

GREEN BUILDING CERTIFICATION SYSTEMS: A COMPARATIVE ANALYSIS OF LEED AND BREEAM

Aurel Mihail Titu^{1,2}, Robert-Constantin Rachina³, Doina Banciu⁴, Constantin Oprean^{5,6}

¹Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, România, Corresponding author,  ORCID 0000-0002-0054-6535, mihail.titu@ulbsibiu.ro

²Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania

³National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independenței, București, Romania,  ORCID 0009-0003-5405-6093, rachinarobert@outlook.com

⁴ Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania,  ORCID No. 0009-0002-5109-1283, doina.banciu@aosr.ro

⁵Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, România,  ORCID 0000-0002-1710-0660, constantin.oprean@ulbsibiu.ro

⁶ Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania

ABSTRACT: In the context of growing concerns over environmental degradation and excessive resource consumption, the construction sector plays a crucial role in promoting sustainability. This article presents a comparative analysis of two of the most influential green certification systems worldwide: LEED and BREEAM. LEED emphasizes energy performance and resource efficiency, while BREEAM offers a comprehensive assessment based on the entire life cycle of the building. The study highlights methodological differences, strengths, and limitations of each system, as well as emerging trends in sustainable certification, such as digitalization, climate neutrality, and adaptability to environmental change. The conclusions underscore the need for an integrated approach that combines the strengths of both frameworks to support the development of sustainable and efficient buildings.

KEYWORDS: LEED vs BREEAM, Green Building Certification, Sustainable Construction, Environmental Performance Assessment, Lifecycle Evaluation, Carbon Neutrality Strategies.

DOI [10.56082/annalsarscience.2025.4.25](https://doi.org/10.56082/annalsarscience.2025.4.25)

1. INTRODUCTION

In a context marked by the rapid intensification of global concerns related to environmental degradation, climate change, and the depletion of natural resources, an increasing number of organizations with a long-term strategic outlook—alongside advocates of sustainable development—are turning toward innovative solutions to meet the growing demand for new constructions. At the same time, these efforts aim to mitigate the negative environmental impact of the construction sector, thereby contributing to the reduction of harmful effects on ecosystems. [1]

Among the technical sectors, the construction industry stands out for its pivotal role in advancing sustainability principles, often being regarded as a key driver in the transition toward a more responsible built environment. This contribution is reflected in the widespread adoption of energy-efficient solutions and the integration of technologies powered by renewable sources. As a result, recent decades have witnessed the emergence of consistent policies and directives focused on sustainable architecture, emphasizing the use of green energy and the reduction of resource consumption, in line with global commitments to sustainable development. [2]

As part of the growing efforts to transform the construction sector into a more environmentally conscious domain, green building certification systems have emerged as key instruments in promoting sustainable practices. These methodological frameworks provide a consistent set of guidelines and criteria for the responsible design, construction, and operation of buildings, while also enabling the clear quantification of their environmental performance. In this context, a comparative analysis is conducted between two of the most widely recognized and applied international standards in the field: Leadership in Energy and Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEAM). [3]

The emergence of these rating systems has marked a fundamental shift in aligning construction practices with genuine sustainability goals. Based on clearly defined and internationally recognized criteria, they provide a reliable decision-making framework that balances technical, economic and environmental considerations. Developers, designers and investors are thus better equipped to assess performance not only in terms of efficiency, but also in terms of long-term environmental impact. Furthermore, these systems contribute to increased accountability by

prioritizing transparency, long-term value and environmental responsibility from the earliest stages of the project. [4]



Figure 1. Sustainable Construction. Methods and Benefits [5]

However, the effectiveness and applicability of these methods vary considerably depending on geographical and socio-economic contexts. The absence of a globally standardized evaluation framework has led to the development of multiple Sustainability Assessment Frameworks (SAFs), such as SBTool, AQUA-HQE, and LiderA, each tailored to address the local needs and specific priorities of the projects in which they are implemented.[4]

As environmental responsibility has increased among the general population, as well as within academic and industrial spheres, green certification systems have gained broader application and growing recognition in the public domain. In this context, certified green buildings are becoming more widespread and are frequently highlighted in the media as examples of best practices in sustainability. Nevertheless, the comparative evaluation of actual performance among such buildings remains a challenge, as the diversity of existing certification systems and the absence of standardized equivalence methods create difficulties in establishing common benchmarking criteria. [6]

In light of these challenges, the present paper examines the degree of alignment between the LEED and BREEAM certification systems, focusing on a comparative analysis of their evaluation criteria, the certification levels assigned by each standard, and their respective methodological strengths and weaknesses. These green building performance assessment systems are widely recognized internationally as tools that support the standardization and strengthening of sustainable practices in the construction industry. They address a range of critical aspects, including energy efficiency, responsible water management, sustainable material selection, indoor environmental quality, as well as the comfort and well-being of building occupants. [7]

2. WHAT IS LEED?

The LEED certification system, developed under the auspices of the U.S. Green Building Council (USGBC), has established itself as an international benchmark for assessing the sustainability of both individual buildings and urban developments, being implemented in over 160 countries. Its primary objective is to provide a unified framework for promoting green construction and for monitoring the environmental performance of buildings throughout their entire lifecycle. The evaluation relies on a rigorous set of technical criteria, grounded in the regulations and standards of reputable U.S. institutions such as ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) and the EPA (Environmental Protection Agency). LEED is a dynamic system, continuously revised and updated in alignment with advances in sustainability and technological innovation. [8]

As shown in Figure 2, LEED certification is awarded at four different levels, based on the total score a project accumulates through the integration of sustainable practices and efficient design strategies.



Figure 2. LEED Performance Levels [9]

Points are awarded based on performance in sustainability areas—such as location, transport, water and energy efficiency, materials, indoor quality, innovation, and regional priorities—as shown in Figure 3. Each certification level reflects progress in sustainable design.[10]



Figure 3. Key LEED Sustainability Categories [11]

The latest edition of the standard, LEED v5, was designed to directly address critical contemporary issues such as carbon emissions reduction, improvement of quality of life, and enhanced resilience to climate change. This version builds upon the foundations established by previous updates, such as LEED v4.1, released in 2019, which broadened the system's scope beyond the design and construction phases by placing increased emphasis on building performance and operational efficiency. These developments reflect a progressively integrated approach to sustainability—one that considers not only technical performance but also the interaction between the building and its surrounding environment throughout its entire lifecycle. [12]

The LEED certification system is structured to cover multiple phases of a building's lifecycle, including: Building Design and Construction (BD+C), Interior Design and Construction (ID+C), as well as the Operation and Maintenance of existing buildings (O+M). [13]

- LEED BD+C – Building Design and Construction

This category is intended for new buildings or those undergoing major renovations. The objective is to integrate sustainability principles from the design phase, ensuring that the future construction has a reduced environmental impact and delivers high long-term performance. It also includes “Core and Shell” developments, where the developer is responsible for the base building infrastructure but not the tenant fit-outs.

Examples of application: hospitals, schools, hotels, logistics centers, office buildings, or commercial spaces. [14]



Figure 4. Children's Healthcare of Atlanta Center for Advanced Pediatrics | LEED Gold | Photo: Children's Healthcare of Atlanta [14]

- LEED ID+C – Interior Design and Construction

This category enables project teams to transform interior spaces into functional and sustainable environments, even without control over the entire

building.



Figure 5. Children's Healthcare of Atlanta Support Center [15]

The focus is placed on indoor air quality, energy efficiency, material selection, and occupant comfort.

Examples of application: office spaces, retail stores, restaurants, service areas, and hospitality units. [15]

- LEED O+M – Operations and Maintenance

Dedicated to existing and operational buildings, this certification promotes a smart approach to building operations and maintenance. Without requiring major construction interventions, it aims to optimize resource consumption, enhance indoor environmental quality, and reduce the ecological impact of daily operations.

Examples of application: schools, hotels, shopping centers, data centers, or administrative buildings. [16]



Figure 6. Whitman Walker Health | LEED Silver | Photo: ©Eric Laignel Photography [16]

3. WHAT IS BREEAM?

Since its inception in 1990, BREEAM has had a significant impact on steering the construction sector toward sustainable practices, supporting the reduction of greenhouse gas emissions, improving energy efficiency, and promoting a more environmentally responsible mindset. As the concept of sustainability has evolved, the standard has progressively expanded

its scope to incorporate the social dimensions of sustainable development.

Today, BREEAM no longer assesses only the environmental performance of buildings, but also considers their impact on quality of life. Its evaluation framework includes areas such as occupant health and well-being, equitable access, safety, social cohesion, support for the local economy, transformative education, and the promotion of ethical leadership. In this way, BREEAM adopts a comprehensive perspective that aligns excellence in the built environment with social responsibility and community equity. [17]

Developed by the Building Research Establishment (BRE) in 2009 and revised in 2012, the BREEAM Communities system is a certification tool designed for large-scale, multifunctional or predominantly residential urban development projects. It assesses the sustainability of built environments based on six key domains: project governance, social and economic impact, resource and energy efficiency, land use and ecological protection, as well as accessibility and mobility.

The final rating is determined according to the total score achieved, ranging—as shown in Figure 7—from “Unclassified” (below 30 points) to the highest level, “Outstanding” (above 85 points). Additionally, certain credits are deemed mandatory and must be met in order for formal certification to be granted, regardless of the overall score. [18]

BREEAM rating	% score
Outstanding	★★★★★
Excellent	★★★★★
Very good	★★★★★
Good	★★★★★
Pass	★★★★★
Unclassified	★★★★★

Figure 7. BREEAM ratings [18]

Launched in 2025, the seventh version of the BREEAM standard marks a key evolutionary milestone in the development of sustainability assessment methodologies in the construction sector. This new edition aims for stronger alignment with international guidelines on sustainable design and the overarching goal of achieving net-zero carbon emissions, placing a particular focus on two fundamental dimensions: energy performance and environmental impact throughout the entire life cycle of a building. This update reinforces BREEAM’s

position as a benchmark tool for sustainability certification, evaluating impact from the conceptual phase through to post-construction.

Among the most significant innovations in Version 7 are the introduction of mandatory minimum standards, recalibration of indicator weightings, and increased emphasis on reducing both operational and embodied emissions associated with materials and processes. [19]

The new requirements introduced in this version target key aspects such as the integration of Whole Life Carbon, energy efficiency, material selection based on carbon footprint, protection of biodiversity and site quality, as well as the enhancement of health, comfort, and well-being for building occupants. [19]

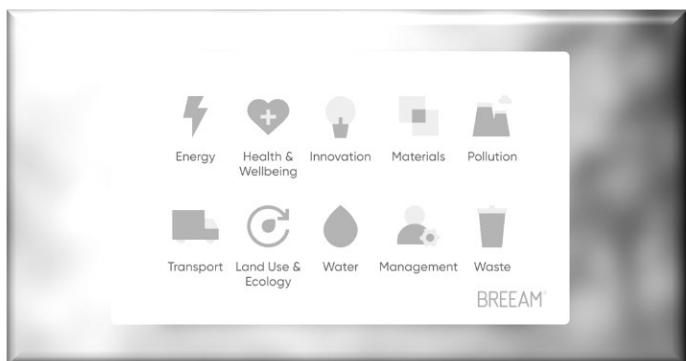


Figure 8. Key BREEAM Sustainability Categories [19]

BREEAM integrates a portfolio of six technical standards that allow the assessment of the sustainability of buildings and projects throughout their entire life cycle, ensuring a coherent and comparable framework for measuring environmental performance. Through this life cycle structuring, the system manages to relate to the various stages of a project's development - from planning and design, to execution and operation - contributing to a complete understanding of the environmental impact. This unified approach not only facilitates alignment with sustainability objectives, but also supports decision-making processes in relation to international good practices and current requirements.

- BREEAM New Construction Residential

Designed for new residential buildings, this standard provides developers with a means to demonstrate housing quality and performance through objective assessments conducted by independent experts.

- BREEAM In-Use

This framework evaluates the sustainability of existing buildings in operation and supports performance improvement through tools for monitoring and validating real data.

- BREEAM Refurbishment and Fit-Out

Aimed at renovation and fit-out projects, the standard encourages the sustainable modernization of buildings, regardless of their function, with the goal of reducing environmental impact.

- BREEAM Communities

It applies to urban planning projects, providing a framework for integrating sustainability into the development of new communities or the regeneration of existing ones.

- BREEAM New Construction

This standard is intended for newly constructed buildings and provides a clear framework for the design and delivery of sustainable constructions, ensuring high performance both environmentally and commercially.

- BREEAM Infrastructure

Formerly known as CEEQUAL, this standard assesses the sustainability of infrastructure projects, promoting best practices in design, construction, and maintenance. [20]

4. LEED VS BREEAM

4.1 Overview of the LEED and BREEAM Certification Process

Widely applied in the United States, LEED is based on a point accumulation system, where projects are scored according to the fulfillment of criteria such as energy efficiency, resource use, and the selection of environmentally friendly materials. This structured approach promotes the adoption of innovative technologies and construction solutions, encouraging measurable performance in terms of environmental impact. [3]

On the other hand, BREEAM, developed in the United Kingdom, adopts a broader perspective by integrating not only environmental considerations but also social and economic factors, assessed across the entire lifecycle of the building. Research has identified points of convergence between the two methods, particularly in regions such as the Middle East, opening the possibility for the development of a hybrid methodology that combines the strengths of both systems without compromising sustainability standards. [3]

Thus, although LEED and BREEAM both aim to promote sustainable architecture, the differences between them stem from their adaptation to the cultural, climatic, and legislative contexts of the geographic regions in which they are applied, as illustrated in Table 1 regarding the certification process. [3]

Table 1. LEED and BREEAM Certification Process -2025 [3]

Indicator	LEED	BREEAM
Developer	U.S. Green Building Council	Building Research Establishment (BRE)
First Introduced	2000	1990
Categories	New Construction, Existing Buildings, Homes, Neighborhood Development	New Construction, Refurbishment, In-Use, Communities, Infrastructure (V7)
Rating Levels	Certified, Silver, Gold, Platinum	Pass, Good, Very Good, Excellent, Outstanding
Assessment Method	Points-based system	Credits-based system
Global Reach	Over 186 countries	Over 90 countries
Focus Areas	Sustainable site development, Water efficiency, Energy performance, Materials selection, Indoor environmental quality	Management, Health & Wellbeing, Energy, Transport, Water, Materials, Waste, Land Use, Ecology, Pollution

Table 2 analyzes the internal architecture of the LEED and BREEAM certification systems, comparing aspects such as the scoring mechanisms (e.g., credit accumulation versus performance optimization), verification procedures, and the structure of certification levels. This comparative analysis provides a clear perspective on how the specific methodological decisions of each framework influence the level of confidence, transparency of the process, and the reproducibility of sustainability-related outcomes. [21]

Table 2. Certification Criteria Weighting Comparison [21]

Evaluation Criteria	LEED Weight (%)	BREEAM Weight (%)
Operational Energy Performance	33	25
Indoor Air & Environmental Quality	15	15
Water Usage Optimization	10	6
Material Efficiency & Lifecycle	13	13
Innovative Design Integration	6	10
Occupant Health and Comfort	5	8
Sustainable Location & Mobility	12	13
Lifecycle Costing & Sustainability Assessment	6	10

4.2 Patterns of Regional Adoption

The degree of adoption of green certifications varies significantly across the globe, influenced by factors such as supportive public policies, market pressure, and prevailing environmental regulations, as illustrated in Table 3.

Table 3. Patterns of regional trends. LEED and BREEAM [22]

Region	LEED – Level of Adoption	BREEAM – Level of Adoption
North America	Widely implemented and well-established	Limited use with minimal market presence
Europe	Moderate adoption with gradual growth	Leading certification system in the region
Asia-Pacific	Expanding adoption with growing interest	Moderate usage, varying by local context
Middle East	Increasing popularity and progressive expansion	Low adoption, with limited influence across projects

The LEED system shows a high level of implementation in North America, where it is regarded as the dominant standard, but it is also experiencing significant growth in the Middle East and maintains a strong presence in the Asia-Pacific region, where interest in sustainable construction continues to expand.

In contrast, BREEAM enjoys a strong foothold in Europe, where it is the most widely used certification system on the continent, largely due to its British origin and its integration into regional policies. In Asia, BREEAM is present, but to a more limited extent compared to LEED.

These differences reflect how each region responds to its economic and regulatory context, as well as the preferences of construction industry stakeholders regarding tools for assessing environmental performance. [22]

4.3 Evaluating the Strengths and Structural Gaps of the LEED and BREEAM Systems

The LEED and BREEAM certification systems reflect two distinct philosophies in the evaluation of sustainable construction practices. Each framework has strategic strengths and inherent limitations that affect its applicability in various contexts, as illustrated in Table 4.

LEED benefits from global recognition and a flexible scoring system that encourages the integration of renewable energy sources. However, it can become burdensome due to the large volume of required documentation and potential discrepancies between predicted and actual energy performance.

In contrast, BREEAM stands out through its life-cycle-based approach and its emphasis on circular economy principles. Nevertheless, its certification process is often seen as bureaucratic and costly, which may pose a barrier for projects with limited budgets. [22]

Table 4. Key Strengths and Limitations of LEED and BREEAM [22]

Certification System	Key Strengths	Key Limitations
LEED	Globally recognized; adaptable scoring model; strong support for renewable energy integration.	Documentation-intensive; potential mismatch between theoretical and real-world energy performance.
BREEAM	In-depth lifecycle evaluation; emphasis on circular economy; early-stage integration in project planning.	High certification costs; complex administrative procedures; limited accessibility in budget-constrained developments.

5. RESULTS AND CONCLUSIONS

The BREEAM and LEED certification systems are among the most influential tools used internationally to assess sustainability in construction. Although both aim to promote environmentally friendly and responsible practices, they differ in their approaches, criteria, and methodologies. For developers, designers, and contractors, a clear understanding of these distinctions is essential for obtaining the desired certification. A systematic application of the suggested steps, along with practical recommendations, can support the successful completion of certification for targeted projects under BREEAM or LEED. [23]

Against the backdrop of the intensifying climate crisis and technological advancement, the LEED and BREEAM certification systems are continuously adapting their methodologies to address the emerging demands of the sustainable construction market. Among the anticipated trends for the upcoming period are:

- Focus on carbon neutrality: The new versions of these standards will include stricter requirements regarding greenhouse gas emissions, aiming to achieve the “net-zero carbon” target across the entire building lifecycle.
- Integration of smart technologies: Increased digitalization of the certification process is anticipated, through the use of IoT sensors and AI-based solutions for continuous monitoring of buildings’ energy and operational performance.
- Assessment of climate adaptability: Both LEED and BREEAM are expected to place greater emphasis on criteria related to building resilience against extreme weather events and other natural hazards, in light of their growing frequency.
- Convergence of sustainability standards: A trend toward hybrid models combining LEED and BREEAM strengths is emerging, offering a unified

and adaptable approach tailored to various project types and geographic contexts. [22]

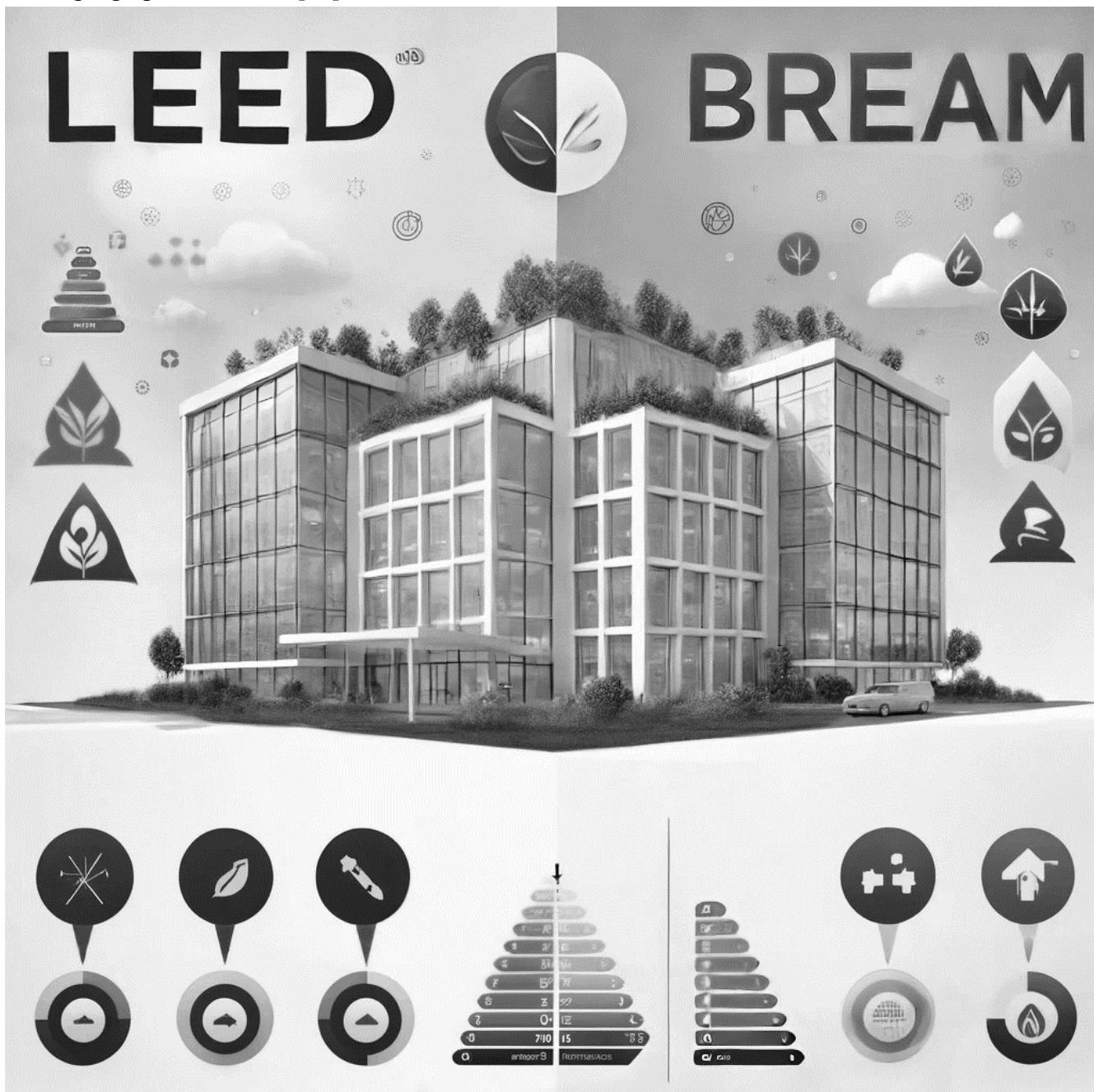


Figure 9. Comparasion between LEED and BREEAM [24]

In conclusion, the conceptual and methodological differences between LEED and BREEAM reflect complementary directions in the approach to sustainability. While LEED focuses its assessment on energy performance and reducing environmental impact, BREEAM provides a structured analysis of sustainability across the entire building lifecycle. Looking toward the development of more comprehensive and effective certifications, there emerges a need to integrate the most relevant features of each system: the energy rigor promoted by LEED and the systemic approach characteristic of BREEAM. Thus, future certification models should address the real challenges of building operation, leverage smart technologies for continuous

monitoring, and be adaptable to diverse economic contexts, including in developing regions. Such an integrative evolution could redefine sustainability standards in the construction sector and significantly contribute to achieving global goals related to the environment, health, and resource efficiency. [22]

6. REFERENCES

1. A. Rezaallah & C. Bolognesi, R. A. (2012). LEED and BREEAM; Comparison between policies, assessment criteria and calculation methods. BSA 2012- Proceedings of the 1st International Conference on Building Sustainability Assessment. ResearchGate.
2. Sami G. Al-Ghamdi, M. M. (2016). On-Site Renewable Energy and Green Buildings: A System-Level Analysis. Environmental Science

& Technology, 50(9). Retrieved from <https://pubs.acs.org/doi/10.1021/acs.est.5b05382>

3. Mohamed Gabr. (2025). Green Building Certification Systems: A Comparative Analysis of LEED and BREEAM. *Tuijin Jishu/Journal of Propulsion Technolog*, 46(1).
4. António Marques, J. F. (2024). Sustainability Certifications in Real Estate: Value and Perception. *Buildings*, 14. Retrieved from <https://doi.org/10.3390/buildings14123823>
5. Learn About Sustainable Construction Technology. (2023, 06 11). Retrieved from pyra-engineering1.blogspot.com/2023/06/learn-about-sustainable-construction.html
6. Ozge Suzer. (2019). Analyzing the compliance and correlation of LEED and BREEAM by conducting a criteria-based comparative analysis and evaluating dual-certified projects. *Building and Environment*, 147, 158-170. Retrieved from <https://doi.org/10.1016/j.buildenv.2018.09.001>
7. Lia Marchi, E. A. (2021). Green Building Rating Systems (GBRSs). *Encyclopedia* 2021, 1(4), 998-1009. Retrieved from <https://doi.org/10.3390/encyclopedia1040076>
8. Laura Michelle Leite Ribeiro, T. P. (2025). LEED Certification in Building Energy Efficiency: A Review of Its Performance Efficacy and Global Applicability. *Sustainability*, 17(5). Retrieved from <https://doi.org/10.3390/su17051876>
9. Looking Back: LEED History. (2016, 08 08). Retrieved from sigearth.com/leed-history/
10. Understanding LEED Certification Levels: A 2025 Guide to Green Building Success. (2025, 05 13). Retrieved from www.constructionplacements.com/leed-certification-levels/
11. LEED (Tiêu chuẩn LEED là gì). (2022, 05 26). Retrieved from [cotto.vn: https://cotto.vn/leed-tieu-chuan-leed-la-gi](https://cotto.vn/leed-tieu-chuan-leed-la-gi)
12. LEED launches updated standards. Do they go far enough? (2025, 02 05). Retrieved from [www.archpaper.com:https://www.archpaper.com/2025/05/leed-updated-standards/](https://www.archpaper.com/2025/05/leed-updated-standards/)
13. LEED v5: Ushering in a New Era of Sustainable Building. (2025, 04 21). Retrieved from www.kimley-horn.com/news-insights/perspectives/leed-v5-new-era-of-sustainable-building/
14. LEED certification for new buildings and major renovations. (n.d.). Retrieved from [www.usgbc.org:https://www.usgbc.org/leed/rating-systems/new-buildings](https://www.usgbc.org/leed/rating-systems/new-buildings)
15. LEED certification for new interior spaces. (n.d.). Retrieved from [www.usgbc.org: https://www.usgbc.org/leed/rating-systems/new-interiors](https://www.usgbc.org/leed/rating-systems/new-interiors)
16. LEED certification for existing buildings and spaces. (n.d.). Retrieved from [www.usgbc.org: https://www.usgbc.org/leed/rating-systems/existing-buildings](https://www.usgbc.org/leed/rating-systems/existing-buildings)
17. Anosh Nadeem Butt. (2025, 03 03). Advancing Social Sustainability in BREEAM New Construction Certification Standards. *Standards* 2025, 5(1), 8. Retrieved from <https://doi.org/10.3390/standards501>
18. A guide to how BREEAM works. (n.d.). Retrieved from [breeam.com: https://breeam.com/about/how-breeam-works](https://breeam.com/about/how-breeam-works)
19. BREEAM V7: The New Era for Sustainable Building and Net Zero Carbon. (n.d.). Retrieved from <https://www.wallacewhittle.com/breeam-version-7/>
20. An introduction to BREEAM. (n.d.). Retrieved from https://breeam.com/standards?p_1_back_url=%2Fbreeam_search%3Fq%3Dbreeam%2Bstandards
21. Elias Tsirovasilis, M. K. (2025, july 7). Benchmarking Building Certification Systems: A Comparative Assessment of LEED, BREEAM, and WELL in Advancing Energy-Efficient and Sustainable Built Environments. *Preprints.org*. Retrieved from [10.20944/preprints202507.0444.v1](https://doi.org/10.20944/preprints202507.0444.v1)
22. Hasibullah Khan, S. (2025, June). The Next Frontier of Green Building Certifications: Evaluating the Future of LEED, BREEAM and WELL Standards. *Journal of Engineering and Applied Sciences Technology*. doi:10.47363/JEAST/2025(7)318
23. Lee, S. (2025). BREEAM vs LEED: Ultimate Guide. [Numberanalytics.com. https://www.numberanalytics.com/blog/breeam-vs-leed-ultimate-guide](https://www.numberanalytics.com/blog/breeam-vs-leed-ultimate-guide)
24. admin. (2025, March 27). What are the key differences between LEED and BREEAM? - LEED UAE. LEED UAE. <https://leeduae.com/what-are-the-key-differences-between-leed-and-breeam/>