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Green Dreams, Hard Realities: The Hidden Struggles of Operating and Maintaining Green Office Buildings in Malaysia

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Abstract: *The main purpose of Green Buildings (GBs) is to support environmental sustainability and improve occupants' health and well-being. Many GBs fail to achieve their sustainability goals during the operation and maintenance (O&M) phase. The majority of existing studies focus on energy performance but there is limited research about the practical management of GBs especially in the Malaysian context. The study investigates these obstacles to enhance facility management effectiveness and sustainability of Green Office Buildings (GOBs). The main reason that GOBs are targeted is because they represent a key segment of commercial real estate with high operational demands, where the gap between design intentions and actual performance is often most visible.*

The research employed a qualitative method which included semi-structured interviews with eight professionals who work in GOB operations. The participants were chosen through purposive sampling because they managed certified green office buildings under different ownership models such as government, REITs and corporate sectors. The NVivo software was utilised to analyse interview data through thematic analysis.

The research reveals multiple connected problems which affect building performance over time. The tropical climate of Malaysia combined with outdated green technologies results in rising energy consumption and maintenance expenses. The combination of specialized vendor dependency and limited in-house expertise and owner-tenant priority conflicts makes daily operations more complicated. The additional problems include high certification renewal expenses together with inadequate water conservation measures and decreased performance in buildings with low occupancy rates. The observed challenges demonstrate a major discrepancy between the intended certification standards and actual operational practices.

The research provides essential knowledge about the real-world obstacles that facility managers encounter when maintaining green performance after certification. The research demonstrates the necessity for flexible management approaches together with technical capability development and better integration between green building regulations and operational field requirements.

Keywords: Green Office Buildings, Operation and Maintenance, Facilities Management, Issue and Challenges, Malaysia

1.0 INTRODUCTION

The certified Green building (GB) in Malaysia has grown steadily in recent years. The government has supported developers through financial incentives and policy frameworks to adopt sustainable practices in design and construction [1], [2], [3]. Many large corporations are integrating corporate social responsibility (CSR) strategies to demonstrate their environmental sustainability commitment [4]. GBs are now viewed as a strategic instrument for organizations to build their corporate reputation and fulfil stakeholder expectations regarding sustainability [5]. The occupancy of green office buildings (GOB) enables organizations to fulfil their Environmental, Social, and Governance (ESG) targets which are now

essential for businesses worldwide and listed companies in Malaysia is mandated to submit annual ESG report.

Research on GBs has produced mixed findings regarding their performance. Some studies have shown substantial reductions in energy consumption along with enhanced indoor environmental quality[6], [7], [8], [9], but others have revealed major discrepancies between design targets and operational realities [10], [11], [12]. Research indicates that inadequate operation and maintenance (O&M) practices serve as the primary factor behind subpar performance of these buildings throughout their operational lifespan [13], [14], [15]. The success of GB depends heavily on facilities management (FM) to ensure they maintain their expected performance levels after occupancy. The achievement of long-term green development requires identifying O&M challenges so effective solutions can be developed.

2.0 LITERATURE REVIEW

2.1 Green Buildings Statistic in Malaysia

Green Building Index (GBI) and GreenRE are the two most recognised GB certification bodies in Malaysia. As of 1 May 2025, a total of 1,294 buildings or projects had been certified across various categories, including residential, industrial, office, township, and interior certifications. Of these, 822 projects received provisional certification, while 402 obtained final certification. However, only 66 buildings have proceeded with renewal, suggesting a potential disconnect between initial certification and the long-term commitment to sustainable performance. **Table 1** shows the statistic of certified green projects by local green certification bodies.

Table 1. Certified Green Projects by Local Green Certification bodies (compiled by author, based on GBI and GreenRE statistic, 2024, as dated 6 May 2025).

Category	GBI	GreenRE	Total
Registered	1280	936	2216
Certified	741	553	1294
• Provisional	437	385	756
• Final	244	158	357
• Final Planning	4	-	4
• Renewal	56	10	66
Rating			
Platinum	27 (4%)	66 (12%)	
Gold	136 (18%)	123 (22%)	
Silver	91 (12%)	107(19%)	
Certified (GBI) /Bronze (GreenRE)	487(66%)	257 (46%)	

The local green certification body GBI project certification statistics in Malaysia from 2009 to March 2025 is shown in **Figure 1**. The number of registered and certified buildings has shown a steady increase since 2009 (1,280 registered and 741 certified buildings). However, the renewal rate is very low with only 56 projects renewed by March 2025. The large difference between the number of certified and renewed projects indicates that there may be a problem with the sustainability practices of the buildings after they have been certified. Although many buildings seek certification for branding or compliance purposes, many buildings may not continue to meet the standards required for renewal.

The trend indicates that certified buildings may not be operated and maintained in a sustainable manner and suggests that there is a need for stronger post-certification support, incentives or enforcement mechanisms to encourage ongoing performance monitoring and recertification.

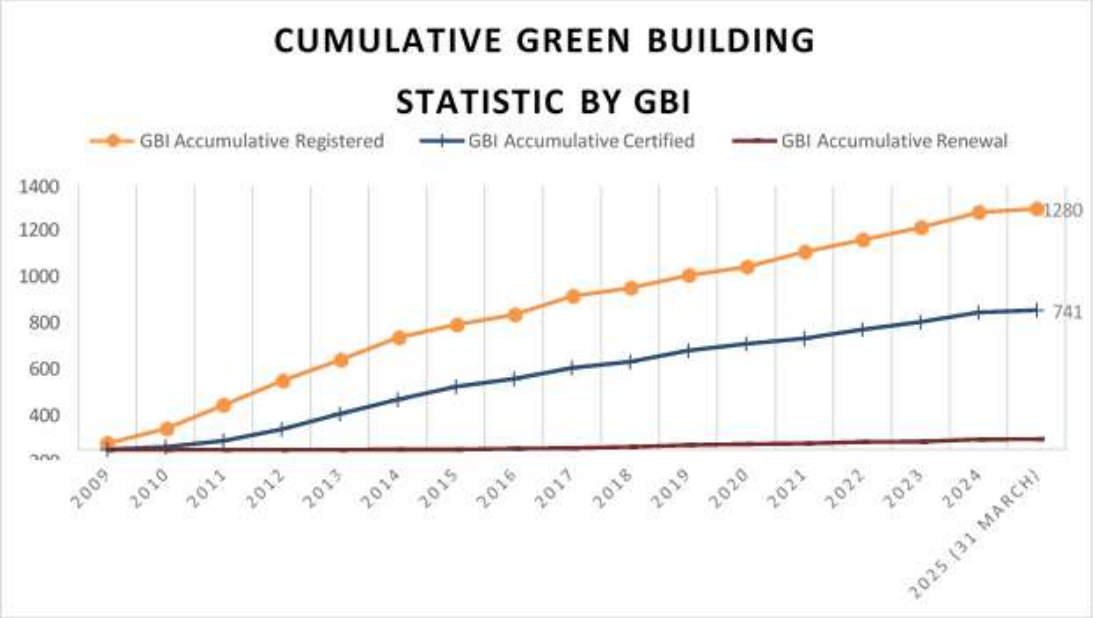

Figure 1 Cumulative Green Building Statistic by GBI

2.2 Definition of Green Office Building

The existing literature discusses green buildings extensively yet researchers have not broadly defined GOBs as a specific category. The existing definitions of GB describe these structures as buildings which reduce environmental impact through energy efficiency and resource conservation and sustainable design practices [16], [17]. The existing definitions lack specific details about operational and functional requirements for office spaces. The distinct sustainability requirements and challenges of GOBs receive insufficient attention in academic and industry discussions.

The research addresses this knowledge gap by establishing a definition for GOBs as "***commercial office facilities which combine environmental sustainability with operational efficiency and occupant well-being through resource optimization and innovative technologies***". The definition combines energy and water efficiency with improved indoor environmental quality (IEQ) and sustainable material implementation to align with broader sustainability goals and evolving FM industry expectations.

2.3 Challenges in Green Building Operations

2.3.1 System Complexity and the Energy Performance Gap

Although GOBs integrate advanced technologies like Building Management System (BMS) and Internet of Things (IoT) systems, many fail to achieve predicted energy savings post-occupancy [18], [19]. Studies reveal significant "performance gaps" between design-stage simulations and actual operational outcomes, often due to improper commissioning, lack of system integration, and reactive maintenance practices [11], [20]. In Malaysia, high cooling loads and mismanaged HVAC systems further impair energy targets [21]. These issues are compounded by low post-occupancy evaluation rates and an absence of real-time feedback systems [22].

2.3.2 Financial Constraints and Lifecycle Oversight

Operating GOBs faces significant economic hurdles. High implementation and maintenance costs for advanced systems like BMS and renewable energy technologies demand substantial investment, straining budgets due to specialized expertise and the need for constant updates [23], [24], [25], [26]. Upfront costs for beneficial preventive maintenance also hinder adoption [27], [28]. Inconsistent government incentives, rarely extending to ongoing O&M, exacerbate these issues [1], [29], [30]. Balancing immediate financial limits with long-term sustainability remains challenging for FM [31], [32]. While solutions like green bonds exist, their use is limited by a lack of awareness and capacity [33], [34], [35].

2.3.3 Behavioural Barriers and Stakeholder Friction

Occupant behaviour directly affects building performance. Research shows that unengaged tenants often override efficiency settings, ignore waste protocols, and misuse energy-saving systems [36], [37]. The problem is intensified by low sustainability awareness and minimal user training [38]. At the management level, GOBs often suffer from stakeholder misalignment—owners prioritise return of investment (ROI), tenants seek comfort, and regulators demand compliance [39], [40]. This divergence makes it difficult to implement coherent O&M strategies or enforce sustainable behaviour across users.

2.3.4 Certification Fatigue and Weak Regulatory Incentives

Green certifications like GBI or GreenRE are voluntary and largely front-loaded. Once a building is certified, there is little institutional pressure to maintain performance [41], [42]. In Malaysia, only a small fraction of GBI buildings renew their status, reflecting a weak post-certification ecosystem. Critics argue that current frameworks encourage checklist-based compliance rather than continuous improvement, risking greenwashing [43], [44]. This undermines credibility and erodes trust among stakeholders.

2.3.5 Workforce Capacity and Training Deficiencies

O&M in GBs demands a highly skilled workforce trained in both conventional FM and emerging green technologies [45], [46]. However, most Malaysian FM personnel lack formal education or upskilling in areas like IoT systems, lifecycle costing, or predictive maintenance [47], [48]. Outsourcing, while common, often results in fragmented knowledge retention and short-term vendor relationships that fail to support long-term sustainability goals [49].

2.3.6 Maintenance Resource and Material Gaps

Access to specialised GB components remains a challenge. Many systems rely on imported parts with long lead times and high replacement costs [24]. In some cases, product obsolescence forces full-system replacements, especially when support is discontinued. Additionally, procurement practices rarely align with green standards, creating bottlenecks in achieving O&M compliance [25], [50].

2.3.7 Lifecycle Misalignment and Operational Blind Spots

A lack of integration between design, construction, and operational teams creates long-term inefficiencies. For instance, design teams may prioritise aesthetics or space use without considering maintainability [22]. Facility managers are often excluded from early planning, resulting in systems that are hard to maintain or incompatible with lifecycle goals [51]. End-of-life management is similarly neglected. Green demolitions, recycling strategies, and material recovery are rarely planned, creating environmental burdens that negate initial sustainability claims [52].

3.0 METHODOLOGY

3.1 Research Design

This study adopted a qualitative exploratory design to investigate the O&M challenges in GOBs in Malaysia. A qualitative approach was chosen to capture the contextual, experiential insights of professionals directly involved in building operations [53], [54].

3.2 Selection of Respondents

The respondent profiles is shown in Table 2. The participants were selected through purposive sampling to ensure relevant expertise in GOB management [53]. The invitations were sent to 20 potential participants, with eight responding and all holding managerial roles. The eligibility required a minimum of three years' experience in managing certified GOBs. To capture diverse perspectives, respondents represented various ownership models (government, corporate, REITs), management approaches (in-house and outsourced), and certification schemes (GBI, LEED, MyCREST, BCA Green Mark). Their roles ranged from Facilities Manager to General Manager, with experience spanning 3 to 25 years.

Table 2. Respondent Profiles

No.	Name of Respondent	Current Position	GOB Certifier	GOB rating	Years of Experience in Building Management	Academic Background	Building Ownership and Type of Management
1	FM 1	Facilities Manager	GBI & LEED	Gold, Gold	5	Bachelor's Degree	REITs ownership Grade A office. Outsource
2	FM 2	Facilities Manager	GBI & LEED	Certified, Gold	3	Bachelor's Degree	REITs ownership Grade A office. Outsource
3	FM 3	Facilities Manager	GBI & LEED	Certified, Gold	15	Bachelor's Degree	REITs ownership Grade A office. Outsource Government office buildin g. Outsource
4	BM 1	Building Manager	GBI MyCREST	Platinum, 5-Star rating	25 years	Diploma	Corporate ownership Grade A office. Outsource
5	BM 2	Building Manager	BCA Green Mark	Gold	10 years	Master Degree	REITs ownership Grade A office.

							Outsource
6	AM 1	Area Manager	GBI	Certified	14 years	Bachelor's Degree	Corporate ownership Grade A office. Outsource
7	AM 2	Asset Manager	LEED	Gold	12 years	Bachelor's Degree	Corporate ownership Grade A office. In-House
8	GM 1	General Manager	GBI	Silver	23 years	Bachelor's Degree	Corporate ownership Grade A office. In-House

Note: Table 2 provides a detailed breakdown of respondent profiles, including their qualifications and building certification status.

3.3 Data Collection Method

Semi-structured interviews were conducted through face-to-face meetings to gather detailed information about GOB operational challenges. The interview method combined structured questions with open-ended opportunities for participants to share their personal experiences [55], [56]. The personal interaction between participants allowed for better rapport development while enabling researchers to detect non-verbal signals which strengthened both the depth and authenticity of collected responses [57]. The interview sessions lasted between 45 to 90 minutes, was audio-recorded with consent, and subsequently transcribed verbatim for analysis.

3.4 Data Analysis

Interview data were analysed using thematic analysis, guided by [58] six-phase framework. The method allowed researchers to identify patterns in the dataset through a systematic process which stayed true to the study's research goals [59]. The analysis started with transcription and familiarisation before moving to initial code development for repeated concepts and issues. The coding process used NVivo software to perform text-based queries and data relationship visualization and categorisation [60]. The tools of word frequency analysis and text search revealed dominant concerns. The thematic structure developed from the review of codes which led to the formation of broader categories. The themes underwent refinement to achieve coherence and consistency before their presentation in the Results section.

4.0 RESULT

The word cloud presents a visual representation of the interview data by showing the most frequently occurring words. The interview participants frequently discussed "building," "maintenance," "cost," "GBI" and "energy" which appear as dominant terms in the word cloud. The operational nature of the discussions becomes evident through the repeated appearance of "electricity," "water," "operation," and "technology." The frequently used terms directed the development of main themes because they

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indicated the areas where participants faced the most difficulties and concerns. The word cloud confirms the thematic results by displaying the essential subjects that emerged from the interview data.

Figure 2 Word cloud generated from NVivo showing the most frequent words mentioned by participants. Note: The size of each word reflects its frequency in the dataset.

The thematic analysis produced fourteen initial themes. The original fourteen themes underwent reorganisation to create five primary thematic clusters for better reporting clarity. The NVivo data showed that the themes were grouped together based on conceptual connections and code frequency. The five main themes listed in **Table 3** contain various sub-themes which represent the specific concerns expressed by participants.

Table 3 Summary of the five main themes and associated sub-themes derived from thematic analysis.

No.	Main Theme	Sub Theme
1.	Operational Efficiency and Resource Management	Energy Efficiency
		Water Efficiency
		Waste Management
		Financial Challenges
2.	Technological and Infrastructure Constraints	Technology and Technical Challenges
		Asset Lifecycle Management
		Procurement Challenges
3.	Human Capital and Behavioural Issues	Manpower Challenges
		Human Behaviour and Occupant Awareness
4.	Stakeholder Management	Stakeholder Management
		Occupant Engagement
5.	Policy, Regulatory and Climate Adaptation Challenges	Regulatory Challenges
		Climate Adaptability

Theme 1: Operational Efficiency and Resource Management

The participants highlighted the persistent difficulties in managing building resources effectively. The main issues were the problems of decreasing building energy intensity (BEI), keeping energy-saving

equipment/services and monitoring electricity consumption. Water efficiency was limited by low user awareness, while waste management practices were often underdeveloped, with only limited application of the 3Rs (Reduce, Reuse, Recycle). Additionally, financial constraints, especially around return on investment, posed challenges to implementing long-term sustainability initiatives.

Theme 2: Technological and Infrastructure Constraints

This theme demonstrates how technical and structural barriers prevent buildings from performing optimally. The participants encountered problems with the operational reliability of installed sensors and other smart systems. The combination of technical problems with insufficient asset lifecycle planning and no capital expenditure (CAPEX) strategies made the situation worse. The operations faced additional delays because of material and part sourcing issues which indicates a requirement for better procurement system resilience and forward planning.

Theme 3: Human Capital and Behavioural Issues

Participants expressed concerns that gaps in staff knowledge and poor working practices could negatively impact building performance. The respondents noted that operational efficiency faces significant risks when such issues emerge although they did not describe all staff members in this manner. The lack of awareness about sustainable practices among building occupants was identified as one obstacle to reaching GB objectives. The human factors demonstrate why training programs and behavioural change initiatives and educational measures are essential to support technical advancements.

Theme 4: Stakeholder and Engagement Strategies

The effectiveness of stakeholder collaboration and occupant engagement emerged as a key concern. Respondents noted gaps in communication between clients, contractors, and building users. While the value of stakeholder involvement was widely acknowledged, its practical execution remained uneven, suggesting that formalised engagement strategies are essential for sustained improvement.

Theme 5: Policy, Regulatory and Climate Adaptation Challenges

Participants discussed multiple regulatory and environmental barriers, particularly those related to ESG compliance and green building certifications. Aligning operations with these evolving standards was described as complex and resource-intensive. The growing impact of climate change added further pressure to adapt building systems and strategies.

5.0 DISCUSSION

This section outlines the key findings from the thematic analysis of the interview data. Based on the participants' experiences managing Green Office Buildings (GOBs), five broad themes were identified.

1. Operational Efficiency and Resource Management

Most participants pointed to the ongoing struggle of maintaining energy and water efficiency while keeping costs under control. Managing the BEI score was described as especially demanding. As FM2 put it, "**One of the biggest challenges is actually how to keep the BEI low.**" Despite efforts to optimise systems, performance often declined over time or was affected by external factors like rising temperatures. AM1 noted, "**The site team tried hard… but it's already going a bit higher**."

Cooling systems were seen as the main energy drain, especially in high-rise buildings. AM2 remarked, "**Just imagine the amount of energy to transport the chilled water from level P2 to level 57… it costs**

a lot of energy." Participants also described using rainwater harvesting, condensate water recycling, and water-saving fixtures. However, not all these strategies worked smoothly in practice. GM1 explained, "**When you use the water-saving tap… it's just flush a little bit, then you have to go in and out to wash your hands.**"

Financial concerns were deeply tied to operational decisions. Many interviewees spoke about the high costs of installing and maintaining green systems, with long payback periods and uncertain returns. BM1 commented, "**We tried to install solar panels, but the ROI was very, very low… about 10 years, so we decided not to proceed.**" Even routine upgrades were difficult to justify. AM1 said, "**If I come after three years [asking for system changes]… the client will say, what the hell? I just approved it three years ago.**"

Rising labour costs and taxes also impacted daily operations. GM1 mentioned, "**SST or the minimum wages does impact us… it will jack up our operations cost.**" As a result, some opted for simpler, more cost-effective green certification alternatives like GreenRE, instead of sticking with more demanding frameworks.

2. Technological Limitations and Infrastructure Obsolescence

Technology was seen as both a strength and a source of frustration. Systems like Building Automation Systems (BAS) and energy sensors helped monitor and manage performance, but participants frequently reported problems with compatibility, outdated software, or unreliable components. AM1 shared, ""**If you have a lot of system here, sensitive system, sensitive sensor, you fuse one, you have to replace it. If not, it will affect your data, affect your consumption, and affect your BEI.**"

There was a strong sense that green systems aged faster than expected. FM3 explained, "**The chiller system used to be 100% efficient. Now, it is 90% or 80%.**" BM2 recalled a case where a lighting control system became completely unusable after 12 years due to lack of support from the vendor. Sourcing replacement parts was another recurring challenge. AM1 described, "**Spare parts keep changing rapidly… If we finish using it, that strip is not available at all.**"

In some cases, these limitations meant that even relatively new buildings needed expensive overhauls. The lack of local suppliers for green equipment/materials and long lead times for imported parts added further complications, especially when quick fixes were needed.

3. Human Capacity and Behavioural Issues

People played a central role in building performance—both positively and negatively. While participants did not suggest that staff were generally unskilled, they did emphasise that when knowledge gaps or passive attitudes occurred, they could lead to significant problems. AM1 remarked, "**You have to have more initiative of your maintenance team to actually work.**"

Small oversights had big consequences. BM2 recalled, "**If we had done the right maintenance for the PC… we wouldn't have had to switch the system to full manual.**" Others stressed the importance of technical training and attitude. GM1 reflected, "**It's the attitude… whether they're willing to pick up and understand what green building means.**"

Tenants also played a role in shaping performance outcomes. Larger companies with ESG goals were generally more compliant, while smaller tenants needed more support. FM2 shared, "**It would be good if they can do the 3R practice and monitor their energy consumption.**" Still, encouraging behavioural change was often difficult without consistent communication or follow-up.

4. Stakeholder Engagement

Working with tenants, clients, and contractors was seen as essential but not always straightforward. Most agreed that good engagement made a real difference in outcomes. FM1 explained, "**Most of the tenants are big names… they have to follow ESG compliance as part of their audit.**" However, with smaller firms or local tenants, convincing them to adopt green practices often took more time and effort.

Tools like tenant handbooks, fit-out guidelines, and green lease agreements were used to guide and align behaviour, but uptake varied. FM1 admitted, "**We share the tenant handbook… but whether they read it is another matter.**" GM1 noted that legal agreements were more reliable: "**It's a legal contract… the most effective way to hold them.**"

Contractor coordination also presented challenges. FM1 described long waits for skilled vendors: "**Sometimes things get delayed just because you cannot find anyone to fix it.**" Others stressed that early collaboration between stakeholders and service providers helped avoid future problems.

5. Policy, Regulatory and Climate Adaptation Challenges

Most participants were generally comfortable working within regulatory frameworks, especially when building designs aligned with requirements from the outset. AM1 explained, "**All consultants… design based on regulations… we always check with our maintenance operation handbooks**." GM1 said, "**broader policy changes……such as ESG and minimum wages……had a knock-on effect on budgets**".

Climate-related risks were a growing concern. AM1 said that: "**I guess, surrounding also plays a contribution to it…"** Buildings with high occupancy or vertical transport needs were especially affected.

6.0 CONCLUSION

This study examined the challenges of operating GOBs through the lens of facilities management professionals. The findings highlight that maintaining building performance is not solely a technical matter, but one shaped by financial constraints, technological limitations, human capacity, and policy pressures. While systems such as energy monitoring tools and water-saving features support sustainability goals, their impact is often limited by usability issues, system obsolescence, and budget limitations.

Operational success depends heavily on the knowledge, initiative, and behaviour of both staff and occupants. Engagement strategies, though available, are inconsistently applied, and external factors such as rising temperatures and regulatory shifts add further complexity. Overall, green building operations require continuous adaptation. Efforts to improve long-term performance should focus on upskilling personnel, improving stakeholder engagement, and ensuring technologies and certification schemes are fit for purpose in practice—not just in theory.

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