.6% as depicted in Figure 21, while the space used for industrial manufacturing being the highest is proportional to 39% of the total size. Multifamily residential space accounts for 27% while retail accounts for 1.1%, attaining the minimum size of the total.

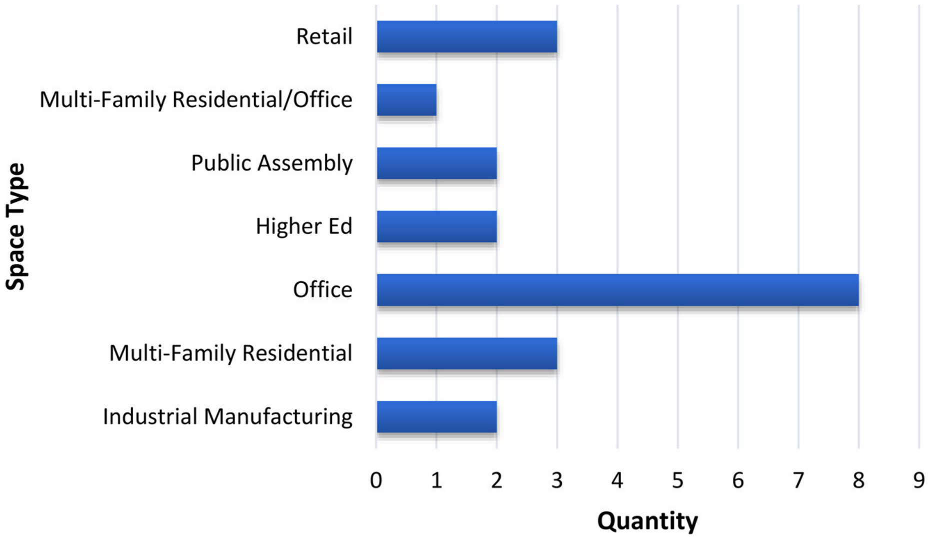


Figure 20. LEED buildings by space type

Source: Authors

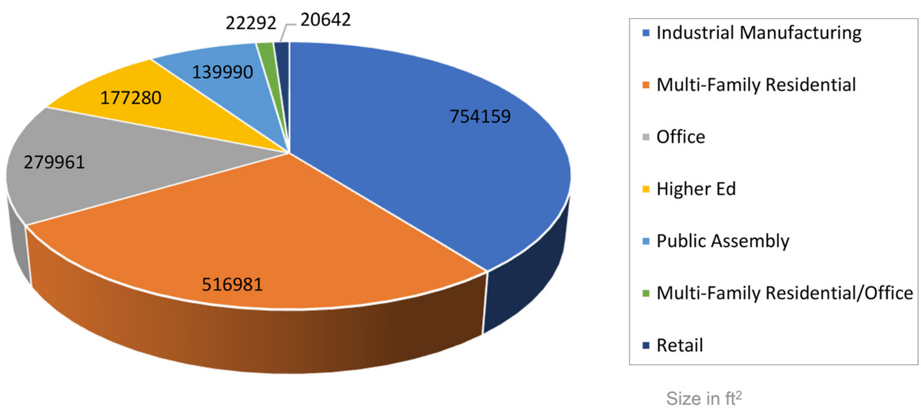


Figure 21. LEED buildings by size of space type

Source: Authors

There are four levels of certification: Certified, Silver, Gold and Platinum. The requirements for each level are based on a point system, with points awarded for features such as energy efficiency, water conservation, sustainable materials and others associated with the categories in Table 1.

Achieving certification at any level demonstrates a commitment to sustainability and environmental responsibility and can provide several benefits such as reduced operating costs, increased property value and improved occupant health and productivity. Table 2 shows certification levels of LBs assessed in this study. Only one LB attained the Certified level under v2.0 rating system whereas four LBs attained the Certified level under v2.2 rating system. However, two LBs attained the Gold level under the latter rating system. For v2008, two LBs

Design criteria or credit category	Emphasis
Sustainable sites (SS)	Minimizing environmental impacts, promoting resource efficiency, enhancing health and well-being
Water efficiency (WE)	Reducing potable water usage, implementing water conservation strategies
Energy and atmosphere (EA)	Improving energy efficiency, reducing environmental impact, promoting renewable energy
Materials and resources (MR)	Reducing waste, promoting material reuse, sourcing environmentally responsible materials
Indoor environmental quality (IEQ)	Enhancing indoor air quality, providing access to daylight, promoting low-emitting materials
Innovation and design (I)	Encouraging innovative sustainable building design and construction approaches
Regional priority credit (RPC)	Providing credits for projects in regions with specific environmental priorities
Integrative process credit (IPC)	Rewarding integrative design approaches across credit categories
Location and transportation (LT)	Promoting sustainable transportation options, reducing transportation-related environmental impacts
Location linkages (LL)	Fostering connectivity between buildings and surrounding areas to create sustainable communities
Alternative water and energy (AWE)	Encouraging the use of alternative water and energy sources, such as on-site renewables

Source: Authors

Table 1. LEED building design criteria and emphasis

Version	Construction type	Level			
		Certified	Silver	Gold	Platinum
v2.0	LEED ID + C CI	1	0	0	0
v2.2	LEED BD + C NC	4	0	2	0
v2008	LEED BD + C H	0	2	0	1
v2009	LEED BD + C NC	2	4	2	0
	LEED ID + C CI	1	0	0	0
v4	LEED ID + C CI	0	1	0	0

Source: Authors

Table 2. Certification levels of LEED buildings in Baton Rouge

attained the level of Silver while one LB attained Platinum. For v2009, there are three Certified, four Silver and two Gold level LBs. For v4, only one LBs was classified and as Silver.

3.3 Leadership in Energy and Environmental Design rating score and criteria analysis

This section examines the LEED certification framework, highlighting the maximum achievable points (MAP) per criterion and the minimum scores needed for different levels of certification across varied rating systems and building types. Table 1 encapsulates the focus of the design criteria. In addition to the correlation analysis conducted, light emphasis is made on how buildings can achieve certification by meeting these predefined standards. Finally, there is a special focus on the PWC, which measures a building's compliance with each standard.

3.3.1 Leadership in Energy and Environmental Design certification points and weighted criteria. The four certification levels in LEED assign points for features like energy and water efficiencies (Table 3). Despite the emphasis on maximum points, achieving

Table 3.
Score points attainable for design criteria and assigned certification levels

Version and building code		Maximum points obtainable per criterion										Minimum points obtainable per level			
		SS	WE	EA	MR	IEQ	I	RPC	IPC	LT/LL	AWE	Certified	Silver	Gold	Platinum
v2.0	ID + C CI	7	2	12	14	17	5	X	X	X	X	21	27	32	42
v2.2	BD + C NC	14	5	17	13	15	5	X	X	X	X	26	33	39	52
v2008	BD + C H	22	15	38	16	21	11	X	X	10	3	45	60	75	90
v2009	BD + C NC	26	10	35	14	15	6	4	X	X	X	40	50	60	80
	ID + C CI	21	11	37	14	17	6	4	X	X	X	40	50	60	80
v4	ID + C CI	X	12	38	13	17	4	6	2	20	X	40	50	60	80
Mean ± SD			9.2 ± 4.8	29.5 ± 11.8	14 ± 1.1	17 ± 2.2	6.2 ± 2.5								
CV			52.1%	40%	7.8%	12.8%	40.3%								
Mean ± SD (excl. v2008)			8 ± 4.3	27.8 ± 12.3	13.6 ± 0.5	16.2 ± 1.1	5.2 ± 0.8								
CV (excl. v2008)			53.7%	44.2%	3.7%	6.8%	15.4%								

Note: X indicates criterion unlisted
Source: Authors

certification does not require a perfect score but rather an aggregate across all categories.

Points vary by criterion and are influenced by construction type and the LEED version applied. For example, under v2.0 for commercial interiors, the Sustainable Sites category has a maximum of seven points, while under v2009 for new construction, it has 26.

This study primarily excludes v2008 data due to inaccessibility, impacting analyses, particularly around design criteria. However, the consistency across other versions is notable, with materials and resources (MR) and IEQ displaying the lowest coefficient of variation (Table 3), indicating stable criteria points over time.

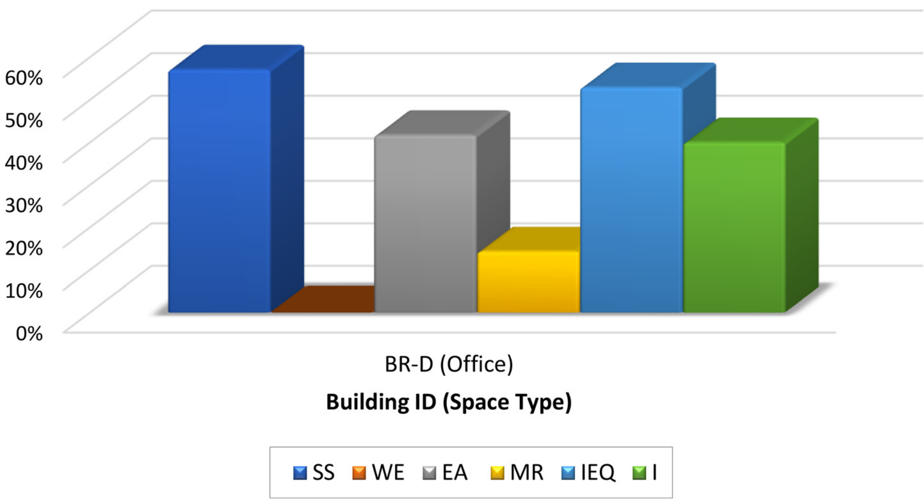
Certification levels for each version reflect the accumulation of these points. In v2.0, the threshold for Certified is 21 points, while in v2008 for Homes, it is 45. The variation underscores the evolving emphasis on different sustainability aspects in the progression of the LEED system.

PWC, derived from the SPs obtained relative to the MAP possible [equation (1)], is used to standardize a building's performance per design criterion:

$$PWC\,(\%) = \frac{\mathrm{SP}}{\mathrm{MAP}} \times 100 = \frac{\sum CSc}{\mathrm{MAP}} \times 100 \qquad (1)$$

where SP is also considered as the summation of points or credits obtained for subcategories of a criterion (CSc).

An office space under v2.0, for instance, achieved a 57% weight in Sustainable Sites, suggesting a strong emphasis on site sustainability in its design and operations. Similar comparisons based on various rating versions are illustrated in Figures 22–25. These weights and point allocations across criteria help delineate a building's sustainability profile, revealing where efforts are concentrated and where there may be room for improvement. For instance, industrial spaces identified as BR-B and BR-F show strong emphasis on Sustainable Sites (SS) and Innovation and Design (I), indicating a focus on site sustainability and innovative strategies.



Source: Authors

Figure 22.
LEED v2.0 rated buildings by percentage weighted criteria

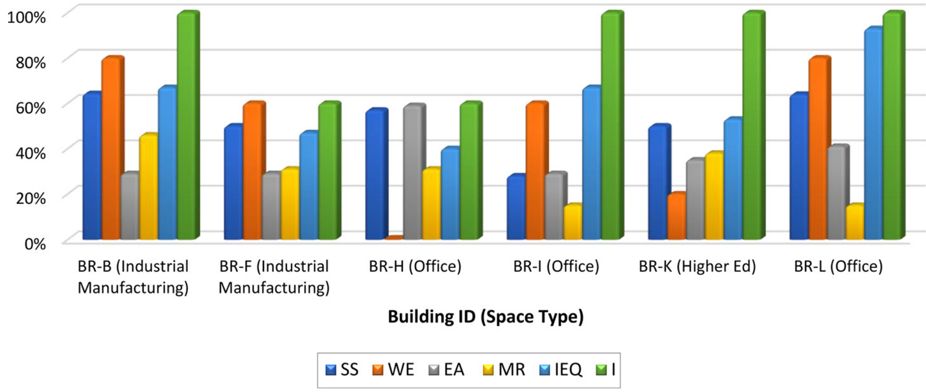


Figure 23.
LEED v2.2 rated buildings by percentage weighted criteria

Source: Authors

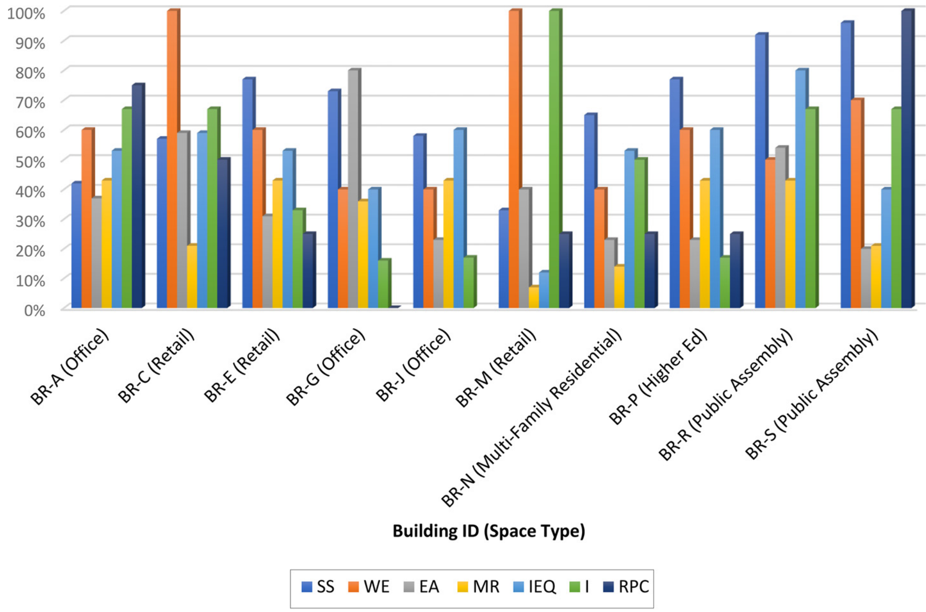
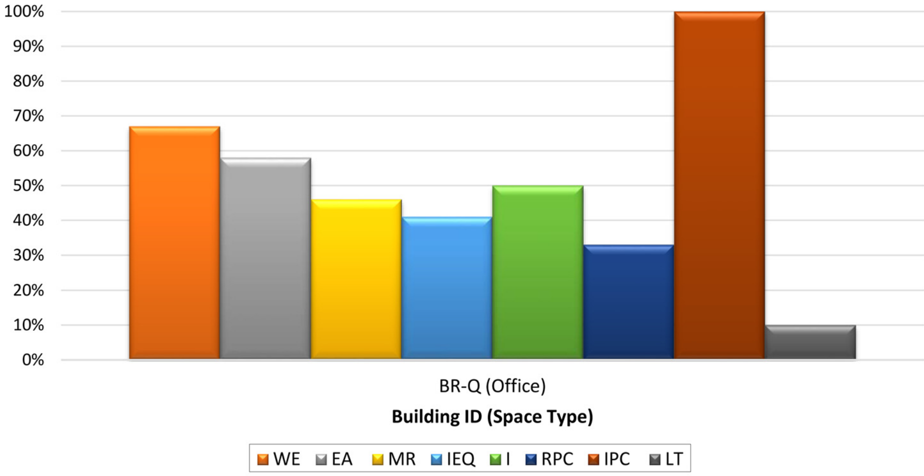


Figure 24.
LEED v2009 rated buildings by percentage weighted criteria

Source: Authors

For v2009, rated across five space types as shown in Figure 24, discrepancies in Regional Priority Credits are illustrated. Offices BR-G and BR-J, certified in 2016, display varied SS and WE weights, while the multifamily residential/office space type (BR-N) and retail spaces (BR-C, BR-E and BR-M) show high commitment to WE.

However, BR-Q, an office space certified under v4 in 2022 (Figure 25), exhibits a lower emphasis and commitment to location and transportation (LT) but a higher level of commitment toward Integrative Process Credit (IPC). This could imply that while the



Source: Authors

Figure 25. LEED v4 rated buildings by percentage weighted criteria

building's site selection and related transportation options may not have met the higher benchmarks of LEED certification, other aspects were prioritized. In contrast, the higher level of commitment toward the IPC suggests that the project excelled in adopting a holistic approach to sustainability early in the development process. This focus on the integrative process often involves a collaborative and informed effort to optimize building performance and environmental impact across all stages of development (USGBC, 2024).

This detailed attention to the IPC, while having lesser emphasis on the LT category indicates a strategic choice in the certification process, possibly influenced by the constraints or opportunities unique to the project's location and scope. The illustrated figures suggest that while there are areas of strength specific to certain categories and building types, there is potential for broader application of best practices across all categories.

3.3.2 Mean percent weighted criteria. The mean PWC for five key design criteria across all LBs in Baton Rouge was analyzed, excluding those evaluated under the v2008 rating system. This was done by comparing the mean values of five different design criteria for the buildings. The findings in Table 4 reveal the prioritization or attainability of LEED criteria among local stakeholders. Innovation and Design, WE and IEQ emerge as the top priorities, in that order, reflecting the emphasis Baton Rouge stakeholders place on these GB practices.

3.3.3 Correlation matrix of Leadership in Energy and Environmental Design criteria. The correlation matrix visualized in Figure 26 provides insights into the relationships between various LEED criteria for the examined LBs in Baton Rouge. In general, the matrix shows that most LEED criteria do not have strong correlations with each other ($-0.37 = r = 0.35$), implying that good performance in one area does not necessarily predict performance

Weighted criteria	WE (%)	EA (%)	MR (%)	IEQ (%)	I (%)
Mean PWC	55	40	31	54	62

Source: Authors

Table 4. Mean percentage weighted design criteria

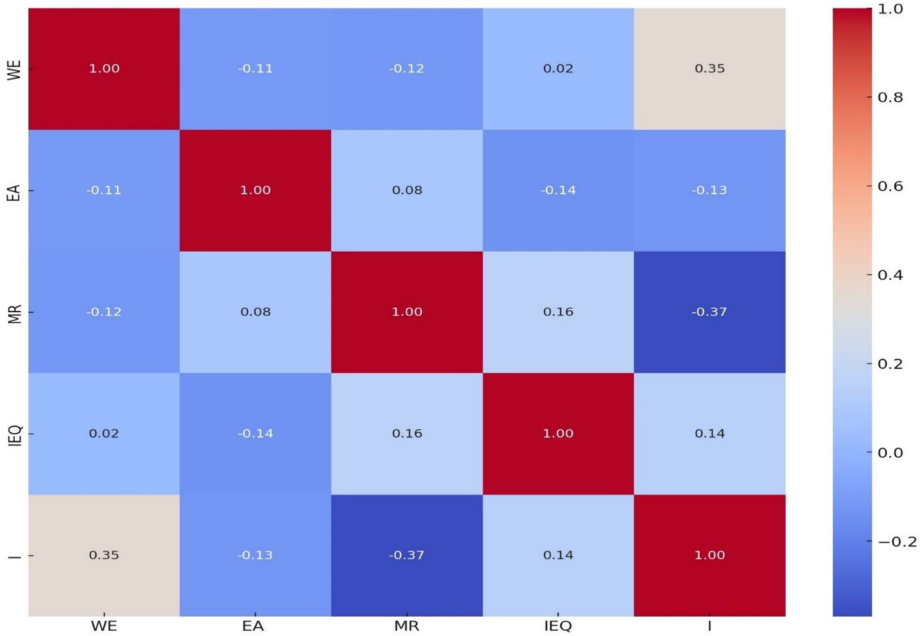


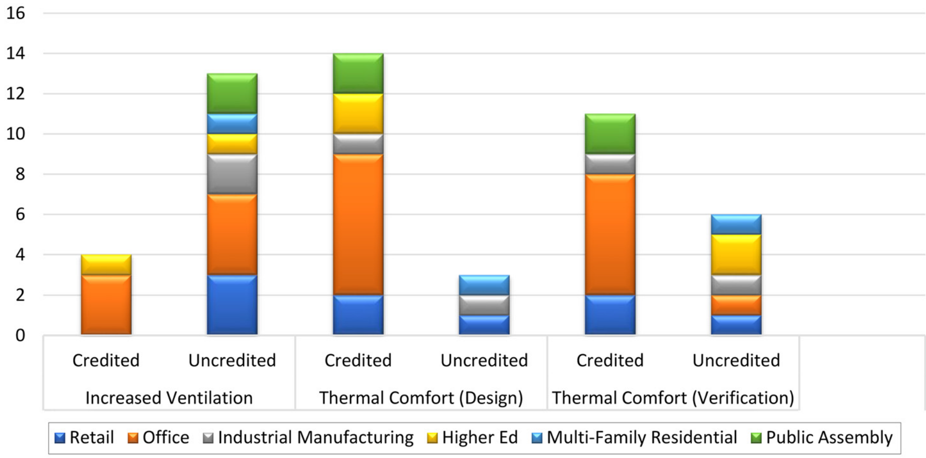
Figure 26.
Correlation heatmap of design criteria in LEED buildings in Baton Rouge

Source: Authors

in another. The most substantial relationships observed is a moderate negative correlation between MR and I, which might suggest that projects focusing on one may have less emphasis on the other; and a moderate positive correlation between WE and I, which might suggest that a moderate level of innovativeness is put into WE measures.

3.3.4 Thermal comfort and increased ventilation. Since most people spend most of their time indoors, their mental and emotional well-being is often impacted by IEQ. Thermal comfort, pivotal for occupant well-being, incorporates design and verification within the IEQ criterion, alongside increased ventilation. The design process focuses on material and HVAC system selection to optimize indoor conditions – temperature, humidity and air movement (Alfano *et al.*, 2014; Omer, 2008; Mirrahimi *et al.*, 2016; Arumugam *et al.*, 2022). Verification then measures these conditions against standards to ensure compliance (USGBC, 2024). Increased ventilation, crucial for temperature regulation and air quality improvement, must be balanced with energy efficiency and system design to prevent issues like drafts.

LEED rating systems acknowledge the significance of these elements, attributing credits for achieving benchmarks in thermal comfort (design and verification) and ventilation. Our analysis highlights variations in credit attainment across building types and LEED rating versions, with a pronounced focus on the design and verification phases. Although the only building associated with v4 rating system has a subcategory named "thermal comfort" but the state in terms of design or verification is not available. However, in general, results illustrated in Figure 27 reveal a tendency toward achieving design over verification credits, indicating challenges in maintaining designed comfort levels postconstruction. Success rates vary by space type, with office spaces and public assemblies often meeting requirements, in contrast to multifamily residential and some educational buildings.



Source: Authors

Figure 27. Compliance status of LEED buildings in Baton Rouge on specific IEQ standards: thermal comfort and increased ventilation

3.4 Limitations of the study

This research aims to establish the relationship between various types of CGBs within and across capital cities in the US. Despite its contributions, the study faces a few limitations that merit attention:

- Dynamic nature of CGBs.

The count of existing CGBs is not static but increases over time, posing a challenge to capturing a fixed snapshot of GB presence:

- Data accuracy and timeliness.

The accuracy of our analysis is contingent upon the currency and completeness of data sourced from the used databases. Any lapses in data update cycles can affect metrological precision:

- Missing LEED v2008 criteria.

The absence of specific values for three buildings associated with the LEED v2008 rating system criteria in Baton Rouge limits the study's capacity to offer a thorough overview of the LEED certification landscape. Moreover, as LEED certification is a voluntary program in the US, not all CGBs pursue LEED certification:

- Postoccupancy verification.

Public data on postoccupancy performance verification is scarce. Factors such as occupant behavior and maintenance practices, which significantly impact building performance, are not accounted for, as this is not the scope of the current study. However, insights focused on occupant-centric perceptions are available in a subsequent publication entitled, "Mixed-Methods Inquiry on Stakeholder Perceptions of Green Building Practices in Baton Rouge, Louisiana, USA."

4. Conclusions and recommendations

To conclude, this study provided a thorough examination of GB development in Baton Rouge, setting it against the backdrop of adoption rates in the US capital cities. The research delved into demographic and socioeconomic influences, revealing the intricate dynamics that underpin sustainable urban development. The interdependencies between GB adoption and sociocultural infrastructure underscore the importance of a holistic approach to urban planning. Fostering an environment rich in educational, cultural and recreational facilities could help cities enhance their sustainability profile and improve overall quality of life. Albeit a wide-ranging approach is essential for crafting effective GB strategies.

Detailed analysis has illuminated a pattern of GB concentration within Baton Rouge, particularly in the Central–Western area, exemplifying targeted urban planning and policymaking. Distance to nearest hub analysis (of GBs to sociocultural infrastructure in Baton Rouge) provided insights for enhancing urban sustainability, improving zoning practices, promoting economic development and fostering community cohesion.

Despite the promising strides, Baton Rouge's engagement with GB practices remains in its infancy. The readiness with which innovation and design criteria have been met suggests a potential pathway for furthering local GB initiatives.

Moreover, the insights derived from this research hold profound implications for policy development in Baton Rouge. Establishing robust building standards, incentivizing sustainable practices and facilitating stakeholder engagement are all critical steps that can be guided by the insights from this study. Additionally, this research lays the groundwork for an evaluative process, allowing policymakers to fine-tune interventions and respond adaptively to the city's evolving needs.

For a holistic understanding of the effectiveness of GB practices and certifications, future research should integrate additional data dimensions, including postoccupancy evaluations and energy usage. Since comprehensive postoccupancy evaluations are critical to understanding the actual performance of GBs versus their designed intentions, more insights into energy savings, WE and IEQ in practice, could be gained. A detailed analysis of construction and operating cost and postoccupancy data comparing certified green against noncertified buildings in Baton Rouge is currently being prepared for publication, aiming to bridge the gap between expected and actual building performance outcomes in CGBs.

Meanwhile, drawing lessons from cities that have successfully navigated the GB landscape, Baton Rouge can formulate strategies that resonate with its unique challenges, thus paving the way for sustainable urban development.

Publicized financial incentives and public-private partnerships can further encourage developers and building owners to adopt GB practices. Through the integration of LEED requirements into model building codes, Baton Rouge, and extensively, Louisiana can streamline sustainability standards and encourage widespread adoption of GB practices. Hence, increased regulation coupled with a great deal of publicity can cultivate a culture of environmental responsibility and promote long-term sustainability in the city and state.

Continued scholarly exploration is crucial for deepening our understanding of GB trends in urban centers and state capital territories. Subsequent studies could further dissect the GB rating system, exploring its correlation with sustainable outcomes and environmental performance improvements.

Finally, a qualitative investigation into the barriers and enablers of GB practices could provide valuable context, particularly for cities at the cusp of embracing these practices. Such an analysis could unearth practical insights, empowering Baton Rouge to stride confidently towards a greener future.

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