

Policy Mapping for Direction on Green Vertical Housing Development in Indonesia

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ABSTRACT

Indonesia's rapid urbanization has accelerated the construction of vertical public housing as a state-led response to growing urban housing needs. Compared to the general housing sector, these projects hold strategic importance due to their large scale, policy alignment, and reliance on public financing. However, this expansion intensifies resource consumption and environmental degradation, particularly in the absence of mandatory green building (GB) standards. Although GB initiatives have been introduced across multiple sectors, their fragmented implementation and weak enforcement diminish their overall effectiveness. Vertical public housing, therefore, presents a key opportunity for policy innovation, where governmental authority can effectively institutionalize sustainability practices. This study aims to map existing GB-related regulations and develop strategic policy directions for sustainable vertical housing in Indonesia. The research adopts a four-stage framework: (1) a systematic review of 50 Scopus-indexed articles (1985–2023) to identify key aspects of GB policy, (2) regulatory mapping of 36 official documents analyzed chronologically to capture policy evolution and thematic coverage, (3) a comparative policy review involving six countries to extract relevant lessons, and (4) synthesis of results into actionable policy directions and strategies tailored to Indonesia's vertical housing context. Findings highlight four priorities: enhancing stakeholder engagement and awareness; integrating technical standards and performance assessments; enforcing GB compliance for buildings over 5,000 square meters, and establishing financial and non-financial incentives. The resulting framework promotes stronger coordination, regulatory clarity, and practical enforcement. Ultimately, this study contributes to advancing coherent, context-specific green policies that support Indonesia's transition toward sustainable and resilient urban housing.

Keywords: vertical public housing, green building, policy mapping, sustainable housing, Indonesia

INTRODUCTION

Indonesia is currently facing a severe housing shortage, which has been described as one of the country's most persistent socio-economic challenges. Official data from the Ministry of Public Works and Public Housing (Kementerian PUPR) reported a national housing deficit of approximately 12.7 million units in 2023, with annual demand increasing by 700,000 to 800,000 units (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2023). To address this structural gap, the government initially set a target of constructing 1.5 million housing units per year, aiming to eliminate the backlog by 2045. However, in response to the persistent and widening disparity between demand and supply, this target was revised in 2024 into a more ambitious commitment to build 3 million housing units annually, extending to urban, rural, and coastal areas (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2024).

While these quantitative targets reflect bold political will, they have not been matched by comparable attention to sustainability standards. Many of the newly constructed housing projects do not incorporate principles of environmental sustainability such as energy efficiency, climate resilience, and long-term affordability, raising concerns over potential social and ecological consequences (UN-Habitat, 2020; World Bank, 2022). Data from the Central Agency of Statistics (Badan Pusat Statistik, 2021 or BPS) further highlight this concern, showing that the construction and industrial sectors account for 43.9% of national final energy consumption, with households contributing an additional 31.2% (Badan Pusat Statistik, 2021). At the global level, the urgency of this issue is evident, as the building sector contributes around 21% of greenhouse gas (GHG) emissions, with 57% stemming from energy use, 24% from onsite fuel consumption, and 18% from material production, particularly cement and steel. Without a robust regulatory framework, Indonesia's massive housing expansion risks intensifying its environmental burden.

Although Green Building (GB) frameworks are widely used internationally as a strategy to mitigate risks (Berardi, 2013; Darko & Chan, 2018), Indonesia's adoption remains weak. Regulation No. 21 of 2021 outlines performance

criteria—energy efficiency, indoor air quality, sustainable materials, and waste management—but its implementation in vertical housing is still only recommended, not mandatory (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2021). By 2023, only 234 certified GBs existed, with fewer than 5% in public vertical housing (Green Building Council Indonesia, 2024). Barriers such as high construction costs (Durdyev et al., 2018), insufficient incentives (Suhaida et al., 2013), regulatory fragmentation (Sahid et al., 2020), and poor coordination (Anastasia, 2013) continue to hinder progress. More critically, the lack of binding mandates prevents institutionalization (Darko & Chan, 2018; Shan et al., 2017), reaffirming that effective GB adoption depends on strong institutions, consistent regulations, and incentive structures (Zepeda-Gil & Natarajan, 2020; Zhang et al., 2019).

Against this background, the present study seeks to provide a comprehensive mapping of Indonesia's regulatory framework on GB and vertical housing, identifying policy gaps and inconsistencies, and drawing insights from international experiences. The ultimate aim is to propose a regulatory roadmap that not only ensures the integration of sustainability principles into vertical housing development but also strengthens Indonesia's capacity to meet its housing needs while advancing climate resilience and environmental sustainability.

METHODS

This study adopts content analysis as its principal methodological framework, enabling the systematic examination of scholarly literature, regulatory instruments, and international practices pertaining to GB in vertical housing. The approach is organized into three interrelated stages, namely a literature review, a regulatory review and mapping, and a comparative country study. These stages are integrated to generate coherent policy directions and actionable strategies relevant to the Indonesian context. A detailed account of each stage is presented in the subsequent sections, while the overall methodological phases are depicted in Figure 1.

The research objectives are structured to align closely with the methodological framework,

ensuring coherence between analytical stages and expected outcomes. In this structure, the literature review provides the conceptual foundation, the regulatory review and mapping offer an in-depth national analysis, and the comparative study enriches policy recommendations.

Literature Review

The literature review was conducted based on clearly defined inclusion and exclusion criteria to ensure the rigor and relevance of the selected sources. Only publications indexed in Scopus and published between 1985 and 2023 were included, resulting in a final dataset of 50 scholarly works. Sources that were not peer-reviewed or did not explicitly address GB policies or vertical housing were excluded. The review systematically identified the principal drivers, barriers, and strategies of GB implementation, which were subsequently coded and categorized in accordance with established qualitative synthesis procedures (Corbin & Strauss, 2008). In addition, a structured document analysis was applied to distill key thematic insights (Bowen, 2009). This process ultimately yielded the Key Aspects of Green Building Policy Implementation, which were later employed as the analytical

dimensions in the regulatory mapping stage of the study.

Regulatory Review and Mapping

The regulatory review covered 36 relevant regulations and 2 official event documents issued at both national and ministerial levels, including presidential regulations and ministerial regulations from the Ministry of Public Works and Housing (PUPR), the Ministry of Energy and Mineral Resources (ESDM), and the Ministry of Environment and Forestry (KLHK). A regulation database was compiled from official government websites, documenting titles, content, scope, and legal hierarchy, with the latter formally defined in Law No. 12 of 2011 on Legislation Making, as amended by Law No. 15 of 2019 and Law No. 13 of 2022 (Republik Indonesia, 2011). In total, the regulations were categorized into four clusters: three addressing sustainability and climate change, eight focusing on buildings and GB, ten on public vertical housing, and seven on energy and environmental provisions. Their distribution is illustrated in Figures 2 and 3, which differentiate national-level and ministerial-level policies.

Figure 1
Method Phases in Mapping the Direction of GB Policy in Vertical Residential Development in Indonesia

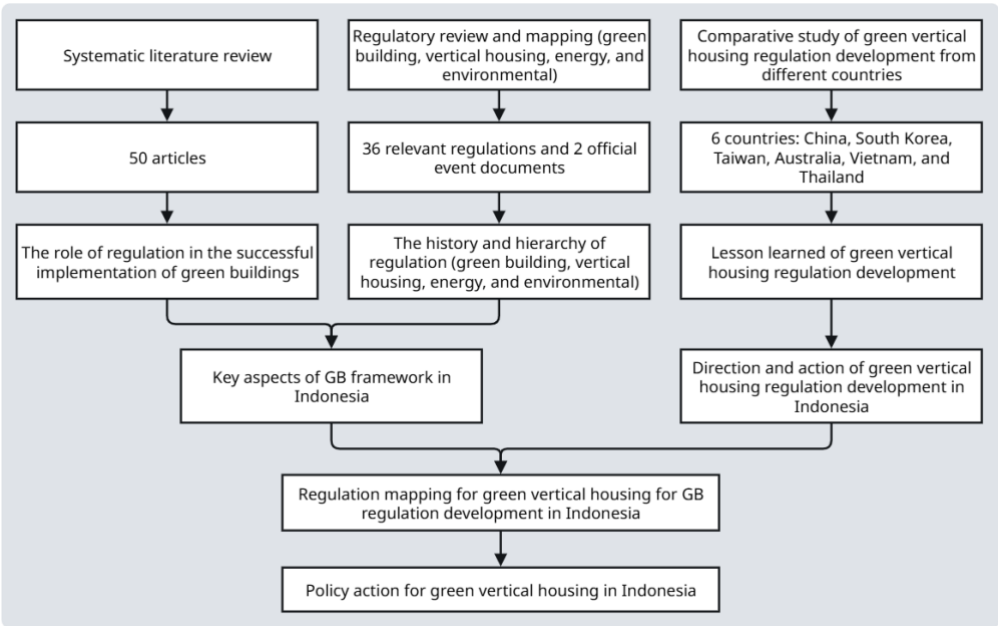
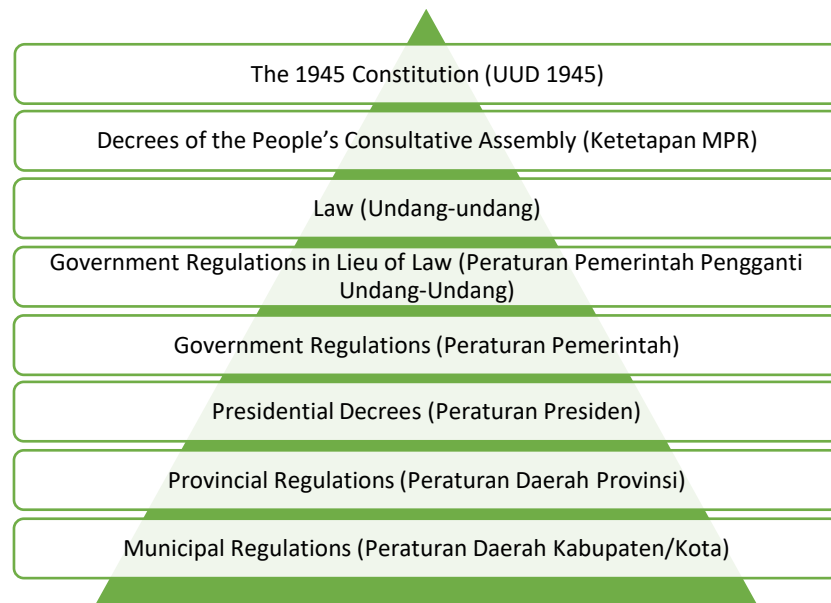
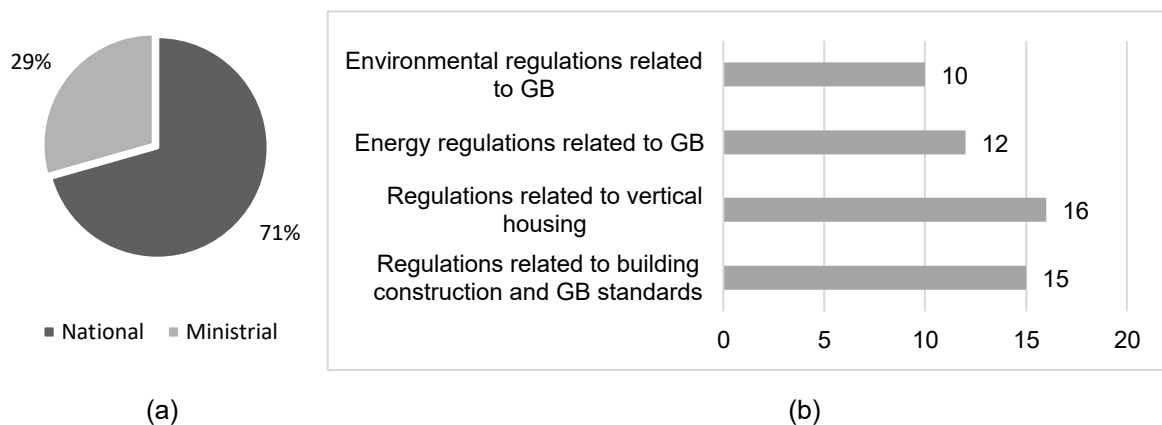


Figure 2

The Hierarchy and Categories of Regulations that Constitute the Legal System in Indonesia

**Figure 3**

(a) Regulation Based on Level (b) Existing Regulations Pertaining to GB and Vertical-Identified Housing



The review combined chronological and content analysis. Chronological analysis traced the evolution of GB regulations to identify institutional changes, milestones, and shifting priorities, while content analysis applied a radar diagram to assess regulatory coverage across the Eight Key Aspects of GB Policy Implementation, including institutional frameworks, codes, compliance, incentives, performance, and monitoring. This mapping revealed strengths in certain technical areas but also exposed significant regulatory

gaps for vertical housing. Importantly, GB regulations in Indonesia have emerged irregularly, often in response to shifting government priorities, ranging from infrastructure expansion to environmental concerns (Reztrie et al., 2017; Widya et al., 2023). External commitments such as the Kyoto Protocol and Paris Agreement have served as critical triggers (Utomo et al., 2022; Zepeda-Gil & Natarajan, 2020), while domestic political transitions and economic crises have added further

inconsistency (Sahid et al., 2020; Zakiah, 2023). These dynamics underscore the need for a structured long-term regulatory roadmap to ensure GB development becomes a consistent pillar of Indonesia's sustainable housing strategy, rather than a fragmented response to short-term or external pressures (Darko & Chan, 2016; Shan et al., 2017; Zhang et al., 2019).

Comparative Country Study

To complement the regulatory review, a comparative study was conducted on six countries—China, South Korea, Taiwan, Australia, Vietnam, and Thailand—representing different stages of GB policy maturity. These six countries were selected because they represent diverse institutional, economic, and environmental contexts within the Asia-Pacific region, allowing Indonesia's policy position and progress to be critically benchmarked against regional best practices. The analysis focused on institutional frameworks, regulatory systems, mandatory requirements for government-owned vertical housing, and incentive mechanisms for non-government projects. The goal was to extract practical lessons relevant to the Indonesian context.

By integrating literature synthesis, regulatory chronology, radar diagram content mapping, and cross-country comparison, the study provides a comprehensive framework for analysis. The radar diagram, based on the Key Aspects of GB Policy Implementation, illustrates regulatory coverage, while the chronological review situates Indonesian policies within their historical trajectory. Comparative insights from regional peers highlight alternative models that can inform Indonesia's own policy development. Overall, this approach moves beyond description to prescriptive guidance, offering concrete directions and actions for embedding GB principles into vertical housing policy and advancing Indonesia's sustainable development agenda.

RESULTS

The Role of Regulation in the Successful Implementation of Green Buildings

Based on the reviewed data, several key themes emerge regarding the focus of GB research and policy implementation across different countries. In Indonesia, the literature predominantly addresses the challenges and barriers associated with the implementation of GB practices within construction projects (Berawi et al., 2019; Linggo & Sutandi, 2023; Prasetyawan et al., 2023; Sahid et al., 2020; Susanto & Sujana, 2023; Zakiah, 2023).

China's research landscape emphasizes policies aimed at carbon reduction and their broader implications for sustainable development (Bai et al., 2017; Luo & Yu, 2024; Pata et al., 2023; Teng & Wang, 2021; Zhou et al., 2019; Zhou et al., 2024). South Korea has concentrated its studies on the development and optimization of GB energy management systems (Baek, 2021; Cho et al., 2023; Kim & Yu, 2020; Kim et al., 2023; Moon et al., 2020; No & Won, 2020; Oh & Kim, 2024; Ren & Kim, 2024; Roh et al., 2018; Woo et al., 2024; Yun et al., 2018; Zhu, 2024). Meanwhile, countries such as Taiwan, Singapore, Australia, and the United Kingdom have explored GB policies and development strategies, with particular attention to their impact on long-term sustainability goals (Darko & Chan, 2016; Han, 2018; Hwang, 2017; Loan & Th  ng, 2021; Shan et al., 2017; Siva et al., 2017; Subramaniam & Loganathan, 2024). In Malaysia and Vietnam, scholarly work often focuses on the practical challenges of enforcing GB regulations and the obstacles faced during implementation (Darko & Chan, 2016; Han, 2018; Hwang, 2017; Loan & Th  ng, 2021; Siva et al., 2017; Subramaniam & Loganathan, 2024). Several previous studies in Thailand have highlighted the importance of policy in supporting building sustainability, particularly in relation to energy efficiency and the cultural preservation of historic buildings (Marome et al., 2023; Tochaiwat & Pultawee, 2024). Studies from Iran highlight the adoption of GB technologies in the context of developing countries, emphasizing the difficulties

and opportunities involved in integrating sustainable practices within existing frameworks (Amiri et al., 2020; Delavar et al., 2023; Zamankhani, 2018).

To specifically examine the variables in the implementation of the green building concept, a content analysis coding was conducted on 50 studied literatures. The results of the coding regarding the independent and dependent variables from the 50 reviewed sources are illustrated in Figure 4 and Figure 5.

Figure 4 shows that regulation and policy are the most influential factors in driving sustainable development, emphasizing the importance of strong government direction and supportive frameworks. Innovation and technology follow as key enablers, addressing the need for efficient, eco-friendly solutions throughout the building

lifecycle. Public education and stakeholder awareness also play a critical role, as broader understanding fosters greater adoption.

In contrast, financial support remains a major barrier due to the high initial costs of green initiatives. Other contributing factors include stakeholder collaboration, resource availability, and socio-cultural dynamics, all essential for practical, community-accepted implementation. While GB certification and community leadership are recognized, they are not yet seen as primary drivers. The construction industry's readiness and building characteristics score lowest, indicating either low perceived urgency or insufficient attention. Overall, the findings confirm that effective policy, innovation, financial access, and cross-sector engagement are central to achieving sustainability goals.

Figure 4

Content Analysis of Independent Variables Influencing Green Building Implementation in 50 Studies

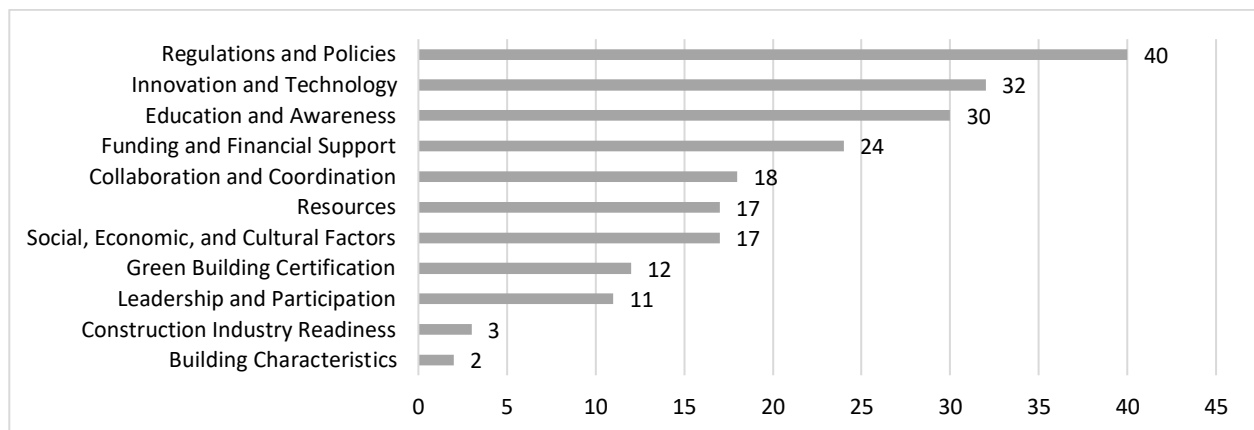


Figure 5

Content Analysis of Key Aspects (Dependent Variables) Influencing GB Implementation in 50 Studies

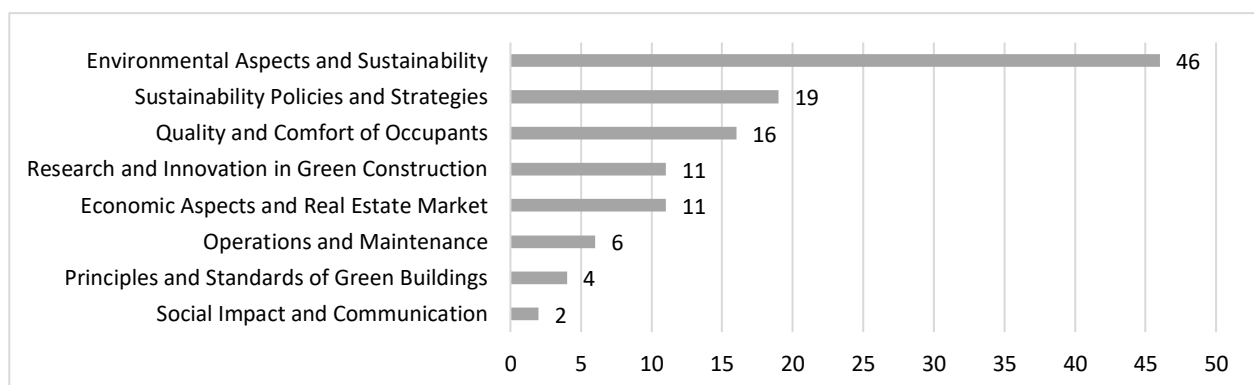


Figure 5 shows that Environmental and Sustainability Aspects are the most common focus, highlighting green buildings' core aim: improving environmental performance. Green Policies and Strategies also rank highly, underscoring the importance of coherent policies. Across 50 studies, regulation and policy emerge as key drivers of green building success and are strongly linked to positive environmental outcomes.

These findings highlight that without a clear and integrated policy environment, green building efforts face major constraints. Policy not only regulates but also enables by aligning innovation, financing, awareness, and stakeholder coordination. Table 1 further shows that Regulation and Policy has the highest frequency of association (39 instances) with Environmental and Sustainability Aspects, underscoring the foundational role of policy in embedding sustainability into planning, design, and construction processes.

Table 1

Distribution of Dependent Variables with Independent Variables Influencing GB Implementation in 50 Studies

		Dependent Variables							
		Economic Aspects and Real Estate Market	Environmental Aspects and Sustainability	Social Impact and Communication	Sustainability Policies and Strategies	Quality and Comfort of Occupants	Operations and Maintenance	Research and Innovation in Green Construction	Principles and Standards of Green Buildings
Independent Variables	Education and Awareness	9	29	1	11	13	3	6	0
	Social, Economic, and Cultural Factors	6	17	1	7	6	1	3	1
	Innovation and Technology	8	31	2	12	12	4	8	1
	Building Characteristics	0	2	0	0	1	0	0	0
	Leadership and Participation	0	11	1	7	3	1	2	1
	Construction Industry Readiness	1	3	0	1	1	1	1	0
	Collaboration and Coordination	4	16	0	4	6	1	5	0
	Funding and Financial Support	7	23	0	10	8	5	7	1
	Regulations and Policies	11	39	1	11	16	6	9	2
	Green Building Certification	1	11	1	5	3	1	5	3
	Resources	3	15	1	8	8	1	4	1

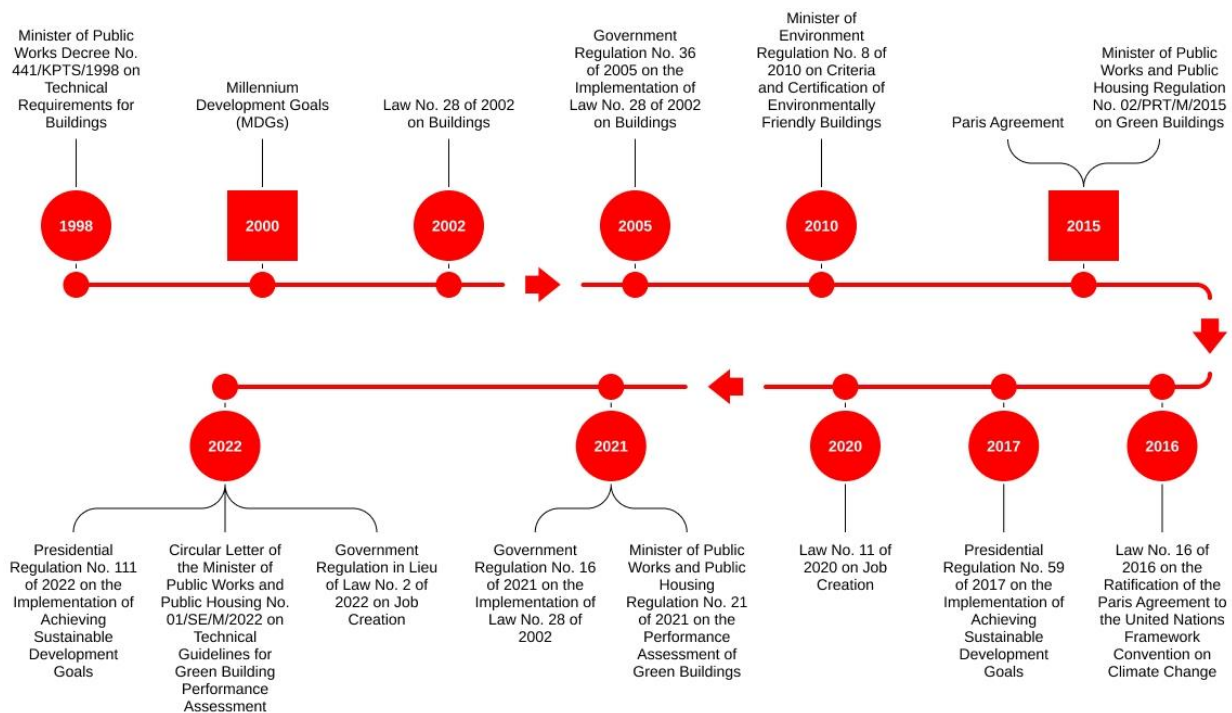
Regulations related to Building Construction and GB Construction in Indonesia

The regulatory analysis identified eleven regulations and two official events shaping Indonesia's building construction and GB policies. The trajectory began with the Minister of Public Works Decree No. 441/KPTS/1998 on Technical Requirements for Buildings (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 1998) and was followed by Law No. 28 of 2002 on Buildings and Government Regulation No. 36/2005 as its implementation (Republik Indonesia, 2002). The Ministry of Environment advanced the agenda with Regulation No. 8/2010 on Environmentally Friendly Buildings, establishing nine sustainability aspects (Kementerian Lingkungan Hidup dan Kehutanan, 2010). In 2015, PUPR issued Regulation No.

02/2015 on GB criteria, aligning with Indonesia's endorsement of the Paris Agreement, which was later ratified through Law No. 16/2016 and supported by Presidential Regulation No. 59/2017 on SDG implementation. The regulatory framework was further consolidated through Law No. 11/2020 on Job Creation and Government Regulation No. 16/2021 introducing the new Building Code, alongside Regulation No. 21/2021 on GB Performance Assessment (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2021; Republik Indonesia, 2020, 2021b). Most recently, regulatory instruments in 2022—Government Regulation in Lieu of Law No. 2/2022, Presidential Regulation No. 111/2022 on SDG acceleration, and Circular Letter No. 01/SE/M/2022 on GB assessment—demonstrated ongoing adjustments to both international and national sustainability agendas (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2022b; Republik Indonesia, 2022a, 2022b). The complete chronology is shown in Figure 6.

Figure 6

Chronology of Regulations related to Building Construction and GB Standards in Indonesia



When viewed through content analysis (Figure 7), this chronological progression reveals a consistent prioritization of environmental sustainability and occupant comfort as the dominant aspects of Indonesia's GB regulations. From the early focus on technical requirements in 1998 to the integration of environmental standards in 2010 and the adoption of Paris Agreement commitments in 2015–2016, policy development has largely been shaped by global environmental frameworks and the need to demonstrate compliance with international commitments such as the Kyoto Protocol (1997) and the Paris Agreement (2015). This explains why regulatory content has concentrated on energy efficiency, water conservation, emission reduction, and indoor comfort. In contrast, economic instruments, green financing, and research and innovation received little attention in earlier regulations and only began to emerge within the last five years, in line with Indonesia's transition toward a green economy.

Thus, the combined chronological and content analysis shows that Indonesia's GB policy development has evolved reactively to international commitments and national environmental priorities, producing strong regulation-driven standards for environmental performance, but with persistent gaps in economic integration, market mechanisms, and

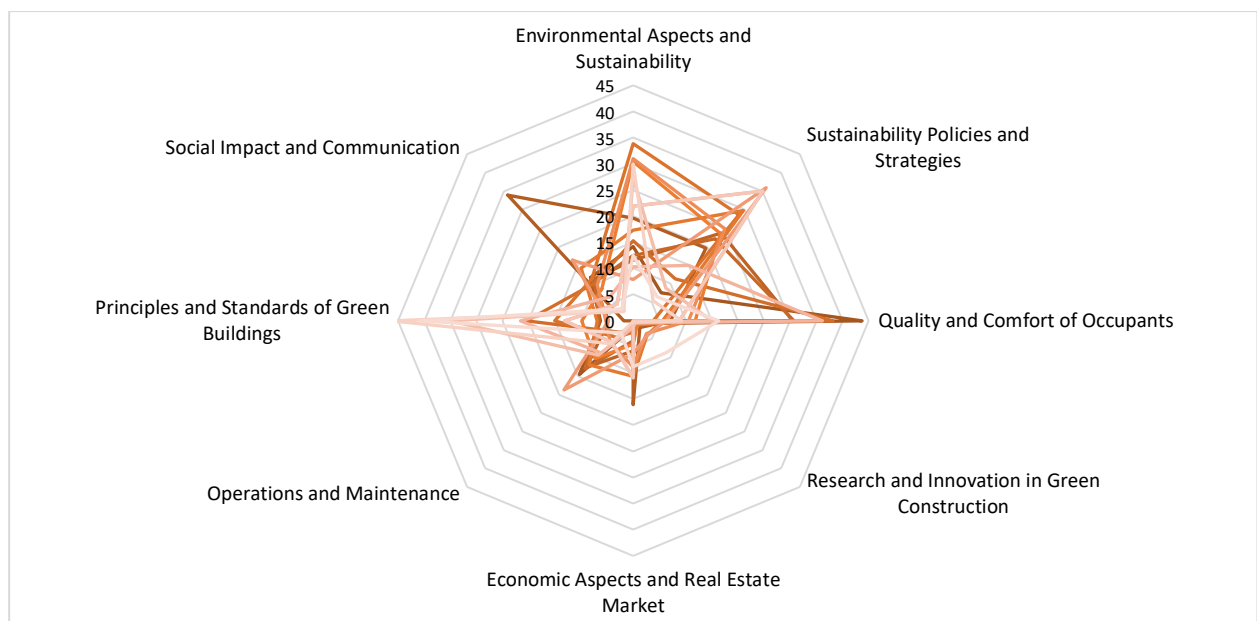
innovation support. This imbalance underscores the need to strengthen regulatory frameworks with complementary instruments that can accelerate adoption and ensure long-term sustainability in the housing and construction sectors.

Regulations related to Vertical Housing in Indonesia

The regulatory framework for vertical housing in Indonesia began with Law No. 16 of 1985 on Vertical Housing (Republik Indonesia, 1985), and Government Regulation No. 4 of 1988 (Republik Indonesia, 1988), later reaffirmed in Law No. 4 of 1992 on Housing and Settlements, which explicitly included vertical housing (Republik Indonesia, 1992). Global sustainability agendas also shaped the policy trajectory, beginning with the Millennium Development Goals in 2000 (United Nations, 2015). In 2007, the Ministry of PUPR issued Regulation No. 05/PRT/M/2007 on technical guidelines for high-rise housing, covering layout, structural reliability, and financing (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2007). A major institutional shift occurred with Law No. 1 of 2011 on Housing

Figure 7

Radar Chart Visualizing the Eight Key Aspects of GB Policy Implementation in Indonesia



and Settlement Areas, followed by Indonesia's ratification of the Paris Agreement through Law No. 16 of 2016 (Kementerian Lingkungan Hidup dan Kehutanan, 2016; Republik Indonesia, 2011, 2016) and Presidential Regulation No. 59 of 2017 on SDG implementation (Republik Indonesia, 2017).

Subsequent reforms included Law No. 11 of 2020 on Job Creation, consolidating earlier laws, including Law No. 20 of 2011 on Vertical Housing (Republik Indonesia, 2020, 2022a) and Government Regulation No. 13 of 2021, which comprehensively addressed vertical housing from classification and ownership (SHM, SKBG) to public housing management and developer incentives, replacing Government Regulation No. 4 of 1988 (Republik Indonesia, 2021a). More recent instruments include Ministry Regulation No. 7 of 2022 on Special Housing (Kementerian Pekerjaan Umum dan Perumahan Rakyat, 2022a), Presidential Regulation No. 111 of 2022 on SDG Acceleration (Republik Indonesia, 2022a), and Circular Letter No. 12/SE/Dr/2022 providing technical guidance for vertical housing development and management (Kementerian Pekerjaan Umum dan Perumahan Rakyat,

2022c). Figure 8 presents the overall timeline of these policy developments.

The content analysis of these regulations (Figure 9) reflects this chronological trajectory. The most dominant policy aspects are Quality and Comfort of Occupants and Sustainability Policies and Strategies, consistent with the historical orientation of government-led vertical housing programs that emphasized livability—safety, ventilation, and fire protection—and the later integration of sustainability principles in response to global environmental commitments such as the SDGs and Indonesia's NDCs. By contrast, Economic Aspects and Research and Innovation in Green Construction remain underdeveloped. This weakness is explained by the strong reliance on government subsidies and direct provision, which limited the development of market-based instruments, green financing mechanisms, and research-driven innovation. Thus, while the chronological development demonstrates Indonesia's responsiveness to global sustainability agendas and its success in securing livability standards, the content analysis reveals that policies still fall short in embedding economic and technological dimensions.

Figure 8

Chronology of Policy Issuance related to Vertical Housing

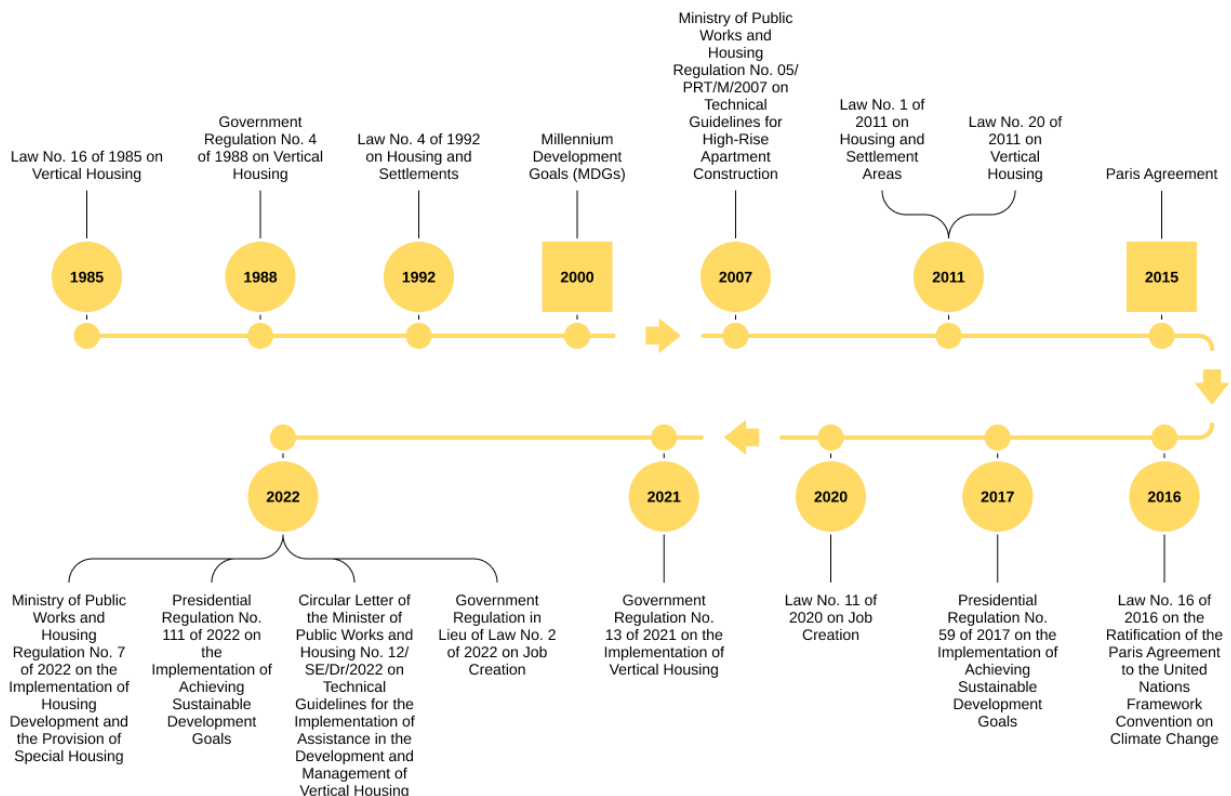
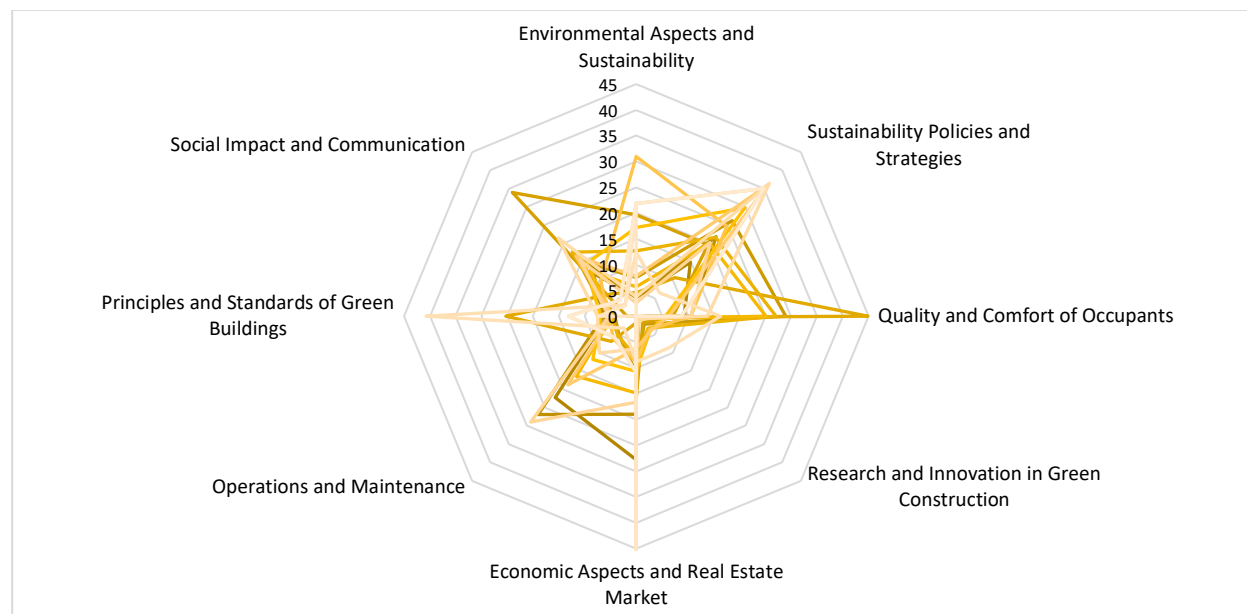


Figure 9

Radar Chart Visualizing the Eight Key Aspects of Vertical Housing Policy Within the GB Framework in Indonesia



Energy Regulations Related to GB in Indonesia

The chronology of energy-related regulations supporting GB (Figure 10) shows a progressive shift shaped by domestic priorities and global sustainability agendas. It began with the Millennium Development Goals in 2000 (United Nations, 2015), followed by Law No. 30 of 2007 on Energy, which established national governance and reserves (Republik Indonesia, 2007). Conservation was reinforced through Presidential Instruction No. 2 of 2008 and Government Regulation No. 70 of 2009 (Republik Indonesia, 2007, 2009) and broadened under Government Regulation No. 79 of 2014 on National Energy Policy, which addressed diversification, conservation, pricing, and innovation (Republik Indonesia, 2014). International commitments further shaped the framework: Indonesia ratified the Paris Agreement in 2015 (Kementerian Lingkungan Hidup dan Kehutanan, 2016; Republik Indonesia, 2016), followed by Presidential Regulation No. 59 of 2017 on SDG implementation (Republik Indonesia, 2017) and Ministry of Energy Regulation No. 9 of 2018 updating renewable energy provisions (Kementerian Energi dan Sumber Daya Mineral, 2018). More recently,

Presidential Regulation No. 111 of 2022 reaffirmed SDG Goal 7 on sustainable energy (Republik Indonesia, 2022a), while Government Regulation No. 33 of 2023 replaced the 2009 regulation, updating national priorities on energy conservation.

The content analysis (Figure 11) shows that Indonesia's energy policies for GB between 2000 and 2023 are primarily concentrated on Environmental Aspects and Sustainability Policies and Strategies, consistent with international frameworks such as the Kyoto Protocol, Paris Agreement, and Nationally Determined Contributions (NDC). Key instruments like Law No. 30/2007 and Government Regulation No. 70/2009 reinforced conservation and emission reduction as central priorities. By contrast, coverage of Economic Aspects, Real Estate Market mechanisms, and Operations and Maintenance is limited, reflecting the absence of strong financial incentives, weak private-sector engagement, and insufficient provisions for long-term performance. Research and innovation also remain modest, constrained by limited funding and collaboration. Overall, the findings point to a regulation-heavy trajectory that prioritizes environmental compliance but lacks the economic and operational instruments needed to ensure broad market adoption and sustained building performance.

Figure 10

Chronology of Policy Issuance related to Energy as part of GB Policy

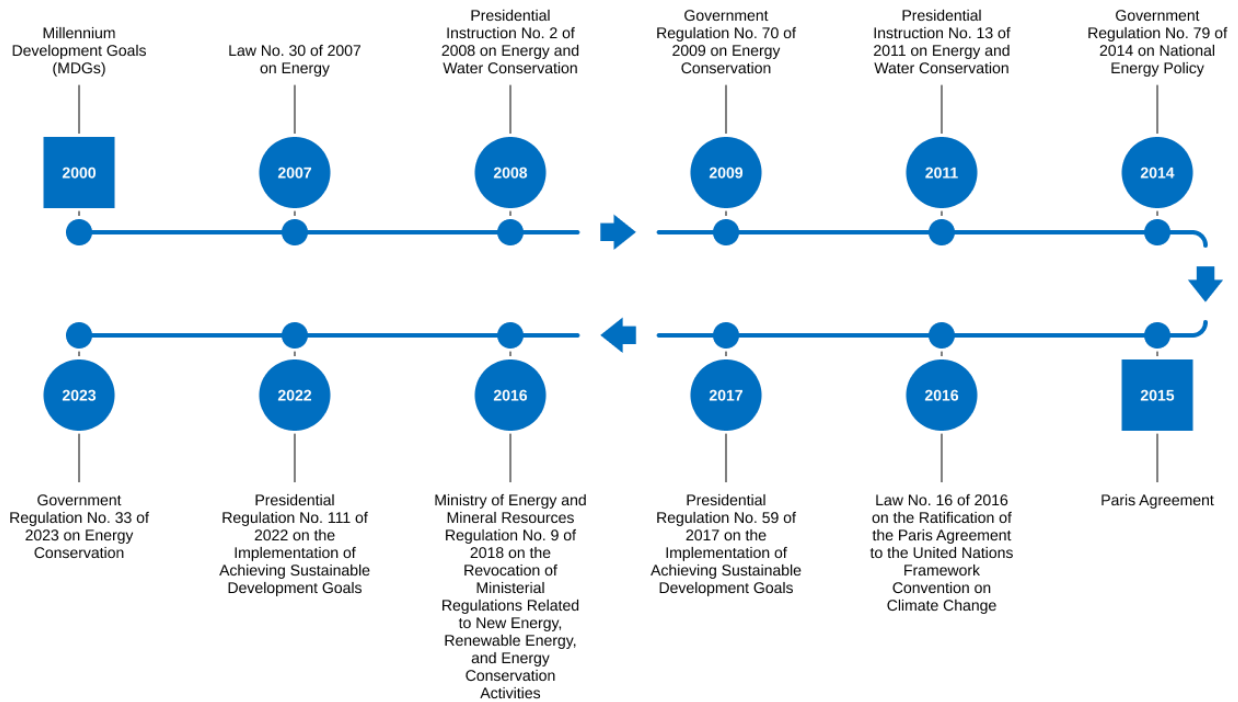
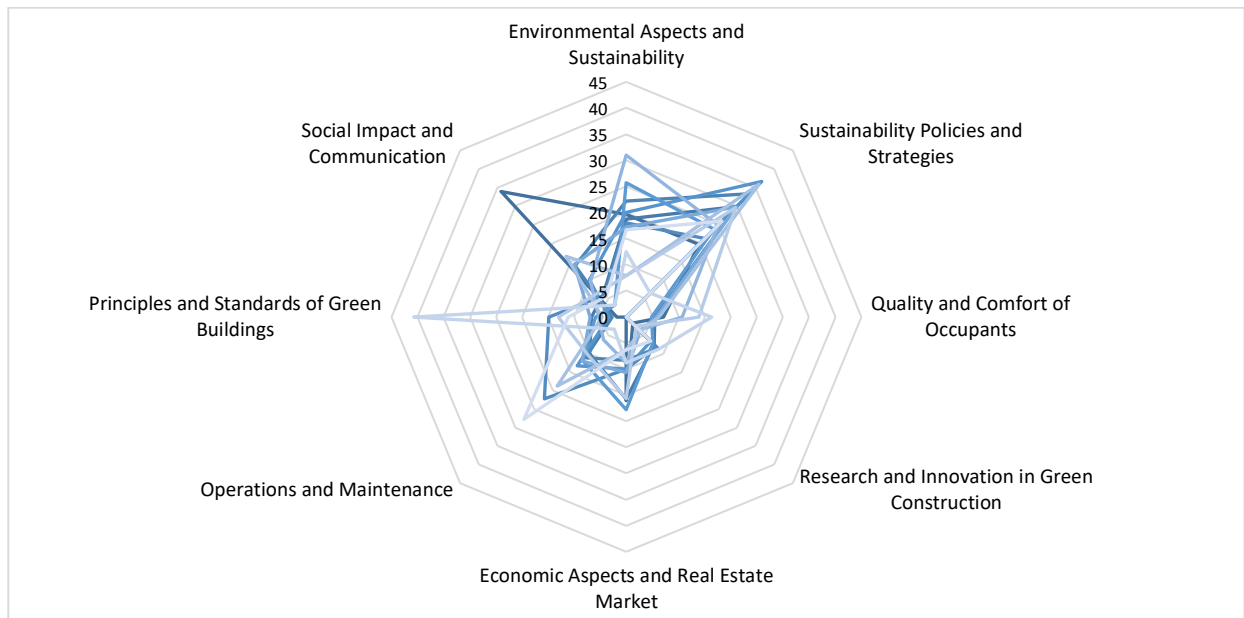


Figure 11

Radar Chart Visualizing the Eight Key Aspects of Energy Policy Within the GB Framework



Environmental Regulations related to Green Buildings in Indonesia

The chronology of environmental regulations on GBs in Indonesia (Figure 12) highlights six key regulations and two major events issued between 2000 and 2022. It began with Indonesia's participation in the Millennium Development Goals (MDGs) in 2000 (United Nations, 2015), followed by Law No. 18 of 2008 on Waste Management, which provided the foundation for sustainability governance (Republik Indonesia, 2008). This was further reinforced by the Minister of Environment Regulation No. 8 of 2010 on Criteria and Certification for Environmentally Friendly Buildings, introducing nine sustainability dimensions into national regulation (Kementerian Lingkungan Hidup dan Kehutanan, 2010). Subsequent developments, including Indonesia's ratification of the Paris Agreement in 2015 (Kementerian Lingkungan Hidup dan Kehutanan, 2016) and the adoption of Presidential Regulation No. 59 of 2017 on SDG implementation (Republik Indonesia, 2017), further embedded environmental priorities into GB policies, demonstrating how international commitments shaped domestic regulatory trajectories.

Content analysis (Figure 13) shows that between 2000 and 2022, Indonesia's environmental policies for GBs were dominated by Environmental Aspects and Sustainability Policies and Strategies, reflecting the state's focus on emission reduction, ecological protection, and resource efficiency, consistent with global frameworks such as the MDGs, Paris Agreement, and Indonesia's Nationally Determined Contributions (NDC). However, Economic Aspects, Real Estate Market mechanisms, and Operations and Maintenance were far less developed, as policies remained regulatory and compliance-oriented rather than market-driven, offering limited incentives or financing instruments to spur private-sector adoption. Similarly, frameworks for long-term operational performance and research innovation in green construction remained underdeveloped, constrained by limited funding and weak industry–academia collaboration. This imbalance demonstrates that while environmental policies have aligned strongly with sustainability agendas, their limited integration with economic instruments and innovation ecosystems has slowed the effective implementation of GB practices in Indonesia.

Figure 12

Chronology of Environmental Policy Issuances Relevant to the GB Policy

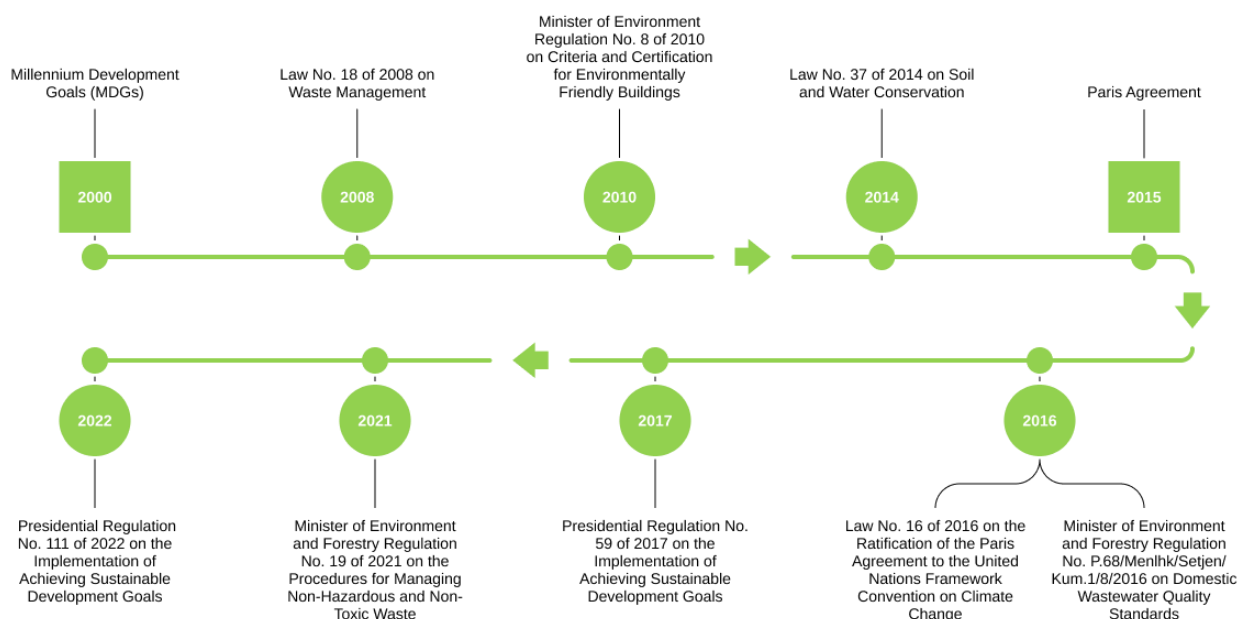
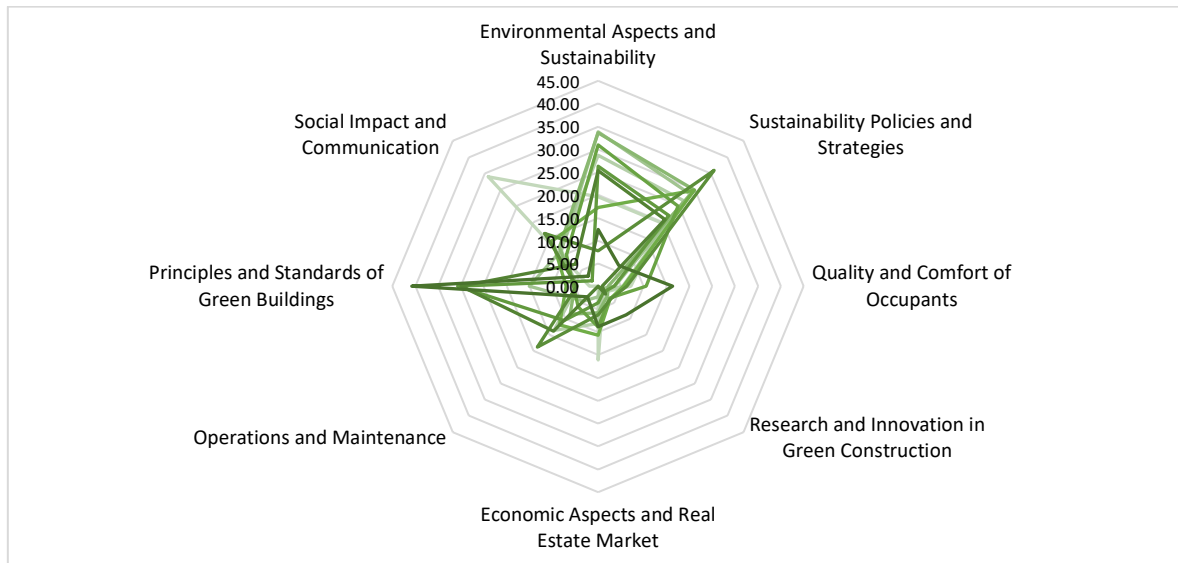


Figure 13

Radar Chart Visualizing the Eight Key Aspects of Environmental Policy Within the GB Framework



Policies Pertaining to Low-Cost Vertical Housing as State-Owned Buildings

Figure 14 illustrates how Indonesia's regulatory landscape for vertical housing and GBs evolved from 1985 to 2023. The initial phase, marked by Law No. 16/1985 and Government Regulation No. 4/1988, focused primarily on establishing a legal foundation for a multi-story housing provision. Subsequent regulations, such as Law No. 28/2002 on Buildings and the Ministerial Decree No. 441/1998 on Technical Requirements, emphasized structural reliability and technical compliance. By the mid-2000s, however, attention began to expand toward broader sustainability concerns, as reflected in Law No. 30/2007 on Energy, Law No. 18/2008 on Waste Management, and Ministerial Regulation No. 8/2010 on environmentally friendly building certification.

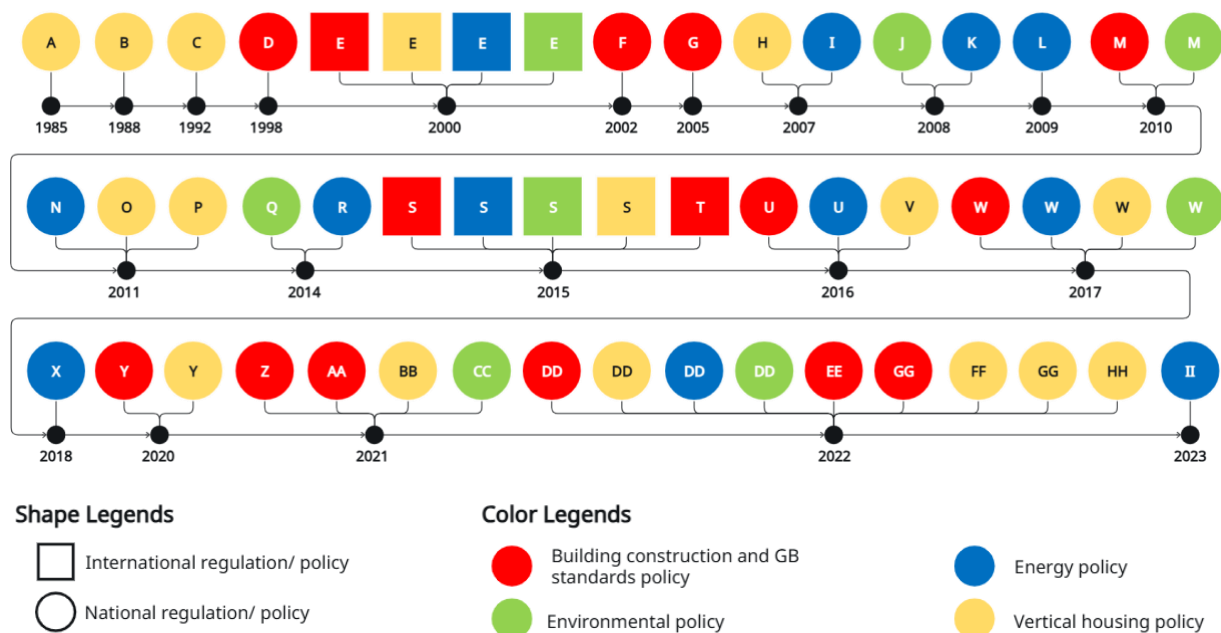
The 2010s marked a turning point with the consolidation of housing governance through Law No. 1/2011 and Law No. 20/2011, followed by comprehensive frameworks such as Government Regulation No. 16/2021 on building codes and Government Regulation No. 13/2021 on vertical housing. These later instruments explicitly link housing, building, and environmental dimensions, suggesting recognition of the need for integrated

approaches. Yet, as shown in the content analysis (Figure 15 and Figure 16), regulatory emphasis remains strongest in environmental sustainability and occupant comfort, while areas such as economic incentives, operations and maintenance, and research and innovation remain weak. This imbalance is directly traceable to the historical trajectory in which technical and environmental standards advanced steadily, while financial mechanisms, market instruments, and innovation ecosystems were largely absent from earlier legislation and only tentatively introduced in the last decade.

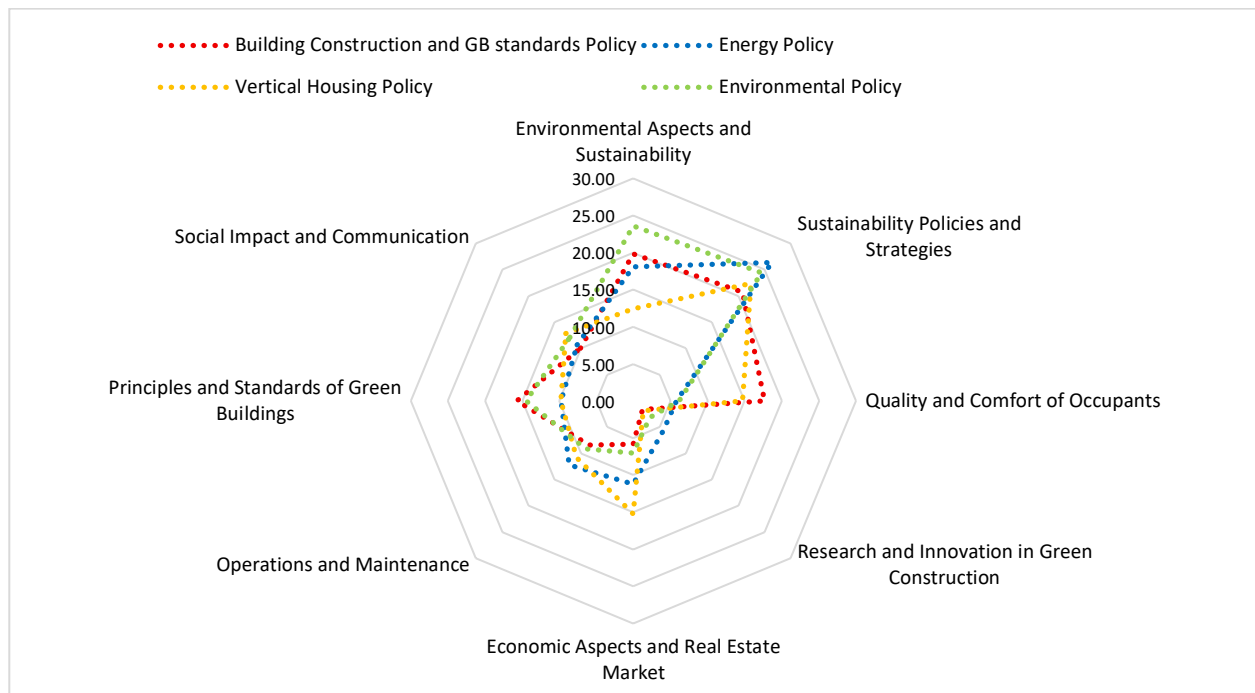
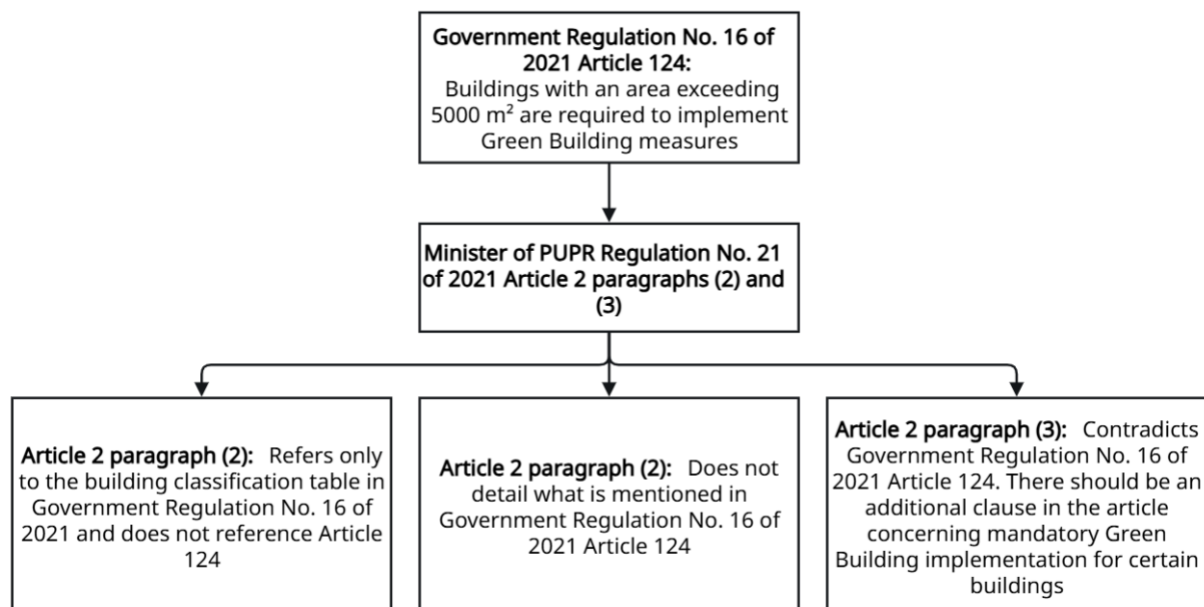
This evidence supports two critical insights. First, the regulatory process has been shaped not only by external sustainability agendas but also by domestic pressures such as rapid urbanization, the housing deficit, and demands for livable public vertical housing. These internal drivers explain why quality and comfort of occupants emerged as dominant policy aspects. Second, the coexistence of multiple, partly overlapping regulations across housing, energy, and environment demonstrates the potential for complementarity. For instance, energy laws emphasize conservation, environmental regulations focus on waste and emissions, and housing laws mandate livability standards. In theory, these could reinforce one another into a coherent framework. However, weak institutional coordination and fragmented issuance—visible in irregular policy intervals in Figure 14—have so far prevented this potential from materializing.

Figure 14

Diagram Pertaining to Low-Cost Vertical Housing as State-Owned Buildings within the GB Policy



- A. Law No. 16 of 1985 on Vertical Housing
- B. Government Regulation No. 4 of 1988 on Vertical Housing
- C. Law No. 4 of 1992 on Housing and Settlements
- D. Minister of Public Works Decree No. 441/KPTS/1998 on Technical Requirements for Buildings
- E. Millennium Development Goals (MDGs)
- F. Law No. 28 of 2002 on Buildings
- G. Government Regulation No. 36 of 2005 on the Implementation of Law No. 28 of 2002 on Buildings
- H. Ministry of Public Works and Housing Regulation No. 05/PRT/M/2007 on Technical Guidelines for High-Rise Apartment Construction
- I. Law No. 30 of 2007 on Energy
- J. Law No. 18 of 2008 on Waste Management
- K. Presidential Instruction No. 2 of 2008 on Energy and Water Conservation
- L. Government Regulation No. 70 of 2009 on Energy Conservation
- M. Minister of Environment Regulation No. 8 of 2010 on Criteria and Certification of Environmentally Friendly Buildings
- N. Presidential Instruction No. 13 of 2011 on Energy and Water Conservation
- O. Law No. 20 of 2011 on Vertical Housing
- P. Law No. 1 of 2011 on Housing and Settlement Areas
- Q. Law No. 37 of 2014 on Soil and Water Conservation
- R. Government Regulation No. 79 of 2014 on National Energy Policy
- S. Paris Agreement
- T. Law No. 16 of 2016 on the Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change
- U. Law No. 16 of 2016 on the Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change (duplicate entry in original list)
- V. Minister of Environment and Forestry Regulation No. P.68/Menlhk/Setjen/Kum.1/8/2016 on Domestic Wastewater Quality Standards
- W. Presidential Regulation No. 59 of 2017 on the Implementation of Achieving Sustainable Development Goals
- X. Ministry of Energy and Mineral Resources Regulation No. 9 of 2018 on the Revocation of Ministerial Regulations Related to New Energy, Renewable Energy, and Energy Conservation Activities
- Y. Law No. 11 of 2020 on Job Creation
- Z. Government Regulation No. 16 of 2021 on the Implementation of Law No. 28 of 2002 on Buildings
- AA. Minister of Public Works and Housing Regulation No. 21 of 2021 on the Performance Assessment of Green Buildings
- BB. Government Regulation No. 13 of 2021 on the Implementation of Vertical Housing
- CC. Minister of Environment and Forestry Regulation No. 19 of 2021 on the Procedures for Managing Non-Hazardous and Non-Toxic Waste
- DD. Presidential Regulation No. 111 of 2022 on the Implementation of Achieving Sustainable Development Goals
- EE. Circular Letter of the Minister of Public Works and Public Housing No. 01/SE/M/2022 on Technical Guidelines for Green Building Performance Assessment
- FF. Ministry of Public Works and Housing Regulation No. 7 of 2022 on the Implementation of Housing Development and The Provision of Special Housing
- GG. Government Regulation in Lieu of Law No. 2 of 2022 on Job Creation
- HH. Circular Letter of the Minister of Public Works and Public Housing No. 12/SE/Dr/2022 on Technical Guidelines for the Implementation of Assistance in the Development and Management of Vertical Housing
- II. Government Regulation No. 33 of 2023 on Energy Conservation

Figure 15*Radar Chart of Regulatory Coverage for GB and Vertical Housing in Indonesia***Figure 16***The State-Owned Vertical Housing Regulation Within the GB Policy Framework.*

To reinforce the policy directions and strategic actions derived from the synthesis, the following diagram presents the current involvement of key actors in GB and vertical housing regulations. Figure 17 highlights the dominance of national and ministerial levels in shaping regulations related to GB, energy, vertical housing, and environmental policies, while the contributions of regional governments, professional and business actors, and academics remain limited. This imbalance suggests that Indonesia's regulatory framework for vertical green housing is still highly centralized, with insufficient multi-actor engagement. Consequently, policy implementation risks becoming fragmented and less responsive to local contexts, market dynamics, and scientific evidence.

DISCUSSION

GB Criteria based on Regulations in Indonesia

Figure 18 shows the distribution of 21 active Green Building (GB) regulations under Government Regulation No. 16/2021, Article 1(4). The ANOVA compares the frequency of seven GB aspects: energy efficiency, site efficiency, water efficiency, indoor air quality, environmentally friendly materials, wastewater, and waste management. Energy efficiency dominates (10 of 21 regulations), reinforced by Regulation No. 21/2021, followed by site and water (8 each), and indoor air quality and materials (7), while wastewater (6) and waste (5) are least covered. Energy and site rank above the mean, while others cluster around or below. This indicates that Indonesia's GB framework, though environmentally focused, remains fragmented—strong in energy and site, but weak in circular resources, air quality, and waste—highlighting the need for stronger inter-ministerial coordination, harmonized standards, and integration into vertical housing policies.

Direction an Action of Green Vertical Housing Regulation Development in Indonesia based on Comparison Study of GB in Vertical Housing from Different Countries

Effective GB implementation depends on strong institutions and stakeholder collaboration, as shown in China, Australia, South Korea, and Taiwan, where councils and research institutes drive policy development (Hu et al., 2023; Kuo et al., 2016; Lee et al., 2017; Luke et al., 2018). Table 2 shows that China, South Korea, Taiwan, and Australia have integrated sustainability standards into building codes with varying levels of enforcement, while Vietnam and Thailand remain at earlier stages with partial or voluntary codes (Nguyen et al., 2021; Shen et al., 2017). Compliance also differs: China and South Korea mandate GB for public buildings, Taiwan and Australia apply partial requirements, while Vietnam relies on voluntary adoption.

Incentives are equally critical. China, South Korea, Taiwan, Australia, and Thailand provide subsidies, tax breaks, or low-interest loans (Amoruso et al., 2021; Li et al., 2022; Pham & Nguyen, 2021; Wu & Lo, 2018), while Vietnam's programs remain donor-dependent (Nguyen & Gray, 2016). Despite differences in governance and priorities, most countries focus on energy and water efficiency, indoor air quality, and site management. Integrating mandatory standards with incentives, as practiced in China and South Korea, illustrates the effectiveness of combined approaches (Amoruso et al., 2021; Li et al., 2022). For Indonesia, the comparison suggests establishing specialized institutions, embedding GB standards in vertical housing codes, shifting from voluntary to mandatory compliance in state-owned projects, and introducing fiscal incentives to encourage private adoption. A balanced mix of regulation and economic instruments, adapted to local contexts, is key to advancing green vertical housing (Darko & Chan, 2018).

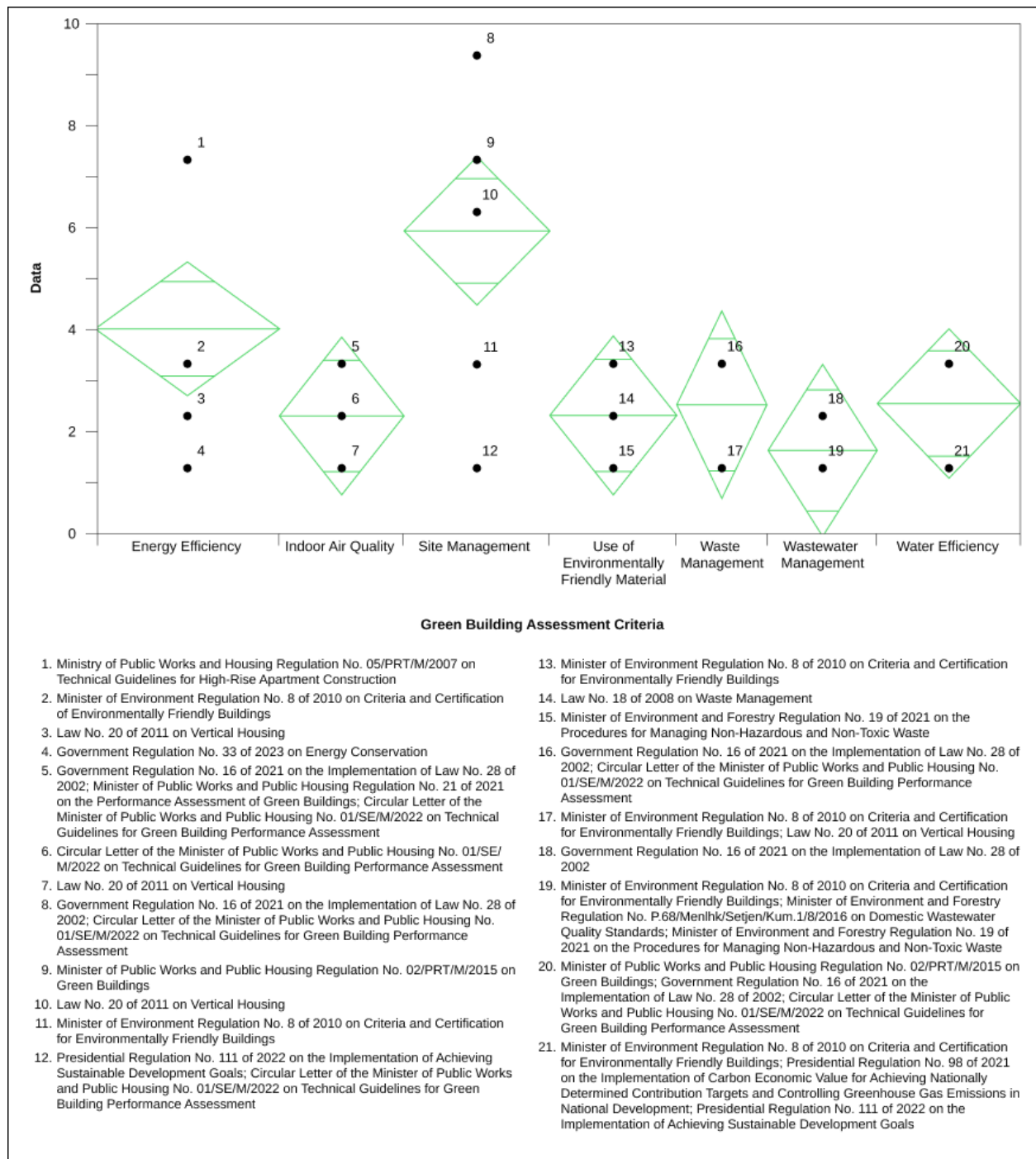
Figure 18*ANOVA of GB Criteria in Relation to the Number of Policies*

Table 2*Comparison Study of GB in Vertical Housing From Different Countries*

Focus on	Implemented by					
	China	South Korea	Taiwan	Australia	Vietnam	Thailand
Organization	✓ (China Green Building Council, research institutes)	✓ (Korea Green Building Council, research networks)	✓ (Architecture & Building Research Institute, EEWB* developers)	✓ (Green Building Council of Australia, state research units)	X (Limited research groups, pilot programs)	✓ (Thailand Green Building Institute/ TGBI)
Building code	✓ (Three-Star Green Building Standard, local codes)	✓ (Green Building Certification integrated in code)	✓ (EEWB Green Building Label integrated with national code)	✓ (National Construction Code includes sustainability)	X (Partial guidelines exist, weak enforcement)	✓ (Energy Code of Building, TGBI standards)
Mandatory system	✓ (Mandatory in public projects and affordable housing)	✓ (Mandatory for government/public buildings)	✓ (Partially mandatory in public housing projects)	✓ (Some states mandate GB for public buildings)	X (Not yet mandatory, mostly voluntary)	✓ (Government buildings must comply with energy & GB standards)
Incentives system	✓ (Tax reductions, subsidies, green loans)	✓ (Tax benefits, Floor Area Ratio [FAR] bonuses, subsidies)	✓ (Financial subsidies, tax incentives)	✓ (Rebates, grants, green finance)	X (Limited incentives (donor/foreign-funded))	✓ (Tax benefits, soft loans, subsidies)

* Ecology, Energy Saving, Waste Reduction, and Health (Taiwan Green Building Rating System).

Figure 19 builds directly on the radar chart findings, which revealed fragmented regulatory coverage and weak integration of green principles in vertical housing. The roadmap addresses these gaps through four sequential steps. It begins with the establishment of a specialized research body to provide certification, training, and stakeholder awareness, thereby strengthening the institutional foundations that the radar analysis showed to be lacking. This is followed by the development of national codes and standards specific to green vertical housing, responding to the current inconsistency of technical requirements across regulations. A mandatory system for government-funded vertical housing projects is then introduced, tackling the compliance weaknesses highlighted

in the radar chart. Finally, comprehensive incentive mechanisms, both financial and non-financial, are added to stimulate private-sector engagement—an aspect currently underrepresented in existing regulations. Taken together, these stages form an integrated response to the policy fragmentation identified earlier, providing a coherent pathway toward mainstreaming sustainability in Indonesia's vertical housing sector.

Figure 20 outlines a phased roadmap for developing green vertical housing (GVH) in Indonesia, translating insights from the international comparison into actionable steps. The roadmap begins with institutional strengthening through stakeholder participation,

research, and awareness programs, followed by the development of dedicated GVH codes and assessment systems. Mandatory compliance is then phased in—starting with state-owned buildings above 5,000 m² before extending to non-state projects—mirroring practices in China and South Korea. Finally, financial and non-financial incentives are introduced to encourage

private sector adoption, as seen in Singapore and South Korea. Together, these stages directly address the gaps highlighted in Figure 20 by linking organizational capacity, regulatory clarity, enforcement, and incentives into an integrated strategy for mainstreaming sustainable vertical housing in Indonesia.

Figure 19

Direction of Green Vertical Housing Regulation Development in Indonesia based on Lessons Learned

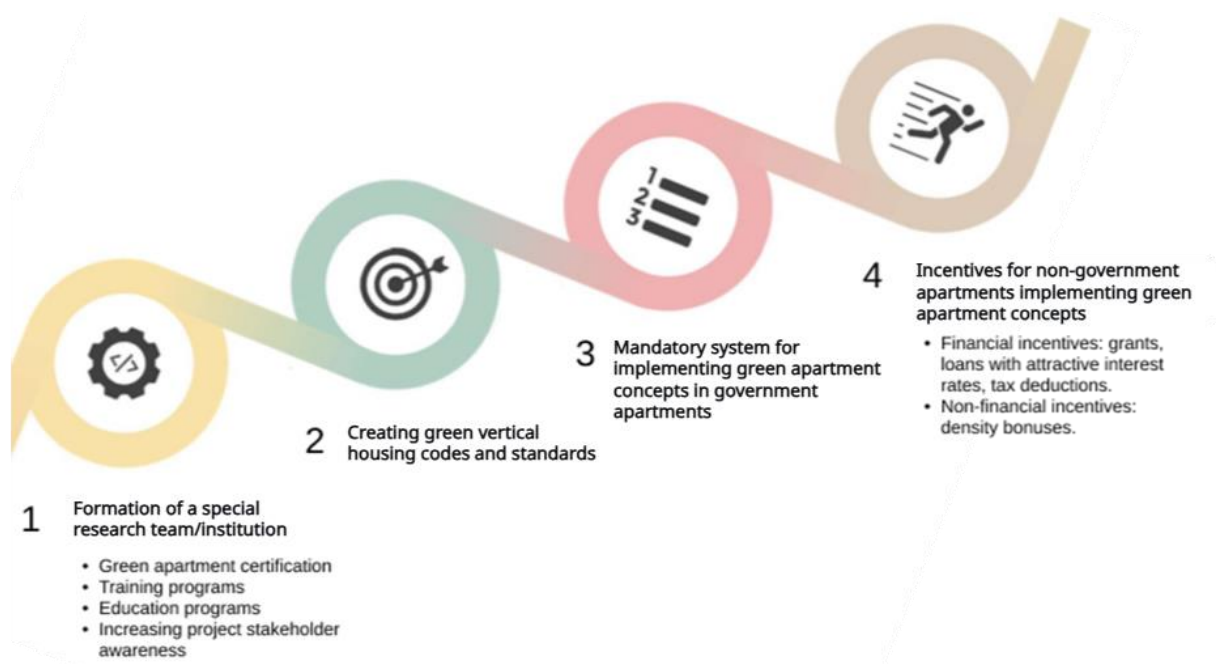
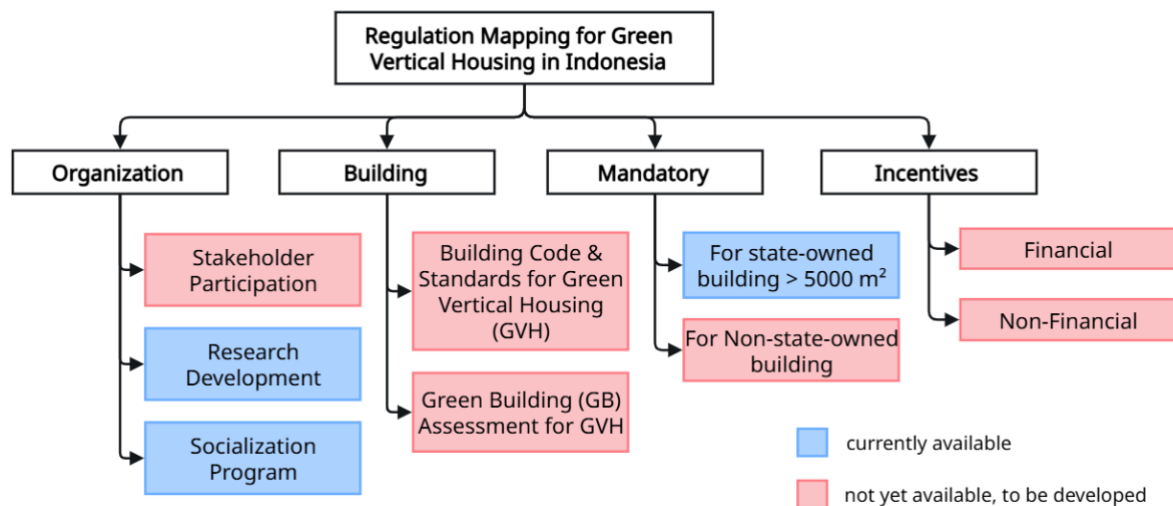


Figure 20

Regulation Mapping for Green Vertical Housing in Indonesia



The proposed roadmap for green vertical housing development in Indonesia (Figure 21) presents a phased transition from foundational measures to systemic transformation, ensuring sustainability principles are embedded coherently rather than fragmented. In the short term (1–2 years), the priority is regulatory strengthening by integrating green codes into vertical housing, supported by fiscal incentives such as tax reductions or Floor Area Ratio (FAR) bonuses, alongside pilot projects, academic–industry collaboration, and capacity building. In the medium term (3–5 years), the agenda expands through green financing instruments (e.g., bonds and concessional loans), smart monitoring, post-occupancy evaluation, and stronger policy harmonization across housing, energy, and environmental frameworks, with public–private partnerships mobilizing investment. In the long term (5–10 years), the vision is full integration: mandatory green standards for all vertical housing, supported by innovation ecosystems advancing IoT, BIM, and renewable energy, together with community-based green neighborhoods and international benchmarking to position Indonesia as a regional leader in low-carbon housing.

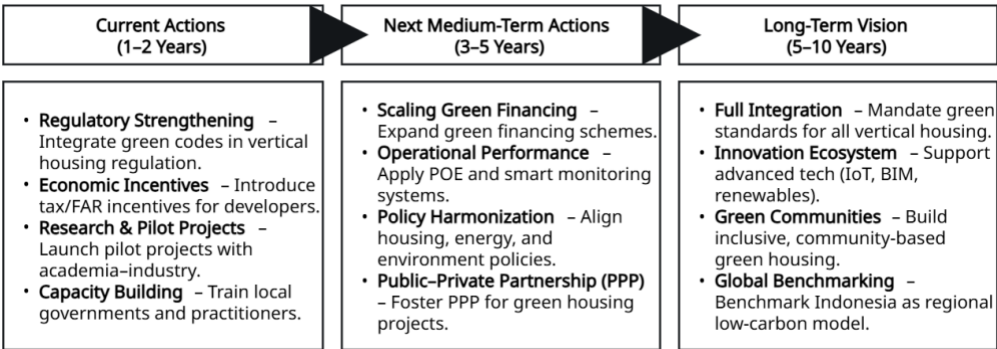
A coherent framework to achieve this roadmap requires clear regulatory alignment and stronger coordination among stakeholders. The national government should establish overarching legal instruments and ensure consistency with global commitments, while ministries provide technical standards and sectoral integration. Regional governments must embed these directives into spatial plans and permitting systems, supported by fiscal and procedural incentives. Professional associations and businesses are expected to

drive implementation through innovation, technical application, and public–private partnerships, while academic institutions supply evidence-based research, policy support, and monitoring tools. Strengthening these linkages will create a more balanced, effective, and sustainable regulatory system for vertical green housing in Indonesia.

CONCLUSION

The regulatory analysis reveals that Indonesia's framework for green vertical housing is fragmented, with irregular issuance of policies and weak inter-ministerial coordination. While some progress has been made—such as technical guidelines, sustainability provisions, and GB performance regulations—these remain reactive and often disconnected. The radar chart underscores this imbalance: environmental aspects, sustainability strategies, and liveability standards are relatively well-covered, but economic incentives, operations and maintenance, and research and innovation lag far behind. This explains why adoption is limited despite the presence of energy and site-related regulations. Addressing these gaps requires a coherent roadmap that aligns vertical housing with broader GB, energy, and environmental policies while introducing enforceable standards, structured incentives, and performance-based monitoring. Only through stronger institutional collaboration and a balanced integration of regulatory, economic, and operational instruments can Indonesia mainstream green vertical housing into its sustainable development agenda.

Figure 21
Policy Action for Green Vertical Housing in Indonesia



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