






## Article

# Challenges and Opportunities for Promoting Sustainability in Public Buildings

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**Abstract:** The building and construction sector remains largely climate-unfriendly as a significant global greenhouse gas emitter. Public buildings can play a significant role in promoting sustainability practices. Unlike developed countries that have successfully promoted sustainable building practices, developing countries have experienced slow progress in implementing sustainable practices in public buildings. This research study investigated the challenges and opportunities for improving sustainability practices in public buildings from a multi-stakeholder perspective within the context of developing countries. Using Indonesian public buildings as a case study, a wide range of stakeholders directly involved in the public building sector such as policy-makers, building owners, building professionals, and building users were interviewed over two time periods of 2019 and 2023. The interview results show consistent findings on challenges and possible opportunities with respect to regulation, occupant behavior, and the primacy of technical intervention in the practice of sustainable buildings. Despite the importance of strong policy and the role of technology in sustainability practices in public buildings, this study advocates the need for greater intervention in occupant behavior so that sustainable practices in public buildings can be continuously promoted.

**Keywords:** public buildings; stakeholders; green buildings; sustainable buildings; sustainability policy; climate change; developing country; Indonesia



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## 1. Introduction

The building and construction sector requires government interventions to mitigate climate change impacts. Buildings are globally responsible for the production of around 39% of greenhouse gas (GHG) emissions and account for 36% of total energy use [1]. Growth in energy consumption and GHG emissions are contributing to global average temperature increases and may lead to catastrophic climate-change-related events in the future [2]. Growing levels of energy consumption and climate change also pose significant challenges to key sustainable development goals [3]. In response to these impacts, there has been an increase in policy and strategy initiatives to ensure the application of sustainable building practices.

Sustainable buildings have been substantially agreed by scholars and practitioners to be buildings that take into account environmental, social, and economic issues in their performance. However, the terms, sustainable building and green building have frequently been used interchangeably in different contexts [4]. Sustainable building terminology is used to discuss the indoor environmental health of buildings [5], while green building terms are used to examine similar topics [6]. Practically, sustainable building performance is measured by relatively similar categories to a green building [7]. This includes economic, social, and environmental outcomes.

Despite significant global initiatives, developed and developing countries have achieved varying progress in responding to the issue of sustainable buildings. For example, the trend towards sustainable buildings in the United States of America (USA) has increased since 2008 [8]. Similarly, the United Kingdom (UK) has successfully introduced a zero-carbon built environment program [9], and recently 68% of the commercial building stock in the UK has green building certification by LEED (Leadership in Energy and Environmental Design) and/or BREEAM (Building Research Establishment Environmental Assessment Method) [10].

In contrast, besides some improvements introduced to boost sustainability practices in the building sector, such as regulations and policies [11], developing countries have struggled to improve sustainability practices in their building sectors. Past research has reported the slow progress of sustainable buildings in developing countries such as Thailand [12], Vietnam [13], Malaysia [14], Nigeria [15], Ghana [16], Brazil [17], and Indonesia [18]. With such slow progress, strategies to promote sustainability in the building sector have become paramount in developing countries. This is also because emissions from construction activities in developing nations account for two-thirds of the global emissions, and this trend is likely to rise by 13 percent by 2035 [19]. Thus, addressing issues for implementing sustainability practices in the building sector is a significant and critical contribution to climate action in developing countries.

The practice of sustainability in private buildings can be different to equivalent principles in the public sector. Profit orientation is the main difference between private and public building management [20]. In the public sector, on the other hand, building management may focus on improving their buildings' performance in order to provide better service for both internal (occupants) and external (clients) stakeholders [21].

The nature and complexity of public management influence all actions of government, including public building sustainability improvement processes. Unlike profit-based real estate management, which focuses on tenants' demands in their property decision processes, non-profit organizations' real estate decision-making process is more influenced by stakeholders; therefore, it is frequently perceived that the success of any decision-making process is determined when agreement is reached, rather than when the clients' demands or the supply of resources have been met [22,23]. Thus, stakeholders' knowledge and experiences are key in exploring issues of sustainability practice in public buildings.

Many countries have achieved different levels of policy innovation in public asset management including sustainability. Some governments have succeeded in reforming public asset management, such as Australia [24], Canada [25], and New Zealand [26], while some developing countries are still working towards managing common issues of pre-reform situations. Five issues in pre-reform public asset management have been identified, which are, the lack of policy frameworks, fragmentation of management, management inefficiency, lack of information, and lack of transparency and accountability [27]. It is now crucial for the countries that are still left behind in terms of the reform agenda to innovate strategies and policies to implement better practices of public asset management.

The issue has guided approaches and strategies to improve public building sustainability in Indonesia.

International policies in relation to sustainability practices in public buildings have emphasized the importance of government leadership. Government leadership in adapting public buildings to be more sustainable through policy development and implementation is crucial [28]. By developing appropriate policies and showcasing sustainable public building projects, governments can encourage and stimulate the private sector to follow the examples and comply with regulations, standards, and policies on improving sustainability practices in private buildings [28]. Hence, governments have a critical role in developing appropriate policies and providing examples of sustainable buildings by implementing these policies in public buildings.

The importance of public buildings in transforming sustainability in the building sector in the context of developing countries was investigated using selected Indonesian government buildings as a case study for this research. Indonesia has one of the largest shares of global construction emissions amongst developing countries [19]. The Indonesian central government owns, occupies, and manages over 200,000 public buildings, with a total value of around 16 billion USD [29]. Despite this significant portfolio of public buildings located across the country, government leadership in sustainability practices in buildings is low [30]. Since the introduction of sustainable building practices in 2008 with the establishment of the Green Building Council of Indonesia (GBCI), to date, there has only been the construction of two new sustainable public buildings and one public building retrofit project [31].

Overall, it is important to explore how sustainable buildings can be progressed in developing countries. This is because developing nations will continue to experience a boom in building stock and population [32]. This boom will be the main driver for the increase in energy demand in buildings, which is expected to increase by 50% by 2050 [33]. Furthermore, the slow progress in transforming public buildings to become sustainable buildings warrants investigating the challenges and identifying opportunities for sustainable building practices. To date, studies have only explored barriers to improving sustainability practices in public buildings in developing countries solely from a government perspective [34,35]. There is a knowledge gap in relation to stakeholder perspectives to develop comprehensive policy [32]. Specific to Indonesia, Fitriani and Ajayi [18] have identified factors that hinder the performance of sustainability practices in the Indonesian building industry. Their study discussed the barriers using responses to questionnaires administered to building construction professionals. However, investigating the challenges based on the experiences of multiple actors, including building owners, managers, and users, can result in a more in-depth unlocking of the barriers and opportunities to sustainability practices in Indonesia. In addition, most studies [18] have focused limited attention on public sector buildings, particularly in Indonesia. However, there is momentum and opportunity for transforming a significant number of public buildings in Jakarta to be more sustainable due to the relocation of Indonesia's capital city [36]. This study contributes to filling the knowledge gap in understanding the challenges and opportunities based on responses from multi-stakeholders for enhancing sustainability performance in the public building sector in the context of developing countries such as Indonesia.

## 2. Materials and Methods

This exploratory research was informed by the perceptions and opinions of key actors who have significant roles in sustainability transitions, specifically in public buildings. The actors often have knowledge, experience, awareness, and authority to create changes in both policy and implementation [37]. The stakeholders' or actors' contributions to sustainability

practices are intrinsic. This is also the case in public sector asset management [38]. Therefore, interpreting responses obtained by interviewing key actors offers the best potential for gaining insights into the critical factors associated with improving the sustainability of existing public buildings in developing countries, which could also contribute to improving the sustainability features incorporated into the design of new buildings.

### 2.1. Data Collection

This study employed semi-structured interviews, which provided more in-depth outputs in comparison to survey techniques conducted in sustainable construction projects in Indonesia [18]. The study conducted two sets of interviews in 2019 and 2023 with the same questions related to the challenges and opportunities to sustainable practices in public buildings. The 2023 interviews were conducted after the announcement of the relocation of the Indonesian capital city. The relocation of Indonesia's capital city from Jakarta to Nusantara on Kalimantan Island was announced by President Joko Widodo on 26 August 2019 [39]. This relocation created the opportunity for sustainable public building adaptation in Jakarta due to the fact that a large number of public buildings would fall vacant.

The selection of interview participants is crucial for conducting semi-structured interviews [40]. This research collected diverse perspectives from public building owners, managers, and users. Thus, the interview participants for this study were selected from state and non-state actors as guided by Phan [41], which ensures the purposiveness and representativeness of the selection of the sample.

State actors such as policy-makers were selected as they play a key role in developing and implementing government sustainability policies and agendas. Inevitably, the role of a policy-maker is important in determining the sustainability agenda direction [41]. However, executive bureaucrats also substantially influence the direction of policy formulated by the government. They are the people who deal with problem-solving, stakeholder consultation, lobbying, and persuading both institutional and non-institutional actors in the policy development area [42]. The executive bureaucracy holds values, has expertise and experience in policy development, and understands the root problems associated with policy implementation [43]. Involving state actors in investigating sustainability issues in public buildings therefore enhances the validity and trustworthiness of the data collected in the research process. In addition, non-state actors also influence the development and progress of the public policy agenda. In many policy development cases, they collaborate with state actors to create a specific policy goal [44]. This applies in most policy contexts, including sustainability policy.

According to Kincaid [45], the key stakeholders who influence the process of decision-making on improving the sustainability of buildings are investors, professionals, market players, law and regulation makers, and users. These stakeholder classifications were adapted in this research study within the context of public sector buildings. The research therefore categorized participants into five groups: policy-makers (PMs), building professionals (BPs), building owners (BOs), and building users (BUs). The code for each participant was defined based on the number of participants in the stakeholder group. For example, the policy-maker group (PM) in 2019 had ten participants with codes from PM1 to PM10. This code system was also used for other stakeholder groups. The 41 participants were selected based on their experience related to sustainable public building issues in policy development or implementation (see Table 1). The main selection criteria for the interview participants were based on their duties and roles in relation to government asset management. The other criteria related to the location of this study included two levels of government that manage government assets in Jakarta, central government, and the local government of Jakarta.

**Table 1.** List of Interviewees.

Stakeholder Code	Stakeholder Group	Number of Interviewees (2019)	Number of Interviewees (2023)
PM	Policy-Maker	10 (PM1 to PM10)	3 (PM11 to PM13)
BP	Building Professional	4 (BP1 to BP4)	2 (BP5 to BP6)
BO	Building Owner	11 (BO1 to BO11)	3 (BO12 to BO14)
BU	Building User	5 (BU1 to BU5)	3 (BU6 to BU8)

- For the policy-maker participants, the interview participants were selected from government agencies, which are responsible for regulation related to government building standards and government asset management policies and standards.
- The building professional participants were selected if they were implementing government policies and involved in sustainable public building projects.
- The selection of government buildings was determined by the flood risk of the location of the building. Then, building owners and building users of the selected government buildings were considered representative owners and users of the selected buildings.

The main selection criteria of the participants were based on their roles and responsibilities and not the type of public buildings or individuals' experiences. This approach was adopted to ensure the reliability and validity of the interview data.

## 2.2. Interview Questions

The semi-structured interview questions were designed to achieve the research objectives. Kallio et al. [34] suggested that designing appropriate questions is a critical step for successfully exploring the knowledge and experience of the interview participants. The questions were prepared and pilot-tested before the commencement of the semi-structured interviews to ensure their appropriateness and to meet the purpose of the research objectives [46]. The final version of the semi-structured questions is provided in Appendix A. These aligned with the following research objectives: Identifying barriers to the implementation of sustainability practices in public buildings; Identifying opportunities to improve sustainability practices in public buildings.

The questions were designed to capture the experience and perspectives of the targeted group. The questions for policy-makers focused on the extent to which existing regulations and policies on public building construction and management have been adapted to the issue of climate change and sustainability. The questions also explored the challenges associated with implementing policy on sustainable public buildings.

The questions for the professional group explored problems and opportunities for public buildings to be sustainably adapted and the real phenomenon of public building adaptation. The questions for this group were also tailored to discuss issues in relation to the readiness of professionals to deal with public building adaptation projects and their professional perspectives on the possibility of adaptation of public buildings.

For the building owner group, the questions focused more on the extent to which current regulations and policies accommodate building sustainability practices and on the challenges and success factors inherent in improving energy efficiency through building adaptation. It is important to note that building owners have multiple interests in relation to public buildings. In the private sector, a building owner primarily focuses from an investment perspective. However, in the public sector, a building owner occupies the role of building manager and user.

Finally, the building user group was queried about their feelings and experience in relation to the transformation of public buildings from conventional to sustainable buildings.



Some of the questions explored the extent of their involvement in public building adaptation projects, and their feelings as occupants of the buildings, before and after adaptation.

The semi-structured interviews were conducted in the Indonesian language and were transcribed and translated into English. The qualitative data gathered from the interviews were then analyzed thematically. Data analysis in qualitative research needs to be conducted in a precise, consistent, and comprehensive manner for the outcomes to be considered credible [47]. Thematic analysis is used in qualitative research, which involves identifying, analyzing, organizing, describing, and reporting themes that emerge from the data set [48]. The interview transcripts of all participants as a unit of analysis were identified based on similar topics; then, categories and a coding scheme were developed. The coding scheme, then, was tested to ensure the clarity and consistency of the categories. An iterative process was conducted for checking coding consistency until sufficient coding consistency was achieved. When it was achieved, the coding rules were applied to code the entire corpus of text from the interview transcripts. Following this step, coding consistency was assessed again to ensure it was coded in a consistent and reliable manner. The final steps were, drawing conclusions and deriving meaning from the data. Microsoft Excel was utilized to manually scrutinize the thematic analysis.

### 3. Results

#### 3.1. The 2019 Interview Findings

The 2019 interview outcomes identified nine themes of challenges and four themes of opportunities for improving the sustainability of public buildings. Table 2 presents the themes of the challenges and opportunities based on the responses from the interviewees.

**Table 2.** Findings from the 2019 interviews: challenges and opportunities.

Challenges	Opportunities
<ul style="list-style-type: none"> <li>• Lack of mandate on public building sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Government institution initiative and government officers' participation</li> </ul>
<ul style="list-style-type: none"> <li>• Improper policy development</li> </ul>	<ul style="list-style-type: none"> <li>• Budget feasibility</li> </ul>
<ul style="list-style-type: none"> <li>• Lack of coordination between government agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Basic skills to upgrade existing buildings to be sustainable buildings</li> </ul>
<ul style="list-style-type: none"> <li>• Limited knowledge of sustainable buildings</li> </ul>	<ul style="list-style-type: none"> <li>• Attraction to sustainable public buildings through physical appearance.</li> </ul>
<ul style="list-style-type: none"> <li>• Lack of awareness of sustainability practices</li> </ul>	
<ul style="list-style-type: none"> <li>• Problem with staff placement and rotation</li> </ul>	
<ul style="list-style-type: none"> <li>• Lack of leadership</li> </ul>	
<ul style="list-style-type: none"> <li>• Lack of international support</li> </ul>	
<ul style="list-style-type: none"> <li>• Challenges in retrofitting of existing buildings for sustainability</li> </ul>	

The 2019 interview findings highlighted the challenges to improving public building sustainability mainly from the government's perspective. The following top five themes emerged from the interviews: lack of mandate, improper policy development, poor coordination between government agencies, government human resource management issues such as staff rotation, and lack of leadership. From those findings, the lack of a mandate was a dominant issue that most interview participants considered the root cause for the lack of success in implementing sustainability practices in Indonesian public buildings. In total, 46 of the 457 codes identified as issues/challenges in sustainable public buildings were linked to the lack of a mandate. Despite the use of advanced technology in the process of accelerating sustainability practices in the building sector, the requirement of a mandate on sustainable building performance is unavoidable [49]. Thus, a strong mandate is required to establish a comprehensive framework for sustainable public buildings.

In addition, the issues of policies, coordination, human resources, and leadership have caused policy implementation gaps. Interviewees noted that the existing policies were not well-planned and often implemented in a rush (BO6). The policies were also silent on the question of rewards and punishments and were too rigid and lacked means of evaluation (BO6). As a consequence, the policies have been largely set aside as guides to building management. This policy and implementation gap was emphasized as a barrier to improving sustainable building practices in developing countries [50,51].

It was reported that poor coordination creates complex challenges in the process of improving public building sustainability. Poor coordination involves limited stakeholder engagement, lack of policy synergy, and lack of data integration between key agencies. National and local coordination is crucial for the effectiveness of sustainable building policies and should be incorporated into policy planning for implementation [52]. Moreover, besides the importance of coordination, the commitment of government organization leaders is crucial in the implementation of policy and real examples of leadership to encourage building occupants to develop sustainability practices. Managerial discretion for sustainability performance is crucial [53]. Therefore, proper and comprehensive policy development and coordination between agencies should be consistently actioned by government and leadership, which should be an integral part of policy implementation to ensure significant progress on sustainable buildings in the public sector.

Another challenge is problems related to mismatched placements of staff and a general lack of human resources. Staffing changes are a problem, especially if they are responsible for overseeing the project (PM5, PM6, PM7). The replacement of the person in charge during the project can create many difficulties for contractors with identifying and reporting problems, or progress, especially when there is limited knowledge of sustainable construction (BP1, BP2). Staff rotation should be a means to enrich the employees' skills and ensure the sustainability of a project or business process [54]. However, according to the 2019 interview findings, due to the limited number of employees skilled in sustainable building practices, staff rotation can be a barrier to maintaining the sustainability performance of public buildings. Hence, ensuring the availability of skilled and knowledgeable personnel is critical before conducting staff rotation in the context of improving the sustainability of public buildings.

Besides challenges from the government side, critical issues related to 'people' were raised by the interviewees in relation to the lack of knowledge and awareness of sustainability practices. Building users and professionals were identified as stakeholders with inadequate conceptual knowledge of building sustainability. This problem is reflected in instances of improper installation and design, as well as in the absence of experienced certified personnel. This lack of capacity has hampered the attainment of optimum results in sustainable public buildings. The limited knowledge of building sustainability on the part of building professionals, managers, and users was discussed at great length by the interviewees (BO5, BO6, BO7). Public building contractors still held conventional renovation perspectives in relation to sustainability projects (BO2). Others failed to apply green standards to the project (BU2). This behavior occurred not only among contractors as technical executors of the project, but also among experienced project planners who had limited knowledge of sustainable building design (PM5). This situation has also been documented by researchers [55] in the case of Nigerian green construction development. Hence, it raises concerns regarding industry readiness for sustainability, which is important to accelerate sustainability practices in government buildings.

Lack of awareness was also raised as a contributing factor to the limited progress on sustainable public buildings. Although knowledge might be available, a lack of awareness of lifestyles and habits relating to sustainability practice was perceived as contributing to

the slow progress of sustainable public building construction. Lack of awareness is one of the biggest challenges in sustainable building development [56]. This evidence underscores the fact that awareness and behavior are critical factors in improving the sustainability of public buildings.

Another two challenges that contribute to the limited growth of sustainable public buildings are international support and difficulties in the sustainable building retrofitting process. International institutions such as the World Bank play an important role in many development programs in developing countries. They not only provide financial and technical support but also, in many cases, influence policy development and government decision-making. These important roles of international organizations were emphasized by the interview participants in relation to how they can help accelerate the progress in sustainable public buildings. The role of international agencies, such as UNEP and IFC who are key promoters of sustainable buildings globally, was noted [57]. Thus, it is an opportunity to have their support in accelerating sustainable public buildings.

The final challenge identified from the 2019 interviews was the difficult process of retrofitting existing buildings. In the case of existing public buildings, achieving a sustainable building does not lie in reaching the ultimate point due to difficulties in adapting existing physical buildings (BO1, BO8). From a policy-maker perspective, existing building designs and conditions represent the tasks to be carried out to reach the desired standard of sustainability (PM6, PM9, PM10). Existing building structures pose a significant challenge to transform conventional buildings to be sustainable [58]. Therefore, considering the existing building structure in the strategic approach to achieving a sustainable public building, it is necessary to ensure that the required building standards are met.

On the other hand, among the challenges, interviewees considered some opportunities to unlock barriers to sustainable public buildings. These include sustainability initiatives, budget availability, basic skills and knowledge regarding sustainable buildings, and the attraction of sustainable buildings. These aspects open opportunities for the development of sustainable public buildings in the future.

This study revealed that budget availability was not a significant problem in improving public building sustainability. This result contradicts other research findings [56] that limited budget availability in many countries is one of the main challenges to building sustainability. Other researchers have stated that the main issue is not the lack of a budget but rather budget allocation [35]. When the government identifies sustainable buildings as a political priority, there is a budget allocation to execute sustainable building development projects [35]. Thus, budget allocation can accelerate the implementation of sustainable public building initiatives.

Interviewees commented that there is a very basic ability among building professionals to conduct public building sustainability projects. Some small technical interventions to existing public buildings were considered to have been completed effectively and professionally. Kasai and Jabaour [17] and Alam et al. [35] stated that basic skills in sustainable buildings in the construction workforce are essential for the development of sustainability practices in buildings. However, interviewees emphasized that one of the barriers to the implementation of sustainable public buildings is the lack of knowledge of sustainable buildings among all the other stakeholders (building owners, managers, and users).

The physical appearance of sustainable public buildings has been recognized as an attraction. The current material technology for sustainable buildings provides a modern, aesthetic appearance that attracts public attention [59]. Even though some spaces can be misused by occupants, overall, the buildings look more modern and capture more fresh air and sunlight. The users typically feel more comfortable with the building's interior design.



Building user groups provided positive responses on the improvements undertaken on the adapted public buildings.

### 3.2. The 2023 Interview Findings

In the 2023 interviews, respondents were asked about the challenges and enablers that will promote sustainable public buildings in Jakarta after the capital city relocation. This stage was critical to understanding the key issues in addressing sustainability practice within the context of significant efforts in transforming public buildings in Jakarta. In addition, the interviews were framed in the context of the asset lifecycle to investigate critical issues in all stages of the lifecycle. Hence, these findings can be used to develop policy to transform public buildings in Jakarta to be sustainable.

Most participants agreed that sustainability is not ‘a new thing’ in public asset management in Indonesia. Legislation, even though it is inadequate and problematic, has components that support sustainability practices in public asset management at the central government and Jakarta provincial government levels [60].

Despite much progress, the 2023 interview findings further confirm that the current regulatory framework is the main barrier to progressing sustainable public buildings (see Table 3). This is because the regulations do not provide a clear direction at the planning stage and incentives at the maintenance and operational stages to promote sustainable public buildings. The lack of a comprehensive framework for promoting sustainable buildings is also the experience of some developing countries (Nigeria [15], Malaysia [14], Brazil [17]). This is a priority to be addressed. Hence, to enable the promotion of sustainable buildings due to the post-capital city relocation or not, the public asset management regulatory framework needs to be reformed.

**Table 3.** Findings from 2023 Interview: Challenges and Opportunities.

Challenges	Opportunities
<ul style="list-style-type: none"> <li>Limited knowledge on green buildings.</li> <li>Lack of flexibility on zoning (land use).</li> <li>Challenges to implement/promote green buildings, especially for existing buildings.</li> <li>Limited budget to renovate existing buildings to meet green building criteria.</li> <li>Issue of data availability, reliability, and accuracy.</li> <li>Green building certification is too complex.</li> <li>Retrofitting or new buildings requires technical expertise and an extensive budget.</li> </ul>	<ul style="list-style-type: none"> <li>Regulation and budget to promote green buildings among government assets.</li> <li>Political willingness and leadership.</li> <li>Key institutions to promote green buildings, including state asset management agency.</li> <li>Flexibility in spatial planning for mixed use to meet sustainable or green building requirements.</li> <li>Accurate and reliable data systems to support planning and innovation.</li> </ul>
<ul style="list-style-type: none"> <li>Administrative and technical burdens to be a green building.</li> <li>Limited number of government staff that have the green building certification.</li> <li>The institutional attitudes are mostly on short-term goals, the lowest development costs.</li> <li>Poor data to compare the quality of conventional and green buildings.</li> </ul>	<ul style="list-style-type: none"> <li>Having human resources that are capable of promoting green buildings and their associated requirements.</li> <li>Having green building codes and guidelines will help to expedite implementation.</li> </ul>
<ul style="list-style-type: none"> <li>Most government buildings will not meet the rating standard of green building certification.</li> <li>Changing individual habits and behavior can be difficult and takes time.</li> <li>Tropical climate can be a barrier to changing building users' behavior.</li> </ul>	<ul style="list-style-type: none"> <li>The use of rating tools for green buildings.</li> <li>Green building will cut operational and maintenance costs.</li> <li>Clean and better air quality.</li> <li>Changing behaviour can be part of individual-driven initiatives.</li> </ul>
<ul style="list-style-type: none"> <li>There is no vision to maintain long-term building performances including proper strategies for building disposal.</li> </ul>	<ul style="list-style-type: none"> <li>Need for short- and long-term planning.</li> <li>Repurpose government buildings for mixed uses.</li> <li>Third party collaboration and cooperation.</li> </ul>

*“...The main thing is regulation. It is important to have a regulation that provides a clear direction or vision to all [actors involved in managing] public buildings and*

*organisations that require retrofitting. Public buildings need to follow this regulation accompanied with the financial support to implement the regulation” (BU6).*

Furthermore, reforming public asset management towards sustainability requires political willingness and leadership (Table 3). Undertaking a sustainable building agenda is influenced by political priorities [61]. The leadership should primarily come from political leaders because green building projects are influenced by political interests requiring communication and coordination with the high-level decision makers (PM12). For green buildings to become a priority, high-level decision makers need to understand the concept of and the need for sustainable buildings. Ultimately, their leadership and political willingness are important to promote collaboration among relevant actors and to ensure the conduct of regulatory and budgetary reforms (PM12). Leadership and political willingness are key to having a clear vision at all stages to enhance long-term building performance, including strategies for disposal.

In addition, promoting sustainable buildings is not just physical. It involves behavioral change and community acceptance, especially when these require technological changes. Personal behavior can be a support or barrier to building sustainability practice [62]. This is in line with the interview results, which was mentioned by an interview participant from the building user group. Rejection by users and stakeholders may happen in a public building retrofit due to a lack of readiness to change behavior (BU6).

Increasing the awareness of occupants and users regarding how they can adapt to new functions of the building is needed to promote the implementation of sustainability principles in public buildings. “Not all users can immediately adapt to changes due to retrofit for smart offices” (BU6). A respondent suggested that governments need to work with non-government institutions to campaign for green, or sustainable, buildings similar to what the government has done for the new capital city (BP6). Campaigns are urgently needed, so the government must collaborate with other entities. That is, changing habits and willingness to change are key to transformation, regardless of whether there is a legal basis or not. Encouraging building users to change their behavior to adapt to sustainable building practices is key to successfully achieving sustainable building policy implementation targets [63]. Therefore, willingness can only be delivered if there are campaigns for increasing knowledge awareness. A respondent believed that the new capital relocation is timely for changing Jakarta (BP6). Many public buildings may become idle or vacant once the new capital city in East Kalimantan is functioning. Therefore, ensuring changes to key stakeholders’ behavior for adapting sustainable public buildings in Jakarta is a critical stage to be achieved in line with the decision on the capital city relocation.

The Ministry of Finance established the State Asset Management Agency of Indonesia (Lembaga Manajemen Aset Negara–LMAN) in 2017, with the specific task of managing and optimizing the value and use of under-utilized public buildings. The primary responsibility of this office was asset optimization through repurposing based on market demands. According to a respondent, the government’s vision for repurposing existing under-utilized and vacant buildings does not consider, or adopt, sustainable building practices (BP6). This finding is linked to the findings by Virgayanti [11], who noted that sustainable regulations are perceived as weak, ambiguous, and debatable, which represents the government’s point of view. Thus, in line with the 2019 interview findings, the mandate for sustainable buildings needs to be strengthened.

All respondents agreed with the urgency to adopt sustainable building practices, especially if the under-utilized buildings will be repurposed post-capital city relocation. However, unlike the development of new buildings that have adopted the concept of green buildings in the new capital city of Nusantara, the policy to adopt the green building concept for existing government buildings in Jakarta remains unclear. To fill this gap,

respondents suggested that the Green Building Council Indonesia needs to develop guidelines for the adoption of the green building concept for existing government buildings in Jakarta (BP6). However, adapting existing buildings to be sustainable buildings is more challenging than developing new buildings due to physical constraints and the unavailability of building data [64]. This issue can apply to conventional buildings and heritage buildings, as it was mentioned by one of the participants that several heritage buildings need to be repurposed (BP6). Therefore, this requires not only guidelines from the green building agency, but also a special framework from the government to repurpose existing public buildings.

Furthermore, a building user respondent believed that sustainable building concepts need to be applied at different stages of the asset lifecycle such as design, construction, maintenance, renovation, and disposal (BU6). For example, in an office in Cikini, Jakarta, a green building concept has been adopted, but receiving the green building certificate remains a challenge (BP6). It has only adopted partial requirements for a green building.

In promoting asset optimization, a policy-maker respondent raised a critical point regarding data availability for spatial planning, especially if the idea on mixed use is considered. In the current situation, although imperfect, a respondent suggested that the Jakarta provincial government had started to consider more flexible use in its spatial planning. For example, if a certain area had been allocated for offices previously, then it would not be easy to accommodate a café and other retail businesses. However, now mixed uses have been promoted in office buildings. Mixed use should be profitable, generating revenue, but should also consider environmental aspects such as water storage, green spaces, and green buildings (PM12). The next step is for a comprehensive study and real-time data to be available to enable more careful consideration to promote mixed use (PM12). Many underutilized buildings have been repurposed for mixed use to support the city and surrounding community's needs [65]. Therefore, mixed use can be an option for public building optimization.

For example, maximizing asset utilization in Lapangan Banteng areas in central Jakarta is a primary focus (BO14). The approach can be broadened not only at the building scale but also for area-based development (BO14). In this area, there has been a proposal to connect the Ministry of Finance headquarters with a church, mosque, and other complexes (e.g., businesses, apartments, and museums).

#### 4. Discussion

The research findings from the 2019 and 2023 interviews enrich the understanding of the challenges and opportunities to transform public buildings from conventional to sustainable buildings. The 2019 interviews explored key actors' knowledge and experience in promoting the sustainability of public buildings. The 2023 interviews further documented challenges and opportunities to enhance sustainability in public sector buildings with specific nuance regarding the capital city relocation policy. For this reason, the 2023 interviews focused on sustainable public buildings in Jakarta post-capital city relocation. Even though the two sets of interviews were conducted at different time frames and political moments (i.e., the decision of the capital city relocation), these two sets of interviews were strongly connected to the five factors: regulation and policies, organizational issues, technical problems, data, and people. The four consolidated themes consisting of people, regulation and policies, technical issues, and organizational issues are presented in Table 4.

**Table 4.** Consolidation themes from 2019 and 2023 interviews.

Challenges	Opportunities
<b>Regulation and Policies (11 themes)</b>	
Lack of mandate on public building energy efficiency (2019)	Budget feasibility (2019)
Improper policy development (2019)	Regulation and budget to promote green buildings within government assets (2023)
Lack of flexibility on zoning (2023)	Flexibility in spatial planning for mixed uses to meet sustainable or green building requirements (2023)
Limited budget to renovate existing buildings to meet green building standards (2023)	Having green building codes and guidelines will help to expedite the implementation (2023)
Administrative and technical burdens to be a green building (2023)	The use of rating tool for green buildings (2023)
	Repurpose government buildings for mixed use (2023)
<b>Organisation issues (8 themes)</b>	
Lack of coordination (2019)	Key institutions to promote green buildings include the state asset management agency (2023)
Lack of international support (2019)	Accurate and reliable data systems to support planning and innovation (2023)
Issue of data availability, reliability and accuracy (2023)	Need for short and long-term planning (2023)
The institutional attitudes are mostly on short-term goals, the lowest development costs (2023)	
Poor data to evaluate the quality of conventional and green buildings (2023)	
<b>People (15 themes)</b>	
Lack of knowledge (2019)	Initiative and participation (2019)
Lack of awareness (2019)	Initial skills in sustainable buildings (2019)
Problems with staff placement and rotation (2019)	Political willingness and leadership (2023)
Lack of leadership (2019)	Having human resources that are capable of promoting green buildings and their associated requirements (2023)
Limited knowledge of green buildings (2019)	Changing behaviour can be part of individual-driven initiatives (2023)
Retrofitting or new buildings requires technical expertise and an extensive budget (2023)	
Limited number of government staff that has green building certification (2023)	
Changing individual habits and behaviour can be difficult and takes time (2023)	
Tropical climate can be a barrier in changing of building users' behaviour (2023)	
There is no vision to maintain long-term building performances including proper strategies for their disposal (2023)	
<b>Technical issues (7 themes)</b>	
Problem with physical intervention in the building (2019)	Adapted buildings are attractive (2019)
Challenges to implement/promote green buildings, especially in existing buildings (2023)	Green building will cut operational and maintenance costs (2023)
Green building certification is too complex (2023)	Clean and better air quality (2023)
Most government buildings will not meet the rating standard of green building certification	

#### 4.1. Regulation and Policies

Regulations to support the implementation of sustainable public buildings are available in Indonesia [60]. The central and provincial governments have introduced regulations

to implement green buildings and sustainability practices. Such regulations can be viewed as significant progress with an opportunity for public building managers, users, decision-makers, and other key practitioners to progress sustainability practices in Indonesian public buildings. In the literature, the availability of regulations has been acknowledged as an enabling factor for sustainable public buildings [11]. Therefore, the existence of regulations on green building and other associated sustainability practices in public buildings should be appreciated in transforming the building and construction sector to be more sustainable in coping with climate change issues.

The existence of regulations alone, however, is not enough, especially when the regulatory framework is perceived as weak for its implementation and the absence of governing critical components such as budgeting. In this study it was found that the current regulations do not comprehensively address budget issues—without a budget, the regulations cannot be implemented effectively. For example, the regulation of the Ministry of Public Work number 02/PRT/M/2015 about green building does not regulate sustainable renovation. This is one of the aspects that result in the renovation budget not being used for the sustainable retrofitting of public buildings in Indonesia. This lack of regulation on prioritizing budget allocation for sustainable public building renovation to meet sustainability requirements was identified as a key challenge, and this can be considered as the absence of a strong mandate within the existing sustainable building regulations. In line with these findings, Virgayanti [11] found that current regulations for sustainable buildings in Indonesia are perceived as weak and ambiguous due to the highly hierarchical regulatory framework that lacks encouragement or incentive norms. For regulations to be effective or have a strong mandate, the government should provide incentives (i.e., budget allocation) to accelerate sustainable building growth [66]. If the Government of Indonesia wants to improve its regulatory process, then Alam et al. [35] recommend that regulation should be supported by political will. That is, the authors explained that regulations need to be presented clearly with detailed guidelines and strongly supported with appropriate resources such as a budget and procurement process [35]. Detailed guidelines need to have an encouragement system, such as a reward and punishment [35].

#### 4.2. Organizational Issues

The government's administrative and bureaucratic system was raised as a topic during the two sets of interviews. The positive aspect is that many Indonesian government institutions have voluntarily promoted green practices in their buildings through renovations. Two newly constructed public buildings have been certified as green buildings. GBCI [31] also listed one existing green public building. This number, however, is very low in comparison to a total of 60 certified green buildings in Indonesia [31]. Compared to the neighboring countries of Malaysia and Singapore, Indonesian progress in the uptake of sustainable public buildings (and across the building and construction sector) is very low. In 2020, Singapore had greened more than 40% of its buildings [67]. The Green Building Index has certified 619 buildings in Malaysia [68].

The research study found that the lack of coordination between key government agencies in the implementation of existing green building policies, and other policies to boost sustainability in public buildings, was relatively poor. Kasai and Jabbour [17] argue that coordination is a critical issue for an effective organization that is capable of moving towards sustainability.

Another crucial factor that constrains green projects is the lack of engagement between government institutions and international agencies. In the context of developing countries, the support of international agencies is important in any development program, including energy efficiency [69]. It is even possible, in some developing countries, that international



support can act as political catalyst to escalate an agenda into a position of national priority. International agencies can influence governments in developing countries to prioritize a particular program. Their support varies from financial to technical support. Any type of strong international agency support can be a key success factor for the improvement of sustainability practices in buildings. Therefore, integrating policies and the organizational roles of the government and industry sectors are considered critical aspects for the success of accelerating sustainable public buildings. This study confirmed the previous findings.

#### 4.3. Technical Issues

Green public buildings are a favorable achievement not only for the institution to showcase their commitment to sustainability and for mitigating climate change impacts through their assets, but also for leading by example to demonstrate to the private sector and the community. The physical appearance of green public buildings is a nationwide attraction. This study found that the physical attractiveness of green buildings creates a good impression on occupants. Occupants may have no knowledge or awareness of sustainability, but they become attracted by the new physical appearance of the buildings after the adaptation to the extent that green buildings are seen as an icon in the particular area. The attractiveness of a sustainable building's appearance to occupants and the community and the physical appearance is one element of sustainable building performance [70]. Sustainable buildings' appearance will create public attention [59]. Hence, if sustainable public buildings attract the attention of their occupants and the public favorably, then this is evidence that the green public building project has achieved one of its objectives. This feedback can then be motivating for other public buildings despite many challenges that may have had to be managed.

Retrofitting existing buildings to be sustainable is a challenging process. The main problems facing the sustainability of existing buildings are technical [64,71]. The technical issues include design and sustainable material challenges. Kasai and Jabbour [17], who conducted a case study for greening higher educational institution buildings in Brazil, found that existing building design and sustainable materials were not matched in execution by the projected green program. In promoting sustainability in public buildings in Australia, Alam et al. [35] reported challenges in technical interventions, i.e., energy efficiency of existing buildings, but the material issue was not a problem. One possible reason is that because of the different contexts, material issues are mainly faced by developing nations [72]. The findings of the current study are therefore consistent and make a further contribution to the existing knowledge base.

#### 4.4. People

This research finding demonstrates that people-related issues such as knowledge, skills, initiative and participation, awareness, and leadership are key to progressing sustainable public buildings. The people aspects connect to stakeholders' participation in sustainable buildings. Although not a new finding as it was raised four decades ago [73], stakeholder participation is still relevant. The findings from this study continue to advocate for the importance of considering user participation in designing sustainable buildings. For example, there is a policy in one government agency that created opportunities for users to participate in an energy-efficient buildings program that has encouraged them to enjoy the process of energy efficiency improvement as a habit. This is one practice that has successfully contributed to overcoming barriers to public building sustainability. To increase user participation, the voluntary approach has been found to have limited success [74,75]. A combination of top-down and bottom-up policy approaches is favorable for improving outcomes and enhancing participation in sustainable buildings [76]. Therefore,

a participation approach will complement a strong mandate from the top in sustainable public building implementation.

In addition to user participation, basic sustainability-related skills that building owners and users have are also valuable in promoting sustainable public buildings. These basic skills hold promise for further sustainable building skills development, which is the key to contributing to improving sustainability practices in public buildings. The participants did not directly emphasize the importance of basic skills that can be further developed to support sustainability practices. Other researchers [17,35] have noted that basic skills are important in technically supporting new sustainable developments and adaptations of buildings. When strong regulation is established, the enhancement of basic skills may be accelerated. Particularly in the context of public sector organizations, a mandate and policy are important drivers to achieve organizational goals and objectives [35]. Therefore, basic skills in sustainable buildings and the development of a mandate complement other supporting factors in improving sustainability practices in public buildings.

However, this study documented some critical challenges besides knowledge and awareness of sustainable buildings. It was found that inadequate human resource allocation can be a challenge to the success of sustainable public building development. The appointment of the right personnel in the right position is important if staff placement is to boost organizational performance [77]. The misallocation of human resources in terms of numbers or capabilities can retard performance. This applies to any program in an organization. In this study, it applies to public building management. Poor staff allocation can create challenges around having a sufficient number of appropriately qualified staff to conduct sustainable building programs.

## 5. Conclusions

The inputs from 41 participants from two interview campaigns (2019 and 2023) were analyzed to identify the challenges and opportunities for improving sustainability practices in public buildings. The 2023 interviews were conducted after the announcement of the relocation of the Indonesian capital city. This study used Indonesian public buildings as the focus of analysis to answer the following question: To what extent have the key perceptions regarding the challenges and opportunities for improving sustainability practices in public buildings from a multi-stakeholder perspective within the context of developing countries.

The two sets of interview findings identified four key factors to promote sustainability practices in public buildings in developing countries, including, regulation and policies, organizational issues, technical issues, and people-related issues. Based on the research findings, this study has contributed to enriching the knowledge base for promoting sustainability in public buildings. Specifically, this study argues for the combination of a strong mandate for sustainable public buildings through the effective implementation of the regulatory framework with the promotion of people's participation in sustainable public building development. This approach is arguably able to deal with the challenges and maximize the opportunities to achieve sustainability in public buildings. The findings provide guidance to develop broader policy frameworks with some adaptations in a similar context beyond Indonesia. Such an approach is expected to accelerate the implementation of sustainability practices in public buildings in developing countries.

Limitations are acknowledged in line with knowledge dissemination in this study as a pathway for future research. The limitations associated with the 2019 and 2023 interviews could have been influenced by political uncertainty in Indonesia, since there was a presidential election and capital city relocation was widely debated at the time of data collection. This study identified, analyzed, and validated the qualitative aspects to improve public building sustainability. It is suggested that future research should analyze

quantitative data such as energy efficiency that will enrich analysis for the successful measurement of sustainable public building development.

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## Appendix A

**Table A1.** Semi-structured Interview Questions.

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A. Challenges on improvement of Indonesia public building sustainability practice	
<i>Identify barriers that the interviewees found in implementation of sustainable public buildings</i>	
<b>Questions for policy-makers, building professionals, owners, and users:</b>	
1.	In your experience, what are the hindering factors for transforming existing public buildings to be more energy-efficient? Can you explain? ( <b>Probes</b> )
a.	Financial
b.	Administrative
c.	Knowledge
d.	Awareness
e.	Physical
f.	Social
g.	Assessment
h.	Procurements
i.	Legal (ambiguity)
j.	Others
2.	Why do they become hindering factors for public building sustainability?
3.	Based on your opinion, can you rank the hindering factors from the most important to the least important?
<b>Questions for Owners:</b>	
1.	Why do you decide (not decide) to retrofit/adapt your building to be more sustainable or energy-efficient?
2.	Do you think sustainable buildings give you many benefits? Could you explain? (When many experts and evidence show the benefits of sustainable buildings, do you think conventional buildings give optimum support to your organization?)
3.	What do you think is the most significant difference between sustainable buildings and conventional buildings?
4.	What are the barriers and challenges to transform conventional buildings to be more sustainable?
5.	What is the most significant barrier or challenge?

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**Table A1.** *Cont.*


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B. Opportunities enabling the improvement of Indonesia's public building sustainability practice

*Identify factors that should be taken into consideration as a potential aspect to improve Indonesian public building sustainability practice based on interviewees' knowledge and experience.*

**Questions for policy-makers, building professionals, owners, and users:**

1. In your experience, what are the supporting factors that can accelerate the transformation of existing public buildings to be more energy-efficient? Can you explain? **(Probes)**
  - a. Financial
  - b. Administrative
  - c. Knowledge
  - d. Awareness
  - e. Physical
  - f. Social
  - g. Assessment
  - h. Procurements
  - i. Legal
  - j. Others
2. Why do they become supporting factors for public building adaptation?
3. Based on your opinion, can you rank the supporting factors from the most important to the least important?

**Questions for Owners:**

1. What are the supporting factors that currently exist or are expected to exist to transform conventional buildings to be more sustainable?
2. What are the most significant supporting factors?

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