ISSN: 2634 - 8853

Journal of Engineering and Applied Sciences Technology

SCIENTIFIC Research and Community

Review Article

Open Access

The Next Frontier of Green Building Certifications: Evaluating the Future of LEED, BREEAM and WELL Standards

Hasibullah Khan* and Samiullah Safi

Kabul Polytechnic University, Afghanistan

ABSTRACT

Green building certifications have become a cornerstone in sustainable architecture and urban planning. As environmental concerns escalate and regulatory frameworks evolve, certification systems such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and WELL Building Standard are adapting to new challenges. This study evaluates the current impact, limitations, and future trends of these certification programs. It explores emerging factors such as climate resilience, digital integration, and holistic sustainability to forecast how green building certifications will evolve in the coming decades.

***Corresponding author**

Hasibullah Khan, Kabul Polytechnic University, Afghanistan.

Received: June 04, 2025; **Accepted:** June 06, 2025; **Published:** June 18, 2025

Keywords: Green Building Certification, Sustainability, LEED, BREEAM, WELL Standards, Sustainable Architecture, Climate Resilience

Introduction

The global construction industry is a major contributor to climate change, accounting for nearly 39% of energy-related CO_2 emissions worldwide [1]. In response, green building certifications have emerged as frameworks for reducing environmental footprints while ensuring economic and social benefits. LEED, BREEAM, and WELL have gained prominence in assessing sustainable design and operational efficiency, with varying methodologies and regional influences [2]. However, rapid urbanization, climate change, and new health considerations necessitate a reevaluation of these certification systems.

This paper discusses the evolution, effectiveness, and anticipated developments in LEED, BREEAM, and WELL. It explores whether these systems can integrate advanced technologies, stricter sustainability benchmarks, and climate-adaptive strategies.

The Impact of the Construction Industry on Climate Change

The global construction industry is one of the most resource-intensive sectors, accounting for nearly 39% of energy-related CO_2 emissions and 36% of global energy consumption (International Energy Agency [IEA] [3]. Buildings contribute significantly to greenhouse gas (GHG) emissions due to their reliance on fossil fuel-based energy, inefficient materials, and unsustainable construction practices. In addition, construction and demolition waste make up approximately 40% of total solid waste generation globally, exacerbating environmental degradation (World Green Building Council [4].

To combat these environmental concerns, the concept of green buildings has gained global recognition, promoting energy efficiency, reduced water consumption, and sustainable material use. Green building certification systems, such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and WELL Building Standard, have emerged to regulate and standardize sustainability in construction projects. These certifications assess buildings on various parameters, including carbon emissions, energy efficiency, occupant health, and resource conservation.

The Rise of Green Building Certifications

LEED (Leadership in Energy and Environmental Design)

The U.S. Green Building Council (USGBC) introduced LEED in 1998 as a voluntary certification system for buildings seeking sustainability and efficiency. LEED is one of the most widely adopted certifications worldwide, with over 105,000 certified projects in 190+ countries [5]. It evaluates buildings across multiple categories, including:

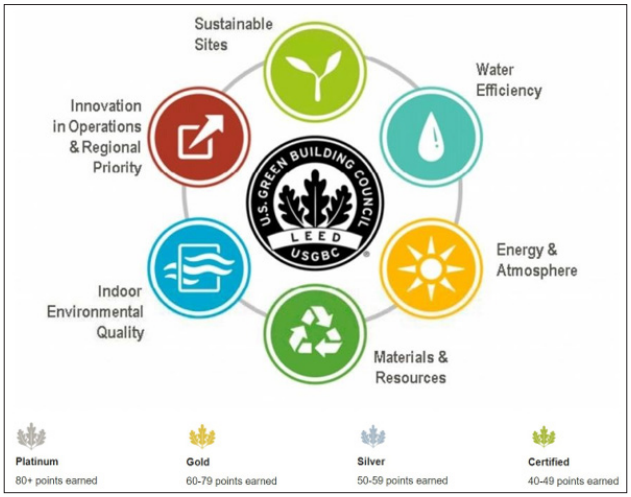

Figure 1: Presents the Distribution of LEED Credits Across its Evaluation Categories

LEED operates on a points-based system, where projects earn points based on performance, leading to one of four certification levels: Certified (40-49 points), Silver (50-59), Gold (60-79), and Platinum (80+ points) [5]. Despite its global presence, critics argue that LEED focuses more on documentation rather than actual performance, with some certified buildings failing to maintain efficiency post-certification [6].

BREEAM (Building Research Establishment Environmental Assessment Method)

Developed in 1990 by the Building Research Establishment (BRE) in the UK, BREEAM is Europe's leading green building certification system. Unlike LEED, which is performance-based, BREEAM adopts a lifecycle assessment approach, evaluating sustainability from design to operation [7]. BREEAM-certified buildings undergo assessment in ten categories, including:

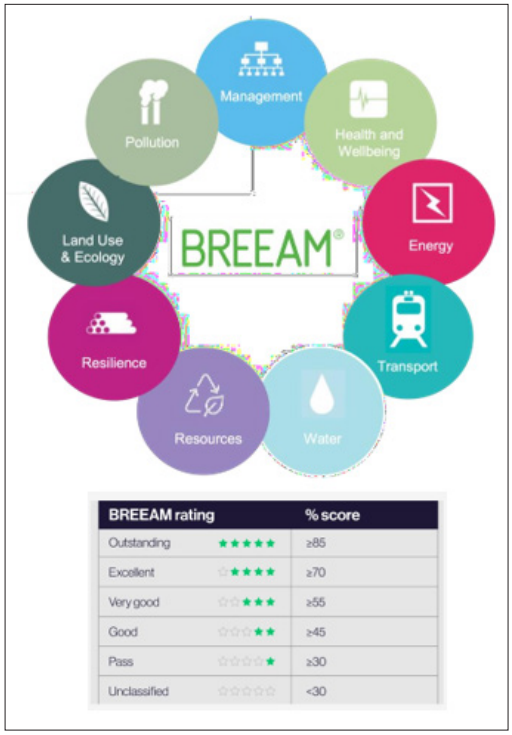

Figure 2: Presents the Distribution of BREEAM Credits Across its Evaluation Categories

Energy Use and Carbon Emissions

BREEAM's rating scale consists of Pass, Good, Very Good, Excellent, and Outstanding levels. One of BREEAM's key strengths is its adaptability to national and regional sustainability regulations, making it a preferred certification in the UK and European Union (EU). However, its high costs and complexity have limited its adoption in developing nations [2].

WELL (WELL Building Standard)

Introduced in 2014 by the International WELL Building Institute (IWBI), WELL is a certification that prioritizes human health and well-being. Unlike LEED and BREEAM, which emphasize environmental sustainability, WELL focuses on air quality, water quality, natural lighting, nutrition, mental health, and ergonomics [8]. WELL-certified buildings are categorized into four levels:

- Bronze (40-49 points)
- Silver (50-59 points)
- Gold (60-79 points)
- Platinum (80+ points)

WELL certification has gained popularity, particularly in corporate offices, healthcare facilities, and educational institutions. Studies indicate that WELL-certified buildings improve productivity, reduce absenteeism, and enhance overall well-being [1]. However, its high cost and limited global presence pose challenges to widespread adoption [9].

The Need for an Evolved Certification System

Despite their contributions to sustainable construction, LEED, BREEAM, and WELL have limitations, including:

- **Performance Gaps:** Many buildings that achieve high ratings during certification fail to maintain energy efficiency or occupant well-being in the long run [6].
- **High Costs:** The costs associated with certification, documentation, and compliance can be prohibitive, particularly for small-scale or developing markets [10].
- **Lack of Integration with Emerging Technologies:** The current certification models do not fully incorporate AI, IoT, and real-time data analytics, which could improve building sustainability [11].
- **Limited Climate Adaptation:** Certifications focus primarily on operational efficiency but lack comprehensive resilience strategies for climate change adaptation, such as extreme weather resistance [12].
- Given these challenges, the next frontier of green building certifications must evolve by:
- Incorporating AI-driven energy monitoring systems
- Enhancing climate resilience frameworks
- Integrating circular economy principles (material reuse, waste reduction)
- Merging sustainability and health-focused standards

This paper critically evaluates the evolution, effectiveness, and anticipated future developments in LEED, BREEAM, and WELL, exploring their potential for greater environmental and social impact in the coming decades.

LEED: A Global Standard for Energy Efficiency

Introduction to LEED

The Leadership in Energy and Environmental Design (LEED) certification was introduced in 1998 by the U.S. Green Building Council (USGBC) to create a standardized framework for sustainable buildings. LEED is now the most widely used green building certification in the world, with over 105,000 certified projects in nearly 190 countries [5].

LEED is designed to promote high-performance, energy-efficient, and environmentally responsible buildings. It applies to a wide range of project types, including commercial buildings, residential developments, schools, healthcare facilities, and entire neighborhoods.

LEED Rating System and Certification Levels

LEED uses a points-based system where buildings earn credits for sustainability performance. The total points determine the certification level:

- Certified: 40–49 points
- Silver: 50–59 points
- Gold: 60–79 points
- Platinum: 80+ points (highest level) [5]

Buildings accumulate points across various categories, such as:

- **Energy and Atmosphere:** Measures energy efficiency, renewable energy integration, and carbon footprint reduction.

- **Sustainable Sites:** Evaluates site selection, storm water management and landscape sustainability.
- **Water Efficiency:** Rewards measures for reducing potable water use and implementing water recycling systems.
- **Materials and Resources:** Encourages responsible material sourcing, waste reduction, and life-cycle assessment.
- **Indoor Environmental Quality:** Focuses on indoor air quality, ventilation, and occupant well-being.

Strengths of LEED
- **Global Recognition:** LEED is the most internationally accepted certification system.
- **Flexible and Adaptable:** LEED applies to various building types, from offices to entire cities.
- **Promotes Carbon Neutrality:** Newer versions of LEED (e.g., LEED v4.1) focus on reducing operational carbon and embodied carbon [5].
- **Encourages Renewable Energy Adoption:** LEED-certified buildings integrate solar, wind, and geothermal energy systems.

Criticism and Challenges of LEED

Despite its advantages, LEED has faced several criticisms:
- **Focus on Documentation:** LEED places heavy emphasis on documentation rather than real-world building performance [6].
- **High Costs:** Certification, consulting, and compliance costs make it less accessible for small-scale projects [10].
- **Performance Gaps:** Studies have found that some LEED-certified buildings do not achieve expected energy savings, particularly in post-certification operation [13].

BREEAM: A Lifecycle-Based European Approach
Introduction to BREEAM

The Building Research Establishment Environmental Assessment Method (BREEAM) was developed in 1990 by the Building Research Establishment (BRE) in the United Kingdom. It is the oldest and one of the most widely adopted green building certifications in Europe [7]. Unlike LEED, which emphasizes energy efficiency, BREEAM evaluates sustainability throughout a building's entire lifecycle, from design to demolition.

BREEAM certification is recognized in over 80 countries and has influenced the development of other certification systems, including Green Star (Australia), CASBEE (Japan), and HQE (France).

BREEAM Rating System and Certification Levels

BREEAM evaluates buildings across ten key categories:
- **Management:** Sustainable project planning and construction.
- **Health and Well-being:** Indoor air quality, lighting, thermal comfort, and occupant satisfaction.
- **Energy:** Operational energy efficiency and carbon emissions reduction.
- **Transport:** Sustainable transportation access and infrastructure.
- **Water:** Water efficiency, recycling, and storm water management.
- **Materials:** Life-cycle impact of building materials.
- **Waste:** Sustainable waste management and circular economy principles.
- **Land Use and Ecology:** Biodiversity, site selection, and environmental impact.
- **Pollution:** Reduction of noise, light, and air pollution.
- **Innovation:** New and emerging sustainable building practices.

BREEAM buildings receive one of the following ratings:
- Pass
- Good
- Very Good
- Excellent
- Outstanding (highest level) [7]

Strengths of BREEAM
- **Comprehensive Assessment:** BREEAM covers the full building lifecycle.
- **Encourages Circular Economy Practices:** Promotes material reuse and low-impact construction materials.
- **Strong Alignment with European Environmental Policies:** Facilitates compliance with EU sustainability directives.

Criticism and Challenges of BREEAM
- **Complex Certification Process:** BREEAM has multiple assessment stages, making certification more time-consuming than LEED [2].
- **High Costs:** The cost of compliance is higher than other certification systems, making it less appealing for smaller buildings [10].

WELL: Prioritizing Human Health and Well-Being
Introduction to WELL

The WELL Building Standard, launched in 2014 by the International WELL Building Institute (IWBI), is the first certification system focused exclusively on human health and well-being. Unlike LEED and BREEAM, which primarily assess environmental sustainability, WELL evaluates the direct impact of buildings on human health [8].

WELL Rating System and Certification Levels

WELL assesses ten core concepts:
- **Air:** Indoor air quality and ventilation.
- **Water:** Safe drinking water and filtration systems.
- **Nourishment:** Healthy food access and nutrition policies.
- **Light:** Natural and artificial lighting strategies.
- **Movement:** Design features that encourage physical activity.
- **Thermal Comfort:** Adaptive thermal conditions.
- **Sound:** Acoustic performance and noise control.
- **Materials:** Non-toxic materials and indoor safety.
- **Mind:** Mental health support and stress reduction strategies.
- **Community:** Social engagement and workplace inclusivity.

WELL certification levels:
- **Bronze:** 40–49 points
- **Silver:** 50–59 points
- **Gold:** 60–79 points
- **Platinum:** 80+ points [8]

Criticism and Challenges of WELL
- **High Cost:** WELL is one of the most expensive certification systems.
- **Limited Adoption in Developing Regions:** Most WELL-certified buildings are in North America, Europe, and Australia [9].

Comparative Analysis of LEED, BREEAM and WELL Certification Systems

Green building certification systems are essential for evaluating and improving sustainability, energy efficiency, and occupant well-being in the built environment. LEED, BREEAM, and WELL represent three of the most prominent certifications, each with unique methodologies and regional influences. This section

presents a comparative analysis of these three systems, highlighting their focus, scoring criteria, certification levels, adoption rates, strengths, and weaknesses.

Comparative Analysis Overview

Each certification system has a distinct approach to sustainability and building performance assessment. The focus areas of the three systems are summarized below:

- **LEED:** Prioritizes energy efficiency, carbon footprint reduction, and sustainable materials to ensure buildings have minimal environmental impact.
- **BREEAM:** Uses a lifecycle approach, evaluating a building's performance from design to demolition with emphasis on regional regulations and resource conservation.
- **WELL:** Focuses primarily on human health and well-being, assessing air quality, lighting, mental health, and nutrition in building environments.

Table 1: Comparative Overview of LEED, BREEAM and WELL Certification Systems

Criteria	LEED	BREEAM	WELL
Focus	Energy efficiency, sustainability	Lifecycle sustainability	Human health and well-being
Scoring System	Points-based	Weighted categories	Performance-based
Certification Levels	Certified, Silver, Gold, Platinum	Pass, Good, Very Good, Excellent, Outstanding	Bronze, Silver, Gold, Platinum
Regional Adoption	Global	Europe-centric	Emerging global standard
Strengths	Flexibility, widespread use	Detailed lifecycle assessment	Focuses on health and wellness
Weaknesses	Documentation-heavy	Costly, complex	High cost, limited regional influence

Scoring System and Certification Levels

LEED Scoring System

LEED operates on a points-based system, where buildings accumulate points based on sustainability performance across multiple categories. The higher the score, the better the certification level.

- **Certified:** 40–49 points
- **Silver:** 50–59 points
- **Gold:** 60–79 points
- **Platinum:** 80+ points

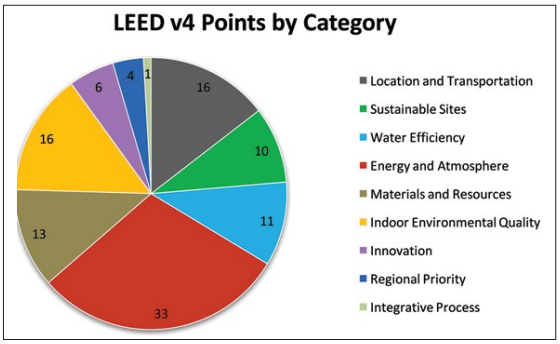

Figure 1: Presents the Distribution of LEED Credits Across its Evaluation Categories

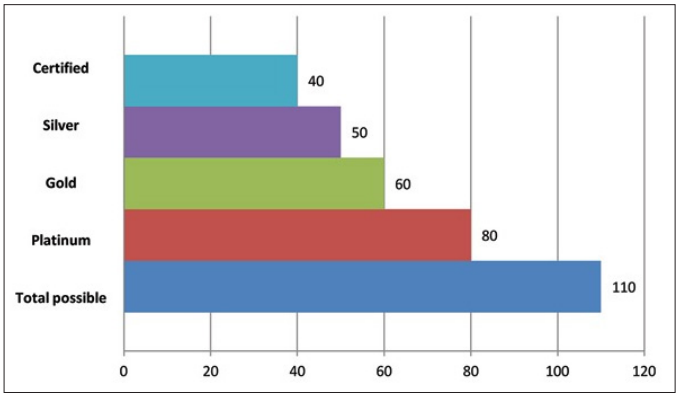

Figure 2: LEED Scoring Breakdown

BREEAM Scoring System

BREEAM utilizes a **weighted category approach**, where each aspect of sustainability is assessed with varying levels of importance. The overall score determines the certification rating:

- **Pass:** 30–44%
- **Good:** 45–54%
- **Very Good:** 55–69%
- **Excellent:** 70–84%
- **Outstanding:** 85%+

Unlike LEED, BREEAM applies regional weighting, allowing adaptability to different climate conditions, materials availability, and national regulations.

WELL Scoring System

WELL certification is performance-based, meaning that buildings must meet specific health and well-being benchmarks rather than just theoretical guidelines. Scoring is determined by the number of WELL features a building successfully implements.

- **Bronze:** 40–49 points
- **Silver:** 50–59 points
- **Gold:** 60–79 points
- **Platinum:** 80+ points

Regional Adoption Trends

The adoption of green certifications varies geographically, depending on government incentives, market demand, and environmental regulations.

Table 2: Regional Adoption of LEED, BREEAM and WELL

Region	LEED Adoption	BREEAM Adoption	WELL Adoption
North America	High	Low	Growing
Europe	Moderate	High	Moderate
Asia-Pacific	Growing	Moderate	Emerging
Middle East	Increasing	Limited	Emerging

- **LEED:** Strongest in North America, Middle East, and Asia-Pacific.
- **BREEAM:** Dominates in Europe, with some presence in Asia.
- **WELL:** Growing globally but more prominent in corporate offices and healthcare sectors.

Strengths and Weaknesses

Each certification system has unique strengths and limitations that influence its adoption and effectiveness.

Table 3: Strengths and Weaknesses of LEED, BREEAM and WELL

System	Strengths	Weaknesses
LEED	Global adoption, flexible scoring system, strong incentives for renewable energy	Documentation-heavy, performance gaps in energy savings
BREEAM	Comprehensive lifecycle assessment, strong focus on circular economy	Expensive, complex certification process
WELL	Focus on occupant well-being, promotes mental and physical health	High cost, limited presence in developing markets

Key Insights:

- LEED is the most widely adopted and flexible, but documentation-heavy.
- BREEAM is comprehensive, focusing on lifecycle sustainability, but costly.
- WELL is revolutionary in health-oriented design but expensive and niche-focused.

Future Trends and Improvements

Future Developments in LEED, BREEAM, and WELL

- **Net-Zero Carbon Certification:** Newer versions of LEED and BREEAM will prioritize net-zero carbon frameworks to address climate change.
- **AI and Smart Technologies:** Future certifications may integrate IoT sensors and AI-driven monitoring systems for real-time energy and health tracking.
- **Climate Adaptation Strategies:** LEED and BREEAM are adopting resilience-based scoring to assess extreme weather resistance and disaster preparedness.
- **Hybrid Certification Models:** The merging of LEED, BREEAM, and WELL frameworks may create comprehensive green building standards incorporating both sustainability and health factors.

Conclusion

The comparison of LEED, BREEAM, and WELL reveals that each certification system serves different sustainability and health priorities. While LEED is the most globally recognized, BREEAM provides in-depth lifecycle assessment, and WELL redefines human-centric design.

Future certification models must:

- Enhance real-world building performance
- Incorporate smart technology and real-time monitoring
- Improve accessibility for developing regions

A combined approach integrating LEED's energy focus, BREEAM's lifecycle sustainability, and WELL's health-based metrics could represent the future of green building certifications.

Future Trends in Green Building Certifications

As the global construction industry moves towards a more sustainable and resilient future, green building certifications must evolve to address climate change, digital transformation, health concerns, and resource efficiency. The next generation of LEED, BREEAM, and WELL certifications is expected to incorporate stricter environmental benchmarks, smart technologies, and circular economy principles to meet the increasing demands for sustainable urban development.

This section explores key future trends in green building certifications, including net-zero carbon targets, AI-driven monitoring, hybrid certification models, and advanced material reuse strategies.

Integration of Net-Zero Carbon and Climate Resilience Metrics

Net-Zero Carbon Commitments in Certifications

With governments and corporations committing to net-zero carbon goals by 2050, green building certifications must integrate stricter carbon assessment frameworks.

Future versions of **LEED and** BREEAM will likely introduce:

- **Operational and Embodied Carbon Tracking:** Expanding Life Cycle Assessments (LCA) to measure total carbon emissions from construction to demolition.
- **Renewable Energy Benchmarks:** Encouraging buildings to generate on-site renewable energy to achieve carbon neutrality.
- **Carbon Credit Incentives:** Promoting offset programs where buildings can invest in reforestation, carbon capture, and clean energy projects to compensate for emissions.

Table 1: Carbon Reduction Strategies in Future Certifications

Carbon Metric	Current Status	Future Integration in LEED & BREEAM
Operational Carbon	Energy efficiency requirements	Mandating net-zero operational energy
Embodied Carbon	Limited consideration	Full Life Cycle Carbon Analysis (LCA)
Renewable Energy	Optional points	Minimum on-site generation required
Carbon Offsetting	Not mandatory	Incentivized for full carbon neutrality

Climate Resilience in Certifications

As climate-related disasters (heatwaves, floods, hurricanes) become more frequent, building resilience will be a major criterion in future certifications.

- **Climate-Adaptive Building Design:** Requiring storm-resistant materials, flood-proof infrastructure, and passive cooling strategies.
- **Heat Resilience and Air Quality:** Integrating WELL-based indoor health metrics into LEED and BREEAM to address heat stress and air pollution.
- **Resilient Urban Planning:** Encouraging green roofs, permeable pavements, and biodiversity integration to counteract urban heat islands.

AI, IoT and Real-Time Building Monitoring

The next frontier in green certifications will leverage Artificial Intelligence (AI), Internet of Things (IoT), and Building Information Modeling (BIM) to:

- **Automate Energy Performance Tracking:** AI-driven analytics will continuously monitor HVAC efficiency, solar

energy generation, and water consumption.

- **Optimize Predictive Maintenance:** IoT sensors will detect faulty insulation, ventilation failures, and system inefficiencies, preventing waste and overconsumption.
- **Replace Manual Documentation:** AI-powered compliance tools will automatically update certification reports in real-time.

Table 2: AI and IoT Integration in Future Green Building Certifications

Technology	Current Use in Certifications	Future Potential
AI-based energy analytics	Limited	Real-time optimization of heating, cooling, and lighting
IoT sensors	Optional monitoring	Automated water, air, and temperature control
BIM (Building Information Modeling)	Design phase only	Continuous performance tracking from construction to operation

Convergence of Sustainability and Health Standards Towards a Hybrid Certification Model

As green building standards advance, LEED, BREEAM, and WELL may merge into an integrated model that evaluates both environmental sustainability and human well-being. Future hybrid certifications will:

- Combine energy efficiency (LEED), lifecycle sustainability (BREEAM), and occupant wellness (WELL).

Table 3: Key Features of Future Hybrid Certification Systems

Aspect	LEED	BREEAM	WELL	Future Hybrid Model
Energy Efficiency	✔ Strong	✔ Strong	✘ Limited	✔ Integrated
Lifecycle Sustainability	✘ Partial	✔ Strong	✘ None	✔ Combined
Occupant Well-being	✘ Partial	✘ Limited	✔ Strong	✔ Comprehensive

Conclusion

LEED, BREEAM, and WELL have transformed the green building industry, but emerging challenges require them to adapt to future needs [14-37].

The Next Generation of Green Certifications will require:

- **Net-Zero Carbon Standards:** Mandatory operational and embodied carbon tracking.
- **AI and Digital Twin Technology:** Automated performance monitoring and optimization.
- **Climate Resilience Frameworks:** Buildings designed to withstand extreme weather
- **Circular Economy & Material Passports:** Resource efficiency and full lifecycle tracking.
- **Integrated Health and Sustainability Metrics**: A hybrid certification model merging LEED, BREEAM, and WELL.

These advancements will ensure that green building certifications remain relevant, impactful, and future-proof.

Declarations

The datasets used during the current study are available from the corresponding author on request.

Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

There is no funding.

References

1. Allen JG, McNaughton P, Satish U, Santanam S, Vallarino J, et al. (2016) Associations of cognitive function scores with carbon dioxide, ventilation, and volatile organic compound exposures in office workers: a controlled exposure study of green and conventional office environments. Environ Health Perspect 124: 805-812.
2. Grace Ding KC (2008) Sustainable construction - The role of environmental assessment tools. Journal of Environmental Management 86: 451-464.
3. (2021) Global status report for buildings and construction 2021. International Energy Agency (IEA) https://www.iea.org/reports/global-status-report-for-buildings-and-construction-2021.
4. (2023) Advancing net zero: Global action for a decarbonized built environment. World Green Building Council (WGBC) https://worldgbc.org/.
5. (2023) LEED v4.1 overview. US. Green Building Council (USGBC) https://www.usgbc.org/.
6. Newsham GR, Mancini S, Birt BJ (2013) Do LEED-certified buildings save energy? Yes, but… Energy and Buildings 41: 897-905.
7. (2023) BREEAM technical standards. Building Research Establishment. BRE https://breeam.com/.
8. (2023) WELL Building Standard v2. International WELL Building Institute (IWBI) https://www.wellcertified.com/.
9. Patterson S, Mathews M (2021) The economics of WELL certification: Costs and benefits in sustainable building design. Journal of Green Building 16: 35-50.
10. Dwaikat LN, Ali KN (2016) Green buildings cost premium: A review of empirical evidence. Energy and Buildings 110: 396-403.
11. Wang C, Liu Y, Zhang R (2022) Smart technologies and artificial intelligence in green building certifications. Smart and Sustainable Cities 10: 210-229.
12. Cochran T, Gellings CW (2020) Resilient buildings for climate adaptation: Challenges and solutions. Energy Policy Journal 142: 111234.
13. Turner C, Frankel M (2008) Energy performance of LEED for new construction buildings. New Buildings Institute Report https://newbuildings.org/.
14. Garcia D, Rubio-Bellido C, Carrasco-Torres J (2021) Impact of artificial intelligence on energy efficiency in smart buildings: A systematic review. Renewable and Sustainable Energy Reviews 143: 110895.
15. O'Brien W, Gaetani I, Gilani S, Carlucci S, Hoes P, et al. (2017) International survey on current occupant modeling approaches in building performance simulation. Journal of Building Performance Simulation 10: 653-671.
16. Pomponi F, Moncaster A, De Wolf C (2018) Whole life carbon assessment in the built environment: A systematic literature review. Energy and Buildings 161: 72-85.

17. Pucker KP (2021) The myth of sustainable fashion: Circular economy challenges in the construction industry. Harvard Business Review 99: 12-19.
18. Rodríguez C, Garcia S (2022) Smart cities and AI-driven building certification: A framework for sustainability assessment. Smart Cities 5: 89-104.
19. Zhou J, Wu Y, Ma M (2020) The role of circular economy principles in green building certifications: A meta-analysis. Renewable and Sustainable Energy Reviews 132: 110122.
20. Azari R, Abbasabadi N (2018) Embodied energy of buildings: A review of data, methods, challenges, and research trends. Energy and Buildings 168: 225-235.
21. Alyami SH, Rezgui Y, Kwan A (2015) Developing sustainable building assessment scheme for Saudi Arabia: Delphi consultation approach. Renewable and Sustainable Energy Reviews 43: 850-863.
22. Atanda J, Olukoya OA (2019) Green building standards: Opportunities for integration in developing countries. Journal of Cleaner Production 227: 366-378.
23. Bocchini P, Frangopol DM, Ummenhofer T, Zinke T (2014) Resilience and sustainability of the civil infrastructure: Towards a unified approach. Journal of Infrastructure Systems 20: 1-16.
24. Darko A, Zhang C, Chan APC (2017) Drivers for green building: A review of empirical studies. Habitat International 60: 34-49.
25. Ding Z, Zhang F, Wang J (2018) Sustainability assessment of green building certification systems: A comparative analysis. Sustainable Cities and Society 39: 774-782.
26. Ghaffarianhoseini A, AlWaer H, Omrany H, Ghaffarianhoseini A, Tookey J, et al. (2018) Sick building syndrome: Are we doing enough? Architectural Science Review 61: 99-121.
27. Hussain A, Malik A (2020) Comparative analysis of LEED and BREEAM for sustainable building design. Building and Environment 168: 106505.
28. Pacheco-Torgal F, Cabeza LF, Labrincha J, De Magalhaes A (2014) Eco-efficient construction and building materials: Review on life cycle assessment (LCA) and environmental impacts. Construction and Building Materials 50: 29-50.
29. Rana S, Bhattacharya P (2021) Net-zero energy buildings: A review of literature and future directions. Energy and Buildings 230: 110538.
30. Shad R, Khorrami M, Taleghani M (2020) Integration of WELL and LEED for enhanced sustainability and occupant health. Sustainable Development 28: 458-474.
31. Alwan Z, Jones P, Holgate P (2017) Strategic sustainable development in the UK construction sector: The role of green building certification. Energy Policy 109: 81-90.
32. Ardente F, Beccali G, Cellura M, Mistretta M (2011) Energy and environmental benefits in public buildings as a result of retrofit actions. Renewable and Sustainable Energy Reviews 15: 460-470.
33. Berardi U (2012) Sustainability assessment in the built environment: Integrating environmental, social, and economic performance. Building and Environment 52: 252-260.
34. Hakkinen T, Belloni K (2011) Barriers and drivers for sustainable building. Building Research & Information 39: 239-255.
35. Matisoff DC, Noonan DS, O'Rear EA (2016) Green buildings: Economics and policies. Review of Environmental Economics and Policy 10: 329-346.
36. Pérez-Lombard L, Ortiz J, Pout C (2008) A review on buildings' energy consumption information. Energy and Buildings 40: 394-398.
37. Wilkinson SJ, Remoy H (2018) Sustainability and the future of the commercial property sector. Journal of Property Investment & Finance 36: 284-296.