The Challenges in Reducing Energy Use in the Construction Industry

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ABSTRACT

The conservation of the energy resources has thus become one of the most significant issues of the global society, facilitated by the want to address climate change, reduce the number of greenhouse gases, and promote sustainable consumption of natural resources. This research investigates the challenges in reducing energy use. Utilizing a quantitative approach, data was collected from a total of 57 respondents in Kuala Lumpur and Selangor. The findings reveal that the that financial factors are still a major obstacle, despite G7 contractors being larger organisations with more resources available to them.

Keywords: Energy Efficiency, Sustainable Construction, Challenges.

INTRODUCTION

The conservation of the energy resources has thus become one of the most significant issues of the global society, facilitated by the want to address climate change, reduce the number of greenhouse gases, and promote sustainable consumption of natural resources (Felius et al., 2020; Singh and Kishore, 2018). The construction industry plays a significant role in defining the built environment and technological, social, and economic characteristics of human activity in modern society (Abeywardhana, 2024; Yan et al., 2025). The importance of the sector does not just end at the development of infrastructure, the sector has a direct effect on the energy consumption habits, the life people live in urban areas and the quality of the environment. The issue of energy efficiency improvement in the economies of the countries is now receiving significant international interest, because it is closely associated with such issues as the sustainability of resources, the productivity of the economy, and climate change resistance (Abeywardhana, 2024; Lewandowski, 2025).

The greater consumption of energy resources has resulted in significant consequences to the environment such as water pollution, air pollution, soil erosion, and deteriorated world climate (Lewandowski, 2025; Umoh et al., 2024). Conversely, some vital concerns exist on whether there will be the source of non-renewable energy sources to supply future generations since they are gradually getting depleted such as coal, oil, and natural gas (Islam and Hasanuzzaman, 2020; Hafez et al., 2023). These problems demonstrate the urgency of the need to make energy use more efficient, which is the general agreement that it is a key move towards sustainable development. Energy efficiency can be achieved when the functionality, usability, or comfort levels of a product, process, or building are not impaired because of the reduction of the energy intensity of the product (or process) (Felius et al., 2020; Singh and Kishore, 2018).

Energy efficiency in the construction industry translates to coming up with structures that consume less energy, maintain healthy indoor areas, and maximize on natural light, ventilation, and heat. The use of sustainable design processes that prioritize the health and comfort of users and energy efficiency has become more common with rising demand of residents and employees for healthier living and working conditions (Islam and Hasanuzzaman, 2020; Hafez et al., 2023). This transformation has been the driving force behind the evolution of green building methods that focus on the inclusion of waste minimization measures, sustainability materials, and energy efficiency systems into the construction and operating processes.

Innovative building technologies and the implementation of energy-saving measures can help the construction industry not only enhance the quality of life in the communities but also significantly reduce the environmental impact of the industry. Hence, energy efficient building is emerging as an important source of addressing the energy dilemma the world is faced with and achieving goals of sustainable development. With setting the balance between economic efficiency, social well-being, and environmental responsibility, the construction industry can become a revolutionary force behind sustainable development, as well as one that will spearhead economic development (Abeywardhana, 2024; Lewandownski, 2025). This proves the changing importance of the profession to enhance the sustainable development goals besides cost-efficiency. Consequently, the present research topic is directly relevant to the discipline of quantity surveying since it emphasizes the need to ensure that the future human resources possess skills and knowledge in energy management and sustainable construction techniques to make their input remain important to the transformation of the industry into sustainability.

LITERATURE REVIEW

The pursuit of bettering energy efficiency in the sphere of sustainable building has received immense levels of coverage in the field of academic literature, industry operations and policy framework. Energy efficiency can be described as the use of technologies, strategies, and practices that allow utilizing and consuming energy optimally (Koskei et al., 2023; Chen et al., 2021; Hafez et al., 2023). It is associated with minimising energy waste, maximising efficiency of the energy systems, and rationally managing the energy resources to produce the same or even greater output using less energy. Energy efficiency does not only entail energy saving but also increases the economic competitiveness, reduction in greenhouse gas emission, and better living standards in the form of less reliance on external energy sources and more consistent energy prices. It is a multifaceted idea that has become the foundation of sustainable development and environmental preservation since it results in a reduced number of fossil fuel consumptions as well as less carbon footprint.

Energy Efficiency

Studies done by Fernando et al., (2023); Karji et al., (2020) have determined that energy efficiency is an established energy resource as it provides energy savings as well as demand savings that can replace electricity production by primary energy sources. The consideration of investments in energy efficiency has a direct impact on utility resource planning, as the savings on energy resources are a cost benefit because the cost of such savings is approximately a third of the cost of a new generation capacity. Efficiency programs minimize the requirement of this and upgraded transmission and distribution infrastructure and, coupled with the smart grid technologies, increase the reliability of the system and assist in the management of peak demand in the power systems. All these components make energy efficiency an economically viable and viable model of energy consumption minimization.

When considering Sustainable Development Goals (SDGs), energy efficiency is crucial towards the promotion of environmental and social goals. The buildings that are energy efficient i.e. play an important role in SDG 11, which envisions the cities to be inclusive, safe, resilient, and sustainable, and SDG 13, which demands urgent climate action. SDG 7 (enhanced accessibility to affordable, reliable, sustainable energy), SDG 8 (sustainable economic growth) and SDG 9 (resilient infrastructure and innovation) are also supported by energy efficiency (Chen et al., 2021; Hafez et al., 2023). Energy efficiency reduces the level of energy demand and greenhouse gas emissions, which leads to sustainable development and states its significance as a policy objective on the international level.

Sustainable Construction

The overall concept of sustainable construction is the involvement of environmental, social, and economic factors in the practices and strategies of the construction industry (Iqbal, Ahmad, et al., 2022; Karji et al., 2020). It implements the concept of sustainable development throughout the whole construction lifecycle, starting with the extraction of raw materials, followed by planning, designing, and building, ending with the demolition and the waste management. It is this method which seeks to reduce adverse effects to the environment and enhance social welfare and economic sustainability. The idea of sustainable construction is

highlighted by governments all over the world as one of the avenues to SDGs since the construction industry has a significant impact on the environment.

Lewandowski, (2025) and Karji et al., (2020) claim that construction industry plays one of the biggest roles in the energy consumption and emission in the globe; around 80 percent of the world consumes energy in urban areas, and buildings alone contribute around 40. Thus, incorporation of energy efficiency into a building design and construction process is essential to achieving SDG 11, which promotes the pursuit of inclusive, safe, resilient, and sustainable cities and SDG 13, which encourages the urgent need to combat climate change. Sustainable construction does not only minimizes the use of resources and waste but also enhances the performance of building and the wellbeing of the occupants, which is also part of the long-term environmental and social sustainability.

In addition, sustainable building encourages resource use and encourages innovation in the construction technologies and processes to result in balanced economic development, environmental sustainability, and social equality (Hafez et al., 2023; Almakayeel et al., 2023). The main principles are to minimize energy and water use, sustainable materials, less waste, improving biodiversity preservation, and engaging the community. These holistic practices will help the construction industry to build healthier environments and sustainable urban development, which will meet the current needs and preserve the resources to be used by future generations.

Challenges in Reducing Energy Use

The challenges in reducing energy use include economic and financial barriers, technical and technological challenges, knowledge and skills gap, regulatory and policy constraints, and organizational and managerial barriers. Economic and financial obstacles are major barriers to the decrease of energy consumption in sustainable construction, and high initial costs are the main challenge (Ayarkwa et al., 2022; Iqbal et al., 2021a, 2021b; Almakayeel et al., 2023; Fernando et al., 2023). Several researchers have established that the initial cost of implementing the green building practices and materials usually discourages the groups when it comes to practicing sustainability. These initial expenses are related to the high cost of sustainable materials like recycled steel, bamboo or low-VOC paints that are more expensive by virtue of limited supply, special processing, and high environmental standards (Ayarkwa et al., 2022). Sustainable buildings usually result in a long-term savings of the energy and maintenance cost, but due to the preoccupation with an immediate budget constraint and the absence of clear and unified cost-benefit analysis, many developers are afraid of it.

Continuing on the obstacle of high initial expenses, one more substantial factor, why it is hard to minimize energy usage in sustainable construction, is the unavailability of financing programs, particularly in the developing world (Iqbal et al., 2021a, 2021b). Lack of affordable and easily accessible sources of financing is a crucial inhibitor that restricts the potential of the builders, developers and investors to embrace energy efficient technologies and green construction methods. The economic constraint is the primary reason why energy consumption cannot be minimized in sustainable construction since many projects have financial limitations to employ highly developed systems and environmentally friendly materials (Hafez et al., 2022; Karji et al., 2020). Initial expenses of energy efficient systems like advanced HVAC systems, solar energy systems and better insulation materials are often above the available budget and developers and contractors find it hard to justify its existence in the specific building (Fernando et al., 2023). On top of that, energy uncertainty of returns is a significant challenge in the approval of energy consumption towards sustainable building. In a number of the studies, they point out that the financial obstacles are compounded by skepticism on whether the green building technologies and practices will have a better payoff in the long term (ROI).

Performance gaps are a technical challenge that is very critical in meeting the goals of energy reduction in the construction process sustainability. As pointed out by Igugu et al., 2024, Iqbal et al., 2021a, there is often a difference between the estimated energy use as projected in the building design phase and the actual energy consumption in the building once it is operational. The existence of material and design constraints is a major challenge to sustainable construction that can be undertaken using 3D printing technology. Dixit (2019) indicates that the following critical limitations include: the inability to print using multi-material printing at the present, which limits the functionality and the complexity of the 3D-printed structures. Advanced facade

systems are very complex and thus pose a great challenge in minimizing the use of energy as a way of constructing them sustainably. Fernando et al., (2023); Karji et al., (2020) explain that these advanced systems demand the professional skills of implementation because they are technically complex and expensive to design, install, and maintain. The process of retrofitting historical buildings to enhance their level of energy efficiency is a complicated one because it requires striking a balance between technical intervention and preserving the historical context of the buildings. According to Panakaduwa et al. (2024), retrofitting projects are to be carefully balanced in terms of the historical importance of the building and the energy performance requirements of the modern buildings.

The lack of knowledge and skills is an important obstacle to decreasing the energy consumption in sustainable construction. Inadequate training and absence of education as well as knowledge of green technologies in professionals is reported in several studies, such as those by Ayarkwa et al. (2022); Almakayeel et al., (2023); Igugu et al., (2024) as the essential hindrances. Numerous construction workers, engineers and project managers do not have full understanding of energy efficient design concepts, sustainable material and current construction methods necessary to apply low-energy solutions (Dixit, 2019). This lack leads to the inappropriate use of technologies, poor choice of designs, and lost energy opportunities (Karji et al., 2020). Besides that, there is also attitudinal and cultural resistance in the way of minimizing energy consumption during sustainable construction. According to Iqbal et al. (2021a) and Hafez et al., (2022) among the barriers to adopting energy management practices is lack of knowledge and awareness which are also part of the reasons behind reluctance by stakeholders in the construction industry. This resistance is seen in acts that reduce the application of sustainable technologies and processes, even where they are found to have potential advantages. The development and servicing of complex facade systems are highly qualified skills needed in the design and maintenance of the system, which is very critical in improving energy efficiency in the sustainable construction. Fernando et al. (2023) emphasize that such systems are characterized by complex technologies and integration processes that demand the involvement of specialists with particular expertise that is not only based on the general knowledge of construction.

The regulatory and policy limits are an important hurdle to curtailing energy consumption in green building, especially because there are no strict guidelines and the government does not support them. In various studies, such as the one conducted by Karji et al., (2020); Almakayeel et al., (2023) argue that the absence of clear and unified regulations generates uncertainty and reluctance among the construction stakeholders. The absence of clear standards will make the builders and developers reluctant to promote sustainable practices, as they can get exposed to risks involving compliance and certification. Among the most critical issues which prevent the implementation of sustainable energy technologies in construction, government barriers are pointed out. Iqbal et al. (2021b) mention that the policy enforcement, the absence of coordinated support, and the absence of incentives to promote energy-efficient technologies to the masses are some of the government-related barriers. Such obstacles tend to cause uncertainty in the regulations and less incentive to stakeholders to invest in green building approaches. Better policy frameworks and stakeholder engagement models are considered crucial but are currently ineffective challenges of sustainable construction. According to Panakaduwa et al. (2024) and Fernando et al. (2023), the available policies are usually not coherent, comprehensive, and flexible to promote energy-efficient construction practices. Lack of properly designed frameworks leads to a disjointed work which causes challenges to the stakeholders to harmonize their objectives and duties. A major problem with the minimization of energy consumption in sustainable construction is fragmentation of implementation, which is mainly due to the absence of supportive policies and effective implementation mechanisms in nature. Isolated formulations and implementation of policies do not bring about coordination in the efforts of the various sectors and government bodies and therefore the implementation of energy reduction measures is applied in unequal ways across projects and states.

Absence of top management support is a major organizational and management impediment that has a great influence on the sustainable construction projects, especially in their quest to minimize energy consumption. Panakaduwa et al. (2024) and Igugu et al., (2024) emphasize that sustainability efforts are frequently not supported by the top management and the strategies of these efforts cannot receive the resources, strategic emphasis, and organizational dedication they require. Lack of coordination among stakeholders in sustainable construction is a major organizational and managerial challenge that may result in poor alignment of the

project goals. Karji et al. (2020) observed that in cases where stakeholders including architects, engineers, contractors, and clients fail to communicate and work together, it leads to divided decision making and conflicting priorities. This incoordination usually leads to delays, cost overruns and reduction of energy performance targets. Poor project management practices are a major challenge in sustainable construction, which affects the effectiveness and success of the reduction of energy utilization in projects. As noted by Almakayeel et al. (2023), lack of proper management of a project usually results in unorganized planning, lack of resource allocation, and incompetent communication among project stakeholders. Lack of sufficient integration of design disciplines is one of the organizational and managerial barriers that affect the sustainable construction projects and the energy use results. Dixit (2019) and Fernando et al. (2023) comment that a lack of coordination among the architectural, structural, mechanical, electrical, and other expert design disciplines due to an individual approach (instead of an integrated approach) results in inefficiencies and contradictions in building systems.

METHODOLOGY

This research adopted a quantitative approach. The list of the targeted population is the contractors Grade G7 in Selangor and Kuala Lumpur that registered with CIDB. The sampling method for this research was the random sampling method. In order to decide the actual sample size of this type of study, the sample size was based on the Krejcie & Morgan (1970) table. A sample of 100 respondents is suggested. Out of the 100 distributed questionnaires, 57 were found to be useful and valid for the analysis. The remaining were not responded, incomplete or invalid for some reason; hence, a response rate of 57 percent was achieved. This response rate is in the acceptable range for the purpose of this study and it is accepted as reliable to investigate the challenges in reducing energy use in the construction industry. Furthermore, the reliability of the research instrument was carried out using Cronbach's Alpha with a value of 0.70 or more, which is generally considered as good internal consistency of the instrument. Descriptive analytics, including mean scores and frequencies of respondents' sociodemographic characteristics and their survey responses, were calculated in SPSS version 21.

FINDINGS AND ANALYSIS

Challenges in Reducing Energy Use

G7 contractors obtained the highest mean score in Statement A2, which indicates that there are limited funds available to invest in energy efficient solutions (Mean = 3.74). The results indicated that financial factors are still a major obstacle, despite G7 contractors being larger organisations with more resources available to them. While there are many technologies and construction solutions that are cost-effective in the long term, they have high initial costs. The greater the size and complexity of a project, the more expensive the financial commitment for these technologies. Thus, capital expenditure and return on investment can affect decisions on sustainable practices. The results confirm past research by Karji et al., 2020, which revealed financial constraints and high initial cost as significant challenges for implementing energy-efficient technologies in the construction sector. G7 contractors see financial investment as their primary challenge, indicating that financial matters remain a driver of sustainability decisions, even for better-established and larger companies. The results overall suggest that energy reduction in sustainable buildings is not a just technical challenge but a complex one that includes human, organizational and financial aspects. The mean scores were between 3.37 and 3.74 indicating that the respondents generally agreed at a moderate to high level about the challenges identified. The findings indicate that enhancing the competency of the workforce, increasing management commitment and tackling financial obstacles are all critical elements to ensure effective energy-efficient building construction. Therefore, there's a need to encourage sustainable construction with a holistic strategy.

Table 1: Challenges in Reduce Energy Use

Challenges in Reduce Energy Use	Mean	Ranking
A. Economic and Financial Barriers		
A1. Sustainable building materials are expensive and discourage adoption.	3.60	8
A2. The financing is limited, which makes it challenging to invest in energy efficient solutions.	3.74	1
A3. Projects are more focused on traditional approaches than sustainable ones due to budgetary limitations.	3.39	15
A4. Lack of long-term returns uncertainty decreases the uptake of energy efficiency technologies.	3.37	17
B. Technical and Technological Barriers		
B1. It is hard to design and maintain complex technologies.	3.65	6
B2. It is limited by material and design constraints to use innovative technologies.	3.54	10
B3. There is often a gap between predicted and actual energy performance in buildings.	3.53	12
B4. It is technically difficult to retrofit older buildings for energy efficiency.	3.67	5
C. Knowledge and Skills Gap		
C1. There is a lack of training amongst construction professionals on energy-efficient design and technologies.	3.63	7
C2. Awareness of the benefits of sustainable construction practices is still not adequate	3.47	13
C3. Lack of specialized expertise leads to incorrect installation and reduced energy performance.	3.67	4

Table 2: Challenges in Reduce Energy Use (cont'd)

Challenges in Reduce Energy Use	Mean	Ranking
D. Regulatory and Policy Constraints		
D1. The government's policy and support for energy efficient practices are limited.	3.39	16
D2. Slow response times in government departments contribute to lack	3.44	14

of sustainable construction practices.		
D3. Fragmented policies result in inconsistent implementation of energy-saving strategies.	3.58	9
E. Organizational and Managerial Barriers		
E1. Lack of coordination between architects, engineers and contractors lowers energy performance.	3.67	3
E2. Lack of top management support limits the prioritization of energy-saving strategies.	3.53	11
E3. Inadequate project management results in poor implementation of sustainable practices.	3.68	2

Note: Scale: Strongly Disagree (1.00 average mean <1.50), Disagree (1.50 average mean <2.50), Neutral (2.50 average mean <3.50), Agree (3.50 average mean <4.50), Strongly Agree (4.50 average mean <5.00).

CONCLUSION

In summary, the results showed that contractors are faced with various obstacles to reduce energy consumption in construction projects. The problems encountered were such as: financial constraints, management issues, technical knowledge and training, and policy implementation and industry awareness. In this study, the practices for energy efficient construction of sustainable buildings for contractors that are registered with CIDB based on Grade G7. The research was aimed at identifying challenges of energy savings. The findings from the data analysis helped in gaining valuable insights on the current situation of energy efficient practices within the construction industry. The recommendations include enhancing financial and technological assistance and also boosting management skills, knowledge of the industry and standardizing policies to promote the broader implementation of sustainable construction practices. The constraint of this research was that the respondents were only contractors. Expanding the scope in future could incorporate other parties involved such as developers, architects, engineers, quantity surveyors and authorities. Thus, the results may reflect the views of other stakeholders throughout the project stages.

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