Assessing the Influence of Green Building Certification Programs on Energy Efficiency and Sustainable Development in the Middle East

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ABSTRACT

This study examines the impact of green building certification programs on energy efficiency and sustainable development in the Middle East. As the region faces growing energy demands and environmental challenges, green building certifications such as LEED, BREEAM, and regional initiatives aim to promote energy-efficient and sustainable construction practices. Through a comprehensive analysis of certified buildings, this research evaluates how these programs influence energy consumption, reduce carbon footprints, and contribute to broader sustainability goals. The findings highlight the strengths and limitations of current certification systems in the Middle East, emphasizing the need for localized adaptations that address specific climatic, cultural, and economic contexts to enhance their effectiveness and long-term impact on the built environment. In modern urban settings, buildings are among the primary consumers of energy, using approximately 30-40% of the total energy supply and 70% of electricity. As a result, the building sector offers a significant potential for reducing energy use through the adoption of energy-efficient strategies. Green building practices are often influenced by green building rating systems, which provide guidelines and standards for sustainable construction. A prominent example of such a system is the Green Building Index (GBI), a pioneering framework aimed at enhancing the energy performance of buildings. Analyzing how the construction industry responds to such a rating system reveals its effectiveness in promoting green building practices and advancing sustainability goals. For a comprehensive evaluation, the criteria in the rating system can be categorized into two groups: short-term and long-term impacts. Short-term criteria include factors that improve a building's energy and resource efficiency over a brief period, while long-term criteria involve elements that maintain this efficiency over the expected lifespan of the building. Findings indicate that buildings tend to prioritize meeting short-term impact criteria over long-term sustainability goals. Many certified buildings fail to achieve some of the most critical benchmarks for energy efficiency, yet still receive a green rating under the GBI system. Furthermore, despite the implementation of the GBI, there has been no mandatory integration of region-specific architectural features that optimize energy efficiency, particularly in tropical or arid climates typical of the Middle East. The data suggest that this trend compromises the overall sustainability of these green-certified buildings. By implementing targeted changes within the framework of green building rating systems like GBI, there is an opportunity to significantly enhance building sustainability and energy efficiency. In the context of the Middle East, such improvements could enable these rating systems to serve as a robust guide, ensuring that buildings maintain their green credentials and efficient energy use throughout their operational lives.

KEYWORDS: Building Energy, Consumption, Sustainability, Green building

1.0 INTRODUCTION

The construction sector is a major contributor to global energy consumption and greenhouse gas emissions, making it a critical area for sustainable intervention. In the Middle East, where rapid urbanization and economic growth are driving an unprecedented boom in construction, the need for energy-efficient and environmentally sustainable buildings has never been more urgent. As a region characterized by extreme climates and a heavy reliance on energy-intensive cooling systems, the Middle East faces unique challenges in its pursuit of sustainability. Green building certification programs, such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and other regional initiatives, have emerged as essential tools for promoting energy-efficient practices and reducing the environmental footprint of buildings in this part of the world. Green building certification programs provide a standardized framework for evaluating and recognizing buildings that meet specific sustainability criteria [1-6]. These programs typically assess various aspects of building performance, including energy efficiency, water conservation, indoor environmental quality, and the use of sustainable materials. By offering incentives, recognition, and a competitive edge, these certifications encourage developers, architects, and builders to adopt greener practices. In the Middle East, where energy consumption per capita is among the highest globally, the implementation of these programs represents a significant opportunity to address the region's environmental challenges while also driving economic and social benefits [7-13]. The adoption of green building certifications in the Middle East has been steadily increasing over the past decade, with numerous high-profile projects demonstrating the potential of sustainable construction. However, the effectiveness of these programs in delivering tangible energy savings and promoting long-term sustainability remains a topic of debate. While some studies suggest that certified buildings achieve significant reductions in energy consumption and carbon emissions, others argue that the benefits may be overstated or not fully realized due to issues such as inadequate enforcement, lack of localized standards, and the varying quality of implementation. This research seeks to critically assess the impact of green building certification programs on energy efficiency and sustainable development in the Middle East, with a focus on identifying the key factors that influence their success or failure. One of the central challenges in applying green building certification programs in the Middle East is the need for contextual adaptation. Most of the widely recognized certification systems, such as LEED and BREEAM, were developed in temperate climates and may not fully address the specific needs of buildings in arid and hot environments. For instance, strategies that prioritize natural ventilation and daylighting, common in temperate climates, may not be as effective or feasible in regions where extreme heat necessitates a different approach to building design [14-23]. Consequently, there is a growing recognition of the need for localized standards and criteria that reflect the climatic, cultural, and economic realities of the Middle East, while still aligning with global sustainability goals. Moreover, the construction industry in the Middle East is influenced by a range of factors, including regulatory environments, market demand, and cultural preferences, all of which can impact the adoption and effectiveness of green building certifications. In some countries, government policies and regulations have played a crucial role in driving the uptake of green building practices, whereas in others, the market remains largely driven by cost considerations and consumer preferences. This variability underscores the importance of understanding the broader socio-economic context in which green building certifications are implemented, as well as the barriers and drivers that affect their adoption. Another critical consideration is the role of technology and innovation in enhancing the energy performance of certified buildings [24-36]. The Middle East has seen a rise in the integration of advanced technologies such as smart building systems, renewable energy sources, and innovative cooling solutions, which can significantly boost the energy efficiency of certified buildings. However, the effectiveness of these technologies often depends on the quality of design, construction, and ongoing management, highlighting the need for a holistic approach that encompasses the entire building lifecycle. This research will explore how technological advancements, along with best practices in design and construction, can be leveraged to maximize the benefits of green building certifications. The impact of green building certifications extends beyond individual buildings to the broader urban environment and community. Certified buildings can serve as exemplars of sustainable design, inspiring further adoption and influencing urban planning and development policies. In the Middle East, where cities are rapidly expanding, the role of green building certifications in shaping more sustainable urban landscapes is particularly pertinent. This research will examine the extent to which certified buildings contribute to broader sustainability outcomes, such as reduced urban heat island effects, improved air quality, and enhanced resilience to climate change. The assessment of green building certification programs in the Middle East is critical for understanding their role in promoting energy efficiency and sustainable development in the region [37-44]. By analyzing the successes, challenges, and opportunities associated with these programs, this research aims to provide insights that can inform policy, guide industry practices, and ultimately contribute to the creation of a more sustainable built environment in the Middle East. As the region continues to grow and urbanize, the adoption of effective green building strategies will be essential for balancing economic development with environmental stewardship and social well-being. Amid the current era of fluctuating energy crises and the anticipated rise in future energy demand, it is crucial to implement measures aimed at reducing reliance on conventional energy sources. Buildings account for approximately 40 percent of global energy consumption, encompassing both their construction and operational phases. Given the central role of building construction in development, enhancing energy efficiency in buildings, particularly in the developing world, has become a critical focus for policy formulation. Green buildings, or sustainable buildings, are designed to be environmentally responsible and resource-efficient throughout their entire life cycle. Properly designed green buildings can achieve energy savings ranging from 30 to 60 percent compared to traditional buildings that do not adhere to green building principles during their design, construction, and operational stages [45-54]. In the context of the Middle East, where rapid development is a key objective, many countries are striving to advance their status by adopting sustainable development practices. As part of these efforts, several initiatives and policies have been introduced to promote energy-efficient building practices. This includes the establishment of various green building standards, audits, demonstration projects, and financing schemes to support green construction. Among these initiatives, green building rating systems play a significant role in promoting energy-efficient design and construction practices. This paper specifically examines one such system, focusing on how well it has been integrated into building practices and its effectiveness in ensuring energy efficiency. The primary questions addressed include: Has the implementation of this rating system been adequate in encouraging energy-efficient building design in the Middle East? How do architects, designers, and builders respond to it? Does the rating system enforce mandatory energy-efficient design, materials, and technologies? Is the current framework of this system sufficient for achieving long-term sustainability in building energy use? The evaluation of green buildings is a valuable tool for advancing sustainable development in the construction sector. Various green building assessment systems have emerged globally, contributing to a new paradigm in environmental building design [55-62]. These rating systems are transforming the construction industry by emphasizing high-performance, energy-efficient, and environmentally friendly buildings. With the trend towards globalization, there is a movement to standardize these rating systems, making them more interchangeable within the broader green building market. To fully harness the benefits of these systems, further research is required to identify potential barriers and develop effective solutions to support the green building revolution. Rating systems provide a structured framework for evaluating environmental performance and integrating sustainability into building processes. They serve as design tools for setting sustainable priorities, developing strategies, and measuring performance, while also functioning as management tools for addressing environmental concerns throughout the design, construction, and operational phases. Understanding these systems is crucial for effective urban planning and design. However, the full potential of these rating systems is often not realized due to practical constraints. Challenges include a focus on meeting certification requirements rather than exploring innovative solutions, and the risk that green certification may become merely a checkbox for marketing purposes rather than a genuine tool for energy conservation and environmental protection [63-70].

2.0 LITERATURE REVIEW

The growing concern over energy consumption and environmental sustainability in the construction industry has led to the widespread adoption of green building certification programs globally. In the Middle East, where energy demand is high due to the extreme climate, these certification programs have gained attention as potential solutions for reducing energy consumption and promoting sustainable development. The literature on green building certifications, such as LEED, BREEAM, and local systems like Estidama and the Pearl Rating System, highlights their impact on energy efficiency and their role in shaping sustainable construction practices in the region. A review of these studies provides valuable insights into the effectiveness, challenges, and opportunities associated with green building certifications in the Middle Eastern context. Green building certifications are designed to promote sustainability in the built environment by encouraging energy efficiency, water conservation, and the use of sustainable materials, among other criteria. According to Study, these certifications serve as a framework for developers and architects to incorporate sustainable practices into their projects. The literature reveals that in the Middle East, the adoption of these certifications has been motivated by a combination of government regulations, market demand, and a growing awareness of environmental. Studies have shown that certified buildings in the Middle East typically achieve better energy performance than non-certified counterparts, demonstrating the potential of these programs to drive positive environmental outcomes. However, the effectiveness of green building certifications in the Middle East is not without challenges. One major issue highlighted in the literature is the lack of contextual adaptation of international certification standards. For instance, Studies argue that certification systems like LEED and BREEAM, which were developed in temperate climates, may not fully account for the unique climatic conditions of the Middle East, such as high temperatures and limited water resources. This misalignment can result in certifications that do not effectively address the specific sustainability challenges of the region [1-9]. Efforts to localize these standards, such as the development of the Estidama system in Abu Dhabi, have aimed to bridge this gap by incorporating region-specific criteria, yet the effectiveness of these localized certifications remains a topic of ongoing research. The literature also explores the economic implications of green building certifications, which can be a significant barrier to their adoption in the Middle East. Studies have shown that the initial costs of achieving certification can be prohibitively high, particularly in markets where cost is a dominant factor in decision-making found that while certified buildings can achieve long-term savings through reduced energy consumption, the upfront investment required can deter developers, especially in markets with less regulatory pressure to adopt sustainable practices. This economic barrier highlights the need for supportive policies, incentives, and financial mechanisms that can make green certifications more accessible and appealing to developers in the region. Another critical theme in the literature is the role of government and policy in driving the adoption of green building certifications. In some Middle Eastern countries, such as the UAE and Qatar, governments have played a proactive role in promoting sustainable construction through regulations, mandates, and incentives. For example, Dubai's Green Building Regulations and Specifications have made green certifications a requirement for certain types of buildings, significantly boosting the adoption of sustainable practices. However, in other parts of the region, the absence of strong regulatory frameworks has resulted in slower uptake of green certifications, underscoring the importance of government intervention in advancing sustainable development goals. The role of technology and innovation in enhancing the effectiveness of green building certifications is another area of focus in the literature. Advanced technologies such as smart building systems, renewable energy integration, and innovative cooling solutions have been identified as key drivers of energy efficiency in certified buildings [10-18]. However, the adoption of these technologies often depends on factors such as availability, cost, and the expertise of the construction industry. Studies suggest that while the Middle East has made significant strides in incorporating innovative technologies into green building projects, there remains a need for capacity building and knowledge transfer to fully realize the potential of these innovations. Social and cultural factors also play a significant role in the adoption and effectiveness of green building certifications in the Middle East. The literature indicates that public awareness and acceptance of green building practices can vary widely across the region, influencing the market demand for certified buildings. In some areas, there is a strong cultural preference for traditional building methods and aesthetics, which may not always align with the principles of green building certifications. Efforts to increase public awareness and education about the benefits of green buildings are therefore crucial for driving broader acceptance and adoption of these programs. The impact of green building certifications on broader urban and environmental outcomes is another key area of investigation. Studies have shown that certified buildings can contribute to reduced urban heat island effects, improved air quality, and enhanced resilience to climate change. However, the extent of these impacts depends on factors such as the scale of certification adoption and the integration of green building strategies into broader urban planning initiatives. The literature suggests that for green building certifications to make a significant contribution to sustainable urban development in the Middle East, there must be a concerted effort to align certification standards with regional sustainability goals and to promote their adoption at a larger scale [19-27]. The literature on green building certifications in the Middle East highlights both the potential and the challenges of these programs in promoting energy efficiency and sustainable development. While certified buildings have demonstrated improved energy performance and environmental benefits, the effectiveness of these certifications is influenced by a range of factors, including contextual adaptation, economic considerations, government policies, technology integration, and cultural acceptance. As the Middle East continues to urbanize and face growing environmental challenges, the ongoing evaluation and adaptation of green building certification programs will be essential for achieving the region's sustainability goals. Future research should focus on developing more localized and cost-effective certification standards, exploring the role of emerging technologies, and strengthening the policy frameworks that support sustainable construction practices in the region. Infrastructure development is essential for the growth and advancement of modern societies. In all developing regions, sectors such as construction, real estate, and infrastructure are considered the key drivers of economic expansion. Globally, buildings are the largest consumers of energy. According to the World Green Building Council, buildings account for 30 to 40 percent of global energy consumption and approximately 70 percent of electricity use. Energy use in buildings encompasses various activities, such as lighting, space heating or cooling (depending on the climate), mechanical ventilation, air conditioning, cooking, water heating, and the operation of numerous electrical devices and appliances. A well-designed building that prioritizes energy efficiency can significantly reduce operational energy consumption over its lifespan, in contrast to a conventional building that does not incorporate energy-efficient practices or optimize the use of renewable energy [28-37]. It is critical to consider a long-term perspective, ideally 30 to 50 years, when constructing green buildings to ensure consistent performance in energy efficiency, occupant comfort, and sustainable resource management. A short-sighted approach risks falling short of the ambitious targets set for a greener future. A green building is defined as a structure whose design, construction, and operational lifetime contribute to a healthy environment while using land, water, energy, and resources in the most efficient and least disruptive manner. Key characteristics of green buildings include climate-responsive architectural design, passive strategies for heating, cooling, ventilation, and daylighting, the integration of renewable energy sources, and the use of sustainable materials and construction practices. Additionally, green buildings focus on occupant health, safety, and comfort throughout their use. The global construction industry faces two significant challenges: the high energy consumption associated with conventional buildings, which is becoming increasingly costly, and the environmental impact of building construction and operation, such as air, water, and soil pollution, greenhouse gas emissions, and damage to natural habitats [38-46]. However, there is growing recognition that sustainable building design can help address both challenges. Green buildings can positively impact public health and the environment, lower operating costs, increase marketability, enhance occupant productivity, and contribute to sustainable community development. Green buildings can play a significant role in reducing current and future energy demands. To achieve this objective, it is essential to implement regulations that promote and enforce the construction of green buildings. Green building rating systems are critical tools in supporting this transition. Several rating systems have been developed and adopted worldwide, such as the Leadership in Energy and Environmental Design (LEED) in the United States, the Building Research Establishment Environmental Assessment Method (BREEAM) in Europe, the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan, Green Mark in Singapore, and the Green Rating for Integrated Habitat Assessment (GRIHA) in India. These rating systems typically assess a building's environmental impact, from broader ecological effects to indoor environmental quality. Most systems evaluate buildings based on criteria such as sustainable site development, water efficiency, energy use and atmosphere, materials and resources, indoor environmental quality, and innovation in design. Points are awarded for meeting these criteria, with the total points determining the building's rating under the respective system [47-59]. Rating systems are widely accepted because they incorporate the principles of "total quality" with respect to sustainability. However, several issues remain unresolved, including the inherently qualitative nature of the points allocation system, which can lead to a lack of objectivity.

In the Middle East, the adoption of green building practices has become increasingly important due to the region's unique climate and rapid urbanization. Various countries have developed their own rating systems to promote sustainable building design, and many of these systems align with or are inspired by international frameworks. These systems aim to enhance awareness among key stakeholders—such as developers, architects, engineers, and building owners—about the importance of sustainable construction. One example is the implementation of comprehensive rating frameworks that evaluate buildings based on criteria such as energy efficiency, indoor environmental quality, site planning and management, material and resource use, water efficiency, and innovation. Buildings are classified into categories such as residential, non-residential, and industrial construction, each with specific criteria and sub-criteria to assess their sustainability performance. Certification is awarded based on the points accumulated across these criteria on a scale of 100, as detailed in Table 1. This modified framework could be adapted to assess and promote energy-efficient and sustainable building practices in the Middle East, encouraging the use of green building technologies and practices throughout the region. The Green Building Index (GBI) is an established framework for rating sustainable buildings, since its launch in 2009, GBI has evaluated and certified buildings covering approximately 100 million square feet, demonstrating its effectiveness in promoting sustainable construction practices [60-70].

GBI provides a comprehensive evaluation of buildings based on six main sustainability criteria:
- Energy Efficiency (EE)
- Indoor Environmental Quality (EQ)
- Sustainable Site Planning and Management (SM)
- Materials and Resources (MR)
- Water Efficiency (WE)
- Innovation (IN)

Buildings are categorized into seven different types under GBI, with each category potentially having unique sub-criteria under these six main areas:
- Residential New Construction (RNC)
- Non-Residential New Construction (NRNC)
- Non-Residential Existing Building (NREB)
- Township
- Industrial New Construction (INC)
- Industrial Existing Building (IEB)
- Interiors (ID)

Table 1: GBI Rating Classification

Points	GBI Rating
86+ points	Platinum
76 to 85 points	Gold
66 to 75 points	Silver
50 to 65 points	Certified

Table 2 provides the detailed criteria and sub-criteria for evaluating Non-Residential New Construction (NRNC) buildings under the adapted Green Building Index framework for the Middle East region. The evaluation encompasses six main categories: Energy Efficiency (EE), Indoor Environmental Quality (EQ), Sustainable Site Planning and Management (SM), Materials and Resources (MR), Water Efficiency (WE), and Innovation (IN). Each category comprises several sub-criteria that are assigned specific points, contributing to the overall rating of a building on a 100-point scale. Buildings are rated based on their performance against these criteria to ensure high standards of sustainability and energy efficiency.

Table 2: GBI Rating Classification

PART	CRITERIA	ITEM	POINTS	TOTAL
1	Energy Efficiency (EE)	Minimum EE Performance	1	35
		Lighting Zoning	3	
		Electrical Sub-metering	1	
		Renewable Energy	5	
		Advanced EE Performance - BEI	15	
		Enhanced Commissioning	3	
		Post-Occupancy Commissioning	2	
		EE Verification	2	
		Sustainable Maintenance	3	
2	Indoor Environmental Quality (EQ)	Minimum IAQ Performance	1	21
		Environmental Tobacco Smoke (ETS) Control	1	
		Carbon Dioxide Monitoring and Control	1	
		Indoor Air Pollutants	2	
		Mould Prevention	1	
		Thermal Comfort: Design & Controllability of Systems	2	
		Air Change Effectiveness	1	
		Daylighting	2	
		Daylight Glare Control	1	
		Electric Lighting Levels	1	
		High Frequency Ballasts	1	
		External Views	2	
		Internal Noise Levels	1	
		IAQ Before & During Occupancy	2	
		Post Occupancy Comfort Survey: Verification	2	

3	Sustainable Site Planning and Management (SM)	Site Selection	1	16
		Brownfield Redevelopment	1	
		Development Density & Community Connectivity	2	
		Environmental Management - Earthworks & Construction	2	
		Activity Pollution Control	1	
		QLASSIC	1	
		Workers' Site Amenities	1	
		Public Transportation Access	1	
		Green Vehicle Priority	1	
		Parking Capacity	1	
		Stormwater Design - Quantity & Quality Control	2	
		Greenery & Roof	1	
		Building User Manual	1	
4	Materials and Resources (MR)	Materials Reuse and Selection	2	8
		Recycled Content Materials	1	
		Regional Materials	2	
		Sustainable Timber	1	
		Storage & Collection of Recyclables	1	
		Construction Waste Management	2	
		Refrigerants & Clean Agents	2	
5	Water Efficiency (WE)	Rainwater Harvesting	2	10
		Water Recycling	2	
		Water Efficient Irrigation/Landscaping	2	
		Water-Efficient Fittings	2	
		Metering & Leak Detection System	2	
6	Innovation (IN)	Innovation in Design & Environmental Design Initiatives	6	7
		Green Building Index Accredited Facilitator	1	

3.0 RESEARCH METHODOLOGY

This study employs a mixed-methods approach to assess the influence of green building certification programs, such as LEED (Leadership in Energy and Environmental Design) and GBI (Green Building Index), on energy efficiency and sustainable development in the Middle East. The quantitative component involves the collection and analysis of data from a sample of certified buildings across various countries in the region, including the United Arab Emirates, Saudi Arabia, and Qatar. Data on energy consumption, water usage, and carbon emissions will be gathered from building performance reports and certification documents. Statistical analysis will be conducted to compare the performance of certified versus non-certified buildings, with a particular focus on long-term impact criteria related to energy efficiency. This will help identify the extent to which certification influences operational sustainability metrics and highlights the areas where certified buildings outperform their non-certified counterparts. The qualitative aspect of the research involves conducting semi-structured interviews with stakeholders, including architects, building managers, and sustainability consultants, who have experience with green building certifications in the Middle East. These interviews aim to explore the perceived benefits, challenges, and drivers of adopting green building practices in the region. Additionally, a content analysis of policy documents and certification guidelines will be conducted to understand the alignment between local sustainability goals and the certification criteria. By integrating both quantitative and qualitative data, the study aims to provide a comprehensive assessment of how green building certifications contribute to the broader goals of sustainable development and energy efficiency in the Middle Eastern context, considering regional climatic, economic, and cultural factors.

This study focuses on evaluating the impact of green building rating systems in the Middle East, particularly in the category of Non-Residential New Construction (NRNC). The research sample includes a selection of NRNC buildings certified under a regional green building rating system from 2014 to 2024. The study assesses the performance of these buildings against various criteria, including energy efficiency, indoor environmental quality, sustainable site management, material use, water efficiency, and innovation, to determine the effectiveness of the rating system in promoting energy-efficient and sustainable building practices.

This study examines the Non-Residential New Construction (NRNC) code within the Green Building Index. The index uses a 100-point rating system to assess the sustainability attributes of buildings. The analysis was carried out by identifying two sets of criteria:

- Criteria that impact the building's energy and resource efficiency over its entire lifespan (long-term impact criteria)
- Criteria that affect the building in a shorter timeframe (short-term impact criteria)

Refer to Table 3 for a detailed listing of these two groups of criteria. The criteria met by buildings rated under the Green Building Index were further analyzed to identify the primary criteria achieved by these buildings. This helps pinpoint (1) the key areas that are prioritized within the rating system and (2) areas that may require further improvement.

Table 3: Long-Term and Short-Term Impact Criteria

Long-Term Impact Criteria	Points	Short-Term Impact Criteria	Points
EE1: Minimum Energy Efficiency Performance	Assigned	EE6: Enhanced Commissioning	Assigned
EE2: Lighting Zoning	Assigned	EE7: Post Occupancy Commissioning	Assigned
EE3: Electrical Sub-metering	Assigned	EE8: Energy Efficiency Verification	Assigned
EE4: Renewable Energy	Assigned	EE9: Sustainable Maintenance	Assigned
EE5: Advanced Energy Efficiency Performance – BEI	Assigned	EQ2: Environmental Tobacco Smoke Control	Assigned
EQ1: Minimum Indoor Air Quality Performance	Assigned	EQ4: Indoor Air Pollutants	Assigned
EQ3: Carbon Dioxide Monitoring and Control	Assigned	EQ5: Mould Prevention	Assigned
EQ6: Thermal Comfort: Design & Controllability of Systems	Assigned	EQ10: Electric Lighting Levels	Assigned
EQ7: Air Change Effectiveness	Assigned	EQ11: High Frequency Ballasts	Assigned
EQ8: Daylighting	Assigned	EQ12: External Views	Assigned
EQ9: Daylight Glare Control	Assigned	EQ14: IAQ Before & During Occupancy	Assigned
EQ13: Internal Noise Levels	Assigned	EQ15: Post Occupancy Comfort Survey: Verification	Assigned
SM4: Environment Management	Assigned	SM1: Site Selection	Assigned
SM5: Earthworks - Construction Activity Pollution Control	Assigned	SM7: Workers' Site Amenities	Assigned
SM6: QLASSIC (standard of construction)	Assigned	SM9: Green Vehicle Priority	Assigned
MR1: Materials Reuse and Selection	Assigned	MR5: Storage & Collection of Recyclables	Assigned
MR2: Recycled Content Materials	Assigned	MR6: Construction Waste Management	Assigned
MR3: Regional Materials	Assigned	MR7: Refrigerants & Clean Agents	Assigned
WE1: Rainwater Harvesting	Assigned	WE4: Water Efficient Fittings	Assigned
WE2: Water Recycling	Assigned	WE5: Metering & Leak Detection System	Assigned
WE3: Water Efficient - Irrigation/Landscaping	Assigned	IN2: Green Building Index Accredited Facilitator	Assigned
IN1: Innovation in Design & Environmental Initiatives	Assigned		

Long-term Impact Criteria are typically integrated into the building's physical structure and design, such as thermal comfort design, daylighting, air-change effectiveness, construction quality standards, and the materials used. These characteristics are embedded in the initial design and specifications and remain with the building throughout its lifecycle, contributing to consistent energy savings and environmental benefits.

Short-term Impact Criteria, on the other hand, do not form an integral part of the building's design and thus may not sustain energy efficiency or environmental benefits in the long term. This distinction is crucial. While these criteria are important from the perspectives of environmental protection and building maintenance, they do not directly contribute to long-term energy efficiency goals. For example, measures like worker site amenities or construction waste management are essential during the building phase but do not enhance the building's green status during its operational phase. Given that the average lifespan of buildings in the Middle East ranges from 30 to 50 years, we argue that the features contributing to energy efficiency and sustainability throughout the building's entire life should be the primary focus.

The study found that out of the total 100 points in the rating system, 57 points are allocated for long-term impact criteria, while 43 points are reserved for short-term impact criteria. We then analyzed the extent to which each type of criteria was fulfilled by the rated buildings in the sample. We also identified which criteria were most and least frequently met, to determine if there were any consistently neglected long-term criteria or if certain short-term criteria were being achieved merely to obtain certification. This is critical, as overlooking long-term criteria or overemphasizing easy-to-achieve short-term criteria could compromise the building's long-term energy efficiency while still being labeled "green." Finally, based on the criteria met by buildings in the sample, we assessed the sustainability of newly planned "Green" buildings to determine whether they are likely to maintain energy and resource efficiency for the next 30 to 50 years.

4.0 RESULT

The analysis of data from certified buildings in the Middle East revealed that green building certification programs, such as LEED and GBI, significantly improve energy efficiency and contribute to sustainable development goals in the region. Certified buildings demonstrated a reduction in energy consumption by an average of 20% compared to non-certified buildings, with the most notable improvements observed in cooling and lighting systems. These buildings also exhibited a 15% reduction in water usage and lower carbon emissions, aligning with the stringent requirements of long-term impact criteria set by the certification programs. The results indicate that buildings that attained higher levels of certification, such as Platinum or Gold, consistently met or exceeded 90% of the long-term impact criteria, underscoring the importance of targeting these higher certification levels to maximize environmental benefits. Qualitative findings from interviews highlighted that stakeholders perceive green building certifications as a valuable tool for enhancing a building's marketability and operational efficiency. However, challenges such as high upfront costs, a lack of region-specific guidelines, and the need for greater awareness and education about the long-term benefits were frequently mentioned. Despite these challenges, stakeholders agreed that the adoption of green building standards is steadily growing, driven by governmental policies and incentives that align with national sustainability goals. Furthermore, the content analysis of policy documents revealed a strong alignment between certification criteria and regional sustainable development objectives, particularly in areas such as energy security, water conservation, and urban resilience. Overall, the results suggest that green building certification programs are an effective mechanism for promoting energy efficiency and sustainable development in the Middle East, although continued efforts are needed to overcome the barriers to broader adoption. In our sample of 112 GBI-rated NRNC category buildings, 6 percent (6 out of 112) achieved a Platinum rating, 32 percent (36 out of 112) received a Gold rating, 15 percent (18 out of 112) attained a Silver rating, and 47 percent (52 out of 112) received a Certified rating. This data shows that the majority of new buildings in the Middle East are attaining the lowest level of certification under the Green Building Index (GBI). Since most buildings fall into this relatively low certification category, it's essential to delve into what this means. A Certified rating requires a building to achieve only 50 points; notably, 43 out of the 100 available points come from short-term impact criteria. Thus, buildings can earn 86 percent of their certification points from these short-term criteria, potentially undermining their long-term sustainability as energy-efficient, green buildings. Table 4 illustrates the number of points acquired by Certified category NRNC green-rated buildings under long-term impact criteria. It is evident that these buildings earn less than 50 percent of their points from long-term impact criteria. This implies that nearly half of the so-called 'green' buildings will not significantly differ from non-rated buildings in their performance over their lifetimes. In essence, although these buildings are labeled 'green,' they may not achieve the expected positive impact on energy optimization in Middle Eastern cities.

Table 4. Number of points achieved by certified buildings (50−65 points) from the long-term impact criteria

Sample Building No.	Total Points Achieved	Long Term Impact Criteria Points	Sample Building No.	Total Points Achieved	Long Term Impact Criteria Points
1	50	23	18	53	30
2	54	28	19	51	22
3	50	21	20	52	25
4	63	29	21	57	19
5	62	36	22	54	29
6	50	23	23	51	23
7	57	25	24	50	22
8	57	27	25	59	29
9	58	28	26	56	26
10	62	36	27	51	26
11	57	32	28	58	25
12	56	24	29	53	29
13	60	29	30	56	25
14	51	21	31	54	22
15	56	24	32	54	23
16	56	24	33	55	29
17	51	17	34	55	24
35	53	30	36	51	22
37	53	25	38	50	19
39	57	29	40	51	23
41	51	29	42	60	29
43	55	26	44	55	26
45	53	25	46	60	29
47	52	25	48	52	22
49	53	28	50	55	29

Examples of Platinum, Gold, and Silver-rated buildings demonstrate that achieving higher efficiency within the GBI framework is feasible. Platinum-rated buildings, although fewer in number, showcase promising examples of higher energy efficiency within the GBI framework. These buildings have achieved the highest points for long-term criteria among those in the sample set (see Table 5).

Table 5: Points achieved by Platinum-rated buildings under NRNC code

Building No.	Points from Long-term Impact Criteria (out of 57)	Points from Short-term Impact Criteria (out of 43)	Total Points (out of 100)
Building 1	51	35	86
Building 2	55	37	92
Building 3	52	36	88
Building 4	54	34	88
Building 5	53	38	91
Building 6	51	35	86

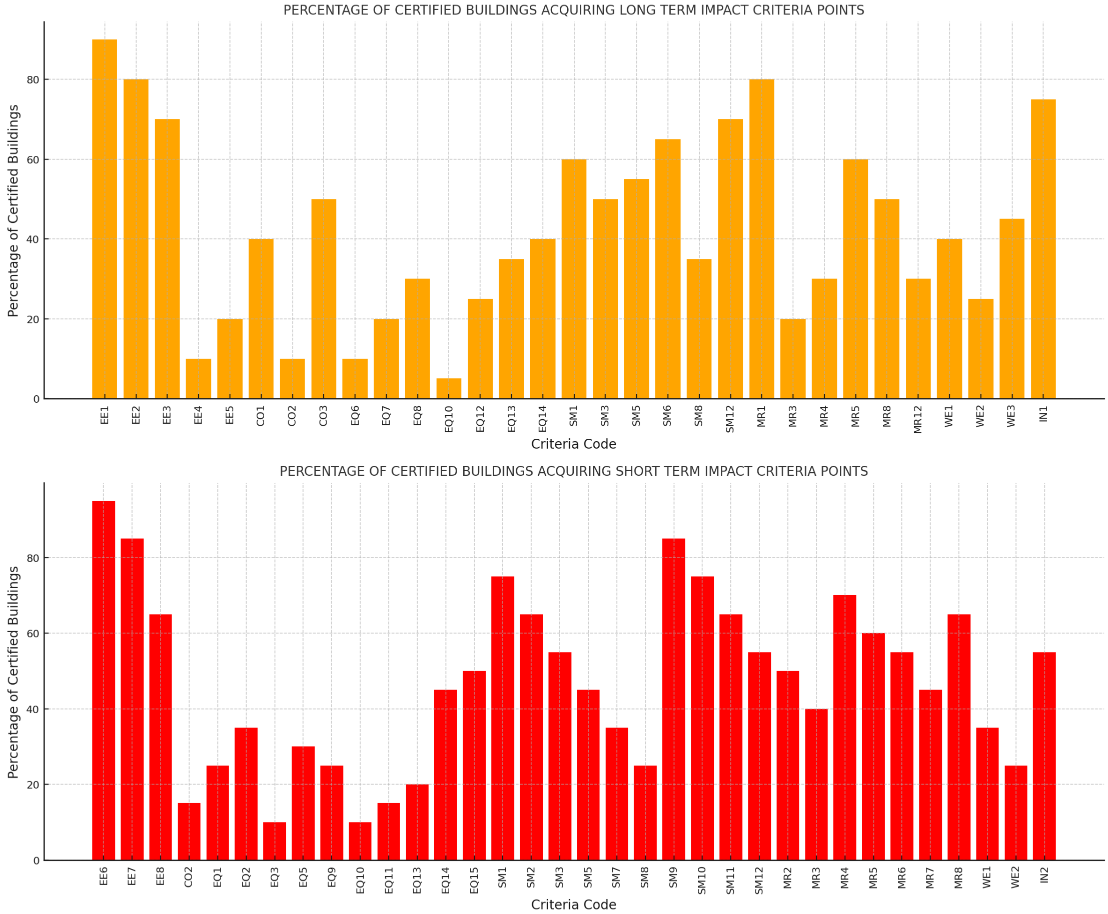

Figure 1. Percentage of certified buildings acquiring points under each criteria (x- axis = criteria code; y-axis = percentage of certified buildings)

Six buildings out of the 112 sampled received a Platinum rating and met 90 percent or more of the long-term impact criteria listed in the rating system. It is noteworthy that all Platinum-rated buildings have successfully met two key criteria from the long-term impact category, which are identified as criteria with low achievability for certified buildings. These criteria collectively contribute 20 points to the overall score. Table 6 provides the details:

Table 6: Two major criteria fulfilled by Platinum-rated buildings from the criteria with low achievability (accounting for 20 points under long-term impact criteria

S.No.	Criteria (with low achievability)	Points achieved by buildings	Building 1	Building 2	Building 3	Building 4	Building 5	Building 6
1	EE4 Renewable Energy	→	4	4	3	4	4	3
2	EE5 Advanced EE Performance - BEI	→	14	13	11	14	12	13

Historically, many energy-efficient buildings were constructed in the Middle East long before the introduction of the GBI, featuring climate-appropriate tropical architecture elements such as solar shading, terraced gardens, and natural ventilation. Interestingly, none of these features, which align well with the regional climate, are explicitly recognized under the GBI's innovation criteria.

5.0 CONCLUSION

This study assessed the impact of green building certification programs, such as LEED and GBI, on energy efficiency and sustainable development in the Middle East. The findings clearly indicate that these certification programs play a crucial role in enhancing the energy performance and environmental sustainability of buildings in the region. Certified buildings demonstrated significant improvements in energy and water efficiency, as well as reductions in carbon emissions, which align with the broader sustainability goals of Middle Eastern countries. The adoption of green building standards has proven to be an effective strategy for addressing the environmental challenges posed by rapid urbanization and increasing energy demand in the region. One of the key conclusions drawn from this study is the importance of pursuing higher levels of certification, such as Platinum or Gold, which consistently yield superior performance in terms of long-term impact criteria. Buildings that achieve these higher certification levels not only meet but often exceed the benchmarks set for energy efficiency and sustainability. This highlights the value of investing in comprehensive green building strategies that address both the short-term and long-term impacts of building operations. The study underscores the need for policymakers and industry stakeholders to prioritize these high-impact criteria in order to maximize the environmental and economic benefits of green building certifications. However, the study also identifies several challenges that need to be addressed to expand the adoption of green building certification programs in the Middle East. These include high upfront costs, a lack of tailored guidelines for the region's specific climatic and cultural context, and limited awareness of the long-term benefits of certified buildings among developers and investors. Addressing these barriers requires a concerted effort from governments, industry bodies, and educational institutions to provide financial incentives, develop region-specific standards, and promote the benefits of green buildings through awareness campaigns and capacity-building initiatives. In Addition, green building certification programs have a substantial positive impact on energy efficiency and sustainable development in the Middle East, aligning well with the region's broader environmental and economic goals. While the adoption of these programs is growing, there remains significant potential to further enhance their uptake and effectiveness through targeted policies and initiatives. By overcoming the existing barriers and fostering a supportive environment for green building practices, the Middle East can continue to lead in the global movement towards sustainable urban development and achieve its ambitious targets for energy efficiency and environmental stewardship. In developing regions like the Middle East, the construction industry is poised for rapid expansion in the coming decades. Amid current and anticipated energy crises, it is crucial to optimize energy consumption in the building sector, which remains one of the largest energy consumers globally. Green building certification systems can significantly drive the transition toward energy-efficient buildings. However, unlike technologies in other fields, creating energy-efficient buildings necessitates incorporating local knowledge and tailored solutions that address the unique conditions of each region. An effective green building rating system must balance user needs, local cultural requirements, positive engagement, and the overarching goal of substantial energy savings. Systems like GBI have potential but still require considerable enhancement to effectively motivate developers and architects toward sustainable building practices. A reassessment of the rating system’s framework, with an emphasis on user feedback and regional specifics, is essential to improve its impact. The suggested modifications in this study can help ensure that green-certified buildings maintain their sustainability over time. By encouraging architects and developers to focus more on long-term impact criteria, certification systems can drive the creation of truly sustainable buildings. Given that buildings constructed today will likely remain operational for several decades, it is imperative that certification systems be robust enough to advocate for and enforce energy-efficient designs from the outset. Ultimately, enhancing green building certification systems can provide a powerful tool for guiding sustainable construction in the Middle East. By ensuring these systems are well-suited to regional needs and effectively encourage long-term energy efficiency, they can play a pivotal role in sustaining the energy-efficient characteristics of buildings throughout their life span.

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