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Evaluating Decision Bias in Green Building Rating Systems: Evidence from Malaysia

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Abstract

The construction sector faces increasing pressure to demonstrate sustainability, with Green Building Rating Systems (GBRSs) increasingly functioning as decision-support tools that influence design prioritization, investment decisions, and certification outcomes. Sustainability in the built environment is commonly understood as the balanced consideration of environmental protection, economic viability, and social equity. However, limited empirical attention has been given to whether credit weighting structures in the rating systems reflect the balance in shaping sustainability decision priorities. This study examines whether GBRSs embed imbalanced decision logics that privilege specific sustainability dimensions over others. Using content analysis of technical manuals and normalized scoring of credit weightings, Malaysian GBRSs of Green Building Index (GBI), GreenRE, and MyCREST are compared with the international Leadership in Energy and Environmental Design (LEED) tool. Credit allocations are mapped across environmental, economic, and social pillars to examine their relative emphasis. The results reveal a pronounced environmental criteria dominance (61–85%), alongside modest attention to social aspects (11–28%) and minimal representation of economic considerations (0–5%). The findings indicate that current GBRSs embed implicit decision biases that systematically prioritize environmental performance while underrepresenting economic viability and social outcomes. By revealing how sustainability assessment frameworks structure decision priorities through credit weighting mechanisms, this study contributes to a more critical understanding of how GBRSs influence sustainability decision-making.

1 Introduction

In the pursuit of sustainable built environment, sustainability is commonly defined as the balanced integration of environmental protection, economic feasibility and social equity [1, 2]. Translating the multidimensional objectives into construction practices requires structured decision-support mechanisms to guide project-level sustainability decisions. In construction sector, Green Building Rating Systems (GBRSs) have become widely adopted sustainability assessment tools used to inform and structure sustainability decisions by evaluating, prioritizing and incentivizing sustainable construction practices [3, 4].

The trend is evident in Malaysia, where more than ten GBRSs are currently in use, including nationally developed tools such as Green Building Index (GBI), GreenRE, PHJKR, and MyCREST, alongside international systems such as LEED and GreenMark [5, 6]. Although the diversity provides developers multiple pathways for sustainability assessment, it also creates a fragmented landscape. Variations in assessment criteria, weighting structures, and lifecycle coverage make it difficult to evaluate sustainability performance consistently [7, 8]. As a result, sustainability decisions are guided by different decision logics and complicate comparisons between projects and stakeholders.

Moreover, as most GBRSs are voluntary basis, the presence of multiple GBRSs with varied assessment rigor raise concerns regarding the consistency of sustainability evaluation. Rather than functioning as neutral assessment tools, GBRSs may inadvertently shape sustainability decisions by privileging certain performance dimensions over others [9, 10]. When certification outcomes are driven by selective credits within particular GBRS structures, the process risks becoming a search for symbolic compliance rather than a commitment to balanced sustainability performance [11, 12]. The variability reduces the credibility of certification outcomes,

contributing to persistent uncertainty regarding the role and value of GBRSs in guiding sustainability decisions, as reflected in Malaysia's low green building certification rate of less than 5% [13, 14].

To address inconsistencies in sustainability evaluation, a structured and balanced assessment framework is required. The Triple Bottom Line (TBL) framework provides such a structure by explicitly organizing sustainability evaluation around environmental, economic, and social dimensions [15, 16]. Compared to expanded frameworks such as the P5 ontology or Quintuple Bottom Line which introduce additional dimensions including governance and process, TBL remains the most widely adopted benchmark for existing GBRSs [7]. The focus on balance makes TBL an ideal lens for examining whether current assessment tools reflect holistic sustainability priorities. Furthermore, the TBL framework aligns with Malaysia's national development policies, including the Thirteenth Malaysia Plan (13MP) and the Green Technology Master Plan (GTMP) 2017–2030. Both policy frame sustainability as a multidimensional objective that integrates economic growth, social equity, and environmental stewardship.

Despite the growing number of GBRSs in Malaysia, there remains limited empirical understanding of how these GBRSs structure sustainability decision priorities across environmental, economic, and social dimensions. While international studies have shown that GBRSs often emphasize environmental performance at the expense of economic viability and social outcomes [17–19], it remains unclear whether similar decision biases are embedded within Malaysian GBRSs. The absence of a TBL-based evaluation limits the ability to assess how well local assessment practices align with Malaysia's broader sustainability vision. Accordingly, this study conducts a comparative analysis of Malaysian GBRSs using the TBL framework to examine how sustainability decision priorities are structured through credit weighting mechanisms.

2 Research background

Early GBRSs were primarily designed as environmental assessment tools that focus on energy efficiency, resource conservation, and pollution reduction [4, 20]. The GBRSs significantly improved the environmental performance of buildings, particularly in reducing energy use and carbon emissions. However, the original scope was narrow as environmental performance alone is insufficient to address the broader challenges of sustainable development [7, 21]. Sustainability extends beyond environmental protection to include economic viability such as lifecycle cost efficiency and affordability as well as social equity that encompasses occupant health, community well-being, and safety conditions [22–24]. Without integrating all three dimensions, sustainability assessments risk promoting buildings are environmentally excellent but economically inaccessible or socially exclusionary.

The conceptual foundation for balanced sustainability was first articulated by the Brundtland Commission which framed sustainable development as the integration of environmental protection with socioeconomic development. Building on the principle, Elkington's Triple Bottom Line (TBL) framework emphasized that sustainability performance must be simultaneously measured across environmental, economic, and social dimensions. The TBL framework makes explicit that progress in one dimension cannot compensate for failures in another, thereby providing a holistic benchmark for evaluating sustainability performance [15]. Hence, TBL has become a widely accepted reference framework for evaluating whether sustainability assessment tools reflect integrated sustainability objectives or selective interpretations.

Despite widespread acceptance of sustainability as TBL balanced concept, the evolution of GBRSs has been uneven. As sustainability gained global prominence, hundreds of GBRSs now operating across different regions and project contexts. Prominent systems such as LEED, BREEAM, and CASBEE have been localized to reflect specific climate conditions, regulatory environments, and development priorities [25, 26]. While the proliferation increased the availability of sustainability assessment tools, it has also resulted in a fragmented assessment landscape characterized by divergent criteria, weighting structures, and certification approaches. The heterogeneity limits comparability across GBRSs and raises questions about how sustainability priorities are embedded within their assessment design [8, 27].

Beyond the role as assessment tools, GBRSs also function as structured decision-support tools [11, 28, 29]. Within GBRSs, sustainability criteria act as proxies for decision priorities by signaling the relative importance of sustainability issues and shaping sustainability decisions. Criteria weightings are intentionally differentiated to reflect local challenges [12, 18]. For example, GBI (Malaysia). GreenRE (Malaysia) and Green Mark (Singapore) place greater emphasis on energy efficiency to address local tropical climates and cooling demand, while GREENSHIP (Indonesia) assign higher weight to water conservation due to local water scarcity problems [5, 30]. At the project level, the weighted criteria guide targeted intervention by directing design effort and financial investment toward areas that yield higher certification value [31]. As a result, sustainability criteria do not just evaluate sustainability performance but actively influence how sustainability trade-offs are interpreted in practice.

While GBRSs are intended to be holistic, empirical evidence suggests that they often operate as proxies specifically for environmental priorities. Comparative studies of GBRSs consistently report that environmental criteria dominate credit allocations at an average of 65% of total weightings [7, 17, 20]. As summarized in Table 1, economic criteria are frequently allocated less than 5% of total credits, while social dimensions are often allocated around 20% and confined to narrow aspect of indoor environmental quality [19, 29]. The imbalance indicates a disconnect between the theoretical intent of TBL and the practical design of rating systems.

The TBL imbalance is particularly critical in developing countries, where economic resilience and social equity are important sustainability concerns [8, 32]. However, most comparative studies largely focused on GBRSs in developed countries, with limited attention given to GBRSs in Southeast Asia. Specifically, Malaysian GBRSs have only been sporadically included in international comparisons [7, 20], making Malaysia an important context for investigating how GBRS design logic reflects sustainability balance through credit weighting mechanisms. Since the launch of GBI in 2009, Malaysia's GBRSs landscape has grown complex with multiple systems emphasizing different priorities [5, 33]. While national development policies like the 13th Malaysia Plan and Green Technology Master Plan advocate for a TBL balanced vision, it remains unclear whether local GBRSs reflect the multidimensional objective in assessment design.

Against the background, there is a clear need for systematic evaluation of Malaysian GBRSs to examine how sustainability decision priorities are structured through credit weighting mechanisms. Addressing the gap is critical to determine whether Malaysian GBRSs replicate global trend of environmental dominance or show progress toward more TBL balanced sustainability assessment. By analyzing the decision logics, the comparative analysis informs the future development of sustainability assessment frameworks that better align with Malaysia's holistic sustainability goals.

Table 1
Comparative GBRSs studies

Reference	Number of GBRSs studied	Specific GBRSs	Included Malaysian GBRSs	Average environmental dimension (%)	Average economic dimension (%)	Average social dimension (%)	Average others dimension (%)
[29]	4	LEED, BREEAM, GSAS, and Estidama	No	80.4	2.5	13	4.1
[12]	4	LEED, BREEAM, CASBEE, and Green Star NZ	No	80.2	0.5	9.2	10.1
[20]	8	LEED, BREEAM, Green Star, GBI, Green Mark, BEAM Plus, IGBC rating, CASBEE	Yes (GBI)	66.5	0.4	19.3	13.8
[18]	10	Green Globes, LEED USA, BREEAM, DGNB system, GRIHA, IGBC system, BEAM Plus, Green Mark, CASBEE, Green Star	No	63.8	7.6	23.2	5.4
[19]	10	LEED, BREEAM, GM, BEAM, ASGB, CASBEE, DGNB, HQE, EEWH, GS	No	56.4	6.5	39.5	0

Reference	Number of GBRSs studied	Specific GBRSs	Included Malaysian GBRSs	Average environmental dimension (%)	Average economic dimension (%)	Average social dimension (%)	Average others dimension (%)
[7]	5	BREEAM, LEED, DGNB, Green Star, GBI	Yes (GBI)	41.6	24.1	16.6	17.7
[17]	8	BREEAM, LEED, CASBEE, Green Star, Green Globes, DGNB, VERDE, Level(s)	No	68.3	6	25.7	-
[27]	3	LOTUS, LEED, Green Mark	No	69.8	3.2	27	-

3 Research Methodology

This study adopts a comparative analytical approach that integrates qualitative content analysis with quantitative assessment of credit weightings to examine how sustainability decision priorities are structured within GBRSs. The methodological design is based on the understanding that GBRSs function as formalized decision-support tools, where criteria weightage signals the relative importance of sustainability objectives. As such, criteria weightage is the operational representation of embedded decision priorities within sustainability assessment frameworks. By examining how criteria weightage is distributed across sustainability dimensions, this approach reveals whether GBRSs prioritize certain dimensions over others.

3.1 Selection of Rating Systems

The selection of GBRSs follows the methodologies established by Doan et al. [27] and Luangcharoenrat & Intrachooto [30] because both studies provide well-established procedures for systematic GBRSs comparison. The approaches were selected because they explicitly emphasize transparent GBRSs selection, reliance on publicly available technical documentation, and the use of quantifiable scoring structures to enable cross-GBRSs comparison. Importantly, both studies treat GBRS criteria weightage as indicators of relative sustainability emphasis, allowing consistent evaluation of balance across environmental, economic, and social dimensions.

Building on the methodological precedents, the selection of GBRSs in this study was guided by three criteria to ensure analytical comparability and validity:

1. Relevance: To ensure consistency in assessment scope, the latest technical manuals for new non-residential buildings were selected from each GBRSs. This building type represents approximately 28% in the Malaysian construction sector and is consistently covered by all selected rating systems.
2. Availability: Only GBRSs with complete and publicly accessible technical manuals, reference guides, and scoring documentation were included to ensure transparency and replicability of the analysis.
3. Measurability: Each selected GBRS employs a point-based scoring system that allows quantifiable comparison of sustainability emphasis across systems.

Based on the criteria, four GBRSs were selected. Three nationally developed Malaysian GBRSs of Green Building Index (GBI), GreenRE, and the Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST) were included. Other Malaysian GBRSs were excluded due to the absence of publicly available technical documentation. Additionally, the Leadership in Energy and Environmental Design (LEED) was included as international benchmark. LEED is widely recognized as a global standard and has served as the foundational reference for the development of many national rating tools [20, 34]. Thus, inclusion of LEED provides an external reference point for evaluating the relative positioning of Malaysian GBRSs against established international assessment practices. A summary of the selected GBRS and their characteristics is presented in Table 2.

Table 2
Characteristics of the selected GBRSs

GBRSs	Year of Inception	Developing Organization	Country of origin	Specific Document Analyzed
Green Building Index (GBI)	2009	Malaysian Institute of Architects (PAM) & Association of Consulting Engineers Malaysia (ACEM)	Malaysia	Non-Residential New Construction (NRNC) v1.0
GreenRE)	2013	Real Estate and Housing Development Association (REHDA)	Malaysia	Non-Residential Buildings (NRB) rating tool v3.2
Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST)	2016	Construction Industry Development Board (CIDB) and the Public Works Department (PWD)	Malaysia	Design and Construction Stage v2.0
Leadership in Energy and Environmental Design (LEED)	1998	U.S. Green Building Council (USGBC)	USA	Building Design and Construction: New Construction v4.1

3.2 Development of Analytical Framework

To ensure consistent comparison, a unified analytical framework was developed following established approaches from Doan et al. [27], Illankoon et al. [20] and Varma and Palaniappan [18]. As shown in Fig. 1, the framework consists of two sequential stages of category-level comparison and Triple Bottom Line (TBL) dimension mapping. The stages enable examination of both sustainability focus and higher-level decision priority structures embedded within GBRSs.

Stage 1: Category-Level Weighting Analysis

In the first stage, each GBRS technical manual was examined at the category level to cover major assessment areas such as Energy, Water, Materials, and Indoor Environmental Quality. This stage captures how sustainability themes are organized and emphasized within each rating system. As the selected GBRSs differ in total credits, direct comparison of raw category scores is not meaningful. Therefore, category scores were normalized by dividing the credit allocation of each category by the total maximum points of the respective GBRS and multiplying by 100. The normalization process converts all GBRSs to a common 100-points scale, allowing comparison of relative emphasis rather than absolute number of available credits. The normalization is calculated using Eqs. (1):

$$\text{Normalized weighting (\%)} = \left(\frac{\text{Category credit points}}{\text{Total GBRSs credit}}\right) \text{x } 100 \qquad (1)$$

This step enables identification of how strongly different sustainability themes are prioritized within each GBRS and provides an initial indication of potential imbalance in sustainability emphasis.

Stage 2: TBL Dimension-Level Mapping

The second stage examines sustainability decision priorities at the level of sustainability dimensions by mapping all credits assigned to criteria onto the environmental, economic, and social dimensions. Criteria were classified using a rule-based content analysis approach, guided by the intent and functional objective of each credit as described in the technical manuals. For example, criteria addressing energy efficiency, water conservation, emissions reduction, and resource efficiency were classified under the environmental pillar. Likewise, criteria aimed at improving occupant health, comfort, accessibility, or community well-being were categorized as social. Lastly, economic criteria included those explicitly related to lifecycle cost, financial feasibility, value retention, or economic performance considerations.

Once all criteria were classified, the credits assigned to criteria corresponding to each sustainability pillar were aggregated and normalized using the same 100-point standardization approach to derive comparable weightings. Eqs. (2) shows the calculation:

$$\text{Normalized pillar weighting (\%)} = \left(\frac{\text{Sum of credit assigned to pillar}}{\text{Total GBRSs credit}}\right) \text{x } 100 \qquad (2)$$

By treating dimension-level weightings as indicators of embedded decision priorities, the analysis reveals whether sustainability assessment frameworks reflect a balanced interpretation of sustainability or systematically prioritizing certain dimensions over others. Summarily, the two-stage analytical framework enables examination of both thematic sustainability emphasis (category level) and strategic decision prioritization (dimension level). While the analysis does not assess project-level performance outcomes, it provides insight into the intended sustainability priorities embedded in GBRS design. Additionally, normalization facilitates relative comparison of decision emphasis across GBRSs, without implying that the rating systems follow the same assessment approach.

4 Findings and Discussion

4.1 Distribution of Criteria at Category Level

Figure 2 compares the distribution of criteria at category level to reveal differences in how GBRSs structure the sustainability priorities. Across all four GBRSs, energy-related criteria dominate and confirm that energy performance remains the primary driver of sustainability assessment. However, the degree of emphasis varies significantly. GreenRE heavily emphasized energy efficiency in criteria weighting (58.85%), far exceeding GBI (35.00%), MyCREST (37.37%), and LEED (30.00%). The finding indicates that GreenRE conceptualizes sustainability predominantly through an energy performance lens [5]. While such emphasis aligns with Malaysia's priorities on energy conservation and carbon reduction, the concentrated weighting to energy suggests a narrow sustainability focus relative to other GBRSs.

Contrarily, LEED shows the most diversified category structure. Although Energy and Atmosphere remains the largest category (30.00%), LEED also assigns substantial weight to Indoor Environmental Quality (14.55%), Location and Transportation (14.55%) alongside Materials and Resources (11.82%). Importantly, Indoor Environmental Quality is predominantly social in nature, addressing occupant health, comfort, and well-being, while Location and Transportation includes a mix of environmental and social considerations such as public transport accessibility, community connectivity and surrounding density. The distribution indicates that LEED integrates social sustainability considerations into high-weight categories rather than treating them as secondary elements [19].

Malaysian GBRSs show a more compressed category structure, where a small number of categories account for most of the total credits. In GBI, Energy Efficiency, Indoor Environmental Quality, and Sustainable Site Planning and Management collectively account for 72% of total points. GreenRE shows an even stronger concentration, with Energy Efficiency and Environmental Protection alone comprising more than 80% of total weightings. Similarly, MyCREST focuses heavily on Energy Performance Impacts, Infrastructure and Sequestration, and Lowering Embodied Carbon which together exceed 75% of total credits. The concentration suggests that sustainability assessment outcomes in Malaysian GBRSs are driven by a limited set of dominant categories.

Material and embodied carbon criteria is a key point to differentiate between Malaysian GBRSs. MyCREST emphasizes on Lowering Embodied Carbon (17.89%) that supported by explicit lifecycle assessment and sustainable sourcing criteria. In comparison, GreenRE only allocates limited weight to Carbon Emission of Development (1.56%) and Other Green Features (3.65%), while GBI and LEED address materials through more conventional resource efficiency categories. Thus, findings reveal that MyCREST is the only Malaysian GBRS with strong standalone focus on lifecycle carbon impacts, but the priority has yet to be consistently adopted across the national GBRS landscape.

Social criteria are unevenly represented and remain secondary across Malaysian GBRSs. GBI assigns the highest weighting to social considerations through Indoor Environmental Quality (21.00%), with additional minor social elements embedded within Sustainable Site Planning and Management. In contrast, GreenRE allocates only 4.17% to Indoor Environmental Quality, indicating minimal emphasis on occupant health and well-being. MyCREST distributes social considerations across several categories, including Occupant and Health (5.26%) and Social and Cultural Sustainability (3.68%), with additional minor elements embedded in Pre-Design and Infrastructure and Sequestration. However, the combined contribution of the social categories

remains below 9%, indicating that social sustainability is treated as supplementary rather than an integral dimension [22].

Furthermore, all four GBRSs include innovation categories to encourage strategies beyond standard assessment criteria. LEED incorporates Innovation (5.45%) and Regional Priority (3.64%), while MyCREST includes Pre-Design, Demolition and Disposal Factors, and Sustainable Low Carbon Initiatives to extend assessment across the building lifecycle. Although the categories support flexibility and innovation, their relatively low weightings indicate their role as “bonuses” role rather than drivers that shape core sustainability outcomes.

Succinctly, the category-level analysis shows that Malaysian GBRSs remain heavily oriented toward energy and site-related environmental criteria, with limited diversification into social and lifecycle categories. On the other hand, LEED embeds social considerations with higher weightage provision, reflecting a broader interpretation of social sustainability at the assessment level. The structural differences serve as a signal to decision-makers that they do not just change how a building is scored, but also implicitly define what sustainability means in practice.

4.2 Distribution of Criteria at TBL Dimension Level

Figure 3 presents the normalized distribution of credits across the environmental, economic, and social dimensions of sustainability for the four selected GBRSs. The results reveal systematic imbalance in how sustainability decision priorities are structured, with environmental considerations dominating across all rating systems. Environmental criteria account for the largest share of total credits in every GBRS, as evidenced by 60.91% in LEED (60.91%), GBI (64.00%), MyCREST (78.42%) and GreenRE (84.90%). This confirms that both Malaysian and international GBRSs continue to conceptualize sustainability primarily through environmental performance indicators such as energy efficiency, water management, emissions reduction, and resource efficiency [4, 18]. While the focus reflects that GBRSs were historically overshadowed by environmental concerns, the disproportionate weight for environment suggests a narrow interpretation of sustainable building.

Economic criteria are consistently marginalized across all GBRSs. GreenRE assigns no credits to economic sustainability (0.00%), while GBI allocates only 1.00% and MyCREST with 3.16%. Despite being the most balanced GBRSs, LEED assigns just 5.45% to economic considerations. This indicates that critical decision-making drivers like lifecycle cost, financial feasibility, and long-term value retention are largely absent as formal decision criteria within GBRSs. Instead, economic outcomes appear to be treated as indirect by-products of environmental or social improvements instead of integral components of sustainability decision-making [29, 39].

Social criteria receive greater emphasis than economic aspects but remain secondary to environmental priorities. LEED (28.18%) and GBI (28.00%) assign relatively higher weight to social sustainability, largely through criteria related to indoor environmental quality, accessibility, and occupants’ well-being. In contrast, MyCREST (14.21%) and GreenRE (11.46%) allocate less weightage to social considerations. Across Malaysian GBRSs, social criteria are present but unevenly distributed and weakly weighted, indicating that social sustainability is incorporated as supplementary component rather than as a core pillar.

All GBRSs also allocate a small proportion of credits to an “Other” category between 3.65% to 7.00%, which typically covers innovation criteria and professional accreditations. For example, GreenRE allocates points under “Green Features & Innovations”, while MyCREST incorporates “MyCREST Facilitator” and “Innovation”. Consistent with prior studies [12, 18, 29],while the criteria support flexibility and continuous improvement, their limited weightings suggest that they only intend to complement the primary sustainability decision priorities.

Overall, the analysis using TBL framework shows that GBRSs’ criteria weighting structures embed specific decision priorities as they are designed to drive environmental optimization rather than holistic sustainability. Although LEED and GBI provide relatively more balanced distributions compared to GreenRE and MyCREST, none of the assessed GBRSs reflect an equitable integration of the three TBL pillars. The findings indicate that current sustainability assessment frameworks guide sustainability decision-making toward environmental optimization while overlook economic and social outcomes. For the Malaysian construction sector, this means that “going green” may come at the expense of addressing the social and economic trade-offs.

4.3 Implications for Sustainability Decision-Making

The analysis from both category and TBL dimension suggests that GBRSs do not function as neutral measurement tools. Instead, GBRSs structure sustainability decision-making through their credit weighting mechanisms. By assigning disproportionate weight to environmental criteria, particularly energy-related performance while marginalizing economic and social considerations, GBRSs implicitly guide project teams to achieve a narrow subset of sustainability objectives. The imbalance weighting distribution significantly impact how sustainability is interpreted, pursued, and valued in practice.

First, the dominance of environmental criteria creates a risk that GBRSs function primarily as environmental assessment tools rather than comprehensive sustainability frameworks. When certification outcomes are driven largely by performance in highly weighted categories such as energy efficiency, projects may achieve high ratings without adequately addressing economic viability or social outcomes, resulting in environmental efficiency accompanied by a “sustainability mask” [29]. The concentration of credits within dominant categories also encourages decision-making driven by credits, where project teams prioritize interventions that maximize certification scores rather than developing holistic sustainability strategies [5, 11]. Over time, the emphasis on score optimization can weaken the credibility of certification outcomes, as certified buildings may not consistently deliver the holistic sustainability benefits implied by their ratings [9].

Second, the strong environmental emphasis embedded in GBRSs limits their applicability in developing countries where economic feasibility and social development are often more immediate priorities [6, 40]. The findings show that economic sustainability receives minimal weighting across all assessed GBRSs, providing weak decision signals related to lifecycle cost, operational savings, and long-term asset value. As a result, GBRSs may fail to align with local development priorities, where sustainability decisions are closely tied to affordability, return on investment, and economic resilience. The imbalance reinforces the common perception that sustainable buildings are costly premium products rather than viable investments [41]. Without clear criteria for financial viability, stakeholders often struggle to justify the incremental costs of sustainable technologies to investors [42, 43]. In Malaysia’s construction market, this likely explains the cautious adotion with GBRSs, as current assessment frameworks provide limited guidance on how sustainability strategies contribute to long-term economic performance.

Third, by privileging environmental performance, decision-making in GBRSs may also inadvertently sideline social sustainability. Although GBRSs incorporate social criteria, the aspects are often narrowly defined. Broader social sustainability concerns such as inclusivity, accessibility, stakeholder engagement, and community well-being receive limited attention within assessment structures [43–45]. The marginalization leads to sustainability decisions that are energy-efficient but do not meaningfully improve quality of life, productivity, or social acceptance. Moreover, neglecting social feasibility can increase the likelihood of resistance, conflict, or public opposition, which ultimately compromises the social license to execute sustainable building projects [1, 46].

In short, GBRSs credit weighting are critical decision signals that shape how sustainability is interpreted in practice. By prioritizing environmental performance at the expense of economic and social outcomes, GBRSs guide project teams toward certification-oriented optimization rather than balanced sustainability decision-making. The resulting dynamics of symbolic compliance, limited relevance in cost-sensitive contexts, and marginalization of social considerations are not necessarily due to a lack of commitment from stakeholders, but the embedded priorities of assessment frameworks themselves. If GBRSs frameworks continue to signal narrow sustainability objectives, they risk losing their effectiveness as decision-support tools, particularly in developing like Malaysia where economic and social resilience are inseparable from environmental progress.

4.4 Implications for GBRS Development and Policy Alignment

The findings highlight that current GBRSs criteria weighting structures do not fully reflect the balanced intent of TBL framework or Malaysia's national development objectives. While the GBRS are effective at driving environmental performance, the underrepresentation of economic and social criteria limits their utility as holistic decision-support tools. Consequently, GBRSs currently function more as checklists for environmental optimization rather than frameworks for navigating the complex trade-offs between people, planet, and profit.

From GBRS development standpoint, there is an urgent need to recalibrate criteria weightings to better integrate economic and social considerations [47, 48]. Strengthening the economic pillar does not imply converting GBRSs into financial appraisal tools, but rather making cost efficiency, operational performance, and long-term value more visible and rewarded within assessment criteria. Similarly, social sustainability could be expanded beyond occupant comfort to include inclusivity, accessibility, and broader community outcomes, allowing GBRSs to better reflect real-world sustainability priorities.

At the policy level, the observed imbalance suggests a gap between national sustainability ambitions and their translation into assessment frameworks. Malaysia's development policies emphasize sustainability as a multidimensional objective [5, 14], yet the balance is not consistently embedded in GBRS design logic. Hence, greater policy coordination and guidance could help align GBRS structures with national priorities, reinforcing their role as credible and effective tools for guiding sustainable decision-making in the construction sector [49].

5 Conclusion

Green Building Rating Systems (GBRSs) guide sustainability decisions in the construction sector by translating broad sustainability objectives into assessment criteria. Although the concept of sustainability emphasizes Triple Bottom Line (TBL) as balanced consideration of environmental, economic, and social dimensions, there

is limited empirical evidence on whether GBRS criteria structures reflect the balance in practice, particularly in Malaysian contexts where multiple GBRS coexist. To address the gap, this study conducted a comparative analysis of three Malaysian GBRSs of GBI, GreenRE, and MyCREST against the international LEED. Using qualitative content analysis and quantitative normalization of credit weightings, the study examined sustainability priorities at both the category and TBL dimension levels, treating criteria weightings as indicators of embedded decision priorities that drive sustainability decisions.

The findings reveal a pronounced imbalance across all assessed GBRSs. Environmental criteria dominate by accounting between 60% and 85% of total weightings, with energy performance consistently receiving the highest emphasis. Social sustainability remains a secondary concern, while economic sustainability is largely sidelined with less than 6% of allocation in any GBRSs. Although LEED shows relatively stronger integration of social considerations, none of the assessed GBRS achieves a balanced representation of the three TBL dimensions.

The imbalances have important implications for sustainability decision-making. By disproportionately prioritizing environmental performance and weakly embedding economic and social considerations, GBRSs implicitly guide project teams toward optimizing certification outcomes rather than evaluating sustainability trade-offs holistically. The limited visibility of economic criteria weakens decision signals that developers need to justify lifecycle value and financial viability, which likely explains the hesitant adoption of GBRSs in Malaysia's market. Similarly, fragmented social criteria also constrain the ability of GBRSs to support inclusive and socially responsive development. As a result, GBRSs risk functioning as specialized environmental tools rather than comprehensive decision-support tools.

This study has several limitations. First, the analysis focuses on GBRS design logic as reflected in technical manuals and does not assess project-level sustainability performance outcomes. Second, criteria classification into TBL dimensions relies on stated intent which involves interpretive judgment even though guided by established methodologies. Third, this study examines a limited number of GBRSs and building typologies, which may limit generalizability beyond the selected GBRSs and the Malaysian context.

Future research could extend this work in several directions. Empirical studies examining how GBRS weightings influence actual sustainability decisions would strengthen understanding of decision impacts. Comparative studies across different countries could explore how institutional and policy contexts shape GBRS design logic. Finally, future research could explore decision-support models that better integrate environmental, economic, and social dimensions to support more holistic sustainability decision-making. In conclusion, this study shows that GBRSs actively shape sustainability decision priorities. Recognizing and addressing the embedded imbalances in assessment frameworks is essential for ensuring GBRSs support not only environmental ambition, but also financially viable and socially responsive sustainable development.

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Figures

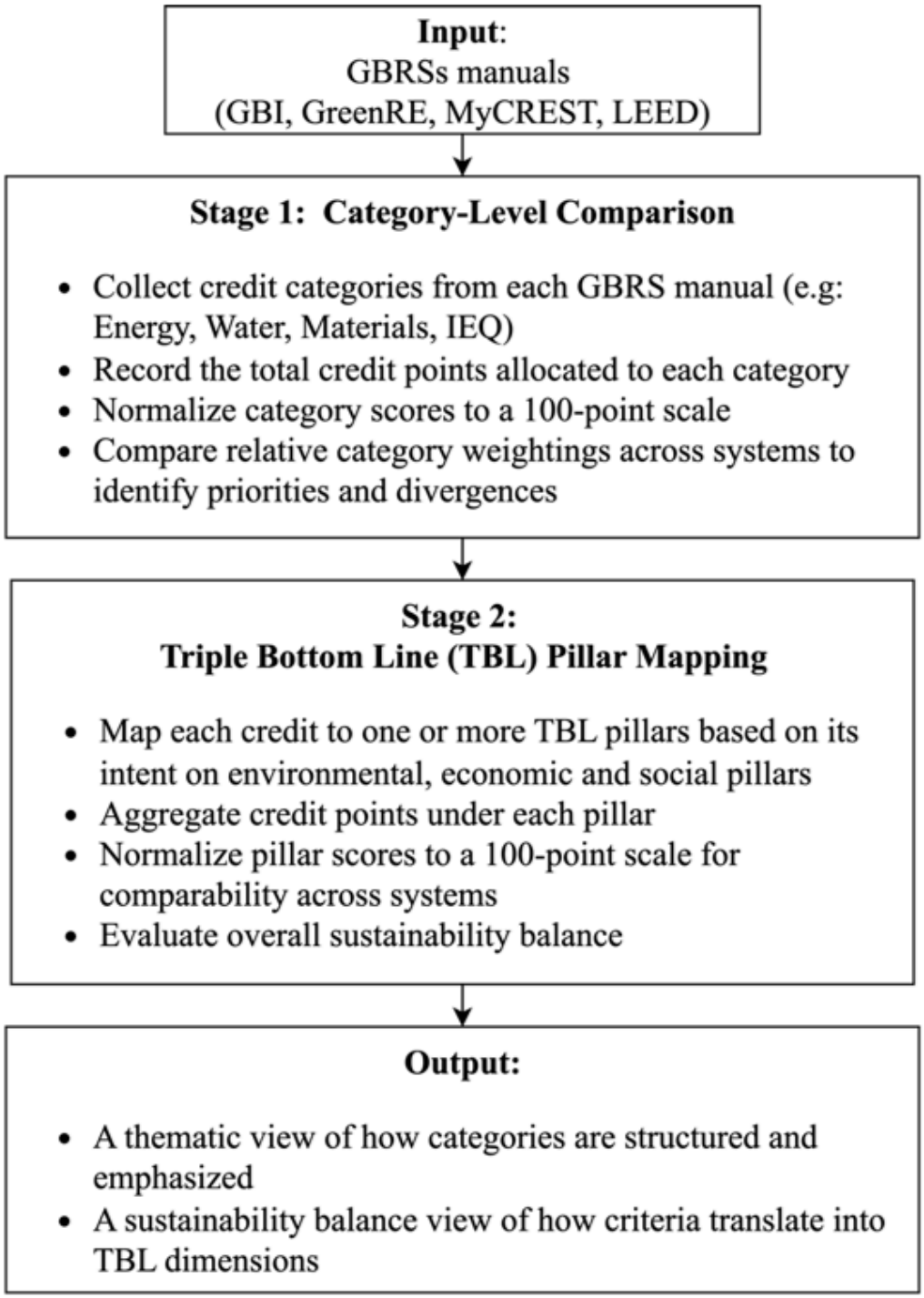


Figure 1

Analysis flowchart for GBRSs comparison

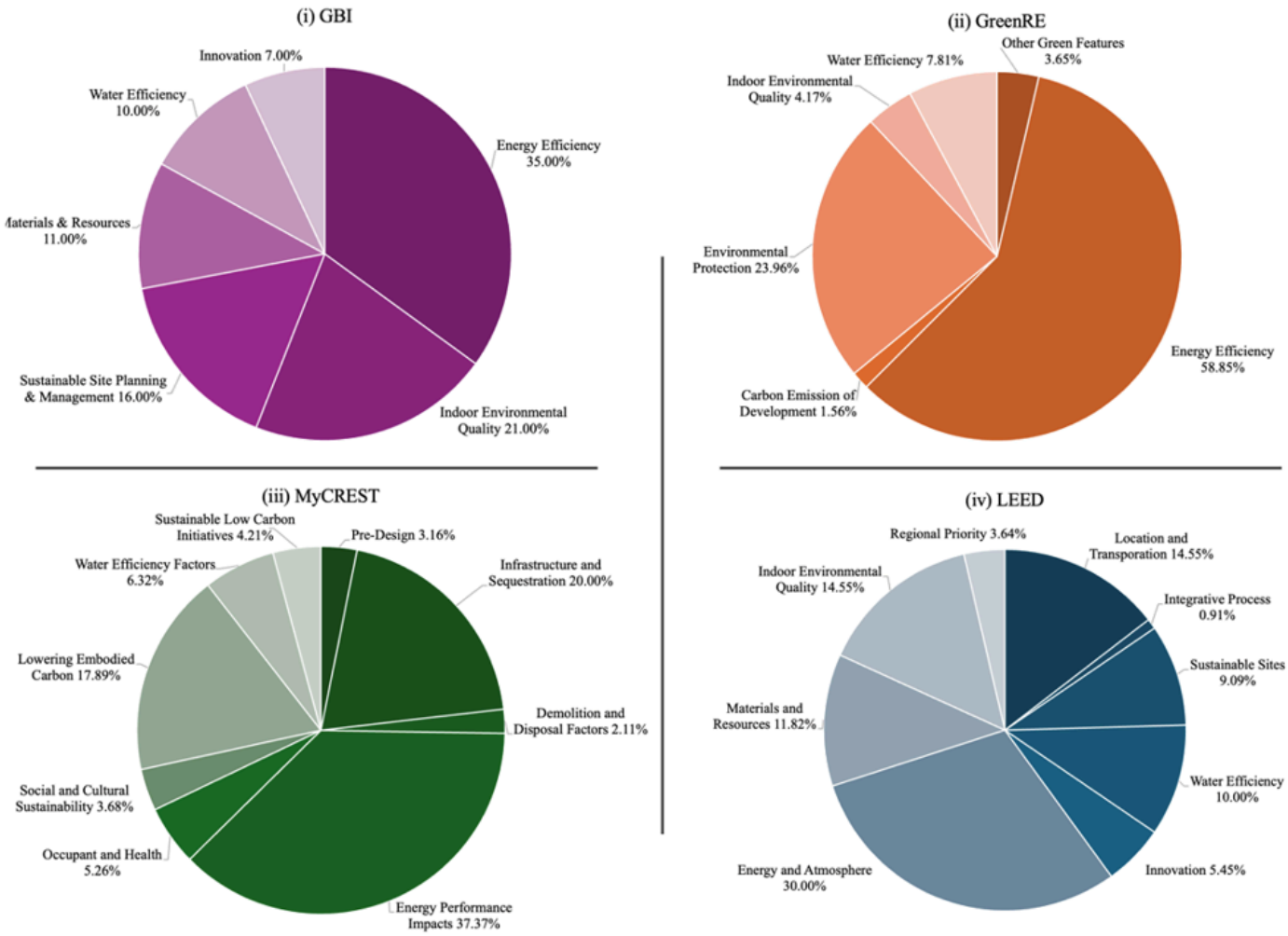


Figure 2

Categories distribution in GBRSs



Figure 3

Comparison of percentage allocation against TBL dimensions